

The South African Species of *Commiphora**

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ABSTRACT

A revision of the South African species of *Commiphora* (Burseraceae) is presented in which 2 keys are provided to the 18 species recognized. A comprehensive morphological study, including an anatomical study of the stems and leaves, was regarded as essential for an accurate delimitation of the different species. Maps, sketches and photographs serve for illustration.

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INTRODUCTION

Berg (1862) was apparently the first author to publish a classification of *Commiphora* under the name *Balsamodendrum* Kunth. He divided the 13 species into two sections, using the type of inflorescence and the structure of the calyx as criteria. These two sections were divided into various subsections, mainly based on leaf characteristics. Berg did not assign names to these sections or subsections.

Engler (1883) extended the classification of Berg, recognizing 35 *Commiphora* species, which he divided into 18 subsections. This classification of Engler was primarily based on leaf characteristics and again no names were assigned to the subsections.

In 1896 Engler revised his classification of 1883 and recognized 63 species. The classification of 1896 was once more extended by Engler in 1913. In this much more elaborate classification, 129 species were divided into 43 sections which he published validly with names and diagnoses. The classifications of Engler published in 1915 and 1931 were principally repetitions of the 1913 classification with a few modifications and additions. Although Engler based the ultimate division of the 43 sections mainly on leaf characteristics such as the type of leaf, hairiness of the leaves, number, colour, shape and margins of the leaflets, he already realized the taxonomic importance of the pseudaril. The variable structure of the pseudaril was used as a criterion for distinguishing between two of the sections.

Sprague (1927) and Chiovenda (1932) adopted Engler's classification, but Wild (1959a) regarded the system as artificial providing no guide to the natural relationships of the species. The classification of Wild (1959a) was mainly based on characteristics of the fruit, inflorescence and flower, although leaf characteristics were used in the subdivision of the sections and subsections. According to Wild the structure of the pseudaril, shape and surface of the putamen and the structure of the disk in the flowers are of vital importance. Wild reduced the number of sections considerably and he also showed that many of Engler's species were in fact synonyms. He distinguished 185 species although 266 names for *Commiphora* species had been published in the Index Kewensis. There are many reasons for the great number of synonyms. Burt (1935) mentioned that specimens in European herbaria often consist of leafless twigs without any flowers or fruit. The irregular branching, the presence of thorns and the fact that the leaves often fall off during the preparation of the specimens contribute to the poor quality of the specimens obtained. White (1962) noted that the plants are leafless for a great part of the year even when flowers and fruits are produced. In addition, it should be mentioned that important taxonomic features such as those of the pseudaril and flower are lost during the drying process. Ripe fruits with exposed pseudarils are very attractive to birds and are seldom found on plants.

* Forms part of a D.Sc. thesis submitted to the University of Pretoria.

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Sonder (1860), Harvey (1862), Hiern (1896), Burt Davy (1932), Verdoorn (1951), Codd (1951), Von Breitenbach (1965) and de Winter (1968) were the main contributors to the knowledge of the South African species of *Commiphora*. In the past, descriptions of the species were mainly based on external morphological features, but due to insufficient available material, the knowledge of these features was also incomplete. South African botanists, such as Verdoorn and de Winter, who are particularly interested in this genus, realize that it is essential to obtain mature flowers and ripe fruit for diagnostic descriptions and for the investigation of the relationships of the different species.

This investigation was conducted on 18 species of *Commiphora*, so far the only representatives of the Burseraceae recorded in South Africa. The majority of species is widely distributed in the central and northern parts of Transvaal, but they are particularly common in the dry bushveld of the northern and north-eastern Transvaal. In the Transvaal, north of the Tropic of Capricorn, 11 species occur and large areas north of the Soutpansberg can be designated as *Commiphora*-veld. Twelve species are recorded from the Kruger National Park, while the genus is also well represented in Zululand. A few mesophytic species occur along the east and south coast, extending as far south as East London. So far two species from the northern Cape, and four from the north-western Cape, have been recorded. The species occurring in the north-western Cape represent the most xerophytic species studied.

The aim of this investigation was primarily to make a contribution to the knowledge of the South African flora by an accurate delimitation of the indigenous species of *Commiphora*. The morphological investigation was conducted on fresh material collected for each of the species. A comprehensive organographic study of the stems, leaves, flowers and ripe fruit, as well as an anatomical study of the leaves and stems, was regarded as essential for the accurate delimitation of the different species. For a comparative anatomical study of the leaves, it was decided to study the terminal leaflets of all the species, and the transverse sections were made a third of the distance from the base of the leaflets. The anatomy of the petioles has also been studied from transverse sections made through the distal part of the petioles. The anatomical study of the stems included a study of the young stems and stems with a diameter of 2,5 cm of each species.

The type specimens of all the species including those of the synonyms, have been studied and, where applicable, lectotypes have been indicated. All gatherings cited are represented in the National Herbarium, Pretoria (PRE), unless otherwise indicated by the herbarium abbreviation shown after the collector's number.

ACKNOWLEDGEMENTS

I wish to express my sincere thanks to my promoters, Prof. H. P. van der Schijff and Dr. B. de Winter. The greater part of my research work was done at the Department of Botany, University of Stellenbosch. I deeply appreciate the facilities put at my disposal by Prof. P. G. Jordaan, chairman of the Department. Mr. E. G. H. Olivier of the Botanical Research Unit, Stellenbosch, acted in liaison with

overseas herbaria in procuring most of the type specimens. I wish to thank him for this important contribution and for help in translating this manuscript.

I offer thanks to Dr. L. E. Codd and his staff of the Botanical Research Institute, Pretoria, for their willing collaboration. Only through the financial aid given by the C.S.I.R. and the grants made available by the Research Committee of the University of Pretoria, could the costs incurred, of collecting trips, preparation of research material and the actual compilation of the manuscript, have been defrayed. For this financial support I am deeply grateful.

COMMIPHORA

Commiphora Jacq., Hort. Schoenbr. 2: 66, t. 249 (1797); Engl. in A.D.C., Monogr. Phan. 4: 7 (1883); Bot. Jahrb. 15: 94 (1893); in Pflanzenfam. 3,4: 251 (1896); Bot. Jahrb. 26: 368 (1899); Bot. Jahrb. 34: 303 (1905); Guillaumin in Ann. Sc. Nat. 9,10: 279 (1909); Engl. in Bot. Jahrb. 44: 144 (1910); Bot. Jahrb. 46: 289 (1912); Bot. Jahrb. 48: 449 (1913); Pflanzenw. Afr. 3,1: 786 (1915); Bot. Jahrb. 54: 292 (1917); Hutch. & Dalz., Fl. W. Trop. Afr. 1: 488 (1928); Engl. in Pflanzenfam. ed. 2,19a: 429 (1931); Chiov., Fl. Somalia 2: 53 (1932); Burt in Kew Bull. 1935: 101 (1935); Webber in Lilloa 6: 443 (1941); Perr. Bathie in Fl. Madag. 5: 5 (1946); Exell & Mendonca in Consp. Fl. Angol. 1: 298 (1951); Miller in J. S. Afr. Bot. 18: 38 (1952); Wild in Bol. Soc. Brot. 2,33: 76 (1959); Dale & Greenway, Kenya Trees: 76 (1961); Capuron in Adansonia 2: 270 (1962); White, For Fl. N. Rhod.: 173 (1962); Wild in Fl. Zamb. 2,1: 263 (1963); Von Breitenbach, Ind. Trees S. Afr. 3,2: 429 (1965); De Wint. in Trees S. Afr. 20,1: 3 (1968); Merxm., Prod. Fl. S.W. Afr. 23: 1 (1968). Type species: *C. madagascariensis* Jacq., Hort. Schoenbr. 2: 66, t. 249 (1797).

Amyris sensu Linn., Mant.: 65 (1767).

Balsamea Gled. in Berl. Ges. Naturf. Fr. Schr. 3: 127 (1782); Engl., Bot. Jahrb. 1: 41 (1881).

Balessan Bruce, Trav. 5: t. 25 (1790).

Balsamodendrum Kunth in Ann. Sc. Nat. 1,2: 348 (1824); DC., Prodr. 2: 76 (1825); Sond. in Fl. Cap. 1: 526 (1860); O. Berg in Bot. Ztg. 21: 161 (1862); Marchand in Adansonia 8: 34, 67 (1867); Oliv. in Fl. Trop. Afr. 1: 324 (1868).

Hemprichia Ehrenb. in Linnaea 4: 396 (1829); Marchand in Adansonia 8: 69 (1867).

Heudelotia A. Rich. in Guill., Perr. & A. Rich., Fl. Sen. 1: 150, t. 39 (1832).

Protium sensu Wight & Arn. in Prod. Fl. Ind.: 176 (1834); Harv. in Fl. Cap. 2: 592 (1862).

Protionopsis Blume in Mus. Bot. Lugd.-Bat. 1: 229 (1850) nom. nud.

Hitzeria Klotzsch in Peters, Reise Mossamb. Bot. 1: 89 (1861).

Balsamophloeos O. Berg in Bot. Ztg. 20: 163 (1862).

Dioecious or polygamous but rarely monoecious many-stemmed shrubs or shrubs with the trunk branching repeatedly above soil level or trees with a single main stem of variable height; bark often peeling or flaking in papery pieces or strips; resin ducts secreting an odoriferous resin occurring in the phloem; wood relatively light and consisting mainly of septated fibres; branchlets often spine-tipped, glabrous, pilose or tomentose. *Leaves* petiolate but rarely sessile or

subsessile, alternate, usually grouped at the ends of the branches, simple, trifoliolate or impari-pinnate, margins or leaflets usually crenate, serrate or lobed but seldom entire, glabrous, pilose or tomentose, leaflets dorsiventral or isobilateral; petioles of a few species with medullary vascular bundles. *Flowers* unisexual rarely bisexual, perigynous or hypogynous, male flowers usually larger than female flowers, appearing before or with the leaves and occasionally after the leaves in axillary simple or compound dichasial cymes, in paniculate cymes or singly in clusters. *Pedicels* of variable length, glabrous or pilose to tomentose. *Calyx* infundibuliform, campanulate or broadly campanulate with 4 valvate persistent lobes, usually yellowish-green or reddish-green, glabrous, glandular or pilose to tomentose, in perigynous flowers continuous with hypanthium, in hypogynous flowers inserted on receptacle. *Petals* 4, usually yellow to green, apex incurved, glabrous or occasionally pilose on outside. *Disk* in perigynous flowers adnate to hypanthium, cylindrical, rarely fleshy, sometimes lobed; in hypogynous flowers not adnate to calyx or corolla, intrastaminal, cylindrical, usually with 4 large lobes but in some species with 4 large and 4 small lobes, lobes bifid or not bifid; disk in male flowers usually more fleshy than in female flowers, glabrous or occasionally pilose. *Stamens* 8 or in a few species 4, obdiplostemonous, 4 antisealous stamens longer than other 4; filaments subterete but lower part usually flattened and broadened, inserted on the outside or on top of disk; anthers introrse and adnate; staminodes in female flowers. *Gynoecium* rudimentary in male flowers; half inferior in perigynous flowers and superior in hypogynous flowers, usually glabrous but occasionally glandular or pilose; ovary ovoid, 2-locular with 2 epitropous ovules per loculus; style of variable length but usually relatively short; stigma capitate, obscurely 2-4 lobed. *Fruit* an ovoid, ellipsoid or subglobose drupe, usually asymmetrically flattened; exocarp relatively thin, glabrous but occasionally pilose; mesocarp usually fleshy, consisting of spongy tissue with resin ducts; exocarp and mesocarp splitting in ripe fruit into 2 longitudinal valves (4 valves in a few species outside our area); endocarp

forming a crustaceous or bony putamen and usually also a pseudaril; putamen ellipsoid or subglobose, irregularly flattened, smooth or rugose, usually enclosing one fertile loculus and a much smaller abortive loculus; seed with a straight embryo, cotyledons much folded; pseudaril clasping putamen, usually red or yellowish, usually fleshy but in a few species thin or membranous or absent, cupular with short lobes or arms or with 2-4 relatively long arms or covering almost whole putamen without distinct arms.

Commiphora is represented in Arabia and western India by only eight species, all the other species occurring on the continent of Africa or on islands along the east coast of Africa. The genus is well represented in Madagascar and the Mascarenes where 25 species occur.

According to Jacquin (1779) the type species, *C. madagascariensis* Jacq., is a plant from Madagascar and Mauritius although the specimen from which the plant was described was a cultivated plant. *C. madagascariensis* has apparently never been re-collected in either Madagascar or Mauritius. There is evidence that species of *Commiphora* have been much in demand for their resin from the earliest times and it may be that the type species was widely cultivated in the past (Wild, 1959a). According to Wild it could easily have been in cultivation in Madagascar or Mauritius before 1797 when Jacquin described it.

Engler (1931) and Wild (1959a&b, 1963) regarded the leaves of *C. glandulosa*, *C. pyracanthoides* and *C. merkeri* as unifoliolate. According to them, representatives of the genus with pinnate leaves are primitive, and the unifoliolate leaves are developed by way of reduction. Sinia (1938) and Leenhouts (1959) rejected this theory and stated that the pinnate condition is advanced. The phylogeny of *Commiphora* species needs further investigation, but observations made during this study, support the view of Sinia and Leenhouts. Since no articulation exists in the petioles of *C. glandulosa*, *C. pyracanthoides* and *C. merkeri*, I prefer to designate the leaves as simple rather than unifoliolate.

Key to the Species Based on Vegetative Characteristics

Branchlets spine-tipped:

Leaves simple or trifoliolate with 2 much smaller lateral leaflets:

Bark grey with large black lenticels and peeling off around the stems in yellowish papery strips, branchlets smooth and purplish, leaves glaucous, small trees with a single stem.....3. *C. merkeri*

Bark yellow to green and flaking in yellowish papery pieces, branchlets greyish, leaves green, trees with a single main stem or many-stemmed shrubs:

Many-stemmed shrubs up to 3 m tall, terminal leaflet up to 4×2 cm, leaflet-margins finely crenate-serrate or entire.....2. *C. pyracanthoides*

Trees with a single main stem up to 8 m tall, terminal leaflet up to 6×3 cm, leaflet-margins finely crenate-serrate, rarely entire.....1. *C. glandulosa*

Leaves trifoliolate with the lateral leaflets at least half the size of terminal leaflet:

Branchlets and leaves pilose to tomentose.....5. *C. africana*

Branchlets and leaves glabrous or with a few scattered short hairs:

Branchlets and leaves glabrous, leaflets elliptic to broadly elliptic, margins coarsely crenate-serrate especially in upper half, terminal leaflet dorsiventral.....4. *C. schimperi*

Branchlets and leaves with a few scattered short hairs, leaflets elliptic to ovate to broadly ovate, margins entire or upper half finely crenate-serrate, terminal leaflet isobilateral.....6. *C. neglecta*

Branchlets not spine-tipped:

Leaves simple.....15. *C. namaensis*

Leaves trifoliolate or impari-pinnate:

Branchlets and leaves pilose to tomentose:

Leaflets often distinctly paler below, margins entire, bark peeling in thick discs, trunk often irregularly fluted.....7. *C. mollis*

- Leaflets not distinctly paler below, margins not entire (or entire as usually the case with *C. edulis*), bark flaking or peeling in thin papery pieces, trunk not fluted:
- Leaves trifoliolate or impari-pinnate, lateral leaflets up to $2 \times 1,2$ cm, branchlets not obtuse, terminal leaflets isobilateral and with hesperidin crystals, petiole without medullary vascular bundles. 14. *C. angolensis*
- Leaves only impari-pinnate, lateral leaflets larger than $2 \times 1,2$ cm, branchlets obtuse, terminal leaflet dorsiventral and without hesperidin crystals, petiole with medullary vascular bundles:
- Bark peeling in large yellowish papery pieces, tree with a single main stem, stems not entwined, leaves dark green, leaflets obovate to broadly elliptic, margins crenate-serrate to finely lobed 9. *C. marlothii*
- Bark flaking in small yellowish papery pieces, many-stemmed shrub or small tree, stems usually entwined, leaves greyish-green, leaflets narrowly elliptic to narrowly ovate, margins usually entire, rarely finely crenate-serrate. 10. *C. edulis*
- Branchlets and leaves glabrous (or with a few scattered short hairs in the case of *C. harveyi*):
- Leaves impari-pinnate or trifoliolate with relatively large leaflets and the petiole usually much longer than 2 cm, trees with a single long trunk or many-stemmed:
- Branchlets and leaves with a few scattered short hairs, bark usually peeling in large brown papery pieces. 8. *C. harveyi*
- Branchlets and leaves glabrous, bark not peeling or peeling in white papery pieces:
- Leaves trifoliolate or impari-pinnate, petiole slender, terminal leaflet isobilateral and with hesperidin crystals, bark usually peeling in large white papery pieces to expose a glaucous underlayer. 13. *C. tenuipetiolata*
- Leaves only impari-pinnate, petiole not slender, terminal leaflet dorsiventral and without hesperidin crystals:
- Leaflets oblanceolate to narrowly elliptic, margins entire to finely serrate, petiole with medullary vascular bundles. 12. *C. zanzibarica*
- Leaflets narrowly elliptic to elliptic, margins crenate-serrate to coarsely crenate-serrate, petiole without medullary vascular bundles. 11. *C. woodii*
- Leaves trifoliolate with relatively small leaflets and the petiole not longer than 2 cm, shrubs with a short trunk branching repeatedly above soil level:
- Leaflets cordate, orbicular or obovate but without irregular lobes, apex usually emarginate but sometimes obtuse, margins finely lobed. 17. *C. capensis*
- Leaflets linear or cultrate and usually with irregular lobes, apex acute to obtuse, margins entire or coarsely dentate-serrate:
- Leaves up to 8 cm long, leaflets linear to cultrate, margins coarsely dentate-serrate, branchlets slender. 16. *C. gracilifrons*
- Leaves up to 2 cm long, leaflets cultrate, margins entire irrespective of lobes, branchlets short and stout. 18. *C. cervifolia*

Key to the Species Based on all Characteristics

- Leaves simple or trifoliolate with 2 much smaller lateral leaflets:
- Branchlets not spine-tipped, leaves simple and usually orbicular, flowers perigynous; pseudaril cupular, covering the lower $\frac{1}{3}$ of putamen, with 2 arms on seam of putamen; putamen smooth. 15. *C. namaensis*
- Branchlets spine-tipped, leaves simple or trifoliolate with 2 much smaller leaflets, leaflets obovate to elliptic; flowers hypogynous; pseudaril covering most of putamen, with or without 4 arms; putamen rugose:
- Calyx glandular, flowers usually bisexual or female but male flowers rare, fruit subglobose 1. *C. glandulosa*
- Calyx glabrous, flowers predominantly unisexual, fruit distinctly apiculate:
- Bark grey with large black lenticels and peeling off around the stem in yellowish papery strips, small tree with a single main stem, disk in flowers not fluted, pseudaril yellow and without distinct arms, stems without a sclerenchymatous pericycle. 3. *C. merkeri*
- Bark yellow to green and flaking in yellowish papery pieces, many-stemmed shrub, disk in flowers fluted, pseudaril red and with 4 distinct arms, stems with a sclerenchymatous pericycle 2. *C. pyracanthoides*
- Leaves impari-pinnate or trifoliolate with the 2 lateral leaflets at least half the size of terminal leaflet:
- Branchlets spine-tipped, leaves trifoliolate, flowers hypogynous:
- Branchlets and leaves pilose to tomentose, leaflets obovate or occasionally elliptic, flowers only unisexual, fruit subglobose, putamen rugose. 5. *C. africana*
- Branchlets and leaves glabrous or with a few scattered short hairs, leaflets elliptic or ovate, flowers bisexual or unisexual, fruit subglobose or ellipsoid and apiculate, putamen rugose or smooth:
- Branchlets and leaves glabrous, leaflet-margins coarsely crenate-serrate, flowers only bisexual, fruit ellipsoid and distinctly apiculate, pseudaril membranous and without distinct arms, putamen rugose. 4. *C. schimperi*
- Branchlets and leaves with a few short scattered hairs, leaflet-margins entire or upper half finely crenate-serrate, flowers bisexual or unisexual, fruit subglobose, pseudaril fleshy and with 4 arms, putamen smooth. 6. *C. neglecta*
- Branchlets not spine-tipped, leaves trifoliolate or impari-pinnate, flowers hypogynous or perigynous:
- Branchlets and leaves pilose to tomentose:
- Leaves trifoliolate or impari-pinnate, lateral leaflets not larger than $3,5 \times 2$ cm, veins on lower surface of leaflets not conspicuously raised, petiole without medullary vascular bundles, fruit less than 1,5 cm in diameter:
- Leaflets often distinctly paler below and margins entire, flowers hypogynous, petals pilose to pubescent on outside, disk fleshy and not adnate to calyx and corolla, pseudaril with 4 winged arms, tree with a single main stem. 7. *C. mollis*

- Leaflets not distinctly paler below and margins crenate-serrate, flowers perigynous, petals glabrous or outside sparsely pilose, disk reduced and adnate to hypanthium, pseudaril cupular with 2 lobes, many-stemmed shrub.....14. *C. angolensis*
- Leaves impari-pinnate, lateral leaflets usually much larger than $3,5 \times 2$ cm, veins on lower surface of leaflets conspicuously raised, petiole with medullary vascular bundles, fruit more than 1,5 cm in diameter:
- Bark peeling in large yellowish papery pieces, leaves dark green, leaflets obovate to broad elliptic, flowers hypogynous; disk fleshy, pilose, not adnate to calyx or corolla; pseudaril yellow, with 2 long and 2 short arms.....9. *C. marlothii*
- Bark flaking in small yellowish papery pieces, leaves greyish-green, leaflets narrowly elliptic to narrowly ovate, flowers perigynous; disk much reduced, glabrous, adnate to hypanthium; pseudaril red, cupular with 4 short lobes.....10. *C. edulis*
- Branchlets and leaves glabrous (or with a few scattered short hairs in the case of *C. harveyi*):
- Leaves impari-pinnate or trifoliolate with relatively large leaflets and the petiole usually much longer than 2 cm, inflorescences relatively long paniculate dichasial cymes or dichasial cymes, trees with a long trunk or many-stemmed trees:
- Branchlets and leaves with a few scattered short hairs, bark usually peeling in large brown papery pieces, inflorescences with large leaf-like bracts, flowers hypogynous, disk not adnate to calyx or corolla, pseudaril with 4 arms.....8. *C. harveyi*
- Branchlets and leaves glabrous, bark not peeling or peeling in white papery pieces, inflorescences with relatively small bracts, flowers perigynous, disk adnate to hypanthium, pseudaril cupular with 0-2 short lobes:
- Leaves trifoliolate or impari-pinnate, petiole slender, bark usually peeling in large white papery pieces to expose a glaucous underlayer, inflorescences simple or compound dichasial cymes, pseudaril cupular with 2 lobes of varying length.....13. *C. tenuipetiolata*
- Leaves only impari-pinnate, petiole not slender, bark not peeling, inflorescences paniculate dichasial cymes, pseudaril cupular without lobes or with one short lobe:
- Leaflets oblanceolate to narrowly elliptic, margins entire to finely serrate, petiole with medullary vascular bundles, inflorescences very long, pedicels relatively long (4-6 mm); pseudaril cupular, covering the lower $\frac{1}{3}$ of putamen, without lobes, margin coarsely crenate.....12. *C. zanzibarica*
- Leaflets narrowly elliptic to elliptic, margins crenate-serrate, petiole without medullary vascular bundles, inflorescences long, pedicels relatively short (less than 1 mm); pseudaril cupular, covering the lower $\frac{1}{3}$ of putamen, with 1 short lobe, margin finely crenate
11. *C. woodii*
- Leaves trifoliolate with relatively small leaflets and the petiole not longer than 2 cm, flowers borne singly or in short simple dichasial cymes, shrubs with a short trunk branching repeatedly above soil level:
- Leaves up to 8 cm long, flowers with only 4 stamens/staminodes, fruit subglobose to ellipsoid, pseudaril fleshy, cupular with 2 arms.....16. *C. gracilifrons*
- Leaves up to 8 cm long, flowers with 8 stamens/staminodes, fruit ellipsoid and flattened, pseudaril absent:
- Leaflets cordate, orbicular or obovate, without irregular lobes, apex usually emarginate but sometimes obtuse, margins finely lobed.....17. *C. capensis*
- Leaflets culate, irregularly lobed, margins entire irrespective of lobes.....18. *C. cervifolia*

1. *Commiphora glandulosa* Schinz in Bull. Herb. Boiss. 2,8: 633 (1908); Codd, Mem. Bot. Surv. S. Afr. 26: 86 (1951); Exell & Mendonca in Consp. Fl. Angol. 1,2: 298 (1951); Miller in J. S. Afr. Bot. 18: 38 (1952); Brenan in Kew Bull. 1953: 106 (1953). Syntypes: S.W.A., Ombandja, Schinz 767 (Z!); Ondangau, Schinz s.n. (not seen). Lectotype: Schinz 767 (Z).

Commiphora lugardae N.E. Br. in Kew Bull. 1909: 99 (1909); Miller in J. S. Afr. Bot. 18: 38 (1952). Type: Botswana, Kwebe Hills, Lugard 23 (K, holo.). *C. seineri* Engl. in Bot. Jahrb. 44: 145 (1910); Bot. Jahrb. 48: 480 (1913); Pflanzenfam. 2,19a: 437 (1931). Type: Zambia, Sesheko, Seiner 57 (B, holo.; K, photo!; BM, sketch!). *C. berberidifolia* Engl. in Bot. Jahrb. 48: 480 (1913); Pflanzenfam. ed. 2,19a: 437 (1931). Type: S.W.A., Okahandja, Waldau, Dinter 385 (B, holo.; K, fragment!). *C. pyracanthoides* subsp. *glandulosa* (Schinz) Wild in Bol. Soc. Brot. 2,33: 44 (1959); Fl. Zamb. 2,1: 268 (1963). Von Breitenbach, Ind. Trees S. Afr. 3,2: 433 (1965); Merxm., Prod. Fl. S.W.Afr. 23: 8 (1968).

Polygamous or dioecious tree up to 8 m tall with a single main stem; bark purple-grey to green, flaking in yellowish papery pieces to expose a green underlayer; branchlets spine-tipped. Leaves simple or trifoliolate, up to 6,3 cm long, with long glandular hairs especially at base of laminae; petiole up to 3 mm long, with long glandular hairs at distal end; petiolules less than 1 mm long; terminal leaflet up to 6×3 cm, narrowly obovate to broadly obovate, rarely elliptic, apex

acute or obtuse, base cuneate, margins finely crenate-serrate, rarely entire; lateral leaflets up to $1,5 \times 0,8$ cm, elliptic. Flowers subsessile, bisexual or unisexual but male flowers rare, hypogynous, appearing before the leaves in axillary clusters on side shoots or spines, in some cases reduced dichasial cymes up to 1,5 cm long; bisexual and male flowers, 6-8 mm, larger than female flowers, 4,5-5,5 mm. Bracteoles up to 1 mm long, lanceolate, with numerous glandular hairs. Pedicels usually less than 1 mm long, with numerous glandular hairs. Calyx campanulate, green to red, 2-3,5 mm long, with numerous long glandular hairs, lobes less than 1 mm long, apex acute. Petals yellowish green to red, 4-6 mm long, without glandular hairs. Disk fleshy, not adnate to calyx and corolla, cylindrical with 4 prominent lobes, indentations between lobes shallow, lobes bifid. Stamens 8, 4 long stamens up to 4,5 mm long, inserted high up on the outside of disk lobes, 4 short stamens up to 3 mm long, inserted on the outside of disk between lobes; filaments subterete, lower part flattened and broadened; staminodes in female flowers. Gynoecium: rudimentary in male flowers; ovary superior; style variable in length; stigma obscurely 4-lobed. Fruit $1,1 \times 1$ cm, subglobose, slightly flattened, asymmetrical; exocarp glabrous; mesocarp fleshy; putamen 7×5 mm, ellipsoid, asymmetrical with one face more convex than the other, rugose; pseudaril red, fleshy, with 4

arms of equal length reaching almost to apex of putamen, margins of arms irregular, arm on more convex face of putamen slightly broader than arm on the other face. FIG 1-7.



FIG. 1.—*Commiphora glandulosa* near Waterpoort, northern Transvaal (height ± 4 m).



FIG. 2.—Close-up view of the trunk of *Commiphora glandulosa* illustrating the bark flaking off in small papery pieces.



FIG. 3.—*Commiphora glandulosa*: A, branchlet with flowers and young fruits; B—E, leaves; F, branchlet with leaves and mature fruits.

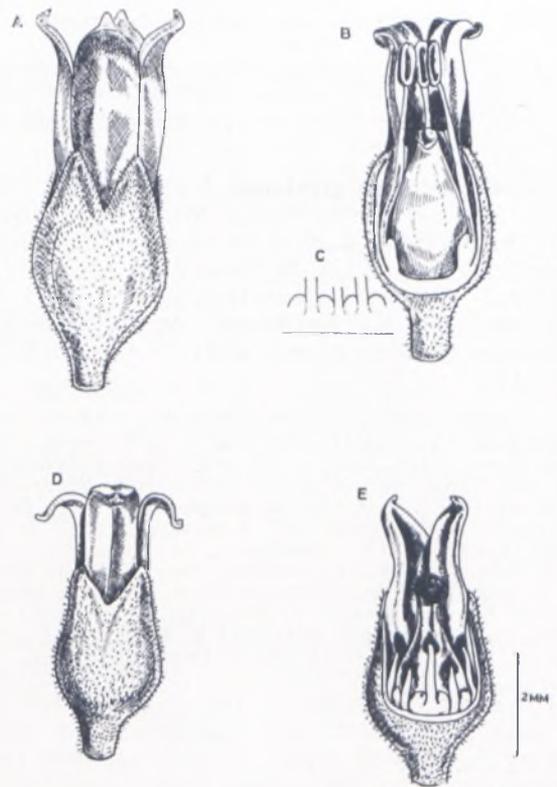


FIG. 4.—Flowers of *Commiphora glandulosa*: A, bisexual flower; B, bisexual flower with calyx and corolla partly removed; C, diagrammatic representation of two disc lobes illustrating the insertion of the filaments; D, female flower; E, female flower with the calyx and corolla partly removed.

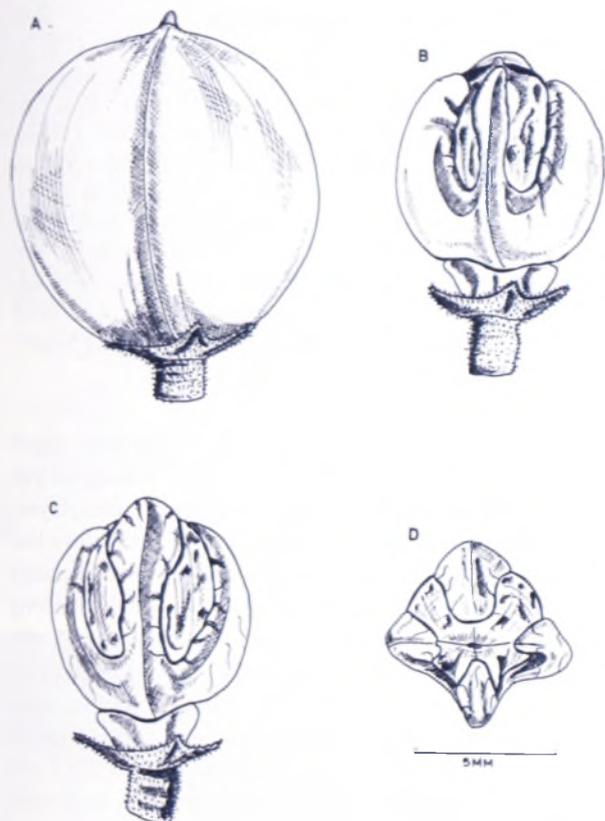


FIG. 5.—Fruit of *Commiphora glandulosa*: A, sideview of the fruit; B, view of the less convex face of putamen with pseudaril; C, view of the more convex face of putamen with pseudaril; D, putamen and pseudaril as seen from above.

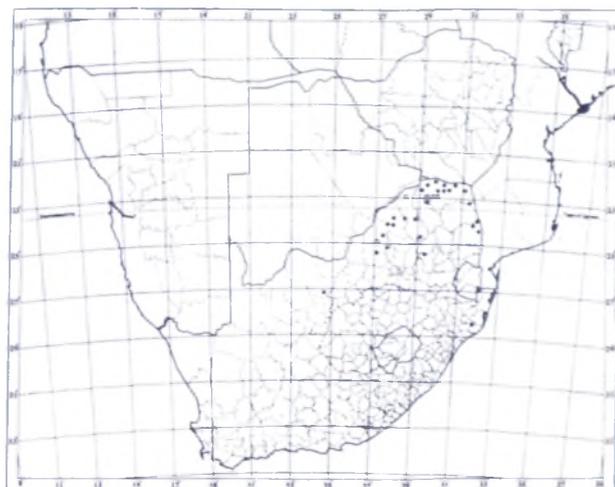


FIG. 6.—Geographical distribution of *Commiphora glandulosa* in South Africa.



FIG. 7.—*Commiphora glandulosa* (in the background) and *C. pyracanthoides* (in the foreground) near Messina, northern Transvaal.

Distinctive anatomical features of the stems and leaves

Young stems with a few glandular hairs especially near apex. *Stems of 2.5 cm diameter*: sclerenchymatous pericycle-cylinder consisting of fibres and stone cells, epithelium cells of resin ducts in xylem rays surrounded by 1–2 layers of cells with slightly thickened walls. *Leaves* with relatively long glandular

hairs; petiole semi-circular as seen in transverse section, sclerenchymatous pericycle absent, vascular bundles triangularly distributed as seen in transverse section; terminal leaflet typically dorsiventral with a single layer of palisade cells adaxially, remaining mesophyll consisting of spongy parenchyma, bulliform cells confined to adaxial epidermis; stomata mainly abaxial.

Diagnostic features

Polygamous or dioecious tree with a single main stem; bark purple-grey to green, flaking in yellowish papery pieces to expose a green underlayer; branchlets spine-tipped. *Leaves* simple or trifoliolate with 2 small lateral leaflets, with long glandular hairs at base of laminae and distal end of petiole, terminal leaflet typically dorsiventral. *Flowers* subsessile; hypogynous; bisexual or unisexual but male flowers rare; calyx with numerous long glandular hairs; disc lobes 4, bifid. *Fruit* subglobose; putamen rugose; pseudaril red with 4 arms of equal length reaching almost to apex of putamen.

Widely distributed in northern Zululand, north-western, northern, far-northern and north-eastern Transvaal, but is particularly common north of the Soutpansberg. Also collected in the northern Cape.

Usually grows in sandy, well-drained soil in areas with a relatively low annual rainfall, and occurs in savanna-woodland or in broken mopaniveld.

Also recorded from South West Africa, Botswana, Rhodesia, Zambia, Mozambique and Angola.

TRANSVAAL.—2229(Waterpoort): Dongola (-BC), *Pole-Evans 4450*; *Verdoorn 2297A*; 2325; Soutpan (-CD), *Obermeyer, Schweickerdt & Verdoorn 159*; near Mopane (-DB), *Strey 3501*; 8 km E. of Waterpoort (-DC), *Van der Walt 20*; Wylliespoort (-DD), *Strey 1857*. 2230(Messina): near Messina (-AC), *Häfstrom & Acocks 1882*; *Rogers 18475*; Tshipise (-CA), *Van der Schijff 5238* (PRU); *Van der Walt 3*; 29 km E. of Tshipise (-CB), *Van der Schijff 5239*. 2231(Pafuri): 7 km N.E. of Punda Milia (-CA), *Codd & Dyer 4569*. 2327(Ellisras): 16 km S.S.E. of Ellisras (-DD), *Van der Walt 108*. 2328(Baltimore): 32 km N.W. of Melkrivier (-CD), *Van der Walt 47*; near Sterkwater (-DD), *Van der Walt 51*. 2329(Pietersburg): near Vivo (-AB), *Strey 3518*. 2331(Phalaborwa): Shingwidzi Rest Camp (-AB), *Codd 4652*; Gorge Rest Camp (-DD), *Van der Schijff 839*. 2427(Thabazimbi): 50 km S. of Ellisras, (-BA), *Van der Walt 54*; 40 km N.N.W. of Vaalwater (-BB) *Smuts 352*; 22 km S.E. of Bulge River (-BB), *Van der Walt 52*; W. of Krantzberg (-CB), *Codd 4432*; *Galpin 13377*; 35 km N.W. of Northam (-CC), *Van der Walt 74*. 2429(Zebediela): 13 km S.S.E. of Roedtan (-CA), *Meeuse 9497*. 2431(Acornhoek): near Olifants Rest Camp (-BA), *Codd 4290*; near Satara Rest Camp (-BD), *Van der Schijff 3497*. 2527(Rustenburg): S. of Pilanesberg (-AC), *Codd 1107*; at confluence of Crocodile and Pienaars Rivers (-BA), *Codd 9839*. 2529(Witbank: Loskopdam Nature Reserve (-AD), *Codd 10365*; *Van der Walt 14*.

NATAL.—2632(Bela Vista): Ndumo Game Reserve (-CC), *Gerstner 3148*; *Tinley 577*; *Van der Walt 99*; 102. 2831(Eshowe): Umfolozi Game Reserve (-BD), *Feely 65*; *Ward 4061* (NH).

CAPE.—2724(Taung): River Valley at Tierkloof (-BA), *Brueckner*.

Wild (1959b) considers this taxon as a subspecies of *C. pyracanthoides* Engl. This taxonomic change by Wild is based mainly on observations made by Merxmüller in South West Africa where *C. glandulosa* occurs in tree and shrub form. However, the flower, and fruit structure of these two taxa differ to such an extent that they should be considered as different species.

This species is easily grown from pole cuttings which are often planted as fencing poles.

Common names: Corkwood ("Kurkhout") and "Kanniedood".

2. *Commiphora pyracanthoides* Engl. in Bot. Jahrb. 26: 368 (1899); Bot. Jahrb. 48: 481 (1913); Pflanzenfam. ed. 2,19a: 437 (1931); Burt Davy, Fl. Transv. 2: 485 (1932); Miller in J.S. Afr. Bot. 18: 38 (1952); Brenan in Kew Bull. 1953: 104 (1953); Wild in Bol. Soc. Brot. 2,33: 43, 82 (1959); White, For. Fl. N. Rhod.: 176, t. 34A (1962); Wild in Fl. Zamb. 2,1: 268 (1963); Von Breitenbach, Ind. Trees S. Afr. 3,2: 432 (1965); De Wint. in Trees S. Afr. 20,1: 16 (1968); Merxm., Prod. Fl. S.W. Afr. 23: 8 (1968). Type: S.W.A., Otjimbingwe, *Fischer 8* (holo.†; ?); Neotype: S.W.A., Little Karas Mountains, Holoog, *Pearson 9747* (K!).

Dioecious or polygamous many-stemmed shrub up to 3 m tall; bark yellow to green, flaking in yellowish papery pieces to expose a green underlayer; branchlets spine-tipped. *Leaves* simple or trifoliolate up to 4,5 cm long, with long glandular hairs especially at base of laminae; petiole up to 3 mm long, with long glandular hairs at distal end; petiolules less than 1 mm long; terminal leaflet up to 4×2 cm, narrowly obovate to broadly obovate, rarely elliptic, apex acute to obtuse, base cuneate, margins finely crenate-serrate, in some cases entire; lateral leaflets 2×1 cm, elliptic. *Flowers* subsessile, predominantly unisexual, rarely bisexual, hypogynous, appearing before the leaves in axillary clusters on side shoots or spines, in some cases in reduced dichasial cymes up to 1,5 cm long; male and bisexual flowers, 8–10 mm, larger than female flowers, 3,5–5 mm. *Bracteoles* up to 2 mm long, lanceolate, with a few glandular hairs. *Pedicels* up to 1,5 mm long, without glandular hairs. *Calyx* campanulate, green to red, 2–4 mm long, without glandular hairs, lobes up to 1 mm long, apex acute. *Petals* yellowish green to red, 3–7 mm long, without glandular hairs. *Disk* fleshy, cylindrical, not adnate to calyx or corolla, folded to form 4 large lobes towards the outside, indentations between lobes shallow, lobes not bifid, inside of lobes deeply grooved; disk of female and bisexual flowers smaller and less fleshy than those of male flowers but the lobes in some cases bifid. *Stamens* 8, 4 long stamens up to 4 mm long, inserted high up on the outside of lobes, 4 short stamens up to 3 mm long, filaments subterete, lower part flattened and broadened; staminodes in female flowers. *Gynoecium*: rudimentary in male flowers; ovary superior; style relatively long; stigma 4-lobed. *Fruit* 1,2×0,8 cm, ellipsoid, irregularly flattened, asymmetrical, apiculate; exocarp glabrous; mesocarp relatively thin; putamen 8×6 mm, ellipsoid, asymmetrical with one face more convex than the other, rugose; pseudaril red, not very fleshy, with 4 arms and isolated fragments on putamen, arms of equal length reaching almost to apex of putamen, margins of arms irregular, arm on more convex face of putamen broader than arm on the other face. FIG. 8–13.



FIG. 8.—*Commiphora pyracanthoides* near Waterpoort, northern Transvaal (height $\pm 1,5$ m).



FIG. 9.—Close-up view of a branch of *Commiphora pyracanthoides* illustrating the bark flaking in small papery pieces.

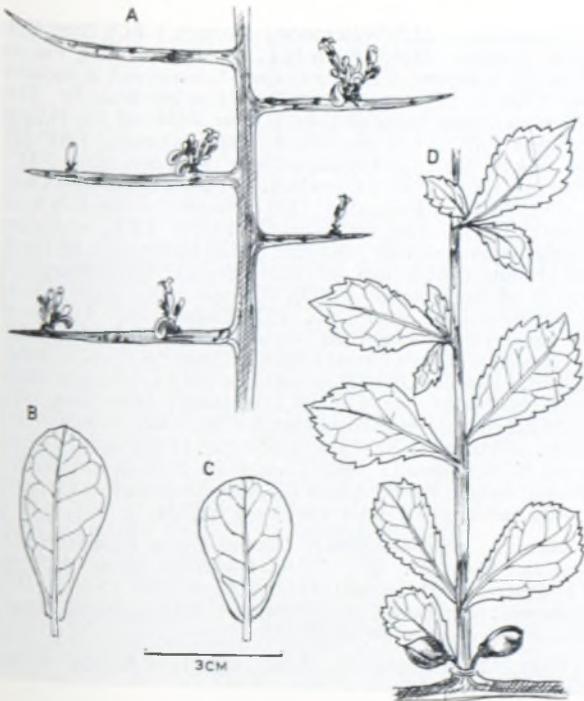


FIG. 10.—*Commiphora pyracanthoides*: A, branchlet with flowers; B, C, leaves; D, branchlet with leaves and mature fruits.

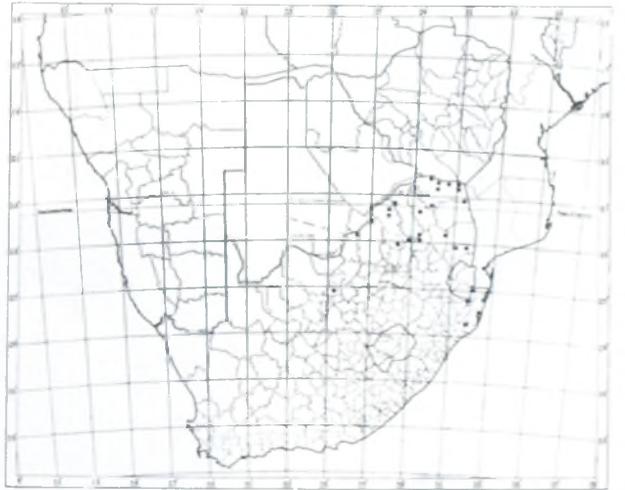


FIG. 11.—Geographical distribution of *Commiphora pyracanthoides* in South Africa.

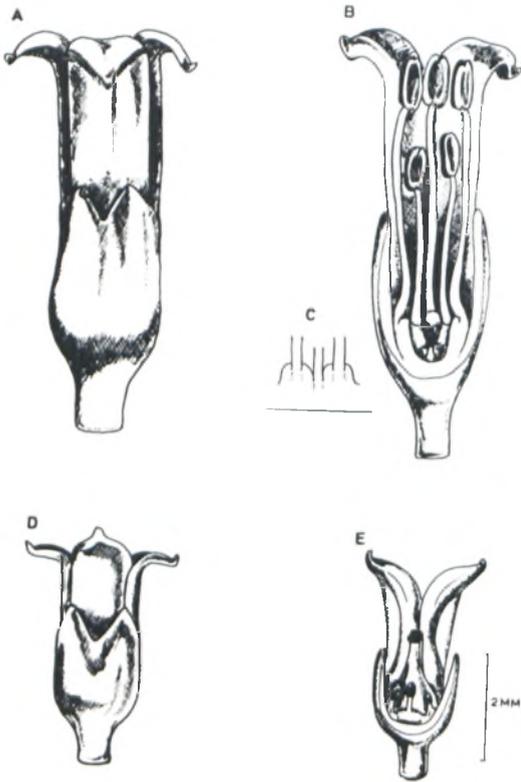


FIG. 12.—Flowers of *Commiphora pyracanthoides*: A, male flower; B, longitudinal section of male flower; C, diagrammatic representation of two disc lobes illustrating the insertion of the filaments; D, female flower; E, female flower with the calyx and corolla partly removed.

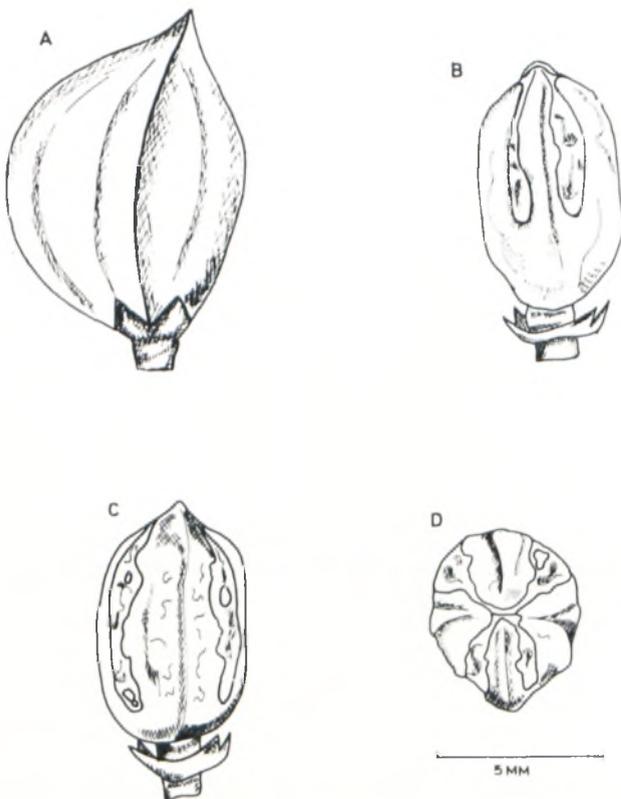


FIG. 13.—Fruit of *Commiphora pyracanthoides*: A, side view of the fruit; B, view of the less convex face of putamen with pseudaril; C, view of the more convex face of putamen with pseudaril; D, putamen and pseudaril as seen from above.

Distinctive anatomical features of the stems and leaves

Young stems with a few glandular hairs especially near apex. Stems of 2.5 cm diameter: sclerenchymatous pericycle-cylinder consisting of fibres and stone cells, epithelium cells of resin ducts in xylem rays surrounded by 1–2 layers of cells with slightly thickened walls. Leaves with relatively long glandular hairs; petiole semi-circular as seen in transverse section, sclerenchymatous pericycle present or absent, vascular bundles triangularly distributed as seen in transverse section; terminal leaflet dorsiventral with a single layer of palisade cells adaxially, remaining mesophyll consisting of spongy or palisade-like cells, bulliform cells confined to adaxial epidermis, stomata mainly abaxial.

Diagnostic features

Dioecious or polygamous many stemmed shrub; bark yellow to green, flaking in yellowish papery pieces to expose a green underlayer; branchlets spine-tipped. Leaves simple or trifoliolate with 2 small lateral leaflets, with long glandular hairs at base of laminae and distal end of petiole, terminal leaflet dorsiventral. Flowers subsessile; hypogynous; predominantly unisexual, rarely bisexual; calyx glabrous; disk folded to form 4 large lobes towards the outside, lobes in male flowers not bifid but in female and bisexual flowers bifid. Fruit ellipsoid; apiculate; putamen rugose; pseudaril red, with 4 arms of equal length reaching almost to apex of putamen.

Widely distributed in northern Zululand, north-western, northern, far-northern and north-eastern Transvaal, but is particularly common north of the Soutpansberg. Also collected in northern Cape.

Usually grows in sandy, well-drained soil in areas with a relatively low annual rainfall, and occurs in savanna-woodland, broken mopaniveld and shrub-thornveld.

Also recorded from Swaziland, South West Africa, Botswana, Rhodesia and Mozambique.

TRANSVAAL.—2229(Waterpoort): Dongola (–BC), Dyer 4314; 4300; Verdoorn 2336; 16 km N.E. of Alldays (–CA), Van der Walt 65; Soutpan (–CD), Obermeyer, Schweickerdt & Verdoorn 48; 8 km E. of Waterpoort (–DC), Van der Walt 10. 2230 (Messina): near Messina (–AC), Dyer 4324; 48 km N.E. of Tshipise (–BC), Van der Schijff 5241; Tshipise (–CA), Van der Schijff 5217. 2231(Pafuri): near Kloppefontein (–AC), Van der Schijff 1861; 21 km N.E. of Punda Milia Rest Camp (–CA), Codd & Dyer 4578. 2327(Ellisras): 8 km E.N.E. of Ellisras (–DB), Van der Walt 57; 10 km S.S.E. of Ellisras (–DD), Van der Walt 119; 120. 2328(Baltimore): 16 km S. of Marnitz (–AC), Van der Walt 58. 2329(Pietersburg): 21 km S. of Bandelierkop (–BD), Gerstner 5576; 3 km N.E. of Kalkbank (–CB), Story 1562. 2331(Phalaborwa): 5 km S. of Shingwidzi Rest Camp (–AB), Van der Walt 76. 2426(Mochudi): 5 km S.E. of Rooibokkraal (–BB), Leistner 3167. 2427(Thabazimbi): 13 km E.N.E. of Rooibokkraal (–AA), Van der Walt 26. 2428(Nylstroom): 5 km N. of Tuinplaats (–DD), Strey 1373. 2429(Zebediela): near Immerpan (–CB), Meuse 9488; 9 km N.W. of Marble Hall (–CD), Codd 10367. 2430 (Pilgrim's Rest): 2 km N. of Origstad (–DA), Codd 6753. 2531 (Komatiport): Numbi (–AA), Van der Schijff 731; near Skukuza Rest Camp on Lower Sabie road (–BA), Van der Schijff 3418.

NATAL.—2632(Bela Vista): Ndumo Game Reserve (–CC), Van der Walt 100; 101. 2731(Louwsburg): 11 km N.W. of Candover (–BD), Acocks 13128; Ward 3697 (NH). 2831 (Eshowe): Umfolozi Game Reserve (–BD), Leibnitz, Fakude & Hancox 10; Van der Walt 84.

CAPE.—2725(Bloemhof): near Schweizer-Reneke (–AB) Van Wyk 14.

Brenan (1953) stated that the type specimen (Fischer 8) could not be traced. *Pearson* 9747 was chosen by him as the neotype because this specimen was sent to Berlin in 1929 where it was compared with material which Engler himself designated as *C. pyracanthoides*.

3. *Commiphora merkeri* Engl. in Bot. Jahrb. 44: 144 (1910); Bot. Jahrb. 48: 480 (1913); Pflanzenfam. ed. 2, 19a: 437 (1931); Burt in Kew Bull. 1935: 110 (1935); Wild in Bol. Soc. Brot. 2, 33: 82 (1959); Dale & Greenway, Kenya Trees 89 (1961); Wild in Fl. Zamb. 2, 1: 269 (1963); Von Breitenbach, Ind. Trees S. Afr. 3, 2: 431 (1965); De Wint. in Trees S. Afr. 20, 1: 12 (1968). Type: Tanzania, Nguruka, Merker 565 (B, holo.†; K, fragment!).

Commiphora viminea Burt Davy, Fl. Transv. 2: 485 (1932); Codd, Mem. Bot. Surv. S. Afr. 26: 88 (1951); Brenan in Kew Bull. 1953: 104 (1953). Type: Transvaal, Messina, Moss & Rogers 184b (K, holo.!).

Dioecious small tree up to 5 m tall; bark grey with large black lenticels, peeling off around the stems in yellowish papery strips; branchlets spine-tipped. *Leaves* simple or trifoliate, glaucous, up to 5 cm long, with long glandular hairs especially at base of laminae; petiole up to 5 mm long, with long glandular hairs at distal end; petiolules less than 1 mm long; terminal leaflet up to 4,5×2,5 cm, narrowly obovate to obovate or elliptic, apex acute to obtuse, base cuneate, margins crenate-serrate especially near apex; lateral leaflets up to 7×5 mm, elliptic. *Flowers*

unisexual, hypogynous, appearing before the leaves or with the young leaves in axillary clusters on side shoots or spines; male flowers, 10–12 mm, usually much larger than female flowers, 5–6 mm. *Bracteoles* up to 1 mm long, \pm triangular, with a few long glandular hairs. *Pedicels* 2–7 mm long, without glandular hairs. *Calyx* campanulate, yellowish green to brown, 2–3 mm long, without glandular hairs, lobes usually less than 1 mm long, apex acute. *Petals* yellowish green 3–5,5 mm long, without glandular hairs. *Disk* cylindrical, not adnate to calyx or corolla; in male flowers very fleshy with 4 prominent lobes, indentation between lobes shallow, lobes not bifid, outside of lobes deeply grooved and inside shallowly grooved; disk in female flowers smaller. *Stamens* 8, 4 long stamens up to 5 mm long, inserted halfway up on the outside of lobes; 4 short stamens up to 3,5 mm long, inserted on the outside of disk between lobes; filaments subterete, lower part flattened and broadened, lower part of 4 long filaments placed in grooves of lobes; staminodes in female flowers. *Gynoecium*: rudimentary in male flowers; ovary superior; style long causing stigma to protrude above petals; stigma obscurely 4-lobed. *Fruit* 1,3×0,7 cm, ellipsoid, slightly flattened, asymmetrical, very apiculate; exocarp glabrous; mesocarp relatively thin; putamen 8×5 mm, ellipsoid, asymmetrically and irregularly flattened, rugose; pseudaril yellow, covering the whole putamen except the apex, forming a prominent ridge on small face of putamen. FIG. 14–19.



FIG. 14.—*Commiphora merkeri* near Waterpoort, northern Transvaal (height \pm 2,5 m).



FIG. 15.—Close-up view of a branch of *Commiphora merkeri* illustrating the large lenticels and bark peeling off around the stem in papery strips.

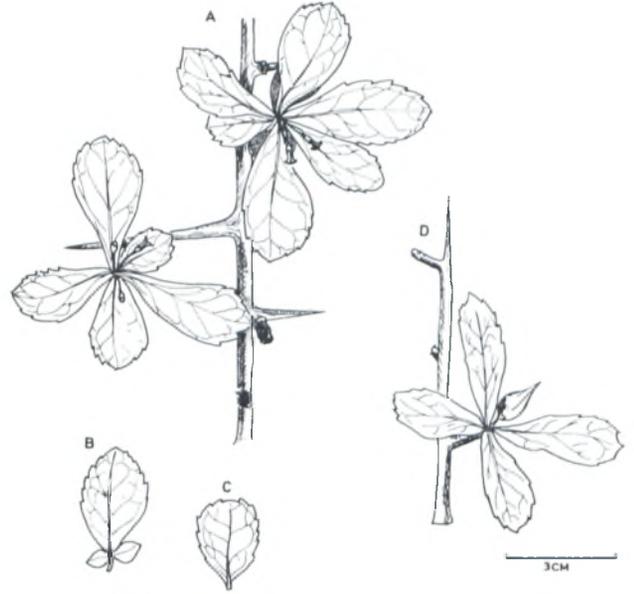


FIG. 16.—*Commiphora merkeri*: A, branchlet with leaves and flowers; B & C, leaves; D, branchlet with leaves and a mature fruit.

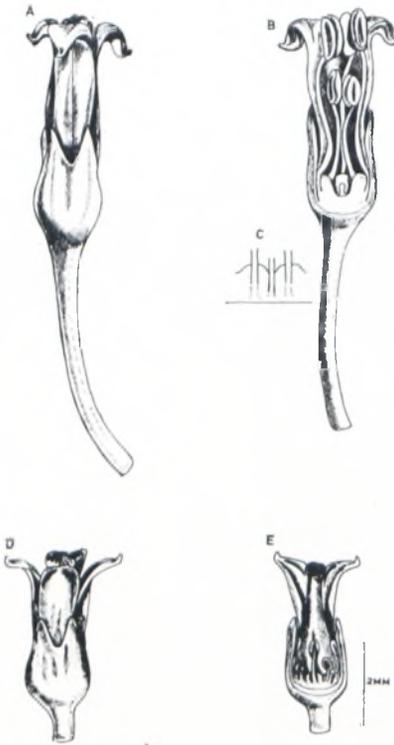


FIG. 17.—Flowers of *Commiphora merkeri*: A, male flower; B, longitudinal section of male flower; C, diagrammatic representation of two disc lobes illustrating the insertion of the filaments; D, female flower; E, female flower with the calyx and corolla partly removed.

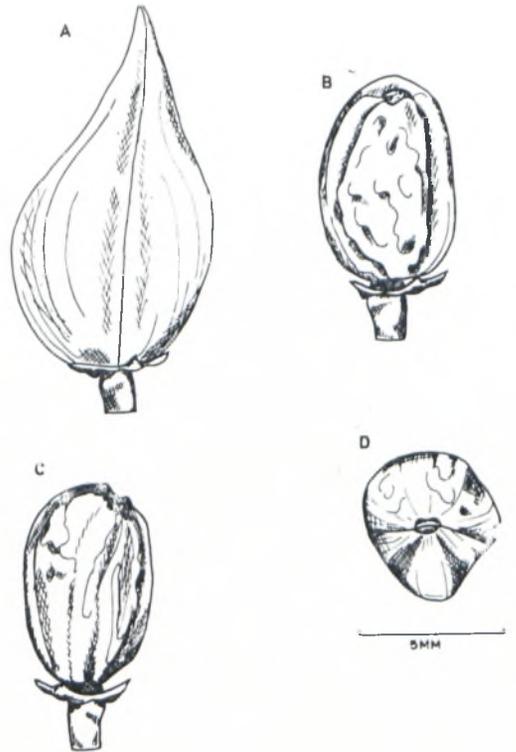


FIG. 18.—Fruit of *Commiphora merkeri*: A, side-view of the fruit; B, view of the less convex face of putamen with pseudaril; C, view of the more convex face of putamen and pseudaril as seen from above.



FIG. 19.—Geographical distribution of *Commiphora merkeri* in South Africa.

Distinctive anatomical features of the stems and leaves

Young stems with a few glandular hairs especially near apex. Stems of 2,5 cm diameter: sclerenchymatous pericycle absent, epithelium cells of resin ducts in xylem rays surrounded by 1–2 layers of sclereids. Leaves with relatively long glandular hairs; petiole semi-circular as seen in transverse section, sclerenchymatous pericycle present or absent, vascular bundles triangularly distributed as seen in transverse section; terminal leaflet typically dorsiventral with a single layer of palisade cells adaxially, remaining mesophyll consisting of spongy parenchyma, bulliform cells confined to adaxial epidermis, stomata mainly abaxial.

Diagnostic features

Diocious small tree; bark grey with large black lenticels, peeling off around the stems in yellowish papery strips; stems without sclerenchymatous pericycle; branchlets spine-tipped. Leaves simple or trifoliate with 2 small lateral leaflets, glaucous, with long glandular hairs at base of laminae and distal end of petiole, terminal leaflet typically dorsiventral. Flowers hypogynous; unisexual: calyx glabrous; disk lobes not bifid. Fruit ellipsoid; very apiculate; putamen rugose; pseudaril yellow without distinct arms, covering the whole putamen except the apex.

Occurs in northern Transvaal from the border of Botswana in the west to Mozambique in the east, but is particularly common north of the Soutpansberg. Grows in well-drained, sandy soil in warm areas with a relatively low annual rainfall. Occurs in savanna-woodland.

Also recorded from Rhodesia, Mozambique, Tanzania, Kenya and South West Africa.

TRANSVALA.—2228(Maasstroom): 16 km N.E. of Swartwater (-CC), Van der Walt 60. 2229(Waterpoort): Dongola area (-BC), Verdoorn 2301; Codd 4104; 4835; Mopane (-DB), Strey 3505; 8 km E. of Waterpoort, Van der Walt 32. 2230 (Messina): Tshipise (-CA), Van der Walt 6; Van der Schijff 5199 (PRU). 2231(Pafuri): 3 km W. of Pafuri (-AC), Codd & Dyer 4634; S.E. of Klopperfontein (-AC), Van der Schijff 2948. 2429(Zebediela): Chuniespoort (-AB), De Winter 2327.

The stems often exude large quantities of gum-resin. Common name: Zebra Tree.

4. *Commiphora schimperi* (O. Berg) Engl. in A.D.C., Monogr. Phan. 4: 13 (1883); Schweinf. in Bull. Herb. Boiss. 7,2: 288 (1899); Engl. in Bot. Jahrb. 48: 477, t.2N (1913); Pflanzenfam. ed. 2,19a: 435, t.204 C–D (1931); Burt in Kew Bull 1935: 110 (1935); Wild in Bol. Soc. Brot. 2,33: 88 (1959); Dale & Greenway, Kenya Trees 80 (1961); Wild in Fl. Zamb. 2,1: 277 (1963); Von Breitenbach, Ind. Trees S. Afr. 3,2: 437 (1965); De Wint. in Trees S. Afr. 20,1: 16 (1968). Syntypes: Ethiopia, Takazze, Schimper 1564 (B†; W!; G!); Schimper 624 (B†; K!); Schoata, Schimper 1139 (B†; W!; G!). Lectotype: Schimper 624 (K).

Balsamodendrum schimperi O. Berg in Bot. Ztg. 20: 162 (1862) *B. africanum* sensu Oliv., Fl. Trop. Afr. 1: 325 (1868), pro parte quoad specim. Schimper.

Balsamea schimperi (O. Berg) Engl. in Bot. Jahrb. 1: 41 (1881).

Commiphora betschanica Engl. in Bot. Jahrb. 44: 149 (1910); Bot. Jahrb. 48: 478 (1913); Pflanzenfam. ed. 2,19a: 435 (1931); Burt Davy, Fl. Transv. 2: 484 (1932); Codd, Mem. Bot. Surv. Afr. 26: 85 (1951); Miller in J.S. Afr. Bot. 18: 38 (1952). Type: Botswana, Mugnune, Seiner 64 (B, holo.†; K, fragment!; BM, sketch!).

Shrub or small tree 2–6 m tall; bark peeling in black discs or flaking in small yellowish papery pieces to expose a green underlayer; branchlets spine-tipped, glabrous. Leaves trifoliate, glabrous; laminae up to 7,5 cm long; petiole up to 2,8 cm long; petiolules up to 2 mm long; leaflets elliptic to broad elliptic, apex acute, base cuneate, margins coarsely crenate-serrate especially in the upper half of leaflets; terminal leaflet up to 5 × 3,5 cm; lateral leaflets up to 2,5 × 2,2 cm. Flowers only bisexual, hypogynous, appearing before the leaves in axillary clusters, often borne on the spines, flowers 6–8 mm long. Bracteoles up to 1 mm long, triangular, with a few glandular hairs. Pedicels 1–2 mm long, with a few glandular hairs. Calyx campanulate, green to red, 3–4 mm long, glabrous, lobes less than 0,5 mm long, apex acute or obtuse. Petals yellow to pink, 6–7 mm long, glabrous. Disk fleshy, not adnate to calyx or corolla, cylindrical with 4 lobes, indentation between lobes shallow, lobes in some cases bifid. Stamens 8, 4 long stamens up to 6 mm long, inserted high up on the outside of disk lobes, 4 short stamens up to 4,5 mm, inserted on the outside of disk between the lobes; filaments slightly flattened, lower part broadened. Gynoecium: ovary superior; style relatively long; stigma 4-lobed. Fruit 1,7 × 1 cm, ellipsoid, asymmetrically and irregularly flattened, very apiculate, apex curved; exocarp rugose and glabrous; mesocarp fleshy; putamen 1,1 × 0,7 cm, ellipsoid, asymmetrically and irregularly flattened, very rugose, slimy; pseudaril red, membranous, covering almost the whole putamen. FIG. 20–26.



FIG. 20.—*Commiphora schimperi* near Ellisras, northern Transvaal (height ± 5 m).



FIG. 21, FIG. 22.—Close-up view of different branches of *Commiphora schimperi* illustrating the bark flaking in papery pieces (Fig. 21) and peeling in thicker discs (Fig. 22).

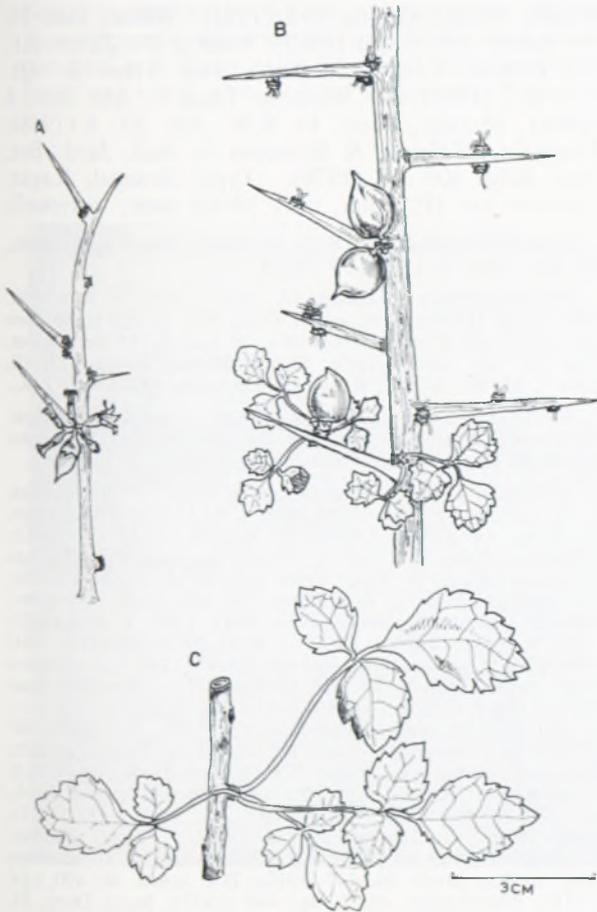


FIG. 23.—*Commiphora schimperi*: A, branchlet with flowers and young fruit; B, branchlet with leaves and mature fruits; C, branchlet with leaves.

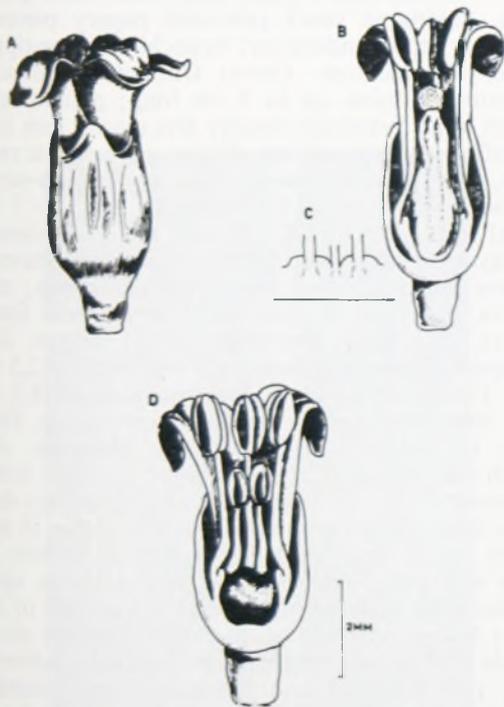


FIG. 24.—Flowers of *Commiphora schimperi*: A, bisexual flower; B, bisexual flower with calyx and corolla partly removed; C, diagrammatic representation of two disc lobes illustrating the insertion of the filaments; D, longitudinal section of the bisexual flower with the gynoecium removed.

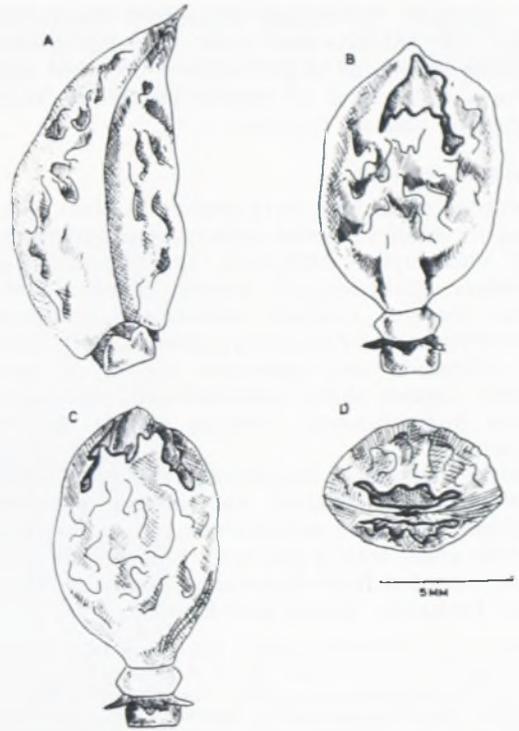


FIG. 25.—Fruit of *Commiphora schimperi*: A, side-view of the fruit; B, view of the less convex face of putamen with pseudaril; C, view of the more convex face of putamen with pseudaril; D, putamen and pseudaril as seen from above.

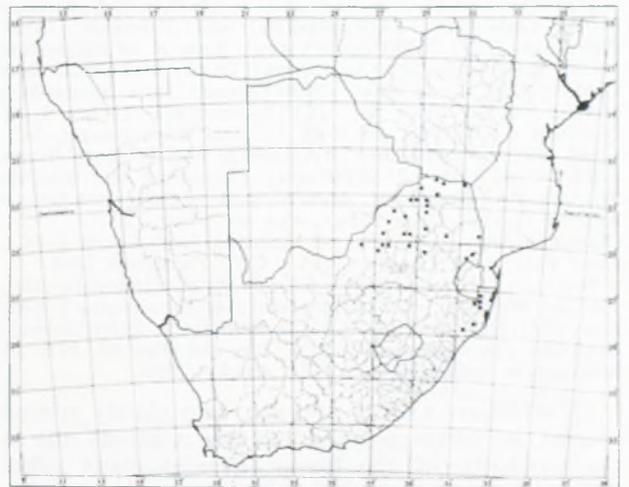


FIG. 26.—Geographical distribution of *Commiphora schimperi* in South Africa.

Distinctive anatomical features of the stems and leaves

Young stems with a few glandular hairs especially near apex. *Stems of 2,5 cm diameter*: sclerenchymatous pericycle consisting of separate fibre strands but stone cells absent, epithelium cells of resin ducts in xylem rays surrounded by thin-walled cells. *Leaves* with a few glandular hairs; petiole heart-shaped as seen in transverse section, sclerenchymatous pericycle present, vascular bundles \pm triangularly distributed as seen in transverse section, vascular bundles on adaxial side smaller than bundles on abaxial side; terminal leaflet dorsiventral with a single layer of palisade

cells adaxially, remaining mesophyll consisting of spongy or palisade-like cells, adaxial epidermis consisting mainly of large bulliform cells but smaller bulliform cells occur in abaxial epidermis, stomata confined to abaxial epidermis.

Diagnostic features

Shrub or small tree; bark peeling in black discs or flaking in small yellowish papery pieces to expose a green underlayer; branchlets spine-tipped. *Leaves* trifoliolate, glabrous, all leaflets elliptic to broad elliptic, margins coarsely crenate-serrate, terminal leaflet dorsiventral. *Flowers* hypogynous, only bisexual. *Fruit* ellipsoid, very apiculate and apex curved; putamen rugose, slimy; pseudaril red, membranous, without distinct arms, covering almost the whole putamen.

Widely distributed in central Transvaal, northern Transvaal and Zululand, and occurs in savanna-woodland. Grows in well-drained, sandy soil, usually in warm areas with a relatively low annual rainfall.

Also recorded from Botswana, Rhodesia, Mozambique, Tanzania, Kenya and Ethiopia.

TRANSVAAL.—2229(Waterpoort): Dongola (–BC), *Hutchinson 2136*; *Verdoorn 2337*; 8 km W. of Alldays (–CA), *Van der Walt 64*; Masekwaspoort (–DD), *Van der Walt 66*. 2230 (Messina): near Messina (–AC), *Gerstner 5716*. 2231(Pafuri): 5 km W. of Klopperfontein (–AC), *Codd 5437*. 2328(Baltimore): 32 km W. of Blaauwberg (–BA), *Mogg 24483*; Blaauwberg (–BB), *Tscheuschner* sub PRE 29494; 32 km N.W. of Melk-rivier (–CD), *Van der Walt 48*. 2329(Pietersburg): near Vivo (–AB), *Van der Walt 11*; 32 km N.N.E. of Kalkbank (–AD), *Codd 4048*; near Kalkbank (–CB), *Van der Walt 68*. 2427 (Thabazimbi): 50 km S. of Ellisras (–BA), *Van der Walt 55*; Kransberg (–CB), *Prosser 1701*. 2428 (Nylstroom): 5 km N. of Nylstroom (–CB), *Van der Walt 1*; 34 km N.E. of Nylstroom (–DA), *Codd 4820*. 2429(Zebediela): near Zebediela (–AD), *Pole-Evans 3112*. 2430(Pilgrim's Rest): 6 km N. of Burgersfort (–CB), *Codd 6766*. 2431(Acornhoek): 16 km S. of Satara Rest Camp (–DB), *Codd 4294*. 2526(Zeerust): near Silkaatskop (–AB), *Van der Walt 78*. 2527(Rustenburg): 21 km S. of Northam (–AB), *Van der Walt 73*; near Pilanesberg (–AC), *Codd 1093*; at confluence of Crocodile and Pienaars Rivers (–BA), *Codd 9338*. 2528(Pretoria): Elandsberg near Rust de Winter (–BA), *Codd 6294*. 2529(Witbank): Loskopdam Nature Reserve (–AD), *Codd 10363*; *Van der Walt 12*; 71. 2531 (Komatiport): 5 km N. of Malelane Rest Camp (–BC), *Codd 4369*; near Louw's Creek (–CB), *Thorncroft 2265*.

NATAL.—2731(Louwsburg): 8 km N.W. of Candover (–BD), *Van der Walt 105*. 2732(Ubombo): near Ingwavuma (–AA), *Strey 4741* (NH); Jozini (–AC), *Van der Walt 29*. 2831(Eshowe): Umfolozi Game Reserve (–BD), *Van der Walt 85*; N.E. of Melmoth in Imfuli Valley (–CB), *Acocks 12993*.

C. schimperi and *C. africana*, two closely related species, are often confused and this is mainly due to the similarity of the leaves. Besides many other differences such as in flower and fruit structure, the two species can also be distinguished on the hairiness of the leaves. The leaves of *C. africana* are pilose to tomentose, while those of *C. schimperi* possess only a few glandular hairs.

A pungent resin odour is emitted when fresh leaves are picked.

5. *Commiphora africana* (A. Rich.) Engl. in A.D.C., Monogr. Phan. 4: 14 (1883); Schweinf. in Bull. Herb. Boiss. 7,2: 289 (1899); Sim, For. Fl. P.E. Afr.: 28 (1909); Engl. in Bot. Jahrb. 48: 484, t.3N (1913); Hutch. & Dalz., Fl. W. Trop. Afr. 1: 488 (1928); Engl. in Pflanzenfam. ed. 2,19a: 438 (1931); Eggeling, Trees Uganda 26 (1940); Exell & Mendonca in Consp. Fl. Angol. 1,2: 300 (1951); Wild in Bol. Soc. Brot. 2,33: 42 (1959); Dale & Greenway, Kenya Trees 83, t.17 (1961); Irvine,

Woody Plants Ghana 510 (1961); White, For. Fl. N. Rhod. 176, t.34B (1962); Wild in Fl. Zamb. 2,1: 276 (1963); Von Breitenbach, Ind. Trees S. Afr. 3,2: 437 (1965); De Wint. in Trees S. Afr. 20,1: 8 (1968); Merxm., Prod. Fl. S.W. Afr. 23: 4 (1968); Lisowski, Malaisse & Symoens in Bull. Jard. Bot. Nat. Belg. 40: 357 (1970). Type: Senegal, Kayar, *Leprieur* s.n. (P, holo., only photo seen; isotypes!).

Heudelotia africana A. Rich. in Guill., Perr. & A. Rich., Fl. Sen. Tent. 1: 150, t. 39 (1832).

Balsamodendrum africanum (A. Rich.) Arn. in Ann. Nat. Hist. 3: 87 (1839); Oliv. in Fl. Trop. Afr. 1: 325 (1868), pro parte excl. syn. *B. schimperi* et vars. *B. kotschy* O. Berg in Bot. Ztg. 20: 162 (1862). Type: Sudan, Nubia, *Kotschy 271* (B, holo.†; S!; W!; MEL!; K!; BM!). Lectotype: *Kotschy 271* (K).

Balsamea pilosa Engl. in Bot. Jahrb. 1: 41 (1881). Type: Tanzania, Zanzibar, *Hildebrandt 1184* (W, holo!). *B. kotschy* (O. Berg) Engl. in Bot. Jahrb. 1: 41 (1881).

Commiphora pilosa (Engl.) Engl. in A.D.C., Monogr. Phan. 4: 12 (1883); Bot. Jahrb. 48: 488, t.3U (1913); Pflanzenfam. ed. 2,19a: 440 (1931); Chiov., Fl. Somalia 2: 124, t.85 (1932); Steedman, Trees S. Rhod. 31 (1933); Eggeling, Trees Uganda 27 (1940); Palgrave, Trees Cent. Afr. 58, t. & photo (1956). *C. loandensis* Engl. in Bot. Jahrb. 26: 370 (1899). Syntypes: Angola, Luanda, *Welwitsch 4497* (BM!; LISU!); 4498 (BM!; LISU!); 4498b (BM!; LISU!); 4500 (BM!; LISU!); 4501 (BM!; LISU!). Lectotype: *Welwitsch 4497* (LISU). *C. rubriflora* Engl. in Bot. Jahrb. 30: 336 (1902). Type: Tanzania, near Rukwa Lake, *Goetze 1406* (B, holo.†; K, fragment! and iso!). *C. nkolola* Engl. in Bot. Jahrb. 34: 308 (1905); Bot. Jahrb. 48: 490 (1913); Pflanzenfam. ed. 2,19a: 440 (1931). Type: Tanzania, Zanzibar coastal area, *Busse 528* (B, holo.†; K, fragment!). *C. sambesiaca* Engl. in Bot. Jahrb. 44: 146 (1910); Bot. Jahrb. 48: 490, t.3W (1913); Pflanzenfam. ed. 2,19a: 330 (1931); Burt Davy, Fl. Transv. 2: 485 (1932). Type: Zambia, Kazungula, *Seiner 90* (B, holo.†; K, fragment!). *C. calcicola* Engl. in Bot. Jahrb. 44: 147 (1910); Bot. Jahrb. 48: 490, t.3V (1913); Pflanzenfam. ed. 2,19a: 440 (1931); Burt Davy, Fl. Transv. 2: 485 (1932). Type: S.W.A., Grootfontein; *Dinter 820* (B, holo.†; K, fragment!; BM, sketch!).

Dioecious shrub less than 1 m tall or small tree up to 4 m tall, with a single main stem; dark grey to green, flaking in small yellowish papery pieces to expose a green underlayer; branchlets spine-tipped, pilose to tomentose. *Leaves* trifoliolate, pilose to tomentose, lamina up to 5 cm long; petiole up to 1,6 cm long; petiolules usually less than 2 mm long; all leaflets obovate seldom elliptic, apex obtuse rarely acute, base cuneate, margins coarsely crenate-serrate or finely lobed; terminal leaflet up to 3,3×3 cm; lateral leaflets up to 1,4×1,1 cm. *Flowers* unisexual, hypogynous, appearing before or with the leaves in axillary clusters, often borne on the spines; male flowers, 6–8 mm, in most cases larger than female flowers, 5–7 mm. *Bracteoles* up to 1 mm long, triangular, pilose to pubescent. *Pedicels* up to 2,5 mm long. *Calyx* campanulate, green to red, 2,5–4,5 mm long, lobes less than 1 mm long, apex acute. *Petals* green to red, 4,5–5,5 mm long, glabrous. *Disk* cylindrical not adnate to calyx or corolla, with 4 prominent lobes, indentation between lobes very deep, upper part of lobes grooved on outside, lobes in male flowers fleshy but not bifid, in female flowers less fleshy and bifid. *Stamens* 8, 4 long stamens up to 5,5 mm long, inserted high up on the outside of disk lobes; 4 short stamens up to 3 mm, inserted on the outside of disk between the lobes; filaments subterete, lower part flattened and broadened and placed in grooves on outside of disk lobes; staminodes in female flowers. *Gynaecium*: rudimentary in male flowers; ovary superior; style relative long; stigma obscurely 4-lobed. *Fruit* 1,5×1,2 cm, subglobose, slightly flattened, asymmetrical; exocarp glabrous; mesocarp

fleshy; putamen 1,0×0,8 cm, subglobose to ellipsoid, asymmetrically and irregularly flattened, very rugose; pseudaril red, fleshy, with 4 arms of variable size and form and often also isolated fragments, 2 arms on

seam of putamen reaching almost to apex, 2 arms on flattened faces of putamen of variable length, in some cases arms not distinct and pseudaril covering almost whole putamen. FIG. 27-32.

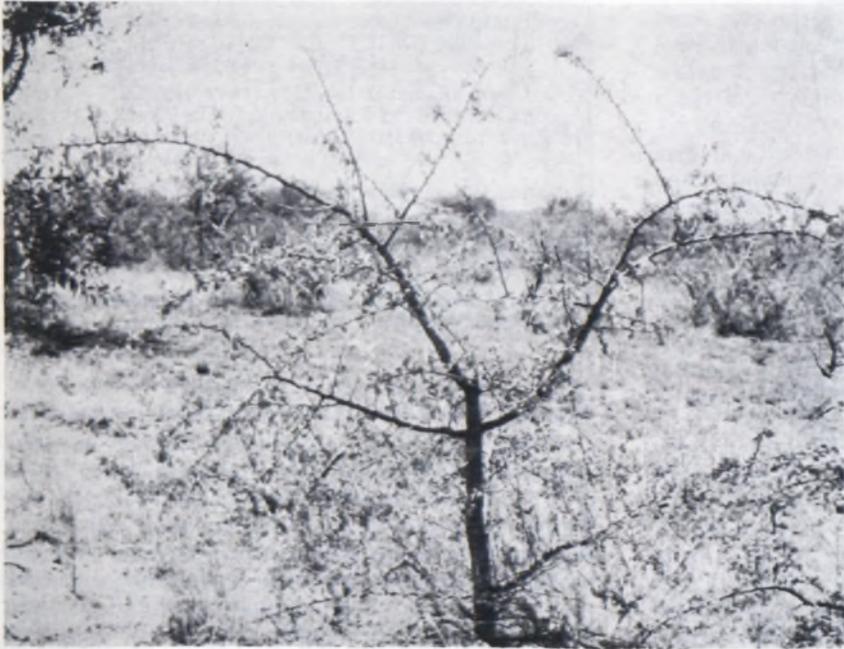


FIG. 27.—*Commiphora africana* near Dendron, northern Transvaal (height ± 1 m).



FIG. 28.—Close-up view of a branch of *Commiphora africana* illustrating the bark flaking in small papery pieces.

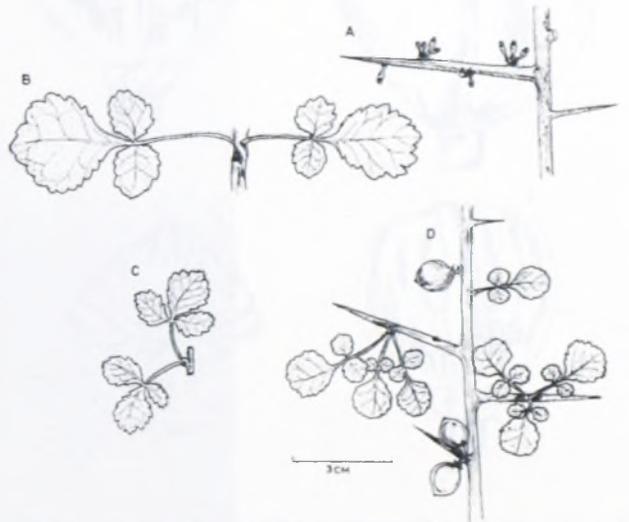


FIG. 29.—*Commiphora africana*: A, branchlet with flowers; B, C, branchlets with leaves; D, branchlet with leaves and mature fruits.

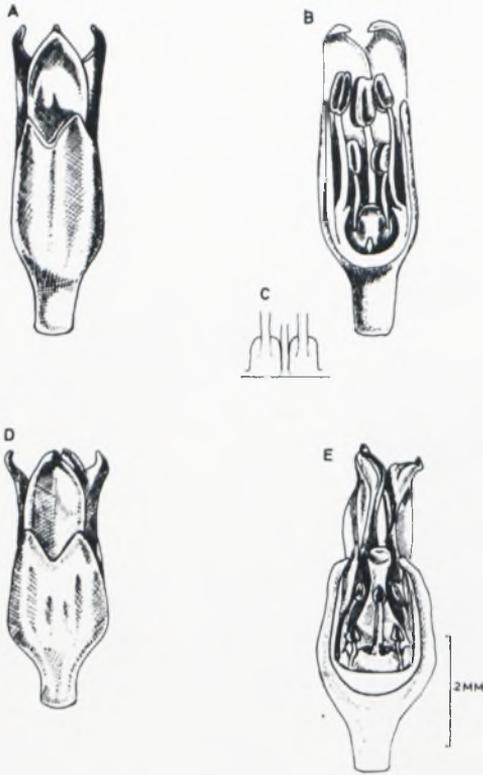


FIG. 30.—Flowers of *Commiphora africana*: A, male flowers; B, longitudinal section of male flower; C, diagrammatic representation of two disc lobes illustrating the insertion of the filaments; D, female flower; E, female flower with the calyx and corolla partly removed.

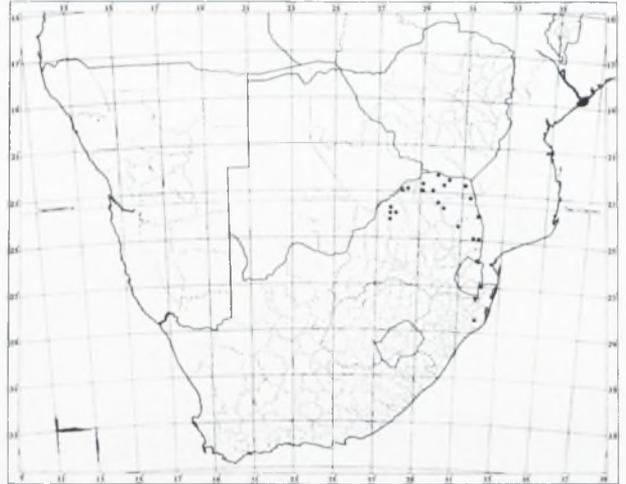


FIG. 32.—Geographical distribution of *Commiphora africana* in South Africa.

Distinctive anatomical features of the stems and leaves

Young stems with a variable number of multicellular non-glandular and glandular hairs. *Stems of 2,5 cm diameter*: sclerenchymatous pericycle consisting of separate fibre strands but stone cells absent, epithelium cells of resin ducts in xylem rays surrounded by thin-walled cells. *Leaves* with a variable number of multicellular non-glandular and glandular hairs; petiole \pm triangular as seen in transverse section, sclerenchymatous pericycle present, vascular bundles \pm circularly distributed as seen in transverse section; terminal leaflet dorsiventral with a single layer of palisade cells adaxially, remaining mesophyll consisting of spongy or palisade-like cells, buliform cells confined to adaxial epidermis, stomata mainly abaxial.

Diagnostic features

Dioecious shrub or small tree; bark grey to green, flaking in small yellowish papery pieces to expose a green underlayer; branchlets spine-tipped, pilose to tomentose. *Leaves* trifoliate, pilose to tomentose; all leaflets obovate, seldom elliptic, margins coarsely crenate-serrate or finely lobed, terminal leaflet dorsiventral. *Flowers* hypogynous, unisexual. *Fruit* subglobose; putamen rugose; pseudaril red, fleshy, with 4 arms of variable size and form and often also isolated fragments.

Distributed in northern Zululand, north-western, far-northern, north-eastern and eastern Transvaal, but is particularly common north of the Soutpansberg.

Usually grows in sandy, well-drained soil in areas with a relatively low annual rainfall. Occurs in shrub-thornveld, savanna-woodland or in broken mopaniveld.

Also recorded from Swaziland, the northern and central parts of South West Africa, Botswana, Rhodesia, Mozambique, Zambia, Malawi, Angola, Tanzania, Kenya, Ethiopia, Uganda, Sudan, Gambia, Senegal, Nigeria, Mauritania, Mali, Ghana, Togo, Niger, Zaire and Rwanda.

TRANSVAAL.—2228(Maasstroom): 15 km S.W. of Swartwater (—CC), *Meeuse 10571*. 2229(Waterpoort): Dongola (—BB), *Verdoorn 2329*; N. of Soutpan (—CC), *Obermeyer, Schweickerdt & Verdoorn 180*. 2230(Messina): 30 km N.E. of Tshipise (—AD), *Van der Schijff 5237*; Tshipise (—CA), *Van der Schijff*

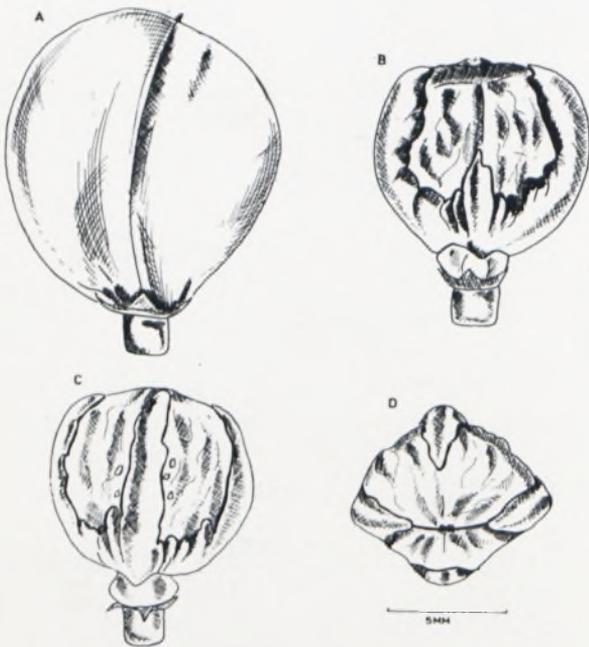


FIG. 31.—Fruit of *Commiphora africana*: A, side-view of the fruit; B, view of the less convex face of putamen with pseudaril; C, view of the more convex face of putamen with pseudaril; D, putamen and pseudaril as seen from above.

5201; *Van der Walt* 9. 2231(Pafuri): near Punda Milia Rest Camp (-CA), *Van der Schijff* 921. 2327(Ellisras): 20 km S. of Ellisras (-DC), *Van der Walt* 56; 16 km S.S.E. of Ellisras (-DD), *Van der Walt* 118. 2329(Pietersburg): near Dendron (-AD), *Codd* 4436; *Van der Walt* 67; *Verdoorn* 2317b. 2330 (Tzaneen): Hans Merensky Nature Reserve (-CA), *Gilliland* 790. 2331(Phalaborwa): 5 km S. of Shingwidzi Rest Camp (-AB), *Van der Walt* 75; near Gorge Rest Camp (-DD), *Van der Schijff* 3495. 2427(Thabazimbi): 50 km S. of Ellisras (-BA), *Van der Walt* 23. 2430(Pilgrim's Rest): Abel Erasmus Pass (-BD), *Killick & Strey* 2527. 2431(Acornhoek): near Skukuza Rest Camp (-DC), *Van der Schijff* 449; near Tshokwane (-DD), *Van der Schijff* 912. 2531(Komatipoort): near Komatipoort (-DD), *Van der Schijff* 893.

NATAL.—2632(Bela Vista): Ndumo Game Reserve (-CC), *Vander Walt* 30; 97. 2731(Louwsburg): 6 km N.W. of Candover (-BD), *Van der Walt* 104; 106. 2831(Eshowe): Umfolozi Game Reserve (-BD), *Van der Walt* 86.

Richard (1832) described *Heudelotia africana* as the type species of this genus. In his description it is mentioned that the flowers are bisexual. An illustration of Dale & Greenway (1961) also indicates that the flower of *C. africana* is bisexual. The staminodes of the female flowers investigated, although relatively long, are always sterile.

Wild (1963) distinguishes the var. *africana* and var. *rubriflora* (Engl.) Wild. The calyx and pedicels of the var. *rubriflora* are hairy, while those of the var. *africana* are glabrous. As far as could be determined, only var. *africana* occurs in South Africa.

Wild (1963) mentions that the pseudaril of *C. africana* is apparently absent. However, all the fruits of this species studied possess a fleshy pseudaril.

According to Irvine (1961) the gumresin is used by the natives for perfuming and fumigating huts. He also mentions that it has several medicinal uses, and it is also used as a varnish. The species is easily grown from pole cuttings which are often planted as fencing poles. Common name: African bdellium.

6. *Commiphora neglecta* *Verdoorn* in *Bothalia* 6,1: 214 (1951); *Codd*, *Mem. Bot. Surv. S. Afr.* 26: 88 (1951); Wild in *Bol. Soc. Brot.* 2,33: 86 (1959);

Wild in *Fl. Zamb.* 2,1: 271 (1963); Von Breitenbach, *Ind. Trees S. Afr.* 3,2: 438 (1965); Moll, *For. Trees Natal* 80 (1967); De Wint. in *Trees S. Afr.* 20,1: 16 (1968). Type: Transvaal, Skukuza, *Codd & Verdoorn* 5498 (PRE, holo.!).

Polygamous or dioecious many-stemmed shrub or small tree with a single main stem up to 8 m tall; bark grey to green, smooth or flaking in small yellowish papery pieces; branchlets spine-tipped and with a few short hairs. *Leaves* trifoliolate, with a few short hairs; lamina up to 7 cm long; petiole up to 4,5 cm long; petiolules usually less than 1 mm long; leaflets elliptic or ovate to broadly ovate, apex acute, base cuneate, margins entire or upper half finely crenate-serrate; terminal leaflet up to 4,4×2,8 cm, lateral leaflets up to 3×2,2 cm. *Flowers* bisexual or unisexual but male flowers rare, hypogynous, appearing before or with the leaves in axillary dichasial cymes up to 1,2 cm long or in clusters, usually on spines; peduncles usually with a few short hairs; bisexual and male flowers, 7–8 mm, usually slightly larger than female flowers, 6–7 mm. *Bracteoles* up to 3,5 mm long, lanceolate, with variable number of short hairs. *Pedicels* 2–5 mm long, often with a few short hairs. *Calyx* campanulate, yellow to green, 2–3 mm long, often with a few short hairs, lobes up to 1 mm long, apex acute to obtuse. *Petals* yellow to green, 3–5 mm long, glabrous. *Disk* fleshy, not adnate to calyx or corolla, cylindrical with 4 lobes, indentation between lobes shallow, lobes of bisexual and male flowers not bifid but in female flowers bifid. *Stamens* 8, 4 long stamens up to 4 mm long, inserted high up on the outside of disk lobes, 4 short stamens up to 2,8 mm long, inserted on the outside of disk between lobes; filaments subterete, lower part flattened and broadened; staminodes in female flowers. *Gynoecium*: rudimentary in male flowers; ovary superior; style relatively short; stigma obscurely 4-lobed. *Fruit* 1,5×1,4 cm, subglobose, slightly



FIG. 33.—*Commiphora neglecta* in the Umfolozi Game Reserve, Zululand (height ± 3 m).

flattened and asymmetrical; exocarp glabrous; mesocarp fleshy; putamen 8×7 mm, ellipsoid, asymmetrically and irregularly flattened, smooth; pseudaril red, very fleshy, with 4 arms. 2 arms on seam of putamen reaching almost to apex, 2 arms on flattened faces of putamen shorter and of equal length, but arm on more convex face usually broader than arm on other face. FIG. 33–38.



FIG. 34.—Close-up view of a branch of *Commiphora neglecta* illustrating the bark flaking in papery pieces.

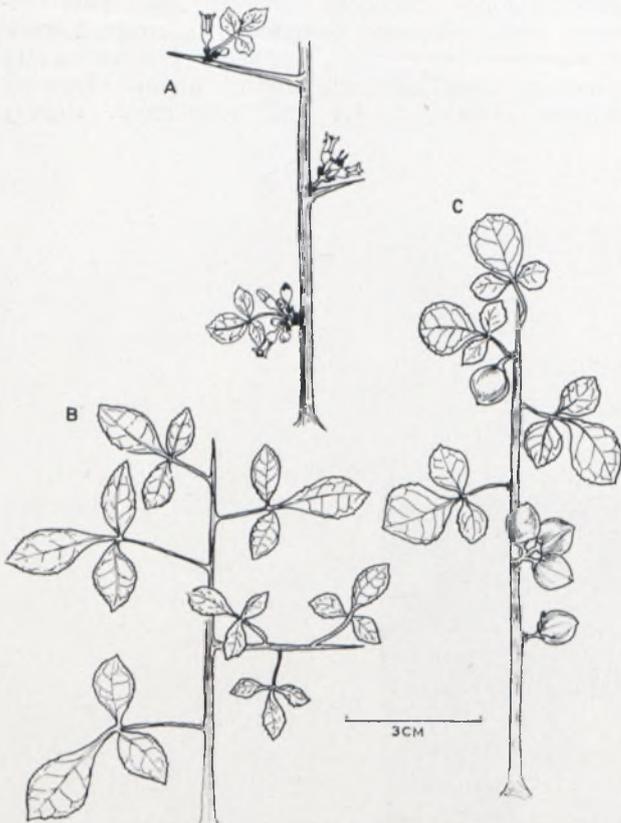


FIG. 35.—*Commiphora neglecta*: A, branchlet with young leaves and flowers; B, branchlet with leaves; C, branchlet with leaves and mature fruits.

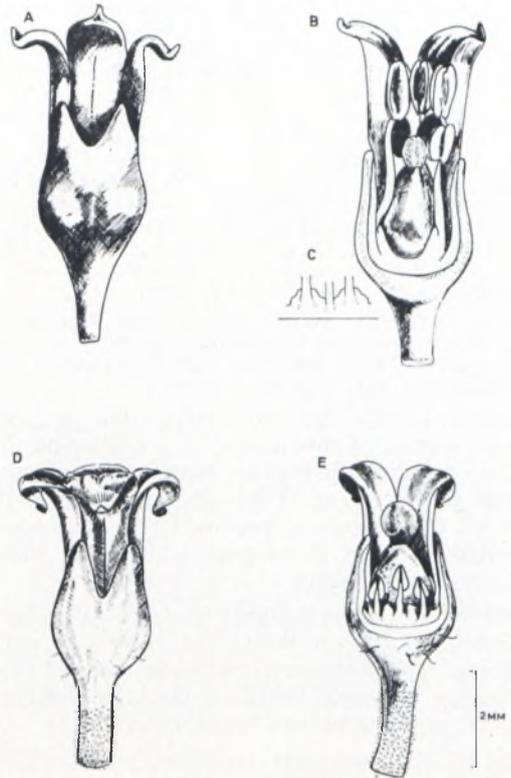


FIG. 36.—Flowers of *Commiphora neglecta*: A, bisexual flower; B, bisexual flower with the calyx and corolla partly removed; C, diagrammatic representation of two disc lobes illustrating the insertion of the filaments; D, female flower; E, female flower with the calyx and corolla partly removed.

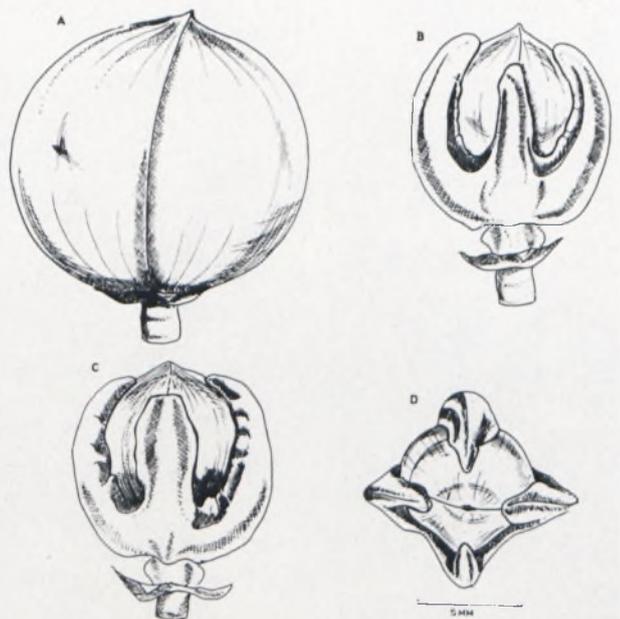


FIG. 37.—Fruit of *Commiphora neglecta*: A, side-view of the fruit; B, view of the less convex face of putamen with pseudaril; C, view of the more convex face of putamen with pseudaril; D, putamen and pseudaril as seen from above.

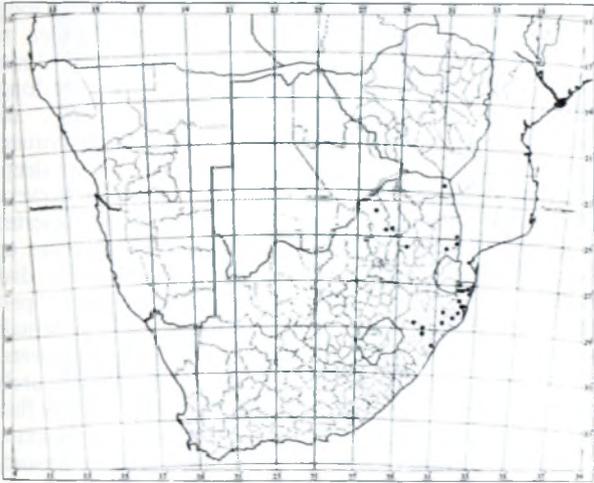


FIG. 38.—Geographical distribution of *Commiphora neglecta* in South Africa.

Distinctive anatomical features of the stems and leaves

Young stems with a few short non-glandular hairs (mostly unicellular) and glandular hairs. *Stems* of 2.5 cm diameter: sclerenchymatous pericycle-cylinder consisting of fibres and stone cells, epithelium cells of resin ducts in xylem rays surrounded by 1 layer of cells with slightly thickened walls. *Leaves* with a few short non-glandular hairs (mostly unicellular) and glandular hairs; petiole \pm triangular as seen in transverse section, sclerenchymatous pericycle present, vascular bundles \pm circularly distributed as seen in transverse section; terminal leaflet isobilateral with a single layer of long palisade cells adaxially and a single layer of shorter palisade cells abaxially, remaining mesophyll consisting of spongy or palisade-like cells, adaxial epidermis consisting mainly of large bulliform cells but smaller bulliform cells occur in adaxial epidermis, stomata mainly abaxial.

Diagnostic features

Polygamous or dioecious many-stemmed shrub or small tree; bark grey to green, smooth or flaking in small yellowish papery pieces; branchlets spine-tipped, with a few short hairs. *Leaves* trifoliolate, with a few short hairs, margins of leaflets entire or upper half finely crenate-serrate, terminal leaflet isobilateral. *Flowers* hypogynous, bisexual or unisexual but male flowers rare. *Fruit* subglobose; exocarp glabrous; putamen smooth; pseudaril red, very fleshy, with 4 arms, 2 arms on seam of putamen reaching almost to apex, 2 arms on flattened faces of putamen shorter.

This species occurs in central and northern Transvaal; is widely distributed in Natal and particularly common in northern Zululand. It usually occurs on the slopes of mountains or in sandy, well-drained soil in areas with an annual rainfall of 500–700 m per year.

Also recorded from Mozambique.

TRANSVAAL.—2231(Pafuri): near Punda Milia Rest Camp (–CA), *Lang* 31083. 2327(Ellisras): 16 km S. of Ellisras (–DD), *Codd* 1013. 2428(Nylstroom): 5 km N.E. of Nylstroom (–CB), *Smuts & Gillett* 3340; *Van der Walt* 2; 34 km N.E. of Nylstroom (–DA), *Codd* 4821; *Verdoorn* 2362. 2431(Acornhoek): 24 km E. of Skukuza (–DD), *Codd & Verdoorn* 5498 (PRE); *Codd* 4396; *Codd & de Winter* 5052. 2527(Rustenburg): 21 km S. of Northam (–AB), *Van der Walt* 72. 2529(Witbank): Loskopdam Nature Reserve (–AD), *Codd* 10362; *Van der Walt* 17.

2531(Komatipoort): Klokwe (–AD), *Van der Schijff* 337; 14 km S.E. of Pretoriuskop Rest Camp (–AD), *Codd & de Winter* 5166; 2 km W. of Skipberg (–AD), *Van der Walt* 69; on Lower Sabie road (–BB), *Van der Schijff* 3268.

NATAL.—2632(Bela Vista): Ndumo Game Reserve (–CC), *Gerstner* 3452 (NH); 45 km N.E. of Jozini, *Van der Walt* 98. 2723(Uhombo): Ingwavuma (–AA), *Vahrmeijer* 812; Manzenzweni Forest Station near Ingwavuma (–AA), *de Winter & Vahrmeijer* 8515; 40 km N.E. of Ubombo (–AB), *Van der Walt* 103; Lalanek (–BA), *Vahrmeijer* 467; Mkuzi Game Reserve (–CA), *Ward* 3570 (NH); near False Bay (–CD), *Gerstner* 6767; *Ward* 1639 (NH); 2829(Harrismith): Tugela Valley near Colenso (–DB), *Edwards* 2465. 2830(Dundee): Tugela Ferry (–CD), *Edwards* 1256. 2831(Eshowe): near Mahlabatini (–AB), *Gerstner* 2222; Umfolozi Game Reserve (–BD), *Van der Walt* 87; 90; 38 km N.E. of Heatonville (–BD), *Van der Walt* 82; near Emplengeni bridge (–CB), *Lawn* 1697 (NH). 2832(Mtubatuba): Hluhluwe Game Reserve (–AA), *Ward* 1750. 2930(Pietermaritzburg): near Middeldrift (–AB), *Edwards* 2083; near Umgeni Dam (–DB), *Bayer* 729.

As Verdoorn (1951) mentions, this species differs in the particular combination of characters rather than in any outstanding characteristics. This is probably the reason why it was described in 1951 for the first time.

Although plants in the veld only develop trifoliolate leaves, it has been observed that leaves of pole cuttings can be impari-pinnate with two pairs of lateral leaflets.

7. *Commiphora mollis* (Oliv.) Engl. in A.DC., *Monogr. Phan.* 4: 23 (1883); *Bot. Jahrb.* 48: 472 (1913); *Pflanzenfam.* ed. 2.19a: 435 (1931); *Burt Davy*, *Fl. Transv.* 2: 484 (1932); *Burt* in *Kew Bull.* 1935: 111 (1935); *Brenan* in *Kew Bull.* 1950: 367 (1950); *Exell & Mendonca* in *Consp. Fl. Angol.* 1,2: 298 (1951); *Codd*, *Mem. Bot. Surv. S. Afr.* 26: 87 (1951); *Wild* in *Bol. Soc. Brot.* 2,33: 85 (1959); *Fl. Zamb.* 2,1: 273 (1963); *Von Breitenbach*, *Ind. Trees S. Afr.* 3,2: 435 (1965); *De Wint.*, *M. de Wint. & Killick*, *Transv. Trees* 90 (1966); *De Wint.* in *Trees S. Afr.* 20,1: 16 (1968); *Merxm.*, *Prod. Fl. S.W. Afr.* 23: 7 (1968). Type: Mozambique, Chiramba, between Tete and coast, *Kirk* s.n. (K, holo.!).

Balsamodendrum molle Oliv. in *Fl. Trop. Afr.* 1: 326(1868).

Balsamea mollis (Oliv.) Engl. in *Bot. Jahrb.* 1: 42 (1881).

Commiphora welwitschii Engl. in A.DC., *Monogr. Phan.* 4: 22 (1883); *Bot. Jahrb.* 48: 473 (1913); *Pflanzenfam.* ed. 2.19a: 435 (1931); *Miller* in *J.S. Afr. Bot.* 18: 39 (1952). Type: Angola, Huila, *Welwitsch* 4493 (G, holo., only photo seen: LISU!). *C. cinerea* Engl. in *Bot. Jahrb.* 19: 139 (1895); *Bot. Jahrb.* 48: 473, t. IR (1913); *Pflanzenfam.* ed. 2.19a: 435 (1931). Type: S.W.A., Otjitambi, *Gurich* 21 (B, holo.†; K, fragment!). *C. stuhlmanii* Engl., *Pflanzenw. O. Afr. C.* 230 (1895); *Bot. Jahrb.* 48: 474 (1913); *Pflanzenfam.* ed. 2.19a: 435 (1931); *Burt* in *Kew Bull.* 1935: 111 (1935). Type: Tanzania, Bukombe, *Stuhlman* 3450 (B, holo.†; K, fragment!; BM, sketch!). *C. dekindtiana* Engl. in *Bot. Jahrb.* 34: 312 (1905); *Bot. Jahrb.* 48: 473, t. IQ (1913); *Pflanzenfam.* ed. 2.19a: 435 (1931). Type: Angola, Huila, Benguela, *Dekindt* 225 (B, holo.†; K, fragment!). *C. heterophylla* Engl. in *Bot. Jahrb.* 34: 312 (1905); *Bot. Jahrb.* 48: 475 (1913); *Pflanzenfam.* ed. 2.19a: 435 (1931). Type: Tanzania, Kilimandjaro area between Taveta and Bura, *Engler* 1906 (B, holo.†; K, fragment!). *C. montana* Engl. in *Bot. Jahrb.* 34: 312 (1905); *Bot. Jahrb.* 48: 473 (1913); *Pflanzenfam.* 2.19a: 435 (1931). Type: Angola, Huila, Benguela, *Dekindt* 46 (B, holo.†; K, fragment!). *C. krausei* Engl. in *Bot. Jahrb.* 44: 152 (1910); *Bot. Jahrb.* 48: 472, t. IP (1913); *Pflanzenfam.* ed. 2.19a: 435 (1931). Type: Tanzania, Tabora, *van Trotha* 8a (B, holo.†; K, fragment!). *C. iringensis* Engl. in *Bot. Jahrb.* 44: 150 (1910); *Bot. Jahrb.* 48: 472, t. IO (1913); *Pflanzenfam.* ed. 2, 19a: 435 (1931). Type: Tanzania, Uhehe, *Spiegel* sub *Amani Herbarium* 2507 (B, holo.†; EA!). *C. boehmii* Engl. in *Bot. Jahrb.* 48: 472 (1913); *Pflanzenfam.* ed. 2.19a: 435 (1931). Syntypes: Tanzania, Gonda, *Böhm* 281 (B†; K, fragment!). *Salanda*, *Fischer* 292 (B†; K, fragment!);

Lectotype: *Böhm* 281 (K, fragment). *C. ndemfi* Engl. in Bot. Jahrb. 54: 293 (1917); Pflanzenfam. ed. 2, 19a: 435 (1931). Type: Tanzania, Urambo, *Stolz* 1678 (B, holo.†; K!; Z!; P.!). Lectotype: *Stolz* 1678 (K).

Dioecious tree with a rounded spreading crown up to 8 m tall, trunk often irregularly fluted or with large knobby outgrowths; bark brown to greyish-green, peeling in discs with an average diameter of 2,5 cm; branchlets pilose to pubescent. *Leaves* imparipinnate but in some cases trifoliolate: grey to green, pilose to tomentose, often distinctly paler and tomentose below; lamina up to 10 cm long; petiole up to 2,5 cm; petiolules up to 3 mm long; leaflets 1–6-jugate, oblong-elliptic to elliptic or obovate, apex acute to obtuse rarely emarginate, base cuneate to broadly cuneate, margins entire; terminal leaflet up to 5,2×3,6 cm; lateral leaflets up to 3,2×1,7 cm. *Flowers* unisexual, hypogynous, appearing before or with the leaves, male inflorescences usually axillary compound dichasial cymes up to 4 cm long, female inflorescences usually axillary simple dichasial cymes up to 2 cm long, branches of inflorescences pilose to pubescent; male flowers, 8–12 mm, usually larger than female flowers, 4–7 mm. *Bracteoles* up to 5 mm long,

linear, pilose to pubescent. *Pedicels* 3–8 mm long, pilose to pubescent. *Calyx* campanulate, green to red, 2–3 mm long, pilose to pubescent, lobes 1–2 mm long, apex acute. *Petals* green to red, 3–6 mm long, pilose to pubescent on outside. *Disk* fleshy, not adnate to calyx or corolla, cylindrical with 4 prominent lobes, lobes bifid, indentation between lobes deep; disk in female flowers smaller than in male flowers. *Stamens* 8, 4 long stamens up to 5 mm long, inserted high up on outside of disk lobes, 4 short stamens up to 2,5 mm long, inserted on outside of disk between lobes; filaments subterete, lower part flattened and broadened; staminodes in female flowers. *Gynoecium* rudimentary in male flowers; ovary superior; style relatively short; stigma obscurely 4-lobed. *Fruit* 1,3×1,2 cm, subglobose, slightly flattened, asymmetrical; exocarp pilose to pubescent; mesocarp fleshy; putamen 1,0×0,8 cm, ellipsoid, asymmetrically and irregularly flattened, smooth; pseudaril bright red, fleshy, with 4 winged arms, 2 arms on seam of putamen reaching almost to apex, 2 arms on flattened faces shorter than arms on seam, arm on more convex face of putamen longer than arm on other face. FIG. 39–44.



FIG. 39.—*Commiphora mollis* near Waterpoort, northern Transvaal (height \pm 3 m).



FIG. 40.—Close-up view of the trunk of *Commiphora mollis* illustrating the knobby outgrowths and the bark peeling in thick discs.

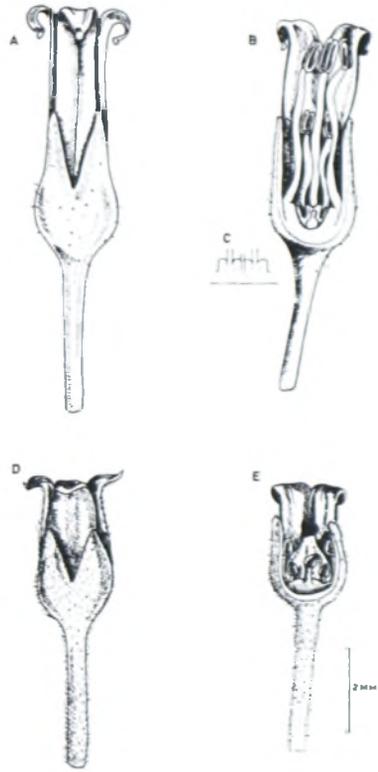


FIG. 42.—Flowers of *Commiphora mollis*: A, male flower; B, longitudinal section of male flower; C, diagrammatic representation of two disc lobes illustrating the insertion of the filaments; D, female flower; E, female flower with the calyx and corolla partly removed.

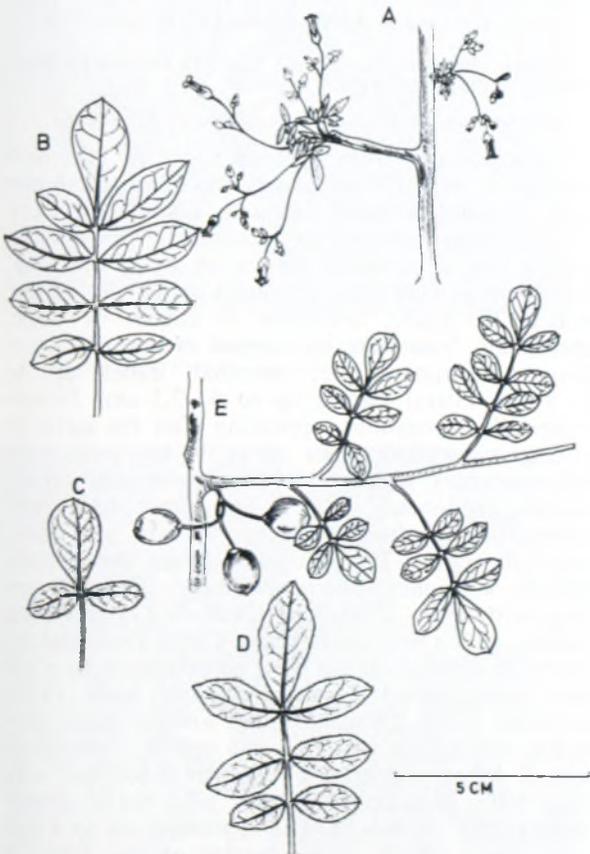


FIG. 41.—*Commiphora mollis*: A, branchlet with young leaves and flowers; B—D, leaves; E, branchlet with leaves and mature fruits.

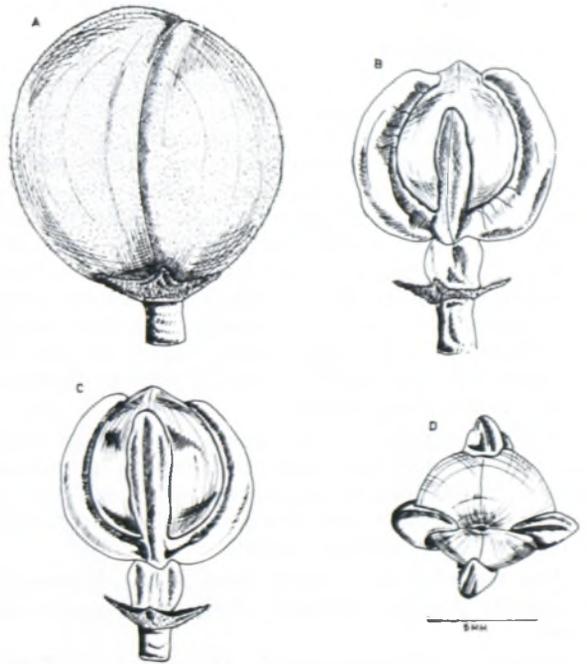


FIG. 43.—Fruit of *Commiphora mollis*: A, side-view of the fruit; B, view of the less convex face of putamen with pseudaril; C, view of the more convex face of putamen with pseudaril; D, putamen and pseudaril as seen from above.

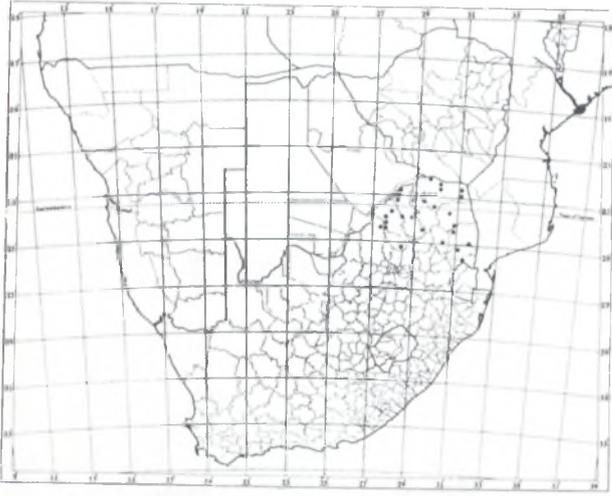


FIG. 44.—Geographical distribution of *Commiphora mollis* in South Africa.

Distinctive features of the stems and leaves

Young stems with a variable number but usually many multicellular non-glandular and glandular hairs, hypodermis consisting mainly of secretory cells. *Stems of 2,5 cm diameter*: sclerenchymatous pericycle-cylinder consisting of fibres and stone cells, epithelium cells of resin ducts in xylem rays surrounded by 1 layer of cells with slightly thickened walls. *Leaves* with a variable number but usually many multicellular non-glandular and glandular hairs; petiole \pm triangular as seen in transverse section, sclerenchymatous pericycle present, vascular bundles \pm circularly distributed as seen in transverse section; terminal leaflet dorsiventral with a single layer of palisade cells adaxially, remaining mesophyll consisting of spongy or palisade-like cells, bulliform cells confined to adaxial epidermis, stomata mainly abaxial.

Diagnostic features

Dioecious tree, trunk often irregularly fluted; bark brown to greyish-green, peeling in discs with an average diameter of 2,5 cm; branchlets pubescent to pilose. *Leaves* impari-pinnate but sometimes trifoliolate, pilose to tomentose, leaflets 1–6-jugate, often distinctly paler and tomentose below, margins entire, terminal leaflet dorsiventral. *Flowers* red, hypogynous, unisexual; pedicels, calyx and corolla pilose to pubescent. *Fruit* subglobose; exocarp pilose to pubescent; putamen smooth; pseudaril bright red, fleshy, with 4 winged arms, 2 arms on seam of putamen reaching almost to apex, 2 arms on flattened faces of putamen shorter.

Widely distributed in north-western, central-northern, far-northern and north-eastern Transvaal. Grows in savanna-woodland on stony hills or in well-drained, sandy soil. Occurs in warm areas with a relatively low annual rainfall.

Also recorded from South West Africa, Botswana, Rhodesia, Zambia, Malawi, Tanzania, Angola and Zaire.

TRANSVAAL.—2228(Maasroom): 14 km N.E. of Koperspruit (–CA), *Van der Walt* 62; 14 km S.W. of Swartwater (–CC), *Meeuse* 10573; 2229(Waterpoort): Dongola (–BA), *Codd* 4114; *Verdoorn* 2269; Soutpan (–CD), *Obermeyer*, *Schweickerdt* & *Verdoorn* 152; 8 km E. of Waterpoort (–DC), *Van der Walt* 21; 5 km N. of Wylliespoort (–DD) *Codd* 4445; Masekwaspoort (–DD), *Hardy* 2240. 2230(Messina): near

Messina (–AC), *Gerstner* 5713; Tshipise (–CA), *Van der Schijff* 5202; *Van der Walt* 7. 2231(Pafuri): Punda Milia Rest Camp (–CA), *Codd* & *Dyer* 4612; *Van der Walt* 77; 19 km S.E. of Punda Milia Rest Camp (–CC), *Codd* & *Dyer* 4589. 2328 (Baltimore): Marnitz (–AA), *Van der Walt* 59; N. of Blaauwberg (–BB), *Obermeyer*, *Schweickerdt* & *Verdoorn* 95; 32 km N.W. of Melkriver (–CD), *Van der Walt* 45; near Sterkwater (–DD), *Codd* 6571; *Van der Walt* 50. 2329(Pietersburg): 13 km S.S.E. of Dendron (–AB), *Van der Walt* 18; 5 km S. of Banelierkop (–BD), *Gerstner* 5575. 2330(Tzaneen): Modjadji Nature Reserve (–DA), *Krige* 7. 2427(Thabazimbi): Centrum (–AD), *Vahrmeijer* 1370; 50 km S. of Ellisras (–BA), *Van der Walt* 53; 32 km N.E. of Thabazimbi (–BC), *Codd* 3726. 2429(Zebediela): Chuniespoort (–AD), *De Winter* 2328. 2430(Pilgrim's Rest): 27 km S.E. of Gravelotte (–BB), *Codd* & *de Winter* 3710; Abel Erasmus Pass (–BD), *Strey* 3636; 8 km N. of Buffelsvlei (–CD), *Codd* 6677. 2431(Acornhoek): Skukuza Rest Camp (–DC), *Letty* 58; *Van der Schijff* 745; 6 km S. of Skukuza Rest Camp, *Van der Schijff* 867. 2528(Pretoria): 1 km N. of Pienaarsrivier (–AB), *Codd* 3709A. 2513(Komatipoort): Numbi (–AA), *Van der Schijff* 3439; Krododilpoort near Baberton (–CB), *Galpin* 1077.

The variation in hairiness of the young stems and leaves, as well as the variation in the form and size of the leaflets, can account for the many synonyms.

This species is easily grown from pole cuttings which are often planted as fencing poles. The young branches are grazed by cattle and game.

Common name: "Ghor-Ghor".

8. *Commiphora harveyi* (Engl.) Engl. in A.D.C., Monogr. Phan. 4: 25 (1883); Bot. Jahrb. 48: 476, t. 2J (1913); Pflanzenfam. ed. 2,19a: 435 (1931); Burt Davy, Fl. Transv. 2: 484 (1932); Henkel, Woody Pl. Natal 213 (1934); Wild in Bol. Soc. Brot. 2,33: 85 (1959); Von Breitenbach, Ind. Trees S. Afr. 3,2: 442 (1965); Moll, For. Trees Natal 79 (1967); De Wint. in Trees S. Afr. 20,1: 12 (1968). Type: Natal Durban, *Gerrard* & *McKen* 689 (TCD, holo. !; K !).

Protium africanum Harv. in Fl. Cap. 2: 592 (1862); Swart, Monog. Protium 393 (1942).

Balsamea harveyi Engl. in Bot. Jahrb. 1: 42 (1881).

Dioecious tree from 4 m up to 18 m tall; bark peeling in large brown papery pieces or in thicker discs; branchlets fluted and with a few short hairs. *Leaves* impari-pinnate, or occasionally trifoliolate, with a few short hairs; lamina up to 15 cm long; petiole up to 6 cm long; petiolules up to 1,5 cm long; leaflets 1–3-jugate, lanceolate to elliptic or ovate, apex acute, base cuneate, margins crenate-serrate to coarsely crenate-serrate; terminal leaflet up to 8×3 cm; lateral leaflets up to 6×2,5 cm. *Flowers* unisexual, hypogynous, appearing after the leaves in axillary paniculate cymes up to 10 cm long, male inflorescences usually longer than female inflorescences, peduncles with a few short hairs and conspicuous leaf-like bracts up to 6 mm; male flowers, 5–7 mm, usually larger than female flowers, 4–5,5 mm. *Bracteoles* linear, up to 3 mm long, with a few short hairs. *Pedicels* 2–3 mm long, usually with a few short hairs. *Calyx* campanulate, yellowish green, 2–3 mm long, sometimes with a few short hairs, lobes 1–1,8 mm long, apex acute. *Petals* yellowish green, 2,5–4 mm long, without hairs. *Disk* fleshy, not adnate to calyx and corolla, cylindrical, with 4 lobes, indentation between lobes not very deep, lobes in male flowers not bifid but in female flowers bifid. *Stamens* 8, 4 long stamens up to 4 mm long, inserted high up on outside of disk lobes, 4 short stamens up to 2,5 mm long, inserted on outside of disk between lobes; filaments slightly flattened, lower part broadened; staminodes in female flowers.

Gynoecium: rudimentary in male flowers; ovary superior; style relatively long; stigma 2-lobed. *Fruit* 1.4×1.2 cm, subglobose, slightly flattened, asymmetrical; exocarp glabrous; mesocarp fleshy; putamen 0.9×0.7 cm, ellipsoid to obovate, asymmetrically and irregularly flattened, smooth; pseudaril light red, very fleshy, with 4 arms, 2 arms on seam of putamen reaching almost to apex, 2 arms on flattened faces of putamen variable in length and breadth but shorter than arms on seam, arm on more convex face of putamen usually shorter but broader than arm on other face. FIG. 45-50.



FIG. 45.—*Commiphora harveyi* near Malelane in the Kruger National Park (height ±6 m).



FIG. 46.—Close-up view of a stem of *Commiphora harveyi* illustrating the bark peeling off in thick pieces.

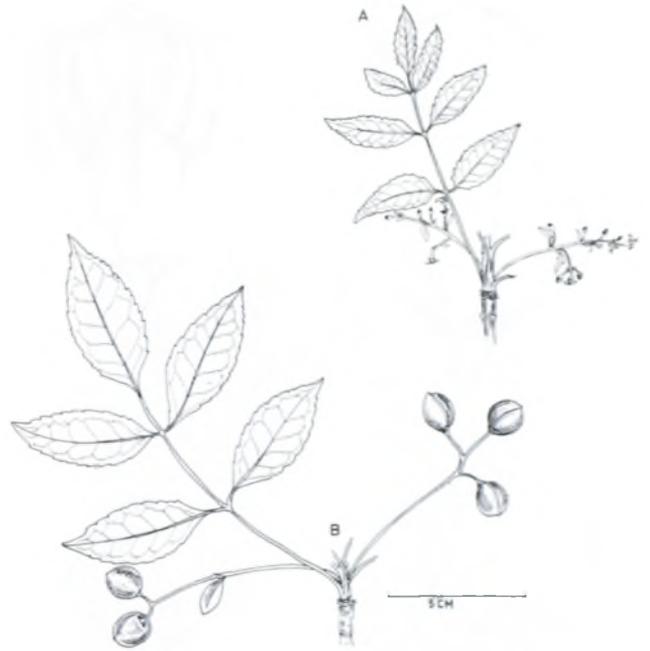


FIG. 47.—*Commiphora harveyi*: A, branchlet with a leaf and flowers; B, branchlet with a leaf and mature fruits.

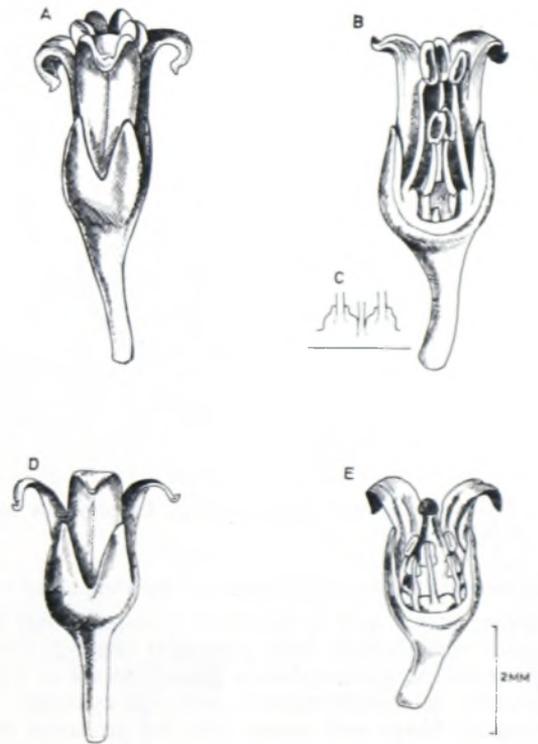


FIG. 48.—Flowers of *Commiphora harveyi*: A, male flowers; B, longitudinal section of male flower; C, diagrammatic representation of two disc lobes illustrating the insertion of the filaments; D, female flower; E, female flower with the calyx and corolla partly removed.

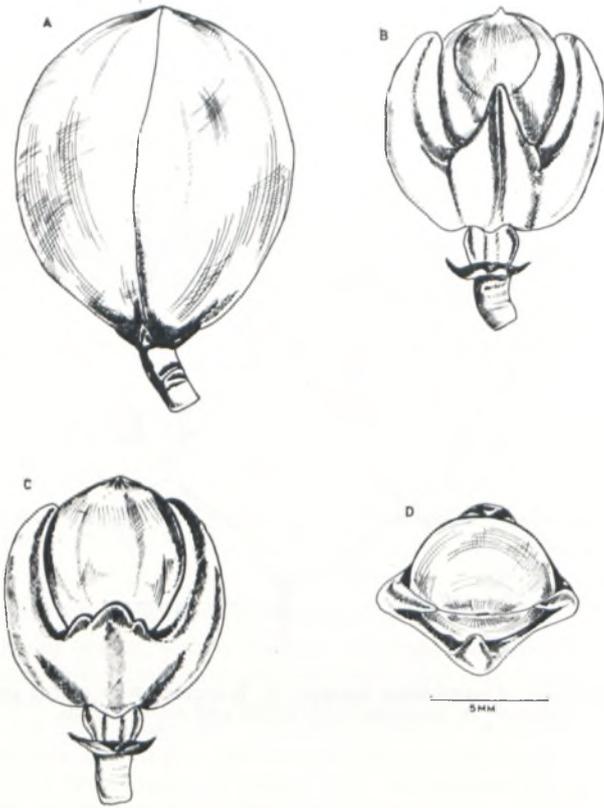


FIG. 49.—Fruit of *Commiphora harveyi*: A, side-view of the fruit; B, view of the less convex face of putamen with pseudaril; C, view of the more convex face of putamen with pseudaril; D, putamen and pseudaril as seen from above.

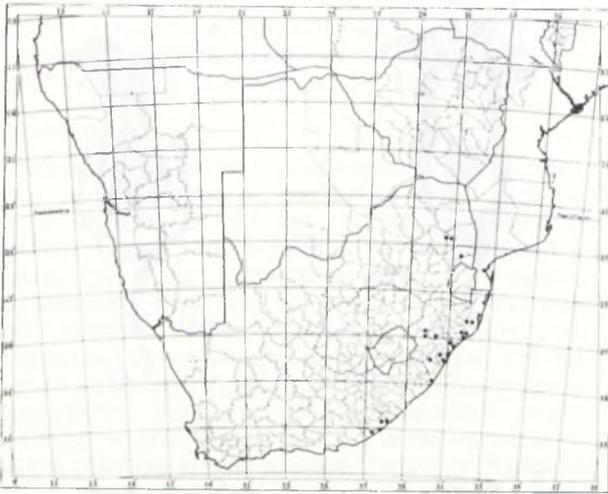


FIG. 50.—Geographical distribution of *Commiphora harveyi* in South Africa.

Distinctive anatomical features of the stems and leaves

Young stems with a few short non-glandular hairs (mostly unicellular) and glandular hairs; sclerenchymatous pericycle-cylinder fluted. *Stems of 2,5 cm diameter*: sclerenchymatous pericycle-cylinder consisting of fibres and stone cells but in some stems already cut off by the development of periderm; epithelium cells of resin ducts in xylem rays surrounded by 1–2 layers of sclereids. *Leaves* with a few short non-glandular hairs (mostly unicellular) and glandular hairs; petiole \pm ovate as seen in transverse

section, sclerenchymatous pericycle present, vascular bundles \pm circularly distributed as seen in transverse section; terminal leaflet dorsiventral with a single layer of palisade cells adaxially, remaining mesophyll consisting of spongy parenchyma, bulliform cells confined to adaxial epidermis, stomata mainly abaxial.

Diagnostic features

Dioecious tree, bark peeling in large brown papery pieces or in thicker discs; branchlets fluted, with a few short hairs. *Leaves* impari-pinnate or occasionally trifoliolate, with a few short hairs, leaflets 1–3-jugate, margins crenate-serrate to coarsely crenate-serrate, terminal leaflet typically dorsiventral. *Flowers* hypogynous, unisexual, peduncles with large bracts. *Fruit* subglobose; exocarp glabrous; putamen smooth; pseudaril light red, very fleshy, with 4 arms, 2 arms on seam of putamen reaching almost to apex, 2 arms on flattened faces of putamen shorter.

Occurs in north-eastern Transvaal, eastern Transvaal, the Transkei and eastern Cape as far south as East London, but is widely distributed in Natal and Zululand.

Usually grows on the slopes of mountains or in kloofs as part of the coastal forests. Occurs in areas with a rainfall up to 1 000 mm or more per annum.

Also recorded from Swaziland and Mozambique.

TRANSVAAL.—2430 (Pilgrim's Rest): 6 km N. of Branddraai (–DA), *Codd & de Winter 3259*; Mariepskop (–DB), *Van der Schijff 6095* (PRU) 2531 (Komatipoort): near Malelane Rest Camp (–AD), *Codd 5263*; *Van der Walt 22*; 14 km S.E. of Pretoriuskop Rest Camp (–AD), *Codd & De Winter 5156*; *Van der Walt 70*.

NATAL.—2829 (Harrismith): Tugela Valley near Colenso (–DB), *Edwards 2467*; 6 km N.E. of Estcourt (–DD), *Cheadle 611*. 2830 (Dundee): near Muden (–CD), *Edwards 2772*. 2831 (Eshowe): Hlabisa (–BB), *Gerstner 715*; 49 km S.E. of Nongoma (–BB), *Van der Walt 107*; 32 km E. of Melmoth (–DA), *Van der Walt 95*; Ngoya forest at Ntimona (–DB), *Venter 4228*; Umhlatuzana (–DD), *Venter 3824*; Umhlatuzi Valley at Ntimona (–DD), *Van der Walt 27*. 2832 (Mtubatuba): Hluhluwe Game Reserve (–AA), *Bayer 1455*; *Ward 2907* (NH). 2930 (Pietermaritzburg): Richmond (–CC), *Moll & Morris 663*; Camperdown (–DA), *Morris 593*; Isipingo (–DD), *Ward 848*. 2931 (Stanger): Mapumulo (–AA), *Moll 1628*; New Guelderland (–AD), *Stewart 121* (NH); Burman Bush in Durban (–CC), *Ross & Moll 1723* (NH). 3030 (Port Shepstone): Ramsgate (–CD), *Nicholson 136* (NH).

CAPE.—3227 (Stutterheim): Komga (–DB), *Schlechter 1403*. 3228 (Butterworth): near Kentani (–CA), *Pegler 2136*. 3327 (Peddie): Keiskama Valley between Peddie and East London (–AB), *Dyer 4539*; Elizabeth Island in East London (–BB), *Galpin?*

This species is easily grown from pole cuttings which are often planted as fencing poles.

Common name: Paper Tree.

9. *Commiphora marlothii* Engl. in Bot. Jahrb. 44: 155 (1910); Bot. Jahrb. 48: 485 (1913); Pflanzenfam. ed. 2, 19a: 438 (1931); Miller in J. S. Afr. Bot. 18: 38 (1952); Palgrave, Trees Cent. Afr. 55, t. & photo (1956); Wild in Fl. Zamb. 2, 1: 281 (1963); Von Breitenbach, Ind. Trees S. Afr. 3, 2: 440 (1965); De Wint. in Trees S. Afr. 20, 1: 12 (1968); Lisowski, Malaise & Symoens in Bull. Jard. Bot. Nat. Belg. 40: 360 (1970). Syntypes: Rhodesia, Matopos, *Marloth 3397* (B \dagger ; K, fragment!; PRE!); 3402 (B \dagger). Lectotype: *Marloth 3397* (PRE).

Dioecious tree with a rounded crown up to 9 m tall; bark peeling in large yellowish papery pieces to expose a green underlayer; branchlets obtuse, densely

pilose to pubescent. *Leaves* impari-pinnate, dark green, pubescent to tomentose; lamina up to 26 cm long; petiole up to 9,5 cm long; petiolules up to 2 mm long; leaflets 3–5-jugate, obovate to broadly elliptic, apex obtuse to acute, base cuneate or rounded, margins crenate-serrate to finely lobed; terminal leaflet up to 8×4 cm; lateral leaflets up to 5,8×3,2 cm. *Flowers* unisexual, hypogynous, appearing with the leaves in axillary panicle simple or compound dichasial cymes up to 10 cm long, peduncles densely pilose to pubescent, male inflorescences usually longer than female inflorescences; male flowers, 6–7 mm, usually larger than female flowers, 4,5–5,5 mm. *Bracteoles* up to 6 mm long, linear, pubescent. *Pedicels* usually less than 1 mm, clustered, pubescent. *Calyx* campanulate, yellowish green, up to 3 mm long, pubescent, lobes up to 1 mm long, apex acute. *Petals* yellowish green, 3–4 mm long, pilose outside. *Disk* fleshy, pilose, not adnate to calyx and corolla, cylindrical, with 4 prominent lobes, indentation between lobes rather shallow, lobes not bifid in male flowers but bifid in female flowers. *Stamens* 8, 4 long stamens up to 3,5 mm long, inserted on top of disk lobes, 4 short stamens up to 2,5 mm long, inserted on top of disk between lobes; filaments slightly flattened, lower part broadened; staminodes in female flowers. *Gynoecium*: rudimentary in male flowers; ovary superior, sparsely pilose; style relatively short, sparsely pilose; stigma obscurely 4-lobed. *Fruit* 1,9×1,7 cm, subglobose, slightly flattened, asymmetrical; exocarp pilose; mesocarp very fleshy; putamen 1×0,8 cm, ellipsoid, asymmetrically and

irregularly flattened, slightly rugose; pseudaril yellow, fleshy, with 4 arms, 2 arms on seam of putamen reaching almost to apex, 2 arms on flattened faces of putamen shorter than arms on seam, arm on more convex face of putamen shorter than arm on other face. FIG. 51–56.



FIG. 52.—Close-up view of a branch of *Commiphora marlothii* illustrating the bark peeling off in large, papery pieces.



FIG. 51.—*Commiphora marlothii* near Sterkwater in the district of Potgietersrus, northern Transvaal (height ± 5 m).

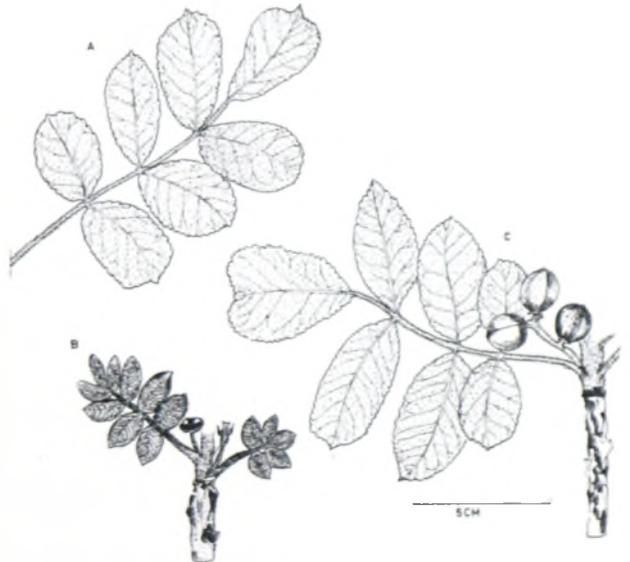


FIG. 53.—*Commiphora marlothii*: A, leaf; B, branchlet with young leaves and flowers; C, branchlet with a leaf and mature fruits.

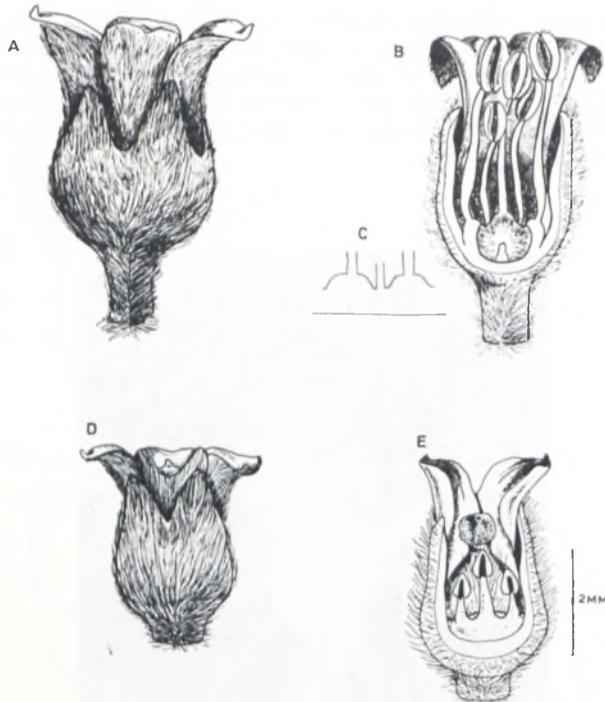


FIG. 54.—Flowers of *Commiphora marlothii*: A, male flower; B, longitudinal section of male flower; C, diagrammatic representation of two disc lobes illustrating the insertion of the filaments; D, female flower; E, female flower with the calyx and corolla partly removed.

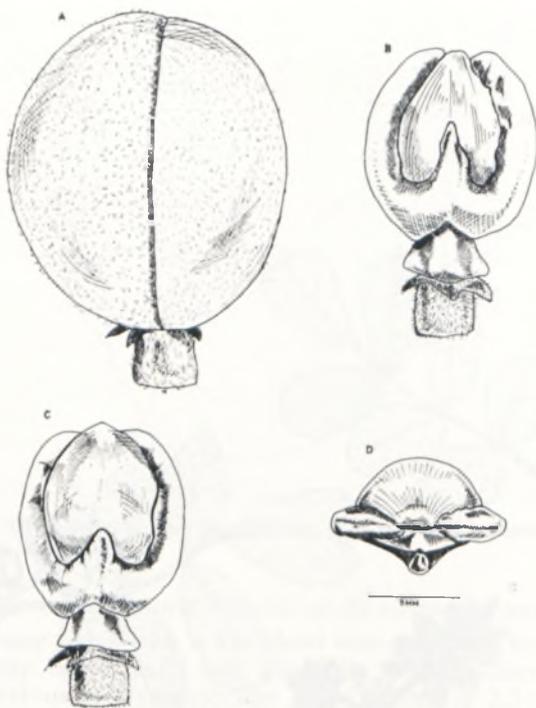


FIG. 55.—Fruit of *Commiphora marlothii*: A, side-view of the fruit; B, view of the less convex face of putamen with pseudaril; C, view of the more convex face of putamen with pseudaril; D, putamen and pseudaril as seen from above.



FIG. 56.—Geographical distribution of *Commiphora marlothii* in South Africa.

Distinctive anatomical features of the stems and leaves

Young stems with numerous multicellular non-glandular and glandular hairs; sclerenchymatous pericycle-cylinder fluted. *Stems of 2.5 cm diameter*; sclerenchymatous pericycle-cylinder consisting of fibres and stone cells; epithelium cells of resin ducts in xylem rays surrounded by 1–2 layers of cells with slightly thickened walls. *Leaves* with numerous multicellular non-glandular and glandular hairs; petiole \pm triangular to ovate as seen in transverse section, sclerenchymatous pericycle present, vascular bundles \pm circularly distributed as seen in transverse section but 3–8 medullary bundles also present; terminal leaflet dorsiventral with a single layer of palisade cells adaxially, remaining mesophyll consisting of spongy or palisade-like cells, bulliform cells relatively small and confined to adaxial epidermis, stomata mainly abaxial.

Diagnostic features

Dioecious tree, bark peeling in large yellowish papery pieces to expose a green underlayer; branchlets obtuse, densely pilose to pubescent. *Leaves* imparipinnate, densely pilose to pubescent, leaflets 3–5-jugate, margins crenate-serrate to finely lobed, terminal leaflet dorsiventral, petiole with 3–8 medullary vascular bundles. *Flowers* hypogynous, unisexual; pedicels, calyx, corolla, disk and gynoecium pilose to pubescent. *Fruit* subglobose; exocarp pilose; putamen slightly rugose; pseudaril yellow, fleshy, with 4 arms, 2 arms on seam of putamen reaching almost to apex, 2 arms on flattened faces of putamen shorter.

Widely distributed in central and northern Transvaal. Usually grows on arid mountain slopes or on granite kopjes.

Also recorded from Botswana, Rhodesia and Zambia.

TRANSVAAL.—2229(Waterpoort): near Soutpan (–CD), Obermeyer, Schweikerdt & Verdoorn 121; 165; Wylliespoort (–DD), Pole-Evans 3765; Masekwaspoort (–DD), Vahrmeijer 151. 2230(Messina): Tshipise (–CA), Van der Walt 8; Nshetele (–CC), Van der Schijff 5275. 2231(Pafuri): 50 km N.E. of

Punda Milia (-AC), *Codd & de Winter 5534*; near Pafuri (-AC), *Van der Schijff & Marais 3711*, 2327(Ellisras): 74 km N.W. of Vaalwater (-DC), *Meeuse 10434*, 2328(Baltimore): near Sterkwater (-DD), *Van der Walt 49*, 2319(Pietersburg): Bandelierkop (-BD), *Gerstner 5622*, 2427(Thabazimbi): S.E. of Rooiberg (-DC), *Verdoorn 2379*, 2430(Pilgrim's Rest): S.E. of Penge (-AD), *Story 4088*; Abel Erasmus Pass (-BD), *Strey 3307*; 6 km N. of Branddraai (-DA), *Codd & de Winter 5260*, 2528(Pretoria: near Rust de Winter (-BA), *Codd 6290*; *Pole-Evans 4249*, 2529(Witbank): near Dennilton (-AC), *Codd 9900*; Loskopdam Nature Reserve (-AD), *Van der Walt 15*; *Mogg 31000*.

It is recorded that the papery bark is used by natives as writing paper.

Common name: Paper Tree.

10. *Commiphora edulis* (Klotzsch) Engl. in A.D.C., Monogr. Phan. 4: 22 (1883); Bot. Jahrb. 48: 474, t. 1S (1913); Pflanzenfam. ed. 2,19a: 435 (1931); Burt Davy, Fl. Transv. 2: 484 (1932); Burt in Kew Bull. 1935: 108 (1935); Codd, Mem. Bot. Surv. S. Afr. 26: 86 (1951); Miller in J. S. Afr. Bot. 18: 38 (1952); Wild in Bol. Soc. Brot. 2,33: 91 (1959); White, For. Fl. N. Rhod. 176, t. 34E (1962); Wild in Fl. Zamb. 2,1 279 (1963); Von Breitenbach, Ind. Trees S. Afr. 3,2 435 (1965); De Wint. in Trees S. Afr. 20: 12 (1968). Type: Mozambique, Sena, Peters s.n. (B, holo.†; K!).

Hitzeria edulis Klotzsch in Peters, Reise Mossamb. Bot. 1: 89 (1861).

Commiphora chlorocarpa Engl. in Bot. Jahrb. 28: 414, t. 1N (1901); Pflanzenfam. 2,19a: 435 (1931). Type: Tanzania, Ruaha River, Goetze 452 (B, holo.†).

Dioecious many-stemmed shrub or small tree up to 6 m tall, stems usually entwined; bark light grey,

flaking in small yellowish papery pieces; branchlets obtuse, densely pubescent. *Leaves* impari-pinnate, greyish green, pubescent; lamina up to 25 cm long; petiole up to 8 cm long; petiolules up to 1 cm long; leaflets 2-6-jugate narrowly elliptic to narrowly ovate, apex acute or rounded, base obtuse, margins usually entire but in some cases finely crenate-serrate; terminal leaflet up to 6,5×3 cm; lateral leaflets up to 5×2.7 cm. *Flowers* unisexual, perigynous, appearing with the leaves in axillary panicle simple or compound dichasial cymes up to 15 cm long, branches of inflorescences pubescent, male inflorescences usually longer than female inflorescences; male flowers, 6-7 mm, usually larger than female flowers, 5-6 mm. *Bracteoles* up to 3 mm long, linear, pubescent. *Pedicels* 1-1,5 mm long, clustered, pubescent. *Calyx* yellow to green, continuous with hypanthium, pubescent, lobes 2-3 mm long, apex acute. *Petals* yellowish green, 3-4,5 mm long, inserted on hypanthium, glabrous. *Disk* much reduced, cylindrical, adnate to hypanthium. *Stamens* 8, inserted on top of disk, 4 long stamens up to 3 mm long, 4 short stamens up to 2 mm long; filaments subterete, lower part flattened and broadened: staminodes in female flowers. *Gynoecium*; rudimentary in male flowers; ovary half inferior, pilose; style relatively short, pilose; stigma obscurely 4-lobed. *Fruit* 2,4×2,3 cm, subglobose, slightly flattened asymmetrical; exocarp pilose; mesocarp very fleshy; putamen 1,5×0,9 cm, ellipsoid, much flattened, slightly asymmetrical smooth; pseudaril red, very fleshy, cupular with 4 short lobes, covering the lower 1/3 of putamen, lobe on less convex face of putamen longer than other 3 lobes. FIG. 57-62.



FIG. 57.—*Commiphora edulis* near Messina, northern Transvaal (height $\bar{x} \pm 4$ m).



FIG. 58.—Close-up view of a branch of *Commiphora edulis* illustrating the bark flaking off in small, papery pieces.

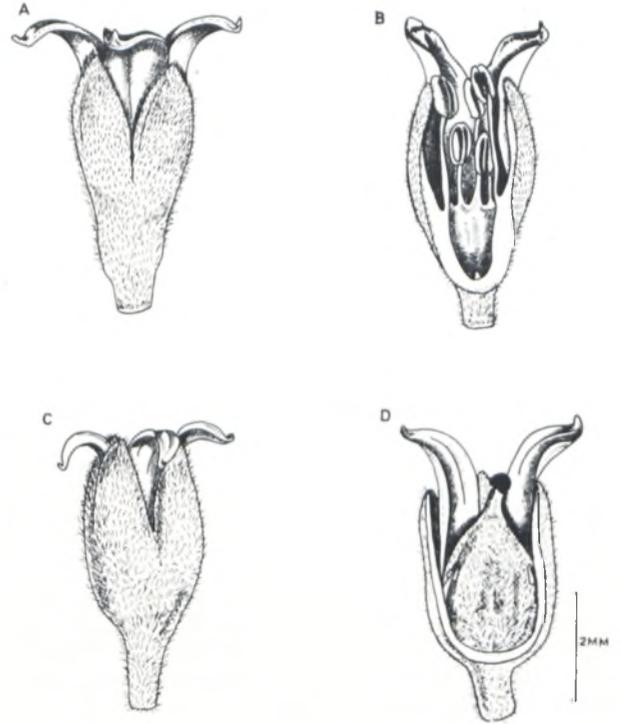


FIG. 60.—Flowers of *Commiphora edulis*: A, male flower; B, longitudinal section of male flower; C, female flower; D, female flower with the calyx and corolla partly removed



FIG. 59.—*Commiphora edulis*: A, branchlet with young leaves and flowers; B, branchlet with leaves and mature fruits.

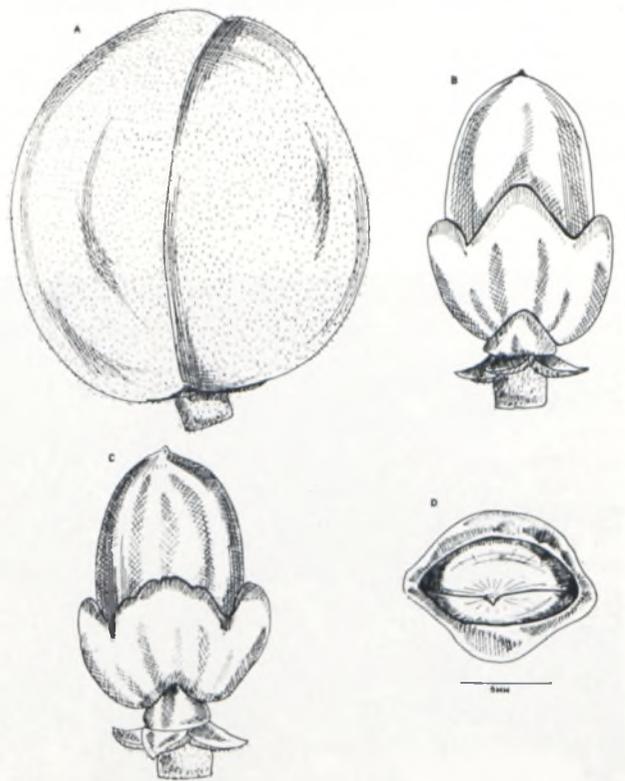


FIG. 61.—Fruit of *Commiphora edulis*: A, side-view of the fruit; B, view of the less convex face of putamen and pseudaril; C, view of the more convex face of putamen with pseudaril; D, putamen and pseudaril as seen from above.



FIG. 62.—Geographical distribution of *Commiphora edulis* in South Africa.

Distinctive anatomical features of the stems and leaves

Young stems with numerous multicellular non-glandular and glandular hairs; sclerenchymatous pericycle-cylinder fluted. Stems of 2.5 cm diameter: sclerenchymatous pericycle-cylinder consisting of fibres and stone cells; epithelium cells of resin ducts in xylem rays surrounded by thin-walled cells. Leaves with numerous multicellular non-glandular and glandular hairs; petiole ± triangular as seen in transverse section, sclerenchymatous pericycle present, vascular bundles ± circularly distributed as seen in transverse section but 3–8 medullary bundles also present; terminal leaflet typically dorsiventral with a single layer of palisade cells adaxially, remaining mesophyll consisting of spongy parenchyma, bulliform cells confined to adaxial epidermis, stomata mainly abaxial.

Diagnostic features

Dioecious many-stemmed shrub or small tree; bark light grey, flaking in small yellowish papery pieces, stems usually entwined; branchlets obtuse, densely pubescent. Leaves impari-pinnate, pubescent,

leaflets 2–6-jugate, margins usually entire, terminal leaflet typically dorsiventral, petiole with 3–8 medullary vascular bundles. Flowers perigynous, unisexual, pedicels and calyx pilose to pubescent. Fruit sub-globose; exocarp pilose; putamen smooth; pseudaril red, very fleshy, cupular with 4 short lobes.

This species is recorded from the far-northern and north-eastern Transvaal. These areas are warm and dry and the annual rainfall is less than 400 mm. It usually occurs in the vicinity of the Limpopo River, but is particularly common in the Messina area.

It grows in savanna-woodland or broken mopani-veld in well-drained, sandy soil.

Also recorded from Botswana, Rhodesia, Zambia, Tanzania, Mozambique and Malawi.

TRANSVAAL.—2229(Waterpoort): 24 km N.W. of Messina (–BB), Van der Walt 24; 24 km W.N.W. of Messina (–BD), Codd 4866. 2230(Messina): near Messina (–AC), Rogers 18473; 40 km N.E. of Tshipise (–AD), Van der Schijff 5222 (PRU). 2231(Pafuri): 45 km N.E. of Punda Milia Rest Camp (–AC), Codd & Dyer 4622; near Pafuri (–AC), Van der Schijff 3566.

C. edulis is one of the first *Commiphora* species of northern Transvaal to shed its leaves, the plants being leafless as early as March.

The fruits are eaten by birds, rodents and baboons.

11. *Commiphora woodii* Engl. in Bot. Jahrb. 15: 97 (1893); Bot. Jahrb. 26: 371 (1899); Bot. Jahrb. 44: 154 (1910); Bot. Jahrb. 48: 476, t. 2E (1913); Pflanzenfam. ed. 2,19a: 435 (1913); Wild in Bol. Soc. Brot. 2,33: 91 (1959); Von Breitenbach, Ind. Trees S. Afr. 3,2: 422 (1965); Moll, For. Trees Natal 80 (1967); De Wint. in Trees S. Afr. 20,1: 18 (1968). Syntypes: Natal, Durban, Wood sub NH 861 (B†?; BM!); Pinetown, Rehmann s.n. (B†?); Inanda, Rehmann s.n. (B†?). Lectotype: Wood s.n. (BM).

Commiphora caryaefolia Oliv. in Hook. Icon. Pl. 23: t, 2287 (1894); Engl. in Pflanzenfam. ed. 2,19a: 435 (1931). Henkel, Woody Pl. Natal 213 (1934). Syntypes: Natal, Durban; Wood 4095 (BOL!; NH!); Inanda, Wood 1046 (NH!); Wood 1409 (not seen); Flanagan 1107 (Z!).

Dioecious tree up to 12 m tall; bark grey, not peeling; branchlets glabrous, shallowly fluted, obtuse. Leaves impari-pinnate, glabrous; lamina up to 32 cm long; petiole up to 9 cm long; petiolules up to 5 mm long; leaflets 3–5-jugate, narrowly elliptic to elliptic,



FIG. 63.—*Commiphora woodii* in the Ubisana valley near Empangeni, Zululand (height ± 3,5 m).

apex acute, base cuneate to rounded, margins crenate-serrate to coarsely crenate-serrate; terminal leaflet up to 12×5 cm; lateral leaflets up to 13×5 cm. *Flowers* unisexual, subsessile, perigynous, appearing before the leaves in axillary paniculate simple or compound dichasial cymes up to 10 cm long, male inflorescences usually longer than female inflorescences; male and female flowers \pm of equal size, 4–5 mm long, relatively broad. *Bracteoles* up to 2 mm long, lanceolate. *Pedicels* usually less than 1 mm long. *Calyx* yellowish green, glabrous, continuous with hypanthium, lobes 2.5–3 mm long, apex acute. *Petals* yellowish green, 3–4 mm long, inserted on hypanthium. *Disk* fleshy or very fleshy in female flowers, adnate to hypanthium, cylindrical, with 4 lobes. *Stamens* 8, inserted on top of disk, 4 long stamens up to 2 mm long, 4 short stamens up to 1.5 mm long; filaments flattened and lower part broadened; staminodes in female flowers. *Gynoecium*: rudimentary in male flowers; ovary half inferior; style relatively short; stigma obscurely 4-lobed. *Fruit* 2×1.9 cm, subglobose, slightly flattened, asymmetrical; exocarp glabrous; mesocarp very fleshy; putamen 1×0.8 cm, ellipsoid, asymmetrically and irregularly flattened, smooth; pseudaril red, very fleshy, cupular, covering lower $\frac{1}{3}$ of putamen, with 1 very short lobe on the less convex face of putamen, margin finely crenate. FIG. 63–68.



FIG. 64.—Close-up view of a branch of *Commiphora woodii*.

Distinctive anatomical features of the stems and leaves

Young stems with a few glandular hairs especially near apex; sclerenchymatous pericycle-cylinder fluted. *Stems of 2.5 cm diameter*: sclerenchymatous pericycle-cylinder consisting of fibres and stone cells; epithelium cells of resin ducts in xylem rays surrounded by thin-walled cells. *Leaves* with a few glandular hairs; petiole \pm oval to ovate as seen in transverse section, sclerenchymatous pericycle present, vascular bundles \pm circularly distributed as seen in transverse section; terminal leaflet typically dorsiventral with a single layer of palisade cells adaxially, remaining mesophyll consisting of spongy parenchyma, bulliform cells confined to adaxial epidermis, stomata exclusively abaxial.

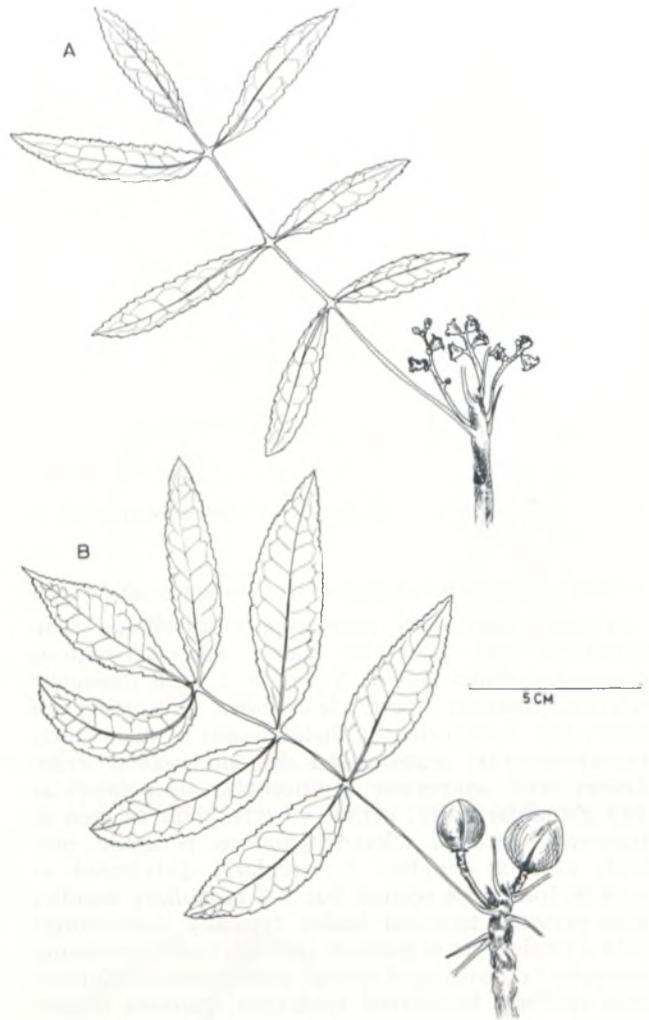


FIG. 65.—*Commiphora woodii*: A, branchlet with a leaf and flowers; B, branchlet with a leaf and mature fruits.

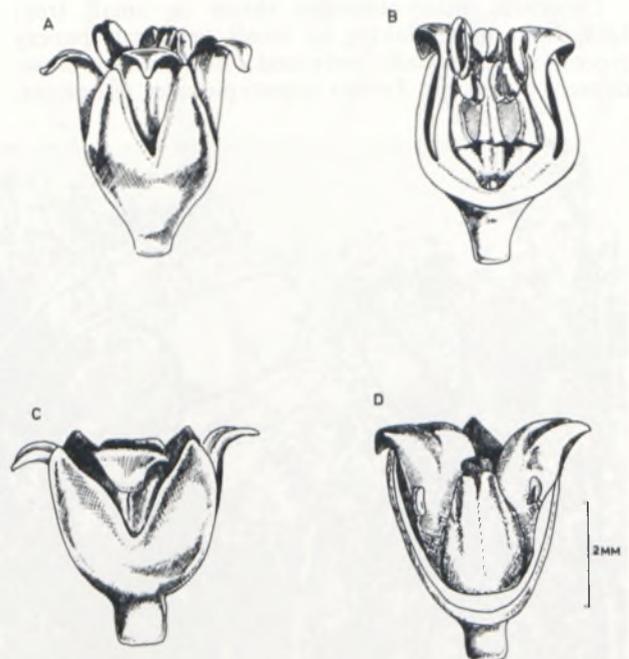


FIG. 66.—Flowers of *Commiphora woodii*: A, male flower; B, longitudinal section of male flower; C, female flower; D, female flower with the calyx and corolla partly removed.

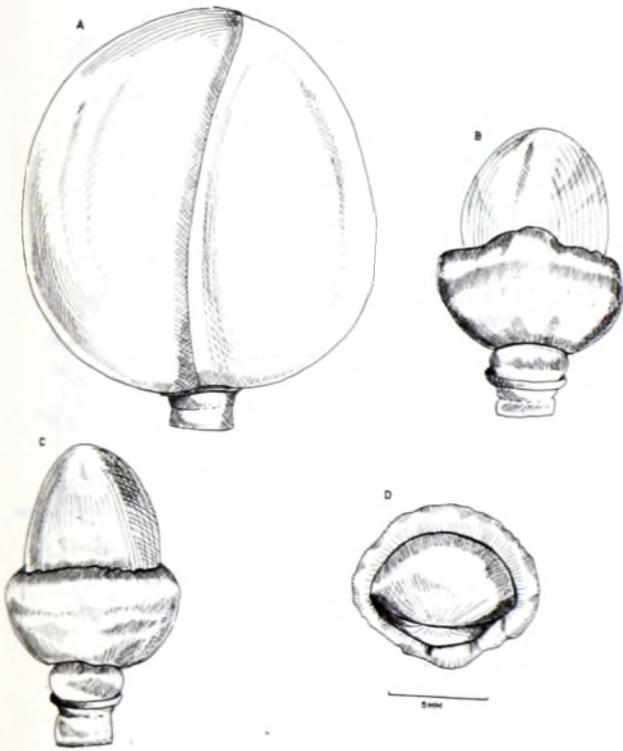


FIG. 67.—Fruit of *Commiphora woodii*: A, side-view of the fruit; B, view of the less convex face of putamen with pseudaril; C, view of the more convex face of putamen with pseudaril; D, putamen and pseudaril as seen from above.



FIG. 68.—Geographical distribution of *Commiphora woodii* in South Africa.

Diagnostic features

Dioecious tree; bark grey, not peeling; branchlets shallowly fluted, obtuse, glabrous. *Leaves* imparipinnate, glabrous, leaflets 3–5-jugate, margins crenate-serrate to coarsely crenate-serrate, terminal leaflet typically dorsiventral, petiole without medullary vascular bundles. *Flowers* perigynous, unisexual, glabrous. *Fruit* subglobose; exocarp glabrous; putamen smooth; pseudaril red, very fleshy, cupular with 1 very short lobe.

This species occurs near the coast, from Zululand southwards to East London. It usually grows on the slopes of mountains or in kloofs as part of the coastal forests with a rainfall of 1 000 mm and more per annum.

Also recorded from Mozambique.

NATAL.—2732(Ubombo): near Ingwavuma (–AA), *Dutton & Tinley* 6; 29 km S. of Jozini (–CA), *de Winter & Vahrmeijer* 8481. 2830(Dundee): S.W. of Weenen (–CC), *Pentz* 545. 2831(Eshowe): Umhlatuzi Valley at Ntmona (–DD), *Van der Walt* 28; Ubisana Valley near Kwa-Dlangezwa (–DD), *Van der Walt* 83. 2832(Mtubatuba): near Hluhluwe (–AA), *Wells* 2130; Hluhluwe Game Reserve (–AA), *Ward* 2982 (NH). 2930(Pietermaritzburg): near Richmond (–CB), *Moll & Morris* 663; Camperdown at Shongweni Dam (–DC), *Marais* ? 3030(Port Shepstone): Port Shepstone (–CB), *Nicholson* 247 (NH).

CAPE.—3226(Fort Beaufort): Victoria East at Pefferskop (–DD), *Acocks* 11900. 3227(Stutterheim): 18 km S.W. of King William’s Town (–CD), *Acocks* 11879; Kei Road (–DA), *Ranger* ?. 3228(Butterworth): Kentani (–AD), *Pegler* 1137.

None of the three syntypes mentioned by Engler (1893) could be traced and it is suspected that they were destroyed in Berlin. A specimen from the British Museum with a label of the Natal Herbarium, collected by Wood in Berea, Durban, was seen. Since no number appears on the label, it is uncertain whether this specimen is an isotype.

C. woodii and *C. zanzibarica*, two closely related species, can be distinguished on features of the inflorescences, flowers and fruit. The inflorescences and flowers of *C. zanzibarica* are relatively long. Medullary vascular bundles occur in the petioles of *C. zanzibarica* but are absent in those of *C. woodii*. The leaves of *C. woodii* and *C. harveyi* are sometimes also confused. Short hairs occur on the leaves of *C. harveyi* while those of *C. woodii* are glabrous.

C. woodii grows easily from pole cuttings which are often planted as fencing poles. Natives prepare gum from the bark.

12. *Commiphora zanzibarica* (Baill.)Engl. in A.DC., Monogr. Phan. 4: 28 (1883); Bot. Jahrb. 48: 468, t. 1A (1913); Pflanzenfam. ed. 2,19a: 433 (1931); Burt in Kew Bull. 1935: 111 (1935); Wild in Bol. Soc. Brot. 2,33: 91 (1959); Dale & Greenway, Kenya Trees 93 (1961); Wild in Fl. Zamb. 2,1: 279 (1963). Type: Tanzania, Zanzibar, *Jablonski* s.n. (P. holo!).

Balsamea zanzibarica Baill. in Adonsonia 11: 180 (1874); Engl. in Bot. Jahrb. 1: 42 (1881).

Commiphora spondioides Engl. in Bot. Jahrb. 26: 371 (1899); Bct. Jahrb. 48: 468 (1913); Pflanzenfam. ed. 2,19a: 433 (1931). Type: Mozambique, Lourenço Marques, *Schlechter* 11559 (B, holo.!, K!).

Dioecious tree, often many-stemmed, up to 7 m tall; bark grey, not peeling; branchlets glabrous, shallowly fluted, obtuse, glabrous. *Leaves* imparipinnate, glabrous; lamina up to 20 cm long; petiole up to 6 cm long; petiolules up to 5 mm long; leaflets 3–5-jugate, oblanceolate to narrowly elliptic, apex obtuse to acute, base cuneate to rounded, margins entire to finely serrate; terminal leaflet up to 7 × 3,3 cm; lateral leaflets up to 6,8 × 2,2 cm. *Flowers* unisexual, perigynous, appearing after the leaves in axillary paniculate simple or compound dichasial cymes up to 30 cm long; male flowers, 1,1–1,3 cm, larger than female flowers, 7–8 mm. *Bracteoles* up to 1 mm long, lanceolate. *Pedicels* 4–6 mm long. *Calyx* yellowish green, glabrous, continuous with hypanthium, lobes 2–3 mm long, apex acute. *Petals* yellowish green, 2–5 mm long, inserted on hypanthium. *Disk* fleshy, adnate to hypanthium, cylindrical, with 4 lobes. *Stamens* 8, inserted on top of disk, 4 long stamens up to 4 mm long, 4 short stamens up to 3 mm long; filaments subterete, lower part flattened and broadened; staminodes in female flowers. *Gynoeceum*:

rudimentary in male flowers; ovary half inferior; style relatively short; stigma obscurely 4-lobed. *Fruit* 1,8 × 1,5 cm, subglobose, slightly flattened, asymmetrical; exocarp glabrous; mesocarp very fleshy; putamen 1,8 × 0,8 cm, ellipsoid asymmetrically and irregularly flattened, smooth; pseudaril red, very fleshy, cupular, covering the lower $\frac{1}{2}$ of putamen, margin coarsely crenate. FIG. 69-74.



FIG. 69.—*Commiphora zanzibarica* near Makanyes Pont, northern Zululand (height ± 7 m).

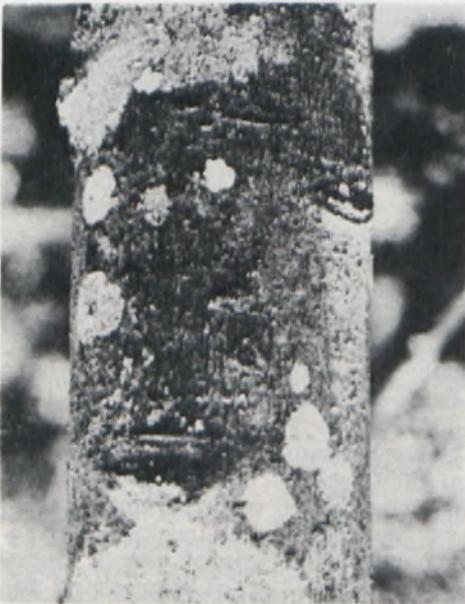


FIG. 70.—Close-up view of a branch of *Commiphora zanzibarica*. The white patches on the bark are lichens.



FIG. 71.—*Commiphora zanzibarica*: A, branchlet with a leaf and flowers; B, branchlet with a leaf and mature fruits.

Distinctive anatomical features of the stems and leaves

Young stems with a few peltate glandular hairs especially near apex; sclerenchymatous pericycle-cylinder fluted. *Stems of 2,5 cm diameter*: sclerenchymatous pericycle-cylinder consisting of fibres and stone cells, epithelium cells of resin ducts in xylem rays surrounded by thin-walled cells. *Leaves* with a few peltate glandular hairs; petiole \pm triangular as seen in transverse section, sclerenchymatous pericycle present, vascular bundles \pm circularly distributed as seen in transverse section but 4-14 medullary bundles also present; terminal leaflet typically dorsiventral with a single layer of palisade cells adaxially, remaining mesophyll consisting of spongy parenchyma bulliform cells confined to adaxial epidermis, stomata mainly adaxial.

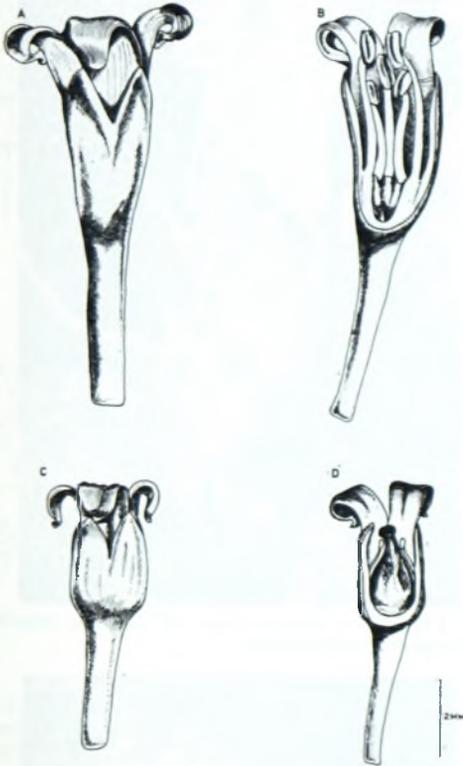


FIG. 72.—Flowers of *Commiphora zanzibarica*: A, male flower; B, longitudinal section of the male flower; C, female flower; D, female flower with the calyx and corolla partly removed.

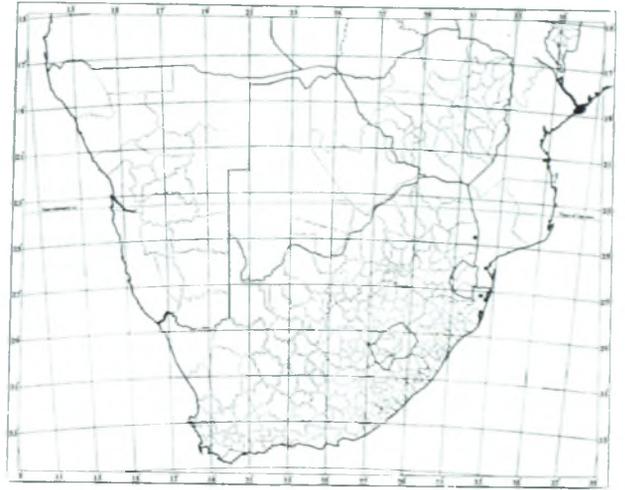


FIG. 74.—Geographical distribution of *Commiphora zanzibarica* in South Africa.

Diagnostic features

Dioecious tree, often many-stemmed; bark grey, not peeling; branchlets shallowly fluted, glabrous. *Leaves* impari-pinnate, glabrous, leaflets 3–5-jugate, margins entire of finely serrate, terminal leaflet typically dorsiventral, petiole with 4–14 medullary vascular bundles. *Flowers* perigynous, unisexual, glabrous, inflorescences relatively long (up to 30 cm). *Fruit* subglobose; exocarp glabrous; putamen smooth; pseudaril red, very fleshy, cupular without lobes.

So far this species has only been collected near the Kumane Dam in the Kruger National Park and on the Makatini Flats in northern Zululand where it grows in deep sandy soil in savanna-woodland. The annual rainfall in these areas lies between 400–550 mm.

Also recorded from Mozambique, Rhodesia, Zanzibar, Tanzania and Kenya.

TRANSCAAL.—2431(Acornhoek): at Kumane Dam (-DB), Van Wyk 4917.

NATAL.—2732(Ubombo): 8 km S.E. of Makanies Pont (-AB), Van der Walt 89.

Dale & Greenway (1961) and also Wild (1963) mention that the bark of this species peels off in papery pieces. This is not the case with the plants from which the material for this study was collected.

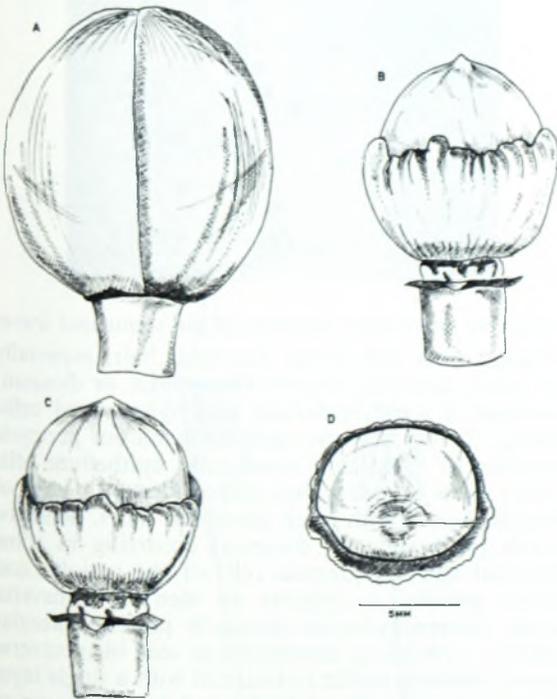


FIG. 73.—Fruit of *Commiphora zanzibarica*: A, side-view of the fruit; B, view of the less convex face of putamen with pseudaril; C, view of the more convex face of putamen with pseudaril; D, putamen and pseudaril as seen from above.

13. *Commiphora tenuipetiolata* Engl. in Bot. Jahrb. 48: 483, 3L (1913); Pflanzenfam. ed. 2,19a: 438 (1931); Burttt Davy, Fl. Transv. 2: 485, t. 52 (1932); Wild in Bol. Soc. Brot. 2,33: 93 (1959); Wild in Fl. Zamb. 2,1: 280 (1963); Von Breitenbach, Ind. Trees S. Afr. 3,2: 434 (1965); De Wint. in Trees S. Afr. 20,1: 16 (1968); Merxm., Prod. Fl. S.W. Afr. 23: 9 (1968). Syntypes: S.W.A., Otjiwarongo, Sesfontein, Dinter 1721 (B†; K, fragment!; BM, sketch!); S.W.A., Bulspoor, Dinter 2109 (B†; K, fragment!).

Dioecious tree with a single main stem up to 7 m tall; bark grey to white, usually peeling in large whitish papery pieces to expose a glaucous under-layer; branchlets glabrous. *Leaves* trifoliolate or impari-pinnate, glabrous; lamina up to 8 cm long; petiole relatively long and slender, up to 5 cm long.

glabrous; petiolules up to 1 mm long; leaflets 1-3-jugate, obovate to broadly elliptic or elliptic; apex acute but more often obtuse, base cuneate, margins entire or crenate-serrate in the upper half; terminal leaflet up to 3×2 cm; lateral leaflet 3×1.8 cm. *Flowers* unisexual, perigynous, appearing after the leaves in axillary simple or compound dichasial cymes up to 5.5 cm long; male flowers 1.2-1.4 cm, usually larger than female flowers, 1-2.2 cm. *Bracteoles* linear, up to 5 mm long. *Pedicels* usually relatively long, 6-10 mm. *Calyx* yellowish green, glabrous, continuous with hypanthium, lobes 1.2-1.5 mm long, apex acute. *Petals* yellowish green, 2-3 mm long, inserted on hypanthium, glabrous. *Disk* reduced, not fleshy, adnate to hypanthium, cylindrical, with 4 inconspicuous lobes. *Stamens* 8, inserted on disk, 4 long stamens up to 2 mm long, 4 short stamens up to 1.5 mm long; filaments subterete, lower part flattened and much broadened; staminodes in female flowers. *Gynoecium*: rudimentary in male flowers, ovary half inferior; style relatively short; stigma 2-lobed. *Fruit* 1.5×1.3 cm, subglobose, slightly flattened and asymmetrical, very much flattened, smooth; pseudaril red, fleshy, cupular with 2 lobes of variable length and shape on flattened faces of putamen, covering lower $\frac{1}{2}$ of putamen, lobe on less convex face of putamen usually longer and more acute than lobe on other face. FIG. 75-81.



FIG. 75.—*Commiphora tenuipetiolata* near Melkrivier in the district of Vaalwater, northern Transvaal (height ± 6 m).



FIG. 76, FIG. 77.—Close-up views of different branches of *Commiphora tenuipetiolata*.



Distinctive anatomical features of the stems and leaves

Young stems with a few glandular hairs especially near apex; dendritic crystals (hesperidin or diosmin) occurring in some epidermal and hypodermal cells. *Stems of 2.5 cm diameter*: sclerenchymatous pericycle consisting of fibres and stone cells, epithelium cells of resin ducts in xylem rays surrounded by 1 layer of sclereids. *Leaves* with a few glandular hairs, dendritic crystals (hesperidin or diosmin) occurring in some epidermal and hypodermal cells of the petioles and leaflets; petiole \pm circular as seen in transverse section, sclerenchymatous pericycle present, vascular bundles \pm circularly distributed as seen in transverse section; terminal leaflet isobilateral with a single layer of long palisade cells adaxially and a single layer of shorter palisade cells abaxially, remaining mesophyll consisting of spongy or palisade-like cells, adaxial epidermis consisting mainly of large bulliform cells but smaller bulliform cells occur in abaxial epidermis, stomata mainly abaxial.

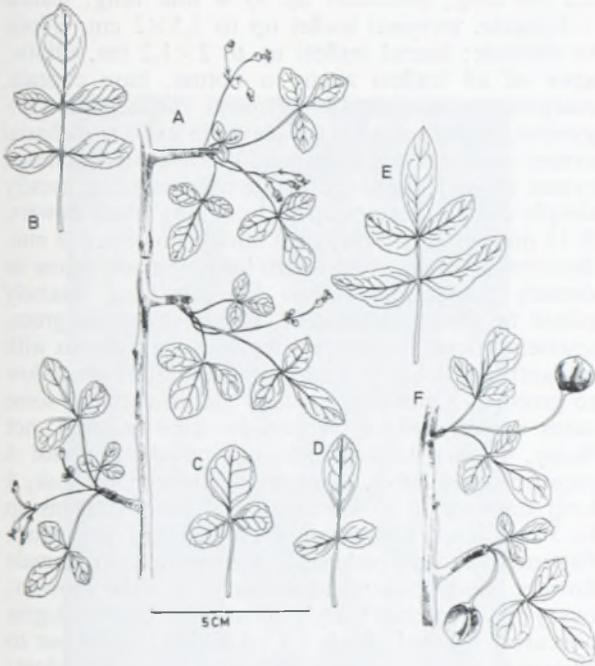


FIG. 78.—*Commiphora tenuipetiolata*: A, branchlet with leaves and flowers; B-E, leaves; F, branchlet with leaves and mature fruits.

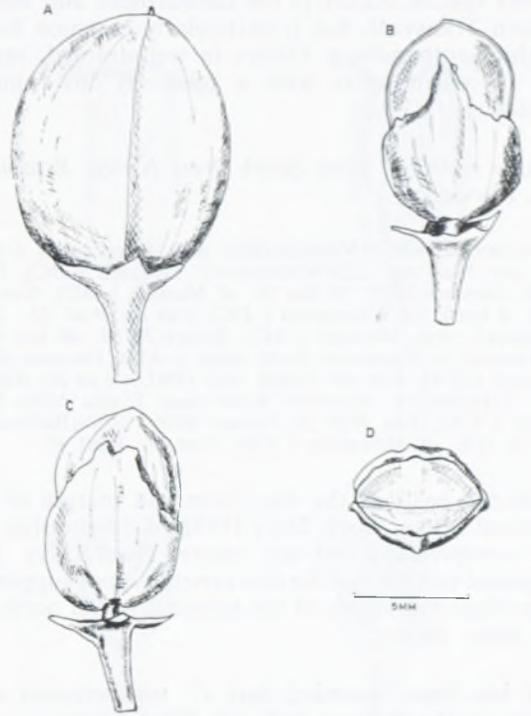


FIG. 80.—Fruit of *Commiphora tenuipetiolata*: A, side-view of the fruit; B, view of the less convex face of putamen with pseudaril; C, view of the more convex face of putamen with pseudaril; D, putamen and pseudaril as seen from above.

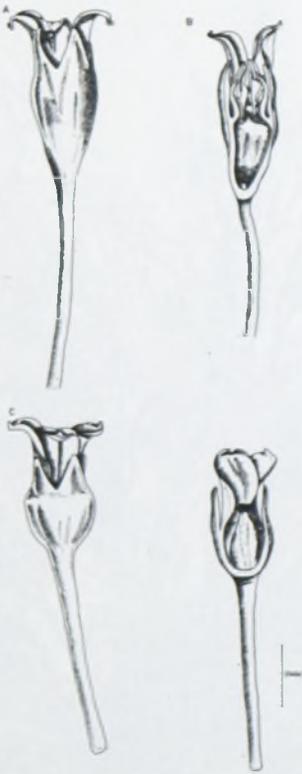


FIG. 79.—Flowers of *Commiphora tenuipetiolata*: A, male flower; B, longitudinal section of male flower; C, female flower; D, female flower with the calyx and corolla partly removed.

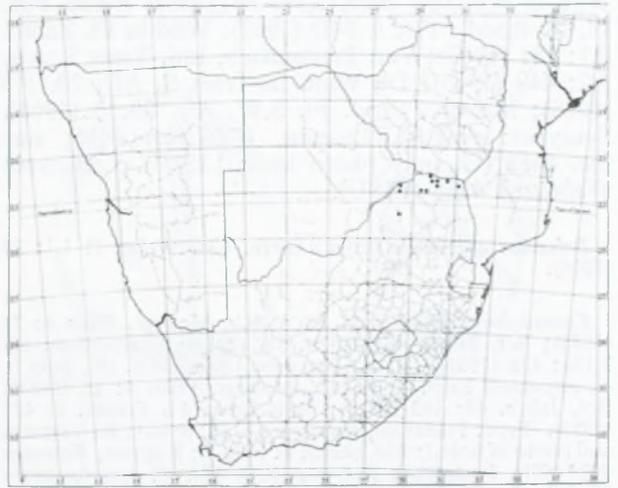


FIG. 81.—Geographical distribution of *Commiphora tenuipetiolata* in South Africa.

Diagnostic features

Dioecious tree with a single main stem; bark grey to white, usually peeling in large whitish papery pieces to expose a glaucous underlayer; branchlets glabrous. *Leaves* trifoliolate or impari-pinnate, glabrous, leaflets 1-3-jugate, margins entire or crenate-serrate in the upper half, terminal leaflet isobilateral, dendritic crystals (hesperidin or diosmin) occurring in some epidermal and hypodermal cells of petioles and leaflets, petioles relatively long and slender (up to 5 cm). *Flowers* perigynous, unisexual, glabrous. *Fruit* subglobose; exocarp glabrous, putamen very much flattened, smooth; pseudaril red, fleshy, cupular with 2 lobes on flattened faces of putamen.

This species occurs in the far-northern and north-eastern Transvaal, but is particularly common north of the Soutpansberg. Grows in well-drained, sandy soil in warm areas with a relatively low annual rainfall.

Also recorded from South West Africa, Botswana and Rhodesia.

TRANSVAAL.—2228(Maasstream): near Koperspruit (—CB), *Van der Walt* 61. 2229(Waterpoort): Dongola (—BC), *Codd* 4140; *Gerstner* 5460; 19 km W. of Messina (—BD), *Gerstner* 5460; 8 km E. of Waterpoort (—DC), *Van der Walt* 31. 2230 (Messina): near Messina (—AC), *Rogers* 20763; 40 km N.E. of Tshipise in Nwanedzi River valley (—AD), *Gerstner* 6039; Tshipise (—CA), *Van der Schijff* 5197 (PRU); *Van der Walt* 4; 15. 2231(Pafuri): Mzimbiti Kloof near Punda Milia Rest Camp (—CA), *Van Wyk & Pienaar* 4696. 2328(Baltimore): 32 km N.E. of Melkriver (—CD), *Van der Walt* 46.

On the basis of the size, form and margin of the terminal leaflet, Burt Davy (1932) distinguishes the var. *tenuipetiolata* and var. *rogersii* Burt Davy. The supposed existence of the two varieties is not supported since these variations of the terminal leaflet occur on the same plant.

It has been recorded that *C. tenuipetiolata* also occurs in shrub form in South West Africa.

14. *Commiphora angolensis* Engl. in A.D.C., Monogr. Phan 4: 24 (1883); Bot. Jahrb. 48: 486 (1913); Pflanzenfam. ed. 2,19a: 438 (1931); Exell & Mendonca in Consp. Fl. Angol. 1,2: 300 (1951); Wild in Bol. Soc. Brot. 2,33: 39 (1959); White, For. Fl. N. Rhod.: 176, t. 34D (1962); Wild in Fl. Zamb. 2,1: 281 (1963); Von Breitenbach, Ind. Trees S. Afr. 3,2: 440 (1965); De Wint. in Trees S. Afr. 20,1: 8 (1968); Merxm., Prod. Fl. S.W. Afr. 23: 5 (1968). Syntypes: Angola, Luanda, *Welwitsch* 4485; sine loc. 4488 (G, only photo seen; LISU!). Lectotype: *Welwitsch* 4485 (LISU).

Balsamea angolensis (Engl.) Hiern, Cat. Welw. Pl 1,1: 24 (1896).

Commiphora oliveri Engl. in A.D.C., Monogr. Phan 4: 24 (1883); Bot. Jahrb. 48: 483, t. 3K (1913); Pflanzenfam. ed. 2,19a: 438 (1931). Type: Botswana, Baines s.n. (K, holo.). *C. rehmannii* Engl. in A.D.C., Monogr. Phan 4: 15 (1883); Bot. Jahrb. 48: 483 (1913); Burt Davy, Fl. Transv. 2: 485 (1932). Type: Transvaal, *Rehmann* s.n. (B, holo.†; K, fragment and photo of holo.†; BM, sketch of holo.†); Klippan, *Rehmann* 5324 (Z!). Lectotype: *Rehmann* 5324 (Z). *C. longibracteata* Engl. in A.D.C., Monogr. Phan. 4: 19 (1883); Bot. Jahrb. 48: 486 (1913); Pflanzenfam. ed. 2,19a: 438 (1931). Type: Angola, *Welwitsch* 4494 (G, holo., only photo seen; LISU!). *C. kwebensis* N.E. Br. in Kew Bull. 1909: 98 (1909); Miller in J.S. Afr. Bot. 18: 38 (1952). Syntypes: Botswana, Kwebe Hills, *Lugard* 34 (K!); *Lugard* 86 (K!). Lectotype: *Lugard* 86 (K). *C. gossweileri* Engl. in Bot. Jahrb. 44: 147 (1910). Type: Angola, Luanda, *Gossweiler* 442 (B, holo.†; K!; BM!). Lectotype: *Gossweiler* 442 (K). *C. nigrescens* Engl. in Bot. Jahrb. 44: 148 (1910); Bot. Jahrb. 48: 484 (1913); Pflanzenfam. ed. 2,19a: 438 (1931). Syntypes: S.W.A., Grootfontein, *Dinter* 727 (B,†; K, fragment!); *Dinter* 727a (B,†; BM, sketch!). Lectotype: *Dinter* 727 (BM).

Dioecious many-stemmed shrub up to 3 m tall; bark yellowish green to chestnut-brown, peeling in yellowish pieces to expose a green underlayer; branchlets pilose to densely pubescent. *Leaves* trifoliolate or impari-pinnate, sparsely pilose to densely pubescent; lamina up to 9 cm long; petiole up to

2,2 cm long; petiolules up to 4 mm long; leaflets 1–3-jugate, terminal leaflet up to 3,5×2 cm, elliptic to obovate; lateral leaflets up to 2×1,2 cm, elliptic; apex of all leaflets acute to obtuse, base cuneate, margins crenate-serrate. *Flowers* unisexual, perigynous, appearing after the leaves in axillary dichasial cymes, male inflorescences usually compound dichasial cymes up to 5 cm long, female inflorescences usually simple dichasial cymes up to 3 cm long; male flowers, 8–11 mm, usually larger than female flowers, 6–8 mm. *Bracteoles* linear, up to 6 mm long, sparsely pilose to densely pubescent. *Pedicels* 4–5 mm long, sparsely pilose to densely pubescent. *Calyx* yellow to green, sparsely pilose to densely pubescent, continuous with hypanthium, lobes 2–3 mm, apex acute. *Petals* yellow to green, 2–3 mm long, usually glabrous but in some cases sparsely pilose on outside. *Disk* reduced, not fleshy, adnate to hypanthium, cylindrical, with 4 inconspicuous lobes. *Stamens* 8, inserted on disk, 4 long stamens up to 4 mm long, 4 short stamens up to 3 mm long; filaments subterete, lower part much flattened and broadened; staminodes in female flowers. *Gynoecium*: rudimentary in male flowers; ovary half inferior; style relatively short; stigma obscurely 4-lobed. *Fruit* 1,1×0,9 cm, subglobose to ellipsoid, asymmetrically flattened; exocarp pilose; mesocarp fleshy; putamen 9×7 mm ellipsoid, slightly asymmetrical, much flattened, smooth; pseudaril red, fleshy, cupular with 2 lobes of variable length and shape on flattened faces of putamen, covering lower $\frac{1}{4}$ – $\frac{1}{3}$ of putamen, lobe on less convex face of putamen usually longer than lobe on other face. FIG. 82–87.



FIG. 82.—*Commiphora angolensis* near Rooibokkraal, north-western Transvaal (height ±3 m).



FIG. 83.—Close-up view of a branch of *Commiphora angolensis* illustrating the bark peeling in papery pieces.

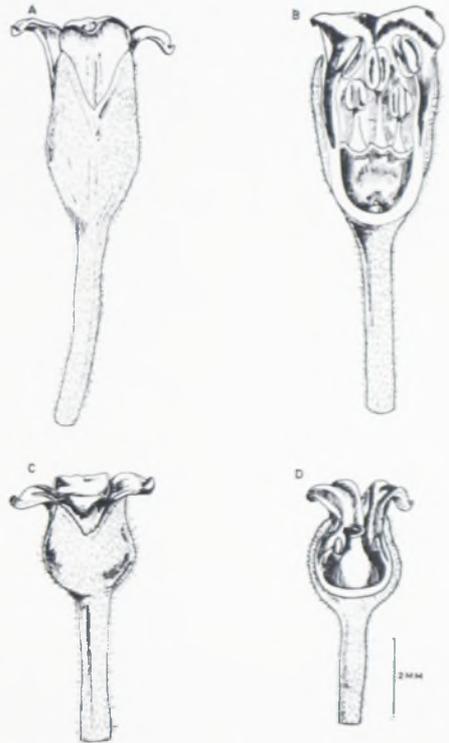


FIG. 85.—Flowers of *Commiphora angolensis*: A, male flower; B, longitudinal section of male flower; C, female flower; D, female flower with calyx and corolla partly removed.

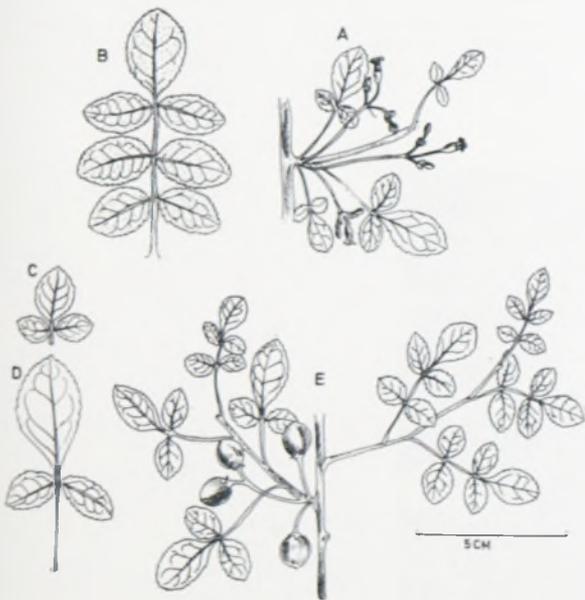


FIG. 84.—*Commiphora angolensis*: A, branchlet with leaves and flowers; B-D, leaves; E, branchlet with leaves and mature fruits.

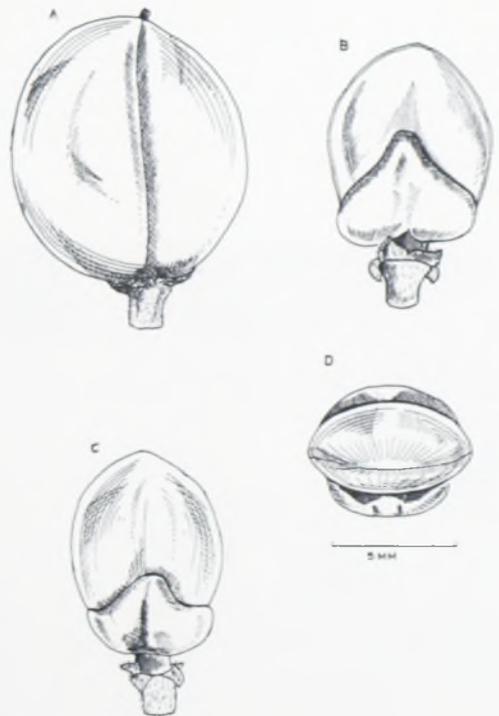


FIG. 86.—Fruit of *Commiphora angolensis*: A, side-view of the fruit; B, view of the less convex face of putamen with pseudaril; C, view of the more convex face of putamen with pseudaril; D, putamen and pseudaril as seen from above.



FIG. 87.—Geographical distribution of *Commiphora angolensis* in South Africa.

Distinctive anatomical features of the stems and leaves

Young stems with a variable number of multicellular non-glandular and glandular hairs; dendritic crystals (hesperidin or diosmin) occurring in some epidermal and hypodermal cells. *Stems of 2,5 cm diameter*: sclerenchymatous pericycle consisting of fibres and stone cells, epithelium cells of resin ducts in xylem rays surrounded by 2–3 layers of sclereids. *Leaves* with a variable number of multicellular non-glandular and glandular hairs; dendritic crystals (hesperidin or diosmin) occurring in some epidermal and hypodermal cells of the petioles and leaflets; petiole \pm triangular as seen in transverse section, terminal leaflet isobilateral with a single layer of long palisade cells adaxially and a single layer of shorter palisade cells abaxially, remaining mesophyll consisting of spongy or palisade-like cells, adaxial epidermis consisting mainly of large bulliform cells but smaller bulliform cells occur in abaxial epidermis, stomata mainly abaxial.

Diagnostic features

Dioecious many-stemmed shrub; bark yellowish green to chestnut-brown, peeling in yellowish pieces to expose a green underlayer; branchlets pilose to densely pubescent. *Leaves* trifoliolate or imparipinnate, sparsely pilose to densely pubescent, leaflets 1–3-jugate, margins crenate-serrate, terminal leaflet isobilateral, dendritic crystals (hesperidin or diosmin) occurring in some epidermal and hypodermal cells of petioles and leaflets, petioles up to 2,2 cm long. *Flowers* perigynous, unisexual, pedicels and calyx pilose to pubescent, corolla in some cases sparsely pilose on outside. *Fruit* subglobose to ellipsoid; exocarp pilose; putamen much flattened, smooth; pseudaril red, fleshy, cupular with 2 lobes on flattened faces of putamen.

In South Africa this species is confined to a few localities in the arid bushveld of north-western and northern Transvaal north of the Soutpansberg. It grows in deep sandy soil presumably derived from the Kalahari.

Also recorded from Botswana, South West Africa, Rhodesia, Zambia and Angola.

TRANSVAAL.—2229(Waterpoort): 10 km N.E. of Vivo (–CD), *Van der Walt 19*; near Mopane (–DB), *Strey 3502*. 2317 (Ellisras): 3 km W. of Monte Christo (–BC), *Codd 6603*; *Van der Walt 110*; 121; 8 km N. of Steenbokpan (–CB), *Van der Walt 122*. 2329(Pietersburg): 3 km N.E. of Vivo (–AB), *Strey 3516*. 2427(Thabazimbi): 13 km E.N.E. of Rooibokkraal (–AA), *Theron & Marsh 258* (PRU); *Van der Walt 25*.

As far as it could be determined, this species occurs only in shrub form in South Africa. In South West Africa it usually develops into a tree with a single main stem.

15. *Commiphora namaensis* Schinz in Bull. Herb. Boiss. 2,8: 633 (1908); Wild in Bol. Soc. Brot. 2,33: 92 (1959); Merxm., Prod. Fl. S.W. Afr. 23: 7 (1968). Type: S.W.A., Inachab, *Dinter 958* (Z, holo.!).

Commiphora rotundifolia Dinter & Engl. in Bot. Jahrb. 46: 289 (1912); Engl. in Bot. Jahrb. 48: 482, t. 3G (1913); Pflanzenfam. ed. 2,19a: 438 (1931). Type: S.W.A., Seeheim, *Dinter 1203* (B, holo.†; K, fragment!).



FIG. 88.—*Commiphora namaensis* near Vioolsdrif, north-western Cape (height \pm 1 m).

Dioecious shrub less than 1 m up to 3 m tall; trunk branching repeatedly above soil level, forming many relatively thin side branches; bark light grey, not peeling; branchlets glabrous. *Leaves* simple, glabrous, lamina up to 1,2×1 cm, orbicular or slightly oblong, apex obtuse, base cuneate, margin dentate to coarsely dentate, petiole up to 7 mm long. *Flowers* subsessile, unisexual, perigynous, appearing before the leaves in axillary clusters; male flowers, 4–5 mm, larger than female flowers, 3–4 mm. *Bracteoles* up to 0,2 mm long, ± triangular, glandular. *Pedicels* less than 0,2 mm long. *Calyx* green to brown, continuous with hypanthium, lobes 0,5–1 mm long, apex acute. *Petals* yellow to brown, 2,5–4 mm long, inserted on hypanthium. *Disk* adnate to hypanthium, cylindrical with 4 fleshy lobes, lobes in male flowers not bifid but in female flowers bifid. *Stamens* 8, 4 long stamens up to 4 mm long, inserted on top of disk lobes, 4 short stamens up to 2,5 mm long, inserted on top of disk between lobes; filaments subterete, lower part flattened and broadened; staminodes in female flowers. *Gynoecium*: rudimentary in male flowers; ovary half inferior, glandular; style relatively long, glandular; stigma obscurely lobed. *Fruit* 1×0,8 cm, subglobose to ellipsoid, slightly flattened, asymmetrical; exocarp glabrous; mesocarp not very fleshy; putamen 8×6 mm, ellipsoid, asymmetrically and irregularly flattened, slightly rugose; pseudaril red, fleshy, cupular with 2 arms on seam of putamen, covering the lower 1/3 of the more convex face of putamen and the lower 1/2 of the other face. FIG. 88-93.



FIG. 89.—Close-up view of a branch of *Commiphora namaensis*.

Distinctive anatomical features of the stems and leaves

Young stems with numerous peltate glandular hairs at apex. *Stems* of 2,5 cm diameter; sclerenchymatous pericycle-cylinder consisting of fibres and stone cells, epithelium cells of resin ducts in xylem rays surrounded by thin-walled cells, resin ducts in primary phloem very conspicuous (up to 2 mm in diameter). *Leaves* with a few peltate glandular hairs; petiole ± semi-circular as seen in transverse section, sclerenchymatous pericycle present or absent, vascular bundles mainly abaxial and distributed in the form of an arc as seen in transverse section, in some cases 1–2 much smaller bundles adaxially, with a large number of stomata; terminal leaflet typically isobilateral with 1–3 layers of palisade cells ad- and abaxially, central mesophyll consisting of ± colourless cells, ad- and abaxial epidermis consisting mainly of large bulliform cells, with a large number of evenly distributed stomata in the ad- and abaxial epidermis.

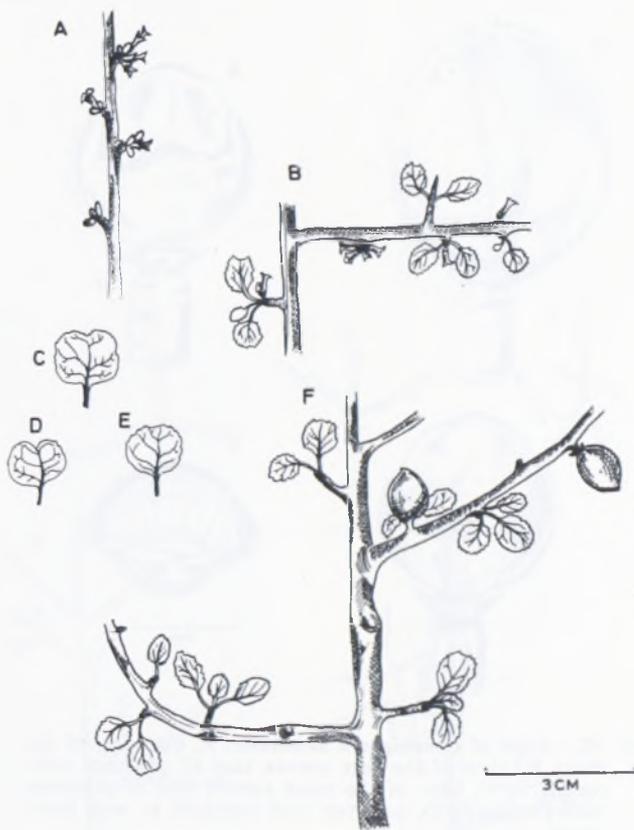


FIG. 90.—*Commiphora namaensis*: A, branchlet with flowers; B, branchlet with leaves and flowers; C–E, leaves; F, branchlet with leaves and mature fruits.

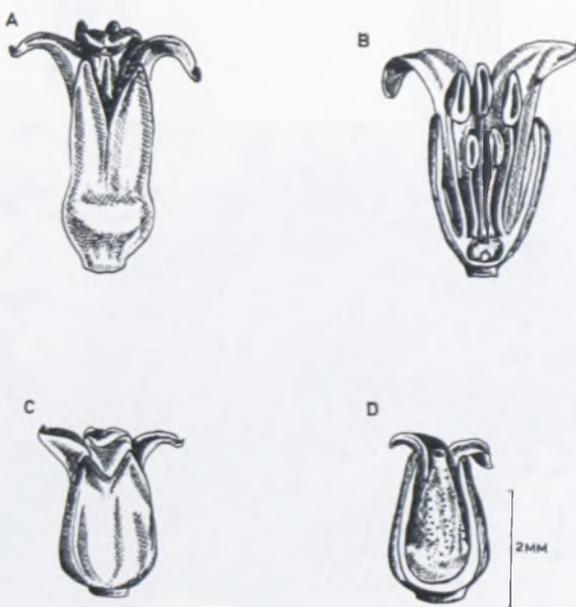


FIG. 91.—Flowers of *Commiphora namaensis*: A, male flower; B, longitudinal section of male flower; C, female flower; D, female flower with the calyx and corolla partly removed.

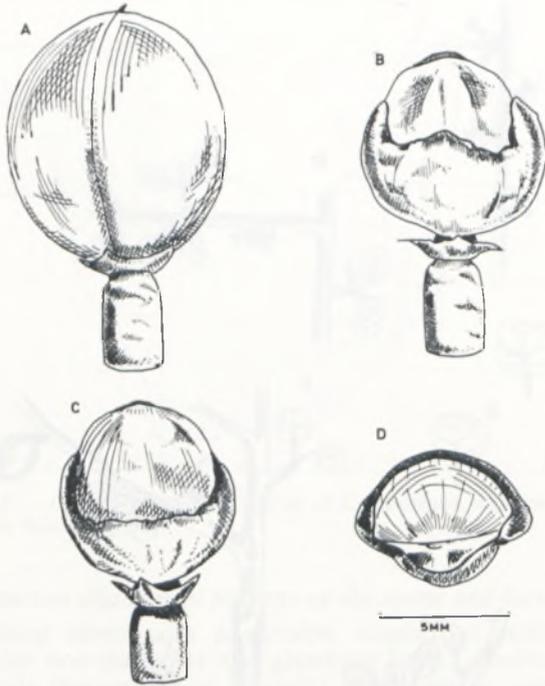


FIG. 92.—Fruit of *Commiphora namaensis*: A, side-view of the fruit; B, view of the less convex face of putamen with pseudaril; C, view of the more convex face of putamen with pseudaril; D, putamen and pseudaril as seen from above.

Diagnostic features

Dioecious shrub, trunk branching repeatedly above soil level, forming many relatively thin side branches; bark light grey, not peeling; stems with very large resin ducts in primary phloem; branchlets with

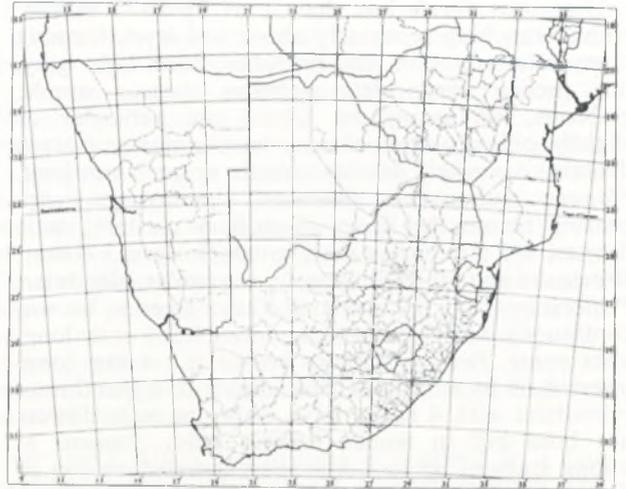


FIG. 93.—Geographical distribution of *Commiphora namaensis* in South Africa.

numerous peltate glandular hairs at apex but otherwise glabrous. Leaves simple, glabrous, lamina orbicular or slightly oblong, margin dentate to coarsely dentate, typically isobilateral. Flowers sessile, perigynous, unisexual. Fruit subglobose to ellipsoid; exocarp glabrous; putamen slightly rugose; pseudaril red, fleshy, cupular with 2 arms on seam of putamen.

In South Africa this species is confined to the semi-desert areas of the north-western Cape. It occurs in the mountains near the Orange River from Goodhouse westwards. These areas are extremely dry and hot with a rainfall of less than 80 mm per annum.

Also recorded from South West Africa.



FIG. 94.—*Commiphora gracilifrons* near Pella, north-western Cape (height $\pm 1,5$ m).

CAPE.—2817(Vioolsdrif): 16 km W. of Violsdrif (—DC), *Van der Walt 113; 114*. 2818(Warmbad): 10 km S. of Goodhouse (—CC), *Van der Walt 120*.

All the plants seen in the veld have simple leaves. Plants cultivated in a glass house at Stellenbosch developed trifoliolate leaves in addition.

16. *Commiphora gracilifronsosa* *Dinter ex Van der Walt* in *J.S. Afr. Bot.* 37,3: 190 (1971); *Dinter* in *Fedde, Rep. Beih.* 53: 48 (1928), nom. subnud. Type: *Dinter 5124* (BOL, holo. !; S! ; B†).

Dioecious shrub up to 3 m tall; trunk branching repeatedly above soil level, stem appearing succose; bark reddish brown with dark patches, not peeling; branchlets slender, glabrous. *Leaves* trifoliolate but terminal leaflet often 3-lobed, glabrous; lamina up to 6 cm long; petiole up to 2 cm long; petiolules up to 3 mm long; leaflets variable in size and form, linear to cultrate, margins irregularly and rather coarsely dentate-serrate, apex obtuse to acute, base cuneate; terminal leaflet up to 4,3×0,2 cm, lateral leaflets up to 3,5×0,2 cm. *Flowers* unisexual, perigynous, appearing before or with the leaves in axillary dichasial cymes or occasionally solitary, male inflorescences up to 5 cm long, female inflorescences up to 1 cm long; male flowers 6–7 mm, usually larger than female flowers, 4–5 mm. *Bracteoles* up to 4 mm long, linear, sparsely glandular. *Calyx* yellow to green, continuous with hypanthium, sparsely glandular, lobes up to 1 mm long, apex acute. *Petals* yellow to green, 2,5–3,5 mm long, inserted on hypanthium. *Disk* adnate to hypanthium, cylindrical with 4 fleshy lobes. *Stamens* only 4, up to 2,5 mm long, inserted on top of disk lobes; filaments slender, subterete, lower part flattened and broadened; staminodes in female flowers. *Gynoecium*: rudimentary in male flowers; ovary half inferior, sparsely glandular; style relatively long, sparsely glandular; stigma obscurely lobed. *Fruit* 1×0,8 cm, subglobose to ellipsoid, asymmetrical, slightly flattened; exocarp glabrous; mesocarp not very fleshy; putamen 8×5 mm, ellipsoid, asymmetrically flattened, smooth; pseudaril red, not very fleshy, cupular with 2 arms on seam of putamen, covering the lower ¼ of more convex face of putamen and ½ of the other face. FIG. 94–99.

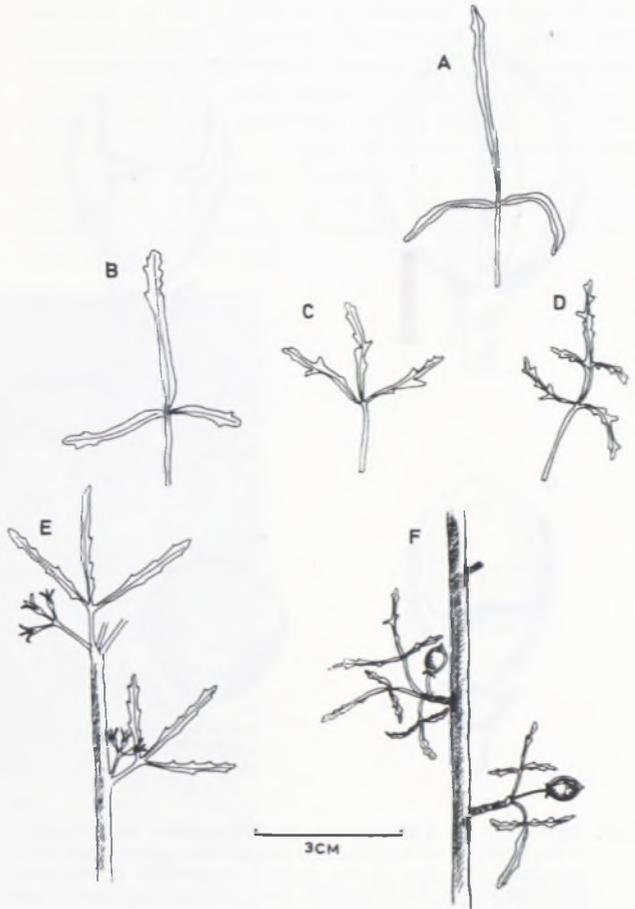


FIG. 96.—*Commiphora gracilifronsosa*: A–D, leaves; E, branchlet with leaves and flowers; F, branchlet with leaves and mature fruits.

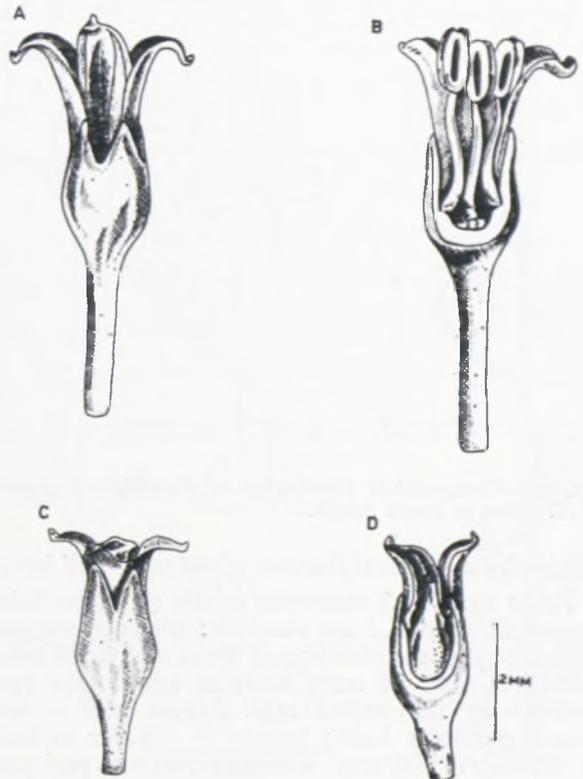


FIG. 97.—Flowers of *Commiphora gracilifronsosa*: A, male flower; B, longitudinal section of male flower; C, female flower; D, female flower with the calyx and corolla partly removed.



FIG. 95.—Close-up view of stems of *Commiphora gracilifronsosa*.

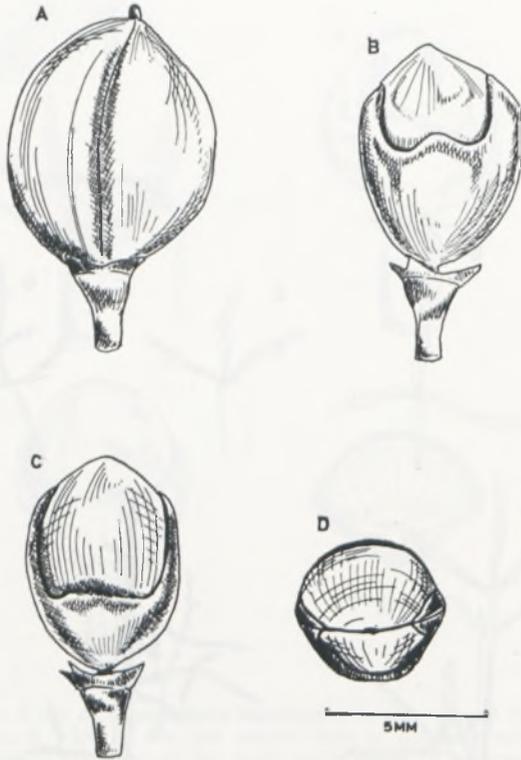


FIG. 98.—Fruit of *Commiphora gracilifrons*: A, side-view of the fruit; B, view of the less convex face of putamen with pseudaril; C, view of the more convex face of putamen with pseudaril; D, putamen and pseudaril as seen from above.

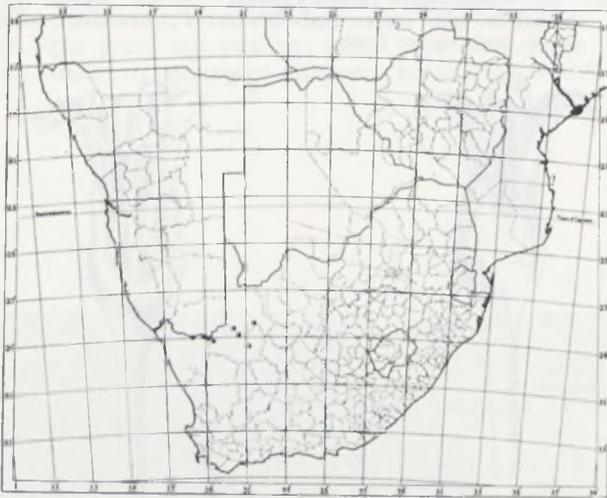


FIG. 99.—Geographical distribution of *Commiphora gracilifrons* in South Africa.

Distinctive anatomical features of the stems and leaves

Young stems with numerous peltate glandular hairs at apex. Stems of 2,5 cm diameter: sclerenchymatous pericycle-cylinder consisting of fibres and stone cells, epithelium cells of resin ducts in xylem rays surrounded by thin-walled cells. Leaves with a few peltate glandular hairs; petiole \pm circular as seen in transverse section, sclerenchymatous pericycle present or absent, vascular bundles mainly abaxial and distributed in the form of an arc as seen in transverse section, in some cases 1–2 much smaller bundles adaxially, with a large number of stomata;

terminal leaflet typically isobilateral, mesophyll consisting mainly of palisade cells with a few \pm colourless cells centrally, ad- and abaxial epidermis consisting mainly of large bulliform cells, with a large number of evenly distributed stomata in the ad- and abaxial epidermis.

Diagnostic features

Dioecious shrub, trunk branching repeatedly above soil level, stems appearing succose; bark reddish brown with dark patches, not peeling; branchlets slender, with numerous peltate glandular hairs at apex but otherwise glabrous. Leaves trifoliolate but terminal leaflet often 3-lobed, glabrous, leaflets linear to cultrate, margins irregularly and rather coarsely dentate-serrate, terminal leaflet typically isobilateral. Flowers perigynous, unisexual, only 4 stamens/staminodes. Fruit subglobose to ellipsoid; exocarp glabrous; putamen smooth; pseudaril red, not very fleshy, cupular with 2 arms on seam of putamen.

This species occurs in the north-western Cape from Kenhardt in the east to Goodhouse in the west. It grows on the arid mountains and kopjes in the vicinity of the Orange River in areas with an annual rainfall up to 160 mm.

Also recorded from the southern part of South West Africa.

CAPE.—2818(Warmbad): 5 km E. of Goodhouse (–CD), *Van der Walt 124*: 27 km W.N.W. of Pella (–DD), *Van der Walt 119*, 2819 (Ariamvlei): 8 km N. of Pella (–CC), *Van der Walt 116*. 2820(Kakamas): near Augrabies (–CB), *Pearson 3567* (BOL); near Kakamas (–DC), *Fuller 24* (BOL). 2919 (Pofadder): 6 km N.E. of Pofadder (–AB), *Acocks 21795*, 2921(Kenhardt): S. of Kenhardt (–AC), *Hutchinson 952* (BOL).

This species is closely related to *C. oblanceolata* Schinz. The type specimen (*Dinter 1497*) of the latter species has been studied. Like *C. gracilifrons*, *C. oblanceolata* has also only 4 stamens. De Winter, who studied the material of these two taxa in Kew, also concluded that they should be considered as different species.

It was observed that goats and game graze on the young branches. The local name of “Suikerkan” is probably derived from the sweet taste of the wood.

17. *Commiphora capensis* (Sond.) Engl. in A.D.C., *Monogr. Phan.* 4: 18 (1883); *Bot. Jahrb.* 48: 470 (1913); *Pflanzenfam.* ed. 2,19a: 433 (1931); *Wild in Bol. Soc. Brot.* 2,33: 89 (1959); *Von Breitenbach, Ind. Trees S. Afr.* 3,2: 436 (1965); *de Wint. in Trees S. Afr.* 20,1: 10 (1968); *Merxm., Prod. Fl. S.W. Afr.* 23: 5 (1968). Type: North-western Cape, Natvoet, *Drège 6809* (ex parte) (S, holo.!, MEL, fragment!).

Balsamodendrum capense Sond. in *Fl. Cap.* 1: 526 (1860). *Balsamea capensis* (Sond.) Engl. in *Bot. Jahrb.* 1: 42 (1881). *Commiphora rangeana* Engl. in *Bot. Jahrb.* 44: 149 (1910); *Bot. Jahrb.* 48: 482, t. 3F (1913); *Pflanzenfam.* ed. 2,19a: 438 (1931). Type: S.W.A., Kovies Mountains, *Range 172* (B, holo.†; BOL!).

Dioecious shrub up to 4 m tall; trunk branching repeatedly above soil level, stems appearing succose; bark brown to green with blackish patches, peeling locally in small white papery pieces; branchlets glabrous. Leaves trifoliolate, glabrous; lamina up to 2,3 cm long; petiole up to 1 cm long; petiolules up to 1,5 mm long; leaflets usually cordate but in some cases orbicular or obovate, apex usually emarginate but in some cases obtuse, base cuneate to obtuse, margins finely lobed; terminal leaflet up to 1,8 \times 1,4

cm; lateral leaflets up to $1,3 \times 1$ cm. *Flowers* unisexual, perigynous, appearing with the leaves in axillary simple dichasial cymes or solitary; male flowers, 5–6 mm, usually larger than female flowers, 4,5–5 mm. *Bracteoles* up to 1 mm long, triangular, glandular. *Pedicels* 0,5–1 mm long, glandular. *Calyx* yellow to green, fleshy, continuous with fleshy hypanthium, glandular, lobes 1,5–2 mm long, apex acute. *Petals* yellow to green, 2–3 mm long, glandular, inserted on hypanthium. *Disk* adnate to hypanthium, cylindrical with 4 fleshy lobes. *Stamens* 8, 4 long stamens

up to 2,5 mm, inserted on top of disk lobes, 4 short stamens up to 2 mm long, inserted on top of disk between lobes; filaments flattened and lower part broadened; staminodes in female flowers. *Gynoecium*: rudimentary in male flowers; ovary half inferior, glandular; style relatively long, glandular; stigma 2-lobed. *Fruit* $1,2 \times 1$ cm, ellipsoid, asymmetrical, very much flattened; exocarp glabrous; mesocarp very thin; putamen $1,1 \times 0,9$ cm, ellipsoid, asymmetrical, very much flattened, smooth; pseudaril lacking. FIG. 100–105.



FIG. 100.—*Commiphora capensis* in Klein Helskloof near Vioolsdrif, north-western Cape (height ± 1 m).



FIG. 101.—Close-up view of a branch of *Commiphora capensis*.

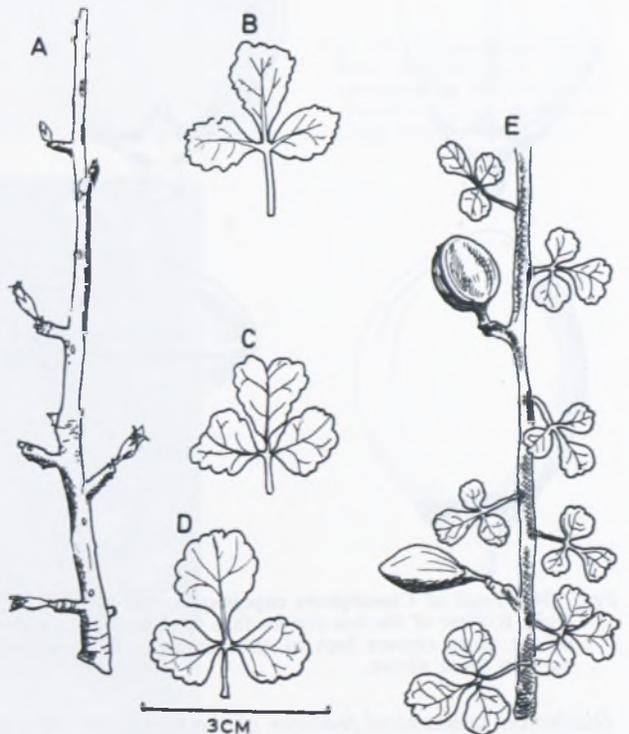


FIG. 102.—*Commiphora capensis*: A, branchlet with flowers; B–D, leaves; E, branchlet with leaves and mature fruits.

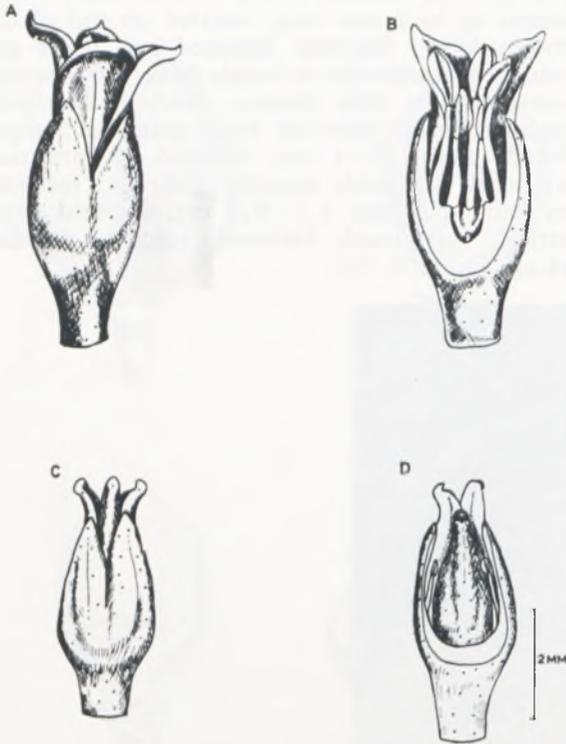


FIG. 103.—Flowers of *Commiphora capensis*: A, male flower; B, longitudinal section of male flower; C, female flower; D, female flower with the calyx and corolla partly removed.

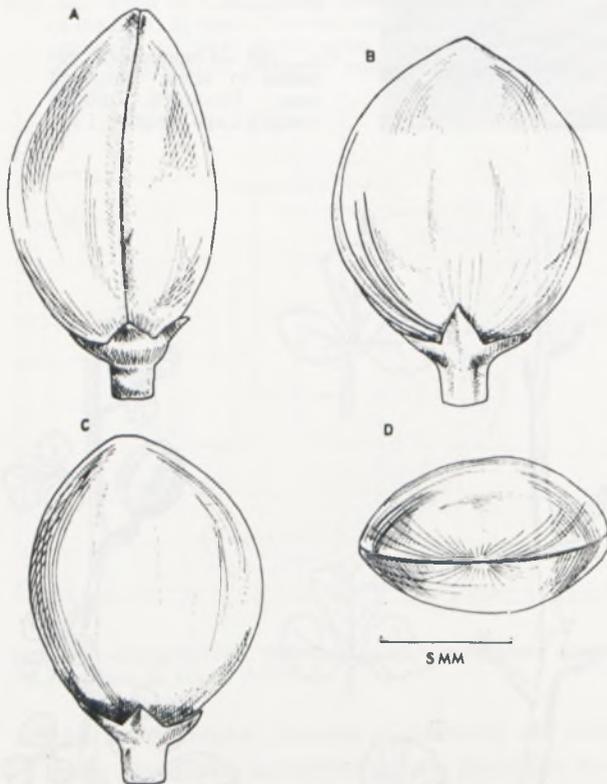


FIG. 104.—Fruit of *Commiphora capensis*: A, side-view of the fruit; B, view of the less convex face of putamen; C, view of the more convex face of the putamen; D, putamen as seen from above.

Distinctive anatomical features of the stems and leaves

Young stems with numerous glandular hairs at apex. *Stems* of 2,5 cm diameter: sclerenchymatous pericycle-cylinder consisting of fibres and stone cells,

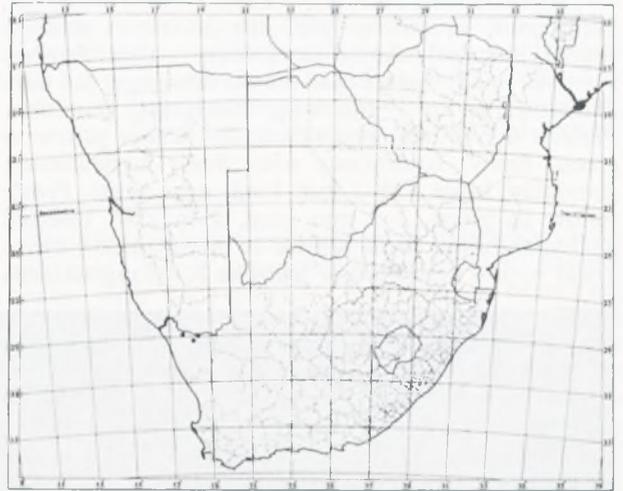


FIG. 105.—Geographical distribution of *Commiphora capensis* in South Africa.

epithelium cells of resin ducts in xylem rays surrounded by thin-walled cells. *Leaves* with a few glandular hairs; petiole \pm heart-shaped as seen in transverse section, sclerenchymatous pericycle present or absent, vascular bundles mainly abaxial and distributed in the form of an arc as seen in transverse section, in some cases 1–2 much smaller bundles (usually only phloem strands) adaxially, with a large number of stomata; terminal leaflet typically isobilateral with 1–3 layers of palisade cells ad- and abaxially, central mesophyll consisting of \pm colourless cells, ad- and abaxial epidermis consisting mainly of bulliform cells, with a large number of evenly distributed stomata in the ad- and abaxial epidermis.

Diagnostic features

Dioecious shrub, trunk branching repeatedly above soil level, stems appearing succose; bark brown to green with blackish patches, peeling locally in small white papery pieces; branchlets with numerous glandular hairs at apex but otherwise glabrous. *Leaves* trifoliolate, glabrous, leaflets usually cordate but in some cases orbicular or obovate, margins finely lobed, terminal leaflet typically isobilateral. *Flowers* perigynous, unisexual, calyx fleshy. *Fruit* ellipsoid, very much flattened; exocarp glabrous; mesocarp very thin; putamen smooth; pseudaril lacking.

This species is confined to the semi-desert areas of the north-western Cape and south-western parts of South West Africa. It grows in the mountains and kopjes in the vicinity of the Orange River from Goodhouse westwards to the Richtersveld. These areas are extremely dry and hot with a rainfall of less than 80 mm per annum.

CAPE.—2816(Oranjemund): S.E. of Sendlingsdrift (–BB), Pillans 5001 (BOL). 2817(Vioolsdrif): 37 km W.S.W. of Vioolsdrif in Klein Helskloof (–CD), Van der Walt 111; 112. 2818(Warmbad): 5 km E. of Goodhouse (–CD), Van der Walt 126; 127.

C. capensis and *C. cervifolia* are closely related species and the two have many characteristics in common, especially as far as growth form, external features of the stems and fruits are concerned. Although both species have trifoliolate leaves, the form of the leaflets differs considerably.

As in the case of *C. cervifolia*, but to a lesser extent, the living shoots, on being touched, exude an aromatic secretion in such quantities that the stems become wet.

The fruits are eaten by animals.

18. *Commiphora cervifolia* Van der Walt in J.S. Afr. Bot. 37,3: 189 (1971). Type: North-western Cape, 8 km S. of Vioolsdrif, Van der Walt 128 (PRE, holo.; PRU).

Dioecious shrub up to 2 m tall; trunk branching repeatedly above soil level, stems appearing succose; bark greyish green to yellowish brown with dark patches, not peeling; branchlets short and stout, glabrous. Leaves trifoliolate, glabrous; lamina up to 1,5 cm long; petiole up to 5 mm long; leaflets small, cultrate, usually irregularly lobed, apex acute to obtuse, base cuneate, margins entire irrespective of lobes; terminal leaflet up to $1 \times 0,2$ cm; lateral leaflets up to $0,8 \times 0,2$ cm. Flowers unisexual, perigynous, appearing before the leaves in axillary dichasial cymes

up to 2 cm long or solitary; male flowers, 6–7 mm, usually larger than female flowers, 5–6 mm. Bracteoles up to 0,5 mm long, lanceolate, sparsely glandular. Pedicels 1–1,5 mm long, sparsely glandular. Calyx yellowish green to brown, fleshy, continuous with fleshy hypanthium, sparsely glandular, lobes up to 2 mm long, apex acute. Petals yellowish green to brown, 2–3 mm long, inserted on hypanthium. Disk adnate to hypanthium, cylindrical with 4 fleshy lobes. Stamens 8, 4 long stamens up to 3 mm long, inserted on top of disk lobes; 4 short stamens up to 2,2 mm long, inserted on top of disk between lobes; filaments slender, subterete, lower part flattened and broadened; staminodes in female flowers. Gynoecium: rudimentary in male flowers; ovary half inferior, sparsely glandular; style relatively short, sparsely glandular; stigma obscurely 4-lobed. Fruit $1,1 \times 1$ cm, ellipsoid, asymmetrically flattened; exocarp glabrous; mesocarp very thin; putamen 9×8 mm, ellipsoid, asymmetrically flattened; pseudaril lacking. FIG. 106–111.

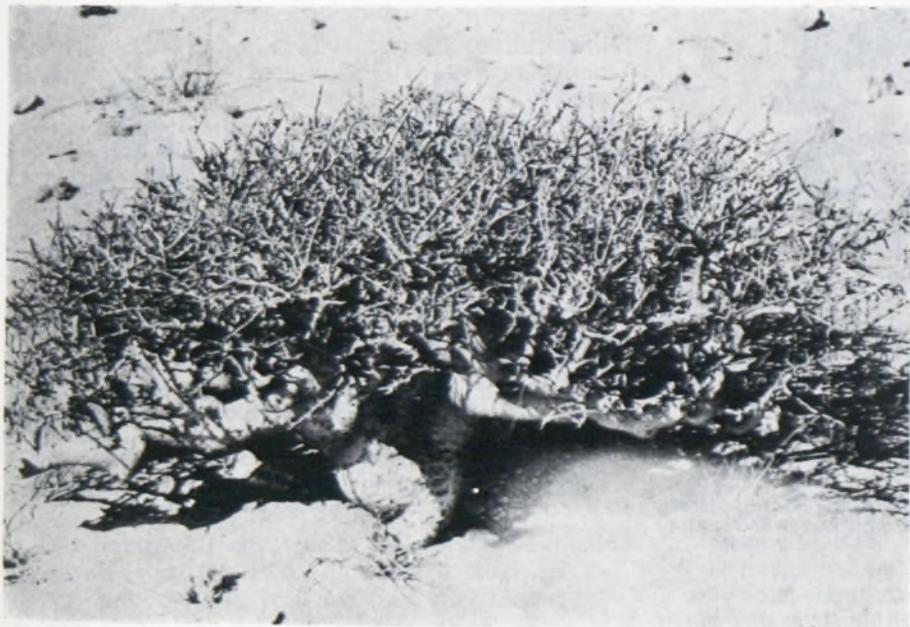


FIG. 106.—*Commiphora cervifolia* on the farm Geselskapbank in the district of Goodhouse, north-western Cape (height $\pm 0,5$ m).



FIG. 107.—Close-up view of a branch of *Commiphora cervifolia*.

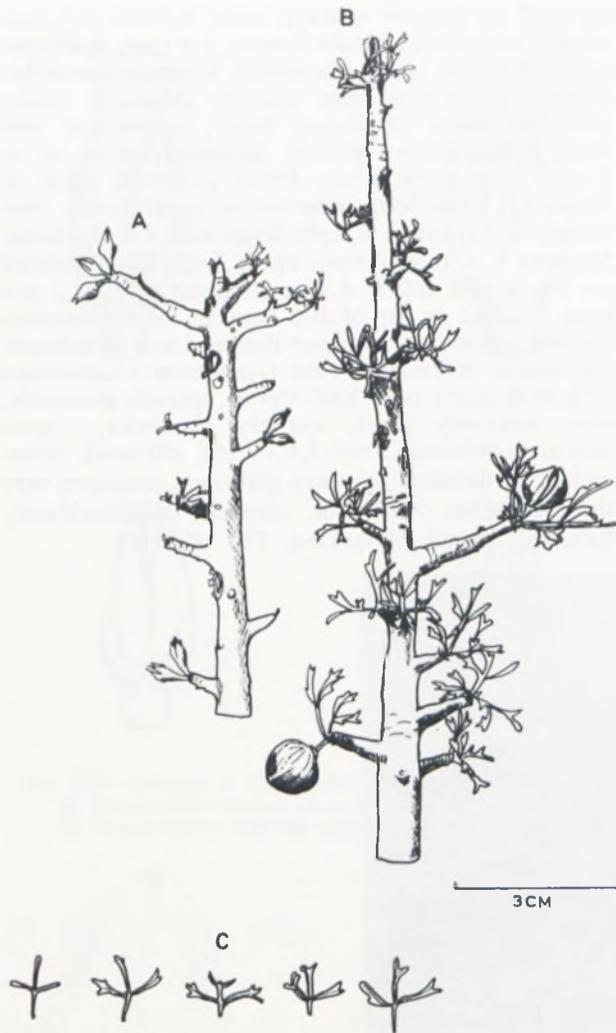


FIG. 108.—*Commiphora cervifolia*: A, branchlet with young leaves and flowers; B, branchlet with leaves and mature fruits; C, leaves.

Distinctive anatomical features of the stems and leaves

Young stems with numerous glandular hairs at apex. Stems of 2,5 cm diameter: sclerenchymatous pericycle-cylinder consisting of fibres and stone cells, epithelium cells of resin ducts in xylem rays surrounded by thin-walled cells. Leaves with a few glandular hairs; petiole \pm heart-shaped as seen in transverse section, sclerenchymatous pericycle usually absent, 1-3 but usually only 1 vascular bundle abaxially and in some cases 1-2 phloem strands adaxially, with a large number of stomata; terminal leaflet typically isolateral, mesophyll consisting mainly of palisade cells with a few \pm colourless cells centrally, ad- and abaxial epidermis consisting mainly of large bulliform cells, with a large number of evenly distributed stomata in the ad- and abaxial epidermis.

Diagnostic features

Dioecious shrub, trunk branching repeatedly above soil level, stems appearing succose; bark greyish green to yellowish brown with dark patches, not peeling; branchlets short and stout, with numerous glandular hairs at apex but otherwise glabrous. Leaves trifoliate, glabrous, leaflets small, cultrate, usually irregularly lobed, margins entire irrespective

of lobes, terminal leaflet typically isobilateral. Flowers perigynous, unisexual, calyx fleshy. Fruit ellipsoid; exocarp glabrous; mesocarp very thin, putamen smooth; pseudaril lacking.

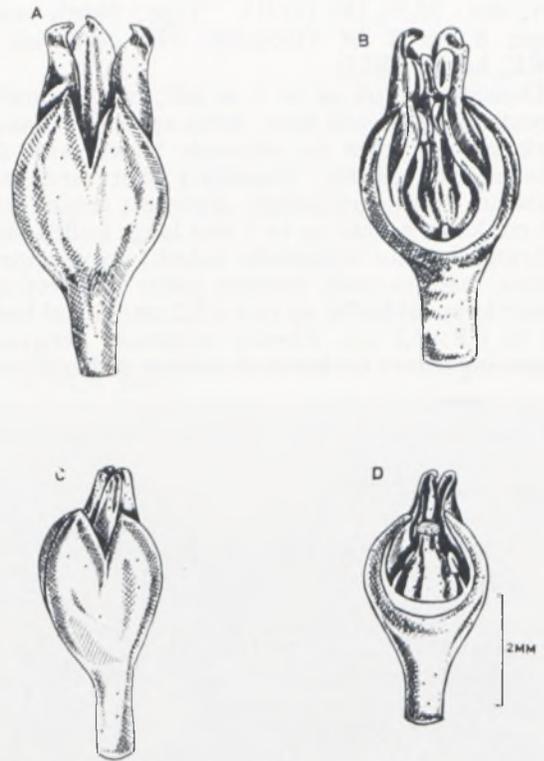


FIG. 109.—Flowers of *Commiphora cervifolia*: A, male flower; B, longitudinal section of male flower; C, female flower; D, female flower with the calyx and corolla partly removed.

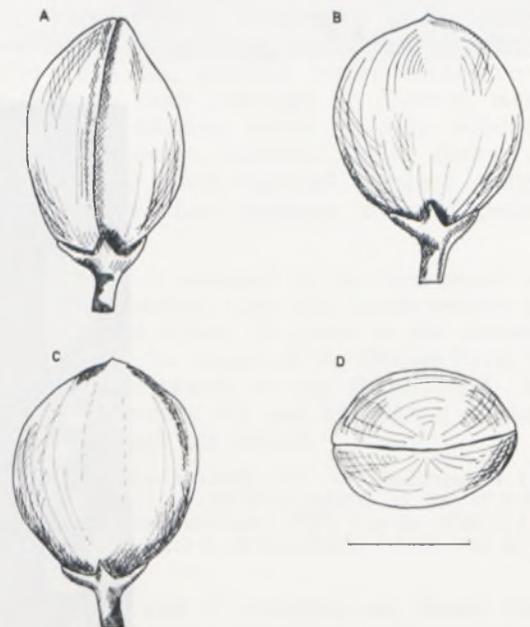


FIG. 110.—Fruit of *Commiphora cervifolia*: A, side-view of the fruit; B, view of the less convex face of putamen; C, view of the more convex face of putamen; D, putamen as seen from above.

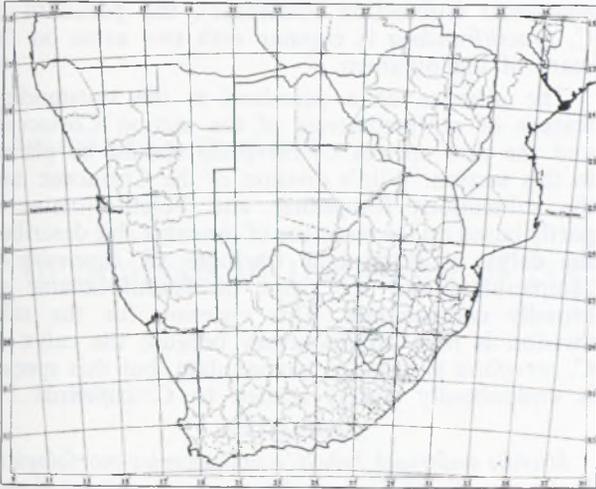


FIG. 111.—Geographical distribution of *Commiphora cervifolia* in South Africa.

This species is apparently confined to the semi-desert areas of the north-western Cape from Goodhouse in the east to Vioolsdrif in the west. It occurs on the arid mountains or kopjes in the vicinity of the Orange River in areas with an annual rainfall of less than 80 mm.

CAPE.—2817(Vioolsdrif): 8 km S. of Vioolsdrif (—DC), *Van der Walt 128*. 2818(Warmbad: 13 km S.E. of Goodhouse (—CD), *Van der Walt 115*. 2918(Gamoep): 56 km N.E. of Okiep at Geselskapbank (—AA), *Van der Walt 123*.

Living shoots, on being touched, exude an aromatic secretion in such quantities that the stems become wet. The form of the leaflets with the irregular lobes resembles the antlers of a stag, hence the name of the species.

DISCUSSION OF THE RELATIONSHIPS OF THE SPECIES

The South African species of *Commiphora* can be divided on the basis of characteristics of the flower, inflorescence, fruit and leaf as follows:

1. *C. glandulosa*, *C. pyracanthoides*, *C. merkeri*, *C. schimperi*, *C. africana*, *C. neglecta*, *C. mollis*, *C. harveyi* and *C. marlothii* have hypogynous flowers. The disk of the flowers is fleshy and not adnate to the calyx or corolla. A great part of the putamen is covered by the pseudaril.
 - 1.1 *C. glandulosa*, *C. pyracanthoides*, *C. merkeri*, *C. schimperi* and *C. africana* have the following characteristics in common: The putamen is rugose, the pseudaril with or without four distinct arms and the flowers are borne in clusters or in reduced cymes.
 - 1.11 *C. glandulosa*, *C. pyracanthoides* and *C. merkeri* have simple leaves or trifoliolate leaves with two much smaller lateral leaflets.
 - 1.12 The leaves of *C. schimperi* and *C. africana* are exclusively trifoliolate.
 - 1.2 The putamen of *C. neglecta*, *C. mollis*, *C. harveyi* and *C. marlothii* is smooth and the pseudaril forms four distinct arms.
 - 1.21 The filaments of *C. neglecta*, *C. mollis* and *C. harveyi* are inserted on the outside of the disk and the leaves are trifoliolate or impari-pinnate.

- 1.22 The filaments of *C. marlothii* are inserted on top of the disk and the leaves are exclusively impari-pinnate.
2. *C. edulis*, *C. woodii*, *C. zanzibarica*, *C. tenuipetiolata*, *C. angolensis*, *C. namaensis*, *C. gracilifronsosa*, *C. capensis* and *C. cervifolia* have perigynous flowers. The disk of the flowers is adnate to the hypanthium and in most cases not fleshy. The pseudaril covers only the lower part of the putamen or is completely absent.
 - 2.1 The pseudaril of *C. edulis*, *C. woodii* and *C. zanzibarica* is cupular without long arms or lobes, the leaves are impari-pinnate and the flowers are borne in long paniculate cymes.
 - 2.2 The pseudaril of *C. angolensis* and *C. tenuipetiolata* is cupular with two lobes on the flattened faces of the putamen, the leaves are trifoliolate or impari-pinnate and the flowers are borne in simple or compound dichasial cymes.
 - 2.3 The pseudaril of *C. namaensis* and *C. gracilifronsosa* is cupular with two arms on the seam of the putamen. The flowers are borne singly or in short dichasial cymes. The leaves of *C. namaensis* are simple or occasionally trifoliolate, while those of *C. gracilifronsosa* are trifoliolate.
 - 2.4 *C. capensis* and *C. cervifolia* have no pseudaril, the flowers are borne singly or in short dichasial cymes and the leaves are trifoliolate.

In the revised classification of Wild (1959a) the genus is divided into the subgenera *Commiphora* and *Opobalsamum*. According to this division all the South African species belong to the subgenus *Commiphora*, characterized by the fruit splitting into two valves at maturity, four stamens which are distinctly shorter than the remaining four and the presence of four or eight disk lobes. It should be noted, however, that the flowers of *C. oblanceolata* Schinz (not mentioned by Wild) and *C. gracilifronsosa* have only four stamens.

In the division of the subgenus into sections, Wild did not make use of the fact that some species possess hypogynous and other perigynous flowers. However, all the South African species of his sections *Commiphora* and *Africanæ* have hypogynous flowers, while those of the sections *Coriaceæ* and *Spondioideæ* are perigynous.

The distinction between the sections *Commiphora* and *Africanæ* by Wild is mainly based on the structure of the pseudaril. Representatives of the section *Commiphora* have a pseudaril forming four arms, while representatives of the section *Africanæ* have no pseudaril. Wild, however, maintained that the pseudaril is only apparently absent in the latter section because it is probably united too intimately with the putamen to be visible. A remarkable similarity exists between the South African species belonging to the section *Africanæ* (*C. africana* and *C. schimperi*) and the species of the subsection *Pyracanthoides* (*C. glandulosa*, *C. pyracanthoides* and *C. merkeri*). The putamen of all these species is rugose; the fruit of *C. pyracanthoides*, *C. merkeri* and *C. schimperi* is apiculate; the length and shape of the four arms of the pseudaril of *C. africana*, *C. glandulosa* and *C. pyracanthoides* are alike, while the pseudaril of *C. merkeri* and *C. schimperi* (although

thin and membranous and only visible in fresh fruits) covers almost the whole putamen. Furthermore, *C. glandulosa*, *C. pyracanthoides* and *C. schimperi* can have bisexual flowers. In addition all these species have spine-tipped branchlets, flaking or peeling bark and petioles which show marked anatomical similarities. A reasonable deduction can be made that a closer affinity exists between these species than Wild realized.

C. marlothii is the only South African representative of the section *Commiphora* where the filaments are not adnate to the outside of the disk, but inserted on top of the disk. This feature, as well as the presence of long, paniculate cymes, impari-pinnate leaves and medullary vascular bundles in the petiole, suggests and affinity with the subsection *Cupulares* of the section *Spondioideae*.

In agreement with the classification of Wild, a cupular pseudaril is found in all the indigenous representatives of the section *Spondioideae*. Species of the subsection *Cupulares* (*C. edulis*, *C. woodii* and *C. zanzibarica*) have large pinnate leaves, perigynous flowers and a pseudaril without long lobes or arms. These three species show marked similarities in stem and leaf anatomy, although medullary vascular bundles are absent from the petiole of *C. woodii*. The short lobes of the pseudaril of *C. edulis* suggest a probable affinity with the section *Commiphora*.

The two closely related species, *C. angolensis* and *C. tenuipetiolata* of the subsection *Glaucidulae*, have a pseudaril with two lobes on the flattened faces of the putamen. The hypanthium of both species is relatively long. The external morphological similarities of the leaves of the two species are reflected anatomically; it is also of particular interest that the dendritic crystals of hesperidin or diosmin only occur in these two species.

The new species *C. gracilifronsosa* should be placed in Wild's subsection *Pruinosae*. As in *C.*

namaensis (subsection *Pruinosae*), the pseudaril of *C. gracilifronsosa* is cupular with two arms on the seam of the putamen.

The absence of a pseudaril is the outstanding feature of representatives of the section *Coriaceae*, and the new species *C. cervifolia* should be placed in this section. Wild's division of the *Coriaceae* into the subsections *Rangeanae* and *Teretifoliolatae* is partly based on the structure of the calyx. He described the calyx of *Rangeanae* (includes *C. capensis*) as campanulate and the calyx of *Teretifoliolatae* as broadly campanulate. This criterion for the subdivision is now unsatisfactory because the calyx of *C. cervifolia* is broadly campanulate, but this species is undoubtedly closely related to *C. capensis*.

OPSOMMING

Hierdie ondersoek behels 'n taksonomies-morfologiese studie van die 18 Commiphora-spesies wat tot dusver in Suid-Afrika versamel is. Die belangrikste oogmerk met die studie was om die verskillende spesies duidelik te omgrens. Om dit te kon bereik is 'n volledige anatomiese studie van die stingels en blare, asook 'n organografiese studie van die stingels, blare, blomme en ryp vrugte gemaak. Die organografiese kenmerke van hierdie organe is met behulp van sketse en foto's geïllustreer.

'n Volledige uiteensetting van die taksonomiese literatuur en geografiese verspreiding in Suid-Afrika, word van elke spesie gegee. Die tipe-eksemplare van al die spesies en hulle sinonieme is bestudeer, en in toepaslike gevalle is lektotipes aangewys. Die onderskeidende anatomiese kenmerke en diagnostiese morfologiese kenmerke van elke spesie, word gegee. Twee sleutels wat lei tot die identifikasie van die verskillende spesies is opgestel. Die een sleutel is slegs op vegetatiewe kenmerke van die stingels en blare gebaseer, terwyl die ander sleutel op alle morfologiese kenmerke gebaseer is. Die moontlike verwantskappe van die spesies word bespreek.

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