A TAXONOMIC REVISION OF THE SPINY MEMBERS OF SUBFAMILY CELASTROIDEAE (CELASTRACEAE) IN SOUTHERN AFRICA

by

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Submitted in partial fulfilment
of the requirements
for the degree

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Supervisor: Prof. Dr. A.E. van Wyk

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Dedicated to my sons

Robertus and Pieter

NOTE

Following the completion of the final draft of this thesis, it was realized that the species *Maytenus bachmannii* (Loes.) Marais should also be transferred to the genus *Gymnosporia*. Although usually nonspiny, plants with a few spines are occasionally found. The species has unisexual flowers, cymose inflorescences and a leaf structure that agrees with that of anatomical Group E. Morphologically it is provisionally associated with *Gymnosporia* section *Mossambicensis*. A concise taxonomic treatment of this species is provided in an Appendix (p. 351).

ABSTRACT

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A taxonomic revision of all the southern African spiny members of the Celastroideae is presented. Evidence from macromorphology, leaf anatomy, ecology and phytogeography is used as a basis for classification. The genus *Gymnosporia* (Wight & Arn.) Hook. f. is reinstated, deviating from *Maytenus* by the presence of spines and brachyblasts, dichasial inflorescences, and mainly unisexual flowers. A new genus, *Gloveria*, is described. Taxa proposed are: four species (one new combination) in *Putterlickia*; one species in *Gloveria*; 31 species and three subspecies in *Gymnosporia* (nine new sections, nine new combinations, seven new species and one new subspecies). The taxonomic treatment includes keys to the genera, sections, species and subspecies, accompanied by descriptions, nomenclatural details, habitat and distribution, plus voucher specimens. A list of herbarium specimens examined is provided. Photographs of herbarium specimens, flowers, fruits and transverse sections of the leaves, as well as distribution maps and a cladogram are included.

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Proposed correct names of taxa occurring in southern Africa are in bold and roman type; synonyms are in italics.

MAYTENUS Molina

PUTTERLICKIA Endl.

PART 1

■ TEXT ■

CHAPTER 1

INTRODUCTION

1.1 Introduction

Maytenus Molina *s.l.*, with *Acacia* Mill. and *Rhus* L., ranks as one of the most widespread woody genera in southern Africa. It is also the second largest woody genus, after *Rhus*, in the flora of Kwazulu/Natal.

This study concerns mainly those southern African plants belonging to subfamily Celastroideae, a natural assemblage of taxa, characterized by dry loculicidally dehiscent capsules and seeds with an aril. In southern Africa, members of the subfamily Celastroideae were in recent years classified under *Maytenus*, *Putterlickia* Endl., *Catha* Forssk. ex Schreb. and *Pterocelastrus* Meisn.

Marais (1960) and Robson (1965, 1966), who were mainly followed in the most recent list of southern African plants species, had a very broad species concept. Only 12 spiny members of *Maytenus* and three of *Putterlickia* are recognized in the Flora of southern Africa region (Arnold & De Wet 1993).

The spiny members of *Maytenus*, as corresponding to Loesener's genus concept of *Gymnosporia*, have more characters in common with the genus *Putterlickia* than with the other nonspiny members of *Maytenus*. In habit, leaf, inflorescence and fruit characters *Gymnosporia* and *Putterlickia* are very similar. These two genera are distinguished mainly on the basis of floral sexuality and the number of ovules per locule.

In this thesis *Gloveria*, a new monotypic genus of spiny Celastroideae, is proposed. It is distinghuished from *Gymnosporia* in always having hermaphroditic flowers, a spotted disc, usually three to six ovules per locule, and a pink aril. *Gloveria* is similar to *Putterlickia* in its floral sexuality and number of ovules per locule, but deviates by having brachyblasts mainly on the spines and more than one node per spine.

Members of these three genera are spiny, much-branched, woody, evergreen perennials, varying from dwarf stoloniferous shrublets, to medium-sized shrubs or small trees, not taller than 8 m in our area. One species, *Putterlickia retrospinosa*, is scandent.

Gymnosporia, of which the species are mostly dioecious and therefore outbreeding, demonstrates the greatest diversity in characters. *Putterlickia* and *Gloveria*, with hermaphroditic flowers, show relatively little infrageneric variation.

In all three genera the flowers are dull in colour (whitish or rarely red) with a disagreeable odour or a sweet scent. Most species are entomophilous, attracting mainly flies and honey bees. Ants, identified as *Polyrhachis* sp. (Formicidae), are also reported to visit the flowers.

The genera *Gymnosporia, Gloveria* and *Putterlickia* are an Old World group confined to Africa, Madagascar, southern Europe, the near Middle East and India. Whereas *Gymnosporia* is widely distributed in all these regions, *Gloveria* and *Putterlickia* are restricted to southern Africa. The greatest concentration of species occurs in the moister eastern parts of southern Africa, particularly in the Eastern Cape, Kwazulu/Natal and Swaziland. Species are adapted to both summer and winter rainfall climates, as well as semidesert regions, but are absent from the Desert Biome (Rutherford & Westfall 1994). Species have been recorded from all six main phytochoria in southern Africa (White 1983), but the group is noticeably absent from higher altitudes. Only two species, *G. devenishii* M. Jordaan ined. and occasionally *G. mossambicensis* Klotzsch, grow in Afromontane regions, but then only at relatively lower altitudes. Habitats include coastal rocky outcrops and sand dunes, karoo scrub, valley bushveld, open savanna, rocky or grassy hillsides as well as the margins and understorey of forest. The group is poorly represented in fynbos.

The polymorphic *Gymnosporia senegalensis* (Lam.) Loes. is the most widely distributed species, ranging from southern Africa northwards to southern Spain and eastwards as far as India. It is the only species of the study group that also occurs outside the African continent. *Gymnosporia* section *Buxifoliae* (including the current *Maytenus heterophylla* (Eckl. & Zeyh.) N. Robson *s.l.*), morphologically the most heterogeneous group, ranges from the Cape Peninsula in the south to Ethiopia in the north.

The nonspiny members of *Maytenus* are distributed in Africa, Madagascar, Maylaysia, Australia and South America. The spiny members of *Maytenus* in South America are placed in the genus *Moya* by Grisebach (1874) and Loesener (1942), but sunk under *Maytenus* by Lourteig & O'Donell (1955).

Lundell (1985) described two new species of *Gymnosporia*, tall forest trees without spines, from South America. However, the generic status of these two species needs further investigation.

Morley & Toelken (1983), in *Flowering plants in Australia*, separate *Maytenus* and *Gymnosporia* on account of their different inflorescence types and state that *Gymnosporia* is represented by only one species, without mentioning a name, presumably *G. montana* (Roth ex Roem. & Schult.) Benth. Jessup (1984), in a revision of the Celastraceae for the *Flora of Australia*, considers *Gymnosporia montana* a synonym of *Maytenus emarginata* (Willd.) Ding Hou, thus following Ding Hou (1962). *Gymnosporia montana*, the type species of *Gymnosporia*, was described from eastern India. In recent years it has been considered as a synonym of *G. senegalensis* by, for example, Sebsebe (1985). The taxonomic identity of *G. montana* in Australia is therefore not certain. Whether it is the same taxon as *G. senegalensis* and *M. emarginata*, and whether the latter can be classified as a species of *Gymnosporia*, need further investigation. *Maytenus emarginata* has cymose inflorescences, which differentiate it from the other species of *Maytenus s. str.* It is stated by Bentham (1863) that the Australian specimens of *Gymnosporia montana* are often without spines, as is the case in India as well as in some tropical African specimens of *Gymnosporia senegalensis*. The Australian specimens agree in every respect with the Indian ones, except for the larger capsules, a tendency to have trilocular ovaries instead of bilocular ones and an association with mangroves, rather than with dry savanna habitats. If *Maytenus emarginata* can be classified under *Gymnosporia*, the distribution range of the genus would extend from India further eastwards to include Sri Lanka, Malaysia and the NE peninsula of Australia.

Relatively few major taxonomic treatments of the spiny members of subfamily Celastroideae in southern Africa have been attempted. The first specimens of *Gymnosporia* and *Putterlickia* were collected in the vicinity of the Cape of Good Hope by Thunberg, Ecklon & Zeyher, Krauss, Drège, and Des Marets received plants from the Cape. Some of this material found its way to Europe where it was cultivated and illustrated by early botanists, such as Plukenet. Linnaeus (1753) described species from southern Africa in the genus *Celastrus*, namely *C. buxifolius* and *C. pyracanthus*. The first major taxonomic treatment was by Thunberg in his *Flora capensis* (1823). Ecklon & Zeyher (1834—1835) were the first to note the extreme variability of Linnaeus's *C. buxifolius*. Don (1832) and Presl (1844) placed all the species in *Catha*, while the latter described two new genera, namely *Eucentrus* and *Polyacanthus*, both now included in *Gymnosporia*, established by Hooker filius

(1862). The second main revision was by Sonder (1860) in *Flora capensis*, a work in which all the species known up to that time, were described, still in the genus *Celastrus*. Szyszylowicz (1888) was the first to place all the species under *Gymnosporia* and *Putterlickia*, the latter described by Endlicher (1840). Loesener's publications on the Celastraceae (1892—1942) are very important as he attempted to include all known taxa in his monographs of the family. He was the first to transfer all spiny members to *Gymnosporia*. The most recent comprehensive taxonomic revision of the group for southern Africa, and in fact all the southern African Celastraceae, was by Davison (1927). Subsequent work on the group is mainly contained in regional floras, all following Exell & Mendonça (1952), Brenan (1953), Blakelock (1956) and Marais (1960) in considering *Gymnosporia* and *Maytenus* as congeneric. Examples of regional floras are: Hutchinson & Dalziel (1958) (West Tropical Africa), Wilczek (1960) (Congo Belge and Ruanda-Urundi), Ding Hou (1962) (Malaysia), Robson (1966) (Flora Zambesiaca Region), Robson & Sousa (1969) (Mozambique), Guillarmod (1971) (Lesotho), Ross (1972) (Natal), Villiers (1975) (Cameroun), Compton (1976) (Swaziland), Bond & Goldblatt (1984) (Cape Floristic Region), Jessup (1984) (Australia), Sebsebe (1985, 1989) (NE tropical Africa, tropical Arabia and Ethiopia).

1.2 Taxonomic problems

Although the Celastroideae (Scholz 1964) appears to be a natural taxon, the delimitation of genera within the subfamily is controversial. At present the generic and specific limits of the genera *Maytenus s.l.* versus *Gymnosporia s. str.* and *Putterlickia* are not clear. Moreover, considerable difficulty is experienced in distinguishing between some of the southern African species, especially in the so-called *Maytenus heterophylla* complex. The taxonomic status of certain species is in dispute and the existence of some new species and subspecies has been suggested.

At present the spiny members of the southern African Celastroideae are included in *Maytenus*, a large inclusive genus, and *Putterlickia*, a small genus endemic to this region (Arnold & De Wet 1993). Two well defined species, their names not cited after 1960, are also included in this study. They were originally described as *Celastrus saxatilis* Burch. and *C. integrifolius* L.f. and treated as belonging to the genus *Gymnosporia* in the last major revision of the southern African Celastraceae (Davison 1927). Marais (1960) excluded these two taxa in his enumeration of the southern African *Maytenus* species as probably belonging to *Putterlickia*. Species of *Gymnosporia* and *Maytenus* have two ovules per locule, whereas *Putterlickia* always

has more than two, usually from six to twelve. These two neglected taxa both have more than two, but fewer than six ovules per locule, and therefore do not belong to *Gymnosporia*. Robson (1965) placed them in synonymy with *Putterlickia pyracantha* (L.) Endl., calling them the small entire-leaved "Karroo" form of *P. pyracantha*. These two taxa were not taken up in Gibbs Russell's (1987) list of plant species in southern Africa, or in the subsequent revision of this list by Arnold & De Wet (1993). The generic placement of these two species proved problematic and an extensive analysis of them as well as all the other spiny members in this subfamily was consequently undertaken to establish their true affinities.

1.3 Aims of this study

Previous taxonomic studies on Celastroideae were based mainly on macromorphological evidence derived from herbarium specimens. In view of the difficulties surrounding the taxonomic status of genera and species in southern African Celastroideae, the present study was undertaken. Its principal aim was to investigate the extent to which the anatomy of leaves and the macromorphology, notably the structure of fruits and seeds, can contribute towards a better understanding of the spiny members of this subfamily in southern Africa. This multidisciplinary study was conducted to assemble as much data as possible to provide a basis for a natural classification of genera and species in the subfamily Celastroideae. A further objective of this study was to provide a taxonomic account of the three genera established in this thesis for the *Flora of southern Africa* (FSA) project.

In recent years most spiny and nonspiny Celastroideae have been treated as belonging to a widely circumscribed genus, *Maytenus* Molina (1782). The alternative view of Loesener (1942) and Ding Hou (1955) that all the spiny Old World members of this genus be referred to the genus *Gymnosporia* is given particular consideration in the present study. Arguments to reinstate *Gymnosporia* as a genus distinct from *Maytenus*, are corroborated in this thesis. The necessary taxonomic and nomenclatural changes are proposed.

There are some interesting disjunct distribution patterns found on generic and specific levels. This has led to the discussion whether some new species, subspecies and genera have developed through this isolation. A further minor aim was therefore to discuss the distribution and ecology as well as phytogeography of all the species in this study and to make tentative suggestions regarding their phylogeny. The phylogeny is protrayed as the most parsimonious cladogram (Figures 49—50).

Detailed studies of various aspects of the pollen morphology of the Celastrales by Lobreau-Callen (1969, 1975) and Lobreau-Callen & Lugardon (1974), Sebsebe (1985) and by various earlier authors have been published. Lobreau-Callen (1975) placed *Gymnosporia* in synonymy under *Maytenus* on the basis of their homogeneous pollen. Pollen studies were, however, not done in this study, because pilot studies showed that the leaf anatomy in combination with fruit and seed characters has more significant diagnostic value on generic and specific levels.

For convenience, this dissertation is presented in two parts. Part 1 comprises the following: an extensive historical review (Chapter 2), material and methods used in this study (Chapter 3), comparative macromorphology (Chapter 4), comparative anatomy of the leaf (Chapter 5), geographical distribution and ecology (Chapter 6), phytogeography (Chapter 7), a provisional cladistic analysis (Chapter 8), taxonomic treatment (Chapter 9), discussion and conclusions (Chapter 10) and specimens examined (Chapter 11).

Part 2 contains all the tables and figures, including all the illustrations, photographs, distribution maps and a cladogram.

Genera, sections, species and subspecies recognized in this study are:

1. The genus *Putterlickia* Endl.
P. pyracantha (L.) Endl.
P. retrospinosa A.E. van Wyk & Mostert
P. saxatilis (Burch.) M. Jordaan comb. nov.
P. verrucosa (E. Mey. ex Sond.) Szyszyl.

2. The genus *Gloveria* M. Jordaan gen. nov.
G. integrifolia (L.f.) M. Jordaan comb. nov.

3. The genus *Gymnosporia* (Wight & Arn.) Hook. f.
SECTION I *Putterlickioides* M. Jordaan sect. nov.
G. putterlickioides Loes.
SECTION II *Mossambicensis* M. Jordaan sect. nov.
G. mossambicensis (Klotzsch) Loes.
G. rubra (Harv.) Loes.
G. vanwykii (R.H. Archer) M. Jordaan comb. nov.

SECTION III *Nemorosae* M. Jordaan sect. nov.

G. nemorosa (Eckl. & Zeyh.) Szyszyl.

SECTION IV *Pubescens* M. Jordaan sect. nov.

G. pubescens (N. Robson) M. Jordaan comb. nov.

SECTION V *Polyacanthae* M. Jordaan sect. nov.

G. polyacantha (Sond.) Szyszyl. subsp. *polyacantha*

G. polyacantha subsp. *vaccinifolia* (P. Conrath) M. Jordaan stat. nov.

SECTION VI *Capitatae* M. Jordaan sect. nov.

G. capitata (E. Mey. ex Sond.) Loes.

SECTION VII *Tenuispinae* M. Jordaan sect. nov.

G. gariepensis M. Jordaan sp. nov.

G. oxycarpa (N. Robson) M. Jordaan comb. nov.

G. tenuispina (Sond.) Szyszyl.

SECTION VIII *Buxifoliae* M. Jordaan sect. nov.

G. arenicola M. Jordaan sp. nov.

G. buxifolia (L.) Szyszyl.

G. devenishii M. Jordaan sp. nov.

G. elliptica (Thunb.) Schönland

G. glaucophylla M. Jordaan nom. nov.

G. grandifolia (Davison) M. Jordaan stat. nov.

G. hemipterocarpa M. Jordaan sp. nov.

G. heterophylla (Eckl. & Zeyh.) Loes.

G. karooica M. Jordaan sp. nov.

G. macrocarpa M. Jordaan sp. nov.

G. szyszylowiczii (Kuntze) M. Jordaan comb. nov. subsp. *szyszylowiczii*

G. szyszylowiczii (Kuntze) M. Jordaan comb. nov. subsp. *namibiensis* M. Jordaan subsp. nov.

G. tenuifolia (Loes.) M. Jordaan stat. nov.

G. uniflora Davison

SECTION IX *Gymnosporia*

G. linearis (L.f.) Loes. subsp. *linearis*

G. linearis (L.f.) Loes. subsp. *lanceolata* (E. Mey. ex Sond.) M. Jordaan stat. nov.

G. markwardii M. Jordaan sp. nov.

G. senegalensis (Lam.) Loes.

CHAPTER 2

HISTORICAL REVIEW OF THE TAXONOMY OF THE SOUTHERN AFRICAN CELASTROIDEAE, WITH BRIEF COMMENTS ON THE MAJOR TAXONOMIC PUBLICATIONS

2.1 Generic status of *Gymnosporia* and *Putterlickia*, with comments on related genera

The genus *Celastrus* was founded and described by Linnaeus in his *Genera Plantarum* (1737). There are about 500 species which have in the past been referred to the genus *Celastrus*; of these, half are African plants, according to Ding Hou (1955). The Old World genera *Maytenus* Molina, *Gymnosporia* (Wight & Arn.) Hook. f. and *Putterlickia* Endl. are all placed in *Celastrus* by most early authors, e.g. Miller (1756, 1768), Linnaeus filius (1781), Lamarck (1785), L'Hèritier (1788), Thunberg (1794, 1823), Willdenow (1798), Sims (1809), Solander (1819), Schultes (1819), Burchell (1824), De Candolle (1825), Ecklon & Zeyher (1834—1835), Walpers (1842), E. Meyer (1843), Krauss (1846), Schlechtendal (1846), Pappe (1854), Ettingshausen (1857, 1861), Sonder (1860), Oliver (1868), Kuntze (1891, 1898) and Wood (1907, 1908).

The name *Celastrus* is derived from the Greek word *kélastròs*. There are three versions of the interpretation of this word. According to Smith (1972) it means *an evergreen tree*. Ding Hou (1955) says, however, that the generic name originally comes from Theophrastos, who designated with the Greek word (*Kélastròs*) an evergreen tree (*Phillyrea*) that had nothing to do with this genus. Jackson (1990) says it means *late season*, referring to the fruits being retained on the plants throughout winter. The third interpretation is that the word means *late ripening* — the fruits are slow to ripen. The last version is probably the most appropriate, because it is a characteristic of species of this subfamily that after flowering, several months may elapse before the fruits and seeds develop. This created problems during this study because it was difficult to find specimens with both flowers and fruits.

Kunth (1825) points out that some *Celastrus* species have peculiar characters and that they may well constitute a new genus. However, he does not propose a name for it.

Wight & Arnott (1834) report on the Indian species of *Celastrus* and, on the basis of ovary and seed characters, divide the genus into two sections, *Eucelastrus* and

Gymnosporia. Section *Eucelastrus* has the ovary free from the disc, with the seed completely enclosed by a fleshy aril. This section corresponds to the genus *Celastrus* as circumscribed today. It is distributed in Asia, America, Australia, and Madagascar. Section *Gymnosporia*, which corresponds to Kunth's (1825) unnamed genus, has the ovary half immersed in the disc, with the seed incompletely enclosed by an aril.

Don (1832) and Presl (1844) place the spiny African and Asiatic species of *Celastrus* in the genus *Catha* Forssk.

Endlicher (1840) describes the genus *Putterlickia*, based on *Celastrus pyracanthus* L. It is characterised by ovaries with 2—6 ovules per locule. The name *Putterlickia* was given to this genus in honour of A. Putterlick, a Dutch botanist (Adamson 1950).

Endlicher (1840) follows Don (1832) in placing the spiny Asiatic and African species under *Catha* Forssk., a genus with hermaphroditic flowers. He also recognizes *Celastrus* Kunth (1825) *non* L. (excluding *C. scandens* L.) as a genus with plants dioecious, 2—4- locular ovaries, and with two ovules per locule. Furthermore, Endlicher recognizes *Maytenus* as an American genus with polygamous flowers, one ovule per locule and plants without spines.

Allowing for the limited knowledge of many genera that existed at the time, the arrangement proposed by Endlicher (1840) in his *Genera Plantarum* under the tribe Evonymeae is a satisfactory starting point for expressing the broad outlines of generic relationships.

Walpers (1842) recognizes the genus *Putterlickia*, but still follows Don (1832) in placing the Asiatic species under *Catha*, and reinstates the European and African species under *Celastrus* Kunth *non* L.

Hooker f. in Bentham & Hooker f. (1862) elevates section *Gymnosporia* Wight & Arn. (1834) (Kunth's and Endlicher's genus concept of *Celastrus*) to genus rank. This genus is geographically restricted to the Old World. *Gymnosporia* is conserved against the following *nomina rejicienda* (Farr 1979): *Catha* Forssk. ex Schreb. (1789); *Eucentrus* C. Presl (1845) ex Endl. (1850), De Dalla Torre & Harms (1900—1907); *Polyacanthus* C. Presl (1845).

The name *Gymnosporia* is derived from the Greek words *gymnos*, naked, and *spora*, a seed (Adamson 1950).

Hooker f. (1862) distinguishes between *Gymnosporia* and *Maytenus* as follows: locule with two ovules; plants often spiny; inflorescences cymose - *Gymnosporia*. Locule with 1 (rarely 2) ovules; plants without spines; inflorescences solitary, fasciculate or cymose — *Maytenus*. He gives the geographical distribution of *Gymnosporia* as Spain, Africa, Asia and Australia, whereas *Maytenus* occurs in tropical America and Australia. This generic concept was followed by subsequent workers such as: Szyszylowicz (1888), Sim (1907), Loesener (1893, 1894, 1896), Engler (1912), Schönland (1919), Bews (1921), Marloth (1925), Davison (1927), Burtt Davy (1932), Henkel (1934), Fourcade (1939), Loesener (1942), Adamson (1950) and Miller (1952).

Loesener (1942) transfers some of the African species without thorns and short shoots and with leaves rather spiral and alternate than fasciculate, to the allied genus *Maytenus* Molina.

Maytenus is derived from the Chilean name *Maytèn*, the vernacular name for the type species *M. boaria*. The specific epithet *boaria* means "pertaining to cattle or feral animals" (Robson 1965).

Maytenus in the sense of Loesener (1942), occurs in the tropics and subtropics of both the Old and New World. By indicating that *Celastrus* is absent from Africa, Loesener (1942) hints that he was aware of the fact that the so-called species of *Celastrus* on the African continent did not belong to this genus.

Exell & Mendonça (1952) and Exell (1953) argue that Loesener's separation of *Gymnosporia* from *Maytenus*, on the basis of the presence of either thorns or inflorescence borne on short shoots in *Gymnosporia*, appears artificial. They propose an amalgamation of the two genera into a widely circumscribed *Maytenus s.l.*

Brenan (1953) shares the latter view and adds that *Maytenus* had been segregated from *Gymnosporia* before the amalgamation of the two genera by rather vague characters such as the prevalence of uniovulate locules and bilocular ovaries. All the species examined in the present study have biovulate locules, except *Gymnosporia integrifolius* (L.f.) Glover, *Gymnosporia saxatilis* (Burch.) Davison and the three species of *Putterlickia*. Therefore, *G. saxatilis* is moved to *Putterlickia* and *G.*

integrifolia to the newly proposed genus *Gloveria*. The biovulate species with spines are removed from *Maytenus* and placed in *Gymnosporia*. Three of the 28 species investigated in *Gymnosporia* always have bilocular ovaries, two species have a strong tendency towards this state, whereas the others are always trilocular or occasionally have a reduction in locule number.

Ding Hou (1955) examined a very large number of herbarium specimens of *Celastrus*, *Gymnosporia* and *Maytenus* and tabulated many character states. He concludes that these three genera are distinct on the basis of a combination of several characters and not any single character on its own.

Exell (1953), Blakelock (1956) and Marais (1960), however, state that there seems to be no single character state, nor combination of characters, constant enough to justify the retention of *Gymnosporia*. They agree that *Celastrus* is a good genus, and that it is absent from the African continent. The genus *Celastrus* is characterized by its scandent habit, the ovary free from the disc, the persistent central axis of the capsule, and the frequently racemose or paniculate inflorescences.

Thonner (1962), following Loesener (1942), bases the main distinction between *Putterlickia* and *Gymnosporia* on the number of ovules and shape of the disc. *Putterlickia* has 3—6 ovules per locule and an almost hemisperical disc. *Gymnosporia* has two ovules per locule, with the disc not hemispherical. Thonner (1962) recognizes two species of *Putterlickia* and 80 species of *Gymnosporia* in Africa.

Ding Hou (1963) states that the differences between *Gymnosporia* and *Maytenus* as listed in his table (1955) cannot be maintained, especially not in the African flora as expressed by Marais (1960). He retains only *Celastrus* and *Maytenus* which can be distinguished by a combination of three characters: habit, degree of adnation of ovary and disc, and fruit structure.

Scholz (1964), under the subfamily Celastroideae tribe Celastreae, recognizes *Gymnosporia* as having 80 species of spiny shrubs from the tropics and subtropics of the Old World, thus following Loesener (1942). He considers *Celastrus* to be present in Asia, Australia, Madagascar and the Americas, therefore following Ding Hou (1955). According to Scholz, *Maytenus* is a genus of about 200 species, from the tropics and subtropics of both hemispheres.

Hutchinson (1969) considers the Celastraceae a family very difficult to recognize by any one character or combination of characters. He upholds the genus *Gymnosporia*, and specifically refers to its spiny branches as being diagnostic. He considers what he describes as the longitudinal ribs of the petals to be an outstanding character of *Putterlickia*.

Airy Shaw (1973) also upholds *Gymnosporia*, comprising 100 species in the tropical and subtropical regions of the Old World, on the basis of its branches being modified into thorns.

The viewpoint that *Gymnosporia* is congeneric with *Maytenus* has been generally accepted and followed by botanists treating that group of plants in the African floras or revisions, for example: Exell & Mendonça (1954), Hutchinson & Dalziel (1958), Wilczek (1960), Marais (1960), Robson (1966, 1969), J.-F. Villiers (1975), Troupin (1982) and Sebsebe (1985, 1989).

Sebsebe (1985), working on *Maytenus* in northeast tropical Africa, states that he is of the opinion that Loesener's (1942) two groups (*Maytenus*, comprising all the species without spines, and *Gymnosporia*, comprising all the spiny species) are largely natural, although not sufficiently distinct to be treated as separate genera.

Mabberley (1887) recognizes *Putterlickia* Endl. as a good genus, but considers *Gymnosporia* (Wight & Arn.) Hook.f. synonymous with *Maytenus* Molina.

2.2 Ordinal, tribal and subfamilial names

Endlicher (1840) and Walpers (1842) classify *Putterlickia* Endl., *Celastrus* Kunth and *Maytenus* Feuill. in the order Celastrineae R. Br., tribus Euonymeae Endl.

Loesener (1892) and De Dalla Torre & Harms (1900—1907) place *Putterlickia, Gymnosporia, Celastrus* and *Maytenus* in the subfamily Celastroideae, tribus Eucelastreae.

Scholz (1964), following Engler's system of classification, includes these genera in the subfamily Celastroideae, tribus Celastreae. Scholz was followed in the present study.

2.3 The southern African species (FSA region)

In the following review the correct scientific names of taxa, as proposed in the present study, appear in bold and italics. For author citation of names, see Chapter 9.

Only publications relevant to the southern African species are dealt with. Publications concerning mostly tropical species are mentioned only when representing an important reference work in the present study.

A summary of the history of taxonomic treatments of the southern African spiny members of Celastroideae is given in Table 1.

Before 1753

The first published illustration of a southern African spiny member of the Celastroideae appeared in the third volume of Plukenet's *Phytographia* of 1692, tab. 202, fig. 3, representing *Celastrus buxifolius* (***Gymnosporia buxifolia***), with the description "*Lycium Portoricense Buxifoliis angustioribus*". In his *Almagestum botanicum* of 1694, tab. 280, fig. 5, *Celastrus pyracanthus* (***Putterlickia pyracantha***) is described as "*Lycium aethiopicum pyracanthae folio*". In 1696, Plukenet again refers to the above two species in his *Almagestum*, tt. 234 and 130.

Under the same name as in Plukenet's *Phytographia*, *Celastrus pyracanthus* (***Putterlickia pyracantha***) appears as an illustration in Commelin's *Horti medici Amstelodamensis rariorum plantarum historia* Volume 1, pl. 163, tab. 84 (1697), and also in Weinmann's *Phytanthoza iconographia* Volume 3, tab. 687b (1742).

Putterlickia pyracantha was mentioned in Boerhaave's *Index alter plantarum quae in horto academico Lugduno-Batavo aluntur* Volume 2: 212.11 & 237.3 (1727) as "*Rhamnuo fimilis Africana fructu triloculari folio pyracanthae*".

The above-mentioned two species are the only southern African members of *Gymnosporia* and *Putterlickia* mentioned in the taxonomically important *Hortus Cliffortianus* (p. 72) of Linnaeus (initially issued privately in 1737). The protologues read: "*Lycium portoriense, buxifoliis angustioribus*" (***Gymnosporia buxifolia***) and "ramis teretibus, spinis nudis, foliis acutis. Lycium aethiopicum, pyracanthae folio" (***Putterlickia pyracantha***). Note: the nomenclatural types of ***G. buxifolia*** and ***P.***

pyracantha are, however, not Plukenet's figures, but Linnaeus specimens 268.5 and 268.6 in LINN fide Wijnands (1983) and Sebsebe (1985). Linnaeus founded and described the genus *Celastrus* in his *Genera Plantarum* (1737).

Since 1753

1753. Linnaeus, C. — *Species plantarum*, edn 1: 197.

Linnaeus includes five species under *Celastrus*: two from southern Africa and three American species. Only one of these, *C. scandens*, is currently retained in *Celastrus*. It is, in fact, the type species of *Celastrus*. The two southern African species are: *C. buxifolius* (***Gymnosporia buxifolia***) and *C. pyracanthus* (***Putterlickia pyracantha***).

1756. Miller, P. — *Gardener's dictionary*, edn 6, Vol. 1: 58, t. 87.

Putterlickia pyracantha is illustrated as a *Celastrus* under the same phrase name as in *Hortus Cliffortianus*: 72.

1762. Linnaeus, C. — *Species plantarum*, edn 2: 285.

The same two southern African species as in edn 1 are mentioned.

1768. Miller, P. — *Gardener's dictionary*, edn 8.

Miller merely listed the same five species as Linnaeus (1753) (three American, two southern African).

1775. Houttuyn, M.— *Handleiding tot de plant- en kruidkunde*: 4, tab. 21, Fig. 1.

Linnaeus's system of classification is followed in this publication. *Celastrus buxifolius* (***Gymnosporia buxifolia***) and *C. pyracanthus* (***Putterlickia pyracnatha***) are mentioned and illustrated.

1781. Linnaeus, C. (filius). — *Supplementum plantarum*: 153.

Thunberg worked closely with the younger Linnaeus to complete this work. Thunberg's contribution was almost 500 new species from the Cape. However, he never received the credit, since they are all cited with Linnaeus filius as author (Nordenstam 1994). Four new names are published under *Celastrus*, two of which are relevant to the present study, namely: *C. integrifolius* (***Gloveria integrifolia***) and *C. linearis* (***Gymnosporia linearis***). Both names are based on Thunberg specimens in the Thunberg Herbarium.

1785. Lamarck, J.B.A.P.M. de. — *Dictionnaire encyclopèdique de botanique* 1: 661.

Lamarck describes two new species, namely *C. multiflorus* (***Gymnosporia buxifolia***) and *C. senegalensis* (***G. senegalensis***) and lists the two existing names: *C. buxifolius* (***G. buxifolia***) and *C. pyracanthus* (***Putterlickia pyracantha***).

1788. L'Hèritier, C-L. — *Sertum anglicum plantae rariores*: 6.

Celastrus phyllacanthus (***G. senegalensis***) is described.

1789. Aiton, W.— *Hortus kewensis* 1: 272.

This is a catalogue of the plants cultivated in the Royal Botanic Garden at Kew, by W. Aiton, the gardener to His Majesty. *Celastrus pyracanthus* (***Putterlickia pyracantha***), with the vernacular name given as "pyracantha-leaved staff-tree", was cultivated in 1752 and *Celastrus buxifolius* (***Gymnosporia buxifolia***), called the "box-leaved staff-tree", in 1759 by Miller. The botanical descriptions, probably by Solander, following Linnaeus's classification (1753).

1791. Gaertner, J. — *De fructibus et seminibus plantarum* 2: 85, tab. 95, Fig. 4.

Gaertner extends Linnaeus's description of *C. pyracanthus* (***P. pyracantha***) and adds "*Alaternus sempervirens africana, foliis lucidis, spinosa*" of Plukenet's *Phytographia* tab. 126, fig. 2 & 3, as a synonym. Plukenet's figures represent only a branch with leaves and thorns, and hence they cannot with certainty be said to belong to this species.

1794. Thunberg, C. P. — *Prodromus plantarum capensium* 1: 42.

Thunberg, who is called the "Father of South African botany" (MacOwan 1887; Winquist 1978; Nordenstam 1994), includes 15 species of *Celastrus*, most of which have subsequently been transferred to other genera. Only four are relevant to the present study (no new names): *C. buxifolius* (***Gymnosporia buxifolia***), *C. integrifolius* (***Gloveria integrifolia***), *C. linearis* (***Gymnosporia linearis***), *C. pyracanthus* (***Putterlickia pyracantha***).

1798. Willdenow, C.L.— *Caroli a Linné Species plantarum*, edn 4, Vol. 1: 1128—1129.

This, the 4th edition of Linnaeus's *Species plantarum*, summarizes the knowledge of *Celastrus* at that time. The four species mentioned above (Thunberg 1794) are included, together with *C. phyllacanthus* (***Gymnosporia senegalensis***). Lamarck's species *C. senegalensis* is placed as a synonym under *C. phyllacanthus*, despite it being the older name. For the first time the spiny and nonspiny members of *Celastrus* are separated. The spiny species are further subdivided on the basis of whether the leaf margins are entire or dentate.

1809. Sims, J. — In: Curtis's, *Botanical Magazine* 29: pl. 1167.

This contribution contains a description of *Celastrus pyracanthus* (***Putterlickia pyracantha***) with a colour illustration, a list of its synonyms with their literature references, and the vernacular name is given as "leaved staff-tree". This species was previously classified under *Lycium*, *Rhamnus* and *Alaternus*. Under the latter name it appears in Plukenet's *Phytographia* Vol. 1, tab. 126, fig. 2 & 3 as *"Alaternus arbuti foliis lucidis"*. Also see Gaertner (1891).

Sims mentions that this species is a native of the Cape of Good Hope from where it was introduced to The Netherlands, and thence dispatched to many parts of Europe.

In cultivation ***Putterlickia pyracantha*** is sometimes without spines, and the drawing was obviously made from part of a plant with almost no spines.

1819. Solander, D.C. — In: Curtis's, *Botanical Magazine* 46: pl. 2070.

A new species closely related to *Celastrus buxifolius*, namely *C. cymosus*, now considered a synonym of ***Gymnosporia buxifolia***, is described, based on a manuscript of Solander, accompanied by an illustration and the vernacular name "compact-flowered staff-tree". He states: "A native of the Cape of Good Hope; communicated by Mr Sweet, from the Stockwell Nursery, in July 1815". *C. cymosus* is distinguished by its naked spines, flowers which are more numerous, and inflorescences which are shorter than the leaves. Dandy in *The Sloane herbarium* (1958) says: "Plants gathered at the Cape of Good Hope and sent to Monsr des Marets at whose auction in Holland they were bought. Numerous mostly good specimens, most named by Solander and many described as new in his MSS". Des Marets was Superintendent of the Dutch estates of William III.

1822. Schultes, J.A. — *Systema vegetabilium* 5: 424—425.

This 5th edition of Linnaeus's *Systema vegetabilium* includes 44 species of *Celastrus*, which was the sum total known at that time throughout the world. Four southern African species are listed, namely: *C. linearis* (***Gymnosporia linearis***) and *C. integrifolius* (***Gloveria integrifolia***) in the section *Spinosae* (*foliis integerrimis*) and *C. senegalensis* (***G. senegalensis***) and *C. buxifolius* (***G. buxifolia***) in section *Spinosae* (*foliis dentatis*).

Celastrus phyllacanthus L'Hèritier was now correctly put in synonymy of *C. senegalensis* (***Gymnosporia seneglensis***).

1823. Thunberg, C.P. — *Flora capensis*, edn 2, Vol. 1: 218—220.

This detailed work was the first comprehensive taxonomic treatment of the Cape flora and includes notes on synonymy, literature references, localities and full descriptions of 20 species of *Celastrus*. Thunberg lists nine species under his section *Armati*, including four species mentioned in his *Prodromus* and two new species, *Celastrus elliptica* (***Gymnosporia elliptica***) and *C. integer* (***Gloveria integrifolia***). The other four species have been transferred to other genera.

Thunberg describes two new species in his section *Inermis*, namely *C. ellipticus* (***Gymnosporia elliptica***) and *C. obtusus* (***Putterlickia pyracantha***). The type specimens

of these two names are without spines, but the plants they represent are usually with spines.

1824. Burchell, W.J. — *Travels in the interior of southern Africa* 2: 264.

Burchell describes *Celastrus saxatilis* (***Putterlickia saxatilis***) and writes about it as follows: "...an exceedingly pretty sort of *Celastrus* with red branches and very small leaves, decorated these rocks".

1825. De Candolle, A.P. — *Prodromus systematis naturalis regni vegetabilis* 2: 8.

De Candolle distinguishes between four groups under *Celastrus*. In his third and fourth groups he lists all the spiny species. He separates these two groups on account of leaf margins being entire or dentate. In his third group: "*spinosi*, *foliis integerrimis*" he places *C. integer* (***Gloveria integrifolia***), *C. integrifolius* (***G. integrifolia***) and *C. linearis* (***Gymnosporia linearis***) and in his fourth group: "*spinosi, foliis dentatis*", *C. buxifolius* (***Gymnosporia buxifolia***), *C. multiflorus* (***G. buxifolia***), *C. pyracanthus* (***Putterlickia pyracantha***) and *C. senegalensis* (***Gymnosporia senegalensis***). De Candolle also mentions *C. phyllacanthus* L'Hèrit. as a synonym under *C. senegalensis*.

Infraspecific taxa for the study group were introduced for the first time in this publication when De Candolle divides *C. senegalensis* and *C. buxifolius* into two varieties, namely *C. senegalensis* var. *glaucifolius* and *C. buxifolius* var. *cymosus*.

1832. Don, G. — *A general system of gardening and botany* 2: 9.

Don's comprehensive annotated catalogue is to a large extent a translation of De Candolle's *Prodromus*. It also provides notes on the earliest date of cultivation. An English vernacular name is provided for each species.

Furthermore, the value of this work lies in the fact that Don was the first author to treat the African and Asiatic species of Celastroideae in a different genus, namely *Catha* Forssk., on the basis that they bear spines. He retains the American species under *Celastrus*. Don retains the groups sensu De Candolle under *Catha*, based on whether the leaf margins are entire or toothed, and additionally makes provision for geographical separation (Asiatic and African).

Don retains *Celastrus senegalensis* var. *glaucifolius* and *C. phyllacanthus* as synonyms under *Catha senegalensis* (***Gymnosporia senegalensis***), but raises *Catha cymosa* (***G. buxifolia***) to specific rank again.

Since this publication, the name *Celastrus phyllacanthus* L'Hèrit. has disappeared from the literature and has not been taken up by workers on this group.

1834—1835. Ecklon, C.F. & Zeyher, K.L.P. — *Enumeratio plantarum africae australis extra-tropicae* 1: 119—121.

This publication contains an annotated list of the southern African species of *Celastrus*. Having collected the specimens themselves and therefore knowing the plants in the field, the authors recognize many different morphs to which they give names. Of the 20 relevant species listed, 13 were new names. Currently only two of these are upheld, namely *C. nemorosa* (***Gymnosporia nemorosa***) and *C. heterophyllus* (***G. heterophylla***). In the present study the other eleven names are sunk as synonyms (see Table 1).

1842. Walpers, W.G. — *Repertorium botanices systematicae* 1: 532—534.

Walpers is the first since Endlicher described the genus *Putterlickia*, to list *P. pyracantha* under that genus. He treats seven species of *Catha* (thus following Don 1832), one of which is relevant, namely *C. montana* (***G. senegalensis***). For the rest of the species, Walpers follows De Candolle (1825) and Ecklon & Zeyher (1834—35) in classifying the 13 newly described species of Ecklon & Zeyher, as well as *C. senegalensis*, *C. europaeus* and *C. coriaceus* (the latter three being synonyms of ***Gymnosporia senegalensis***) in *Celastrus*.

1843. Meyer, E.H.F. — *Zwei pflanzengeographische Documente von J.F. Drège*: 92—147.

The following new names, which Meyer based on Drège specimens, appear in this work. All are *nom. nud.*, but Sonder (1860) subsequently took them up: *Celastrus capitatus* (***Gymnosporia capitata***), *C. glomeratus* (***G. heterophylla***), *C. lanceolata* (***G. linearis*** subsp. ***lanceolata***) and *C. verrucosus*, (***Putterlickia verrucosa***).

1844. Presl, K.B. — *Botanische Bemerkungen*: 33—34.

Presl's two newly proposed genera, *Eucentrus* and *Polyacanthus*, were both subsequently conserved against *Gymnosporia* (Wight & Arn.) Hook.f. (Farr 1979). *Celastrus linearis* L.f. (***Gymnosporia linearis***) is placed under *Eucentrus* on account of its five-partite, deciduous calyx and petals, bivalved capsules with bilocular ovaries and one-seeded locules. *Celatrus stenophyllus* Eckl. & Zeyh., representing the same species as above (***G. linearis***) is placed in *Polyacanthus* on the grounds that it has a four-lobed persistent calyx, unilocular ovary, bivalved capsule, and one-seeded locules. *C. linearis* Eckl. & Zeyh non L.f. is placed under *Polyacanthus angustifolius* (***Gymnosporia polyacantha***), but mentioned as having a five-partite calyx and trilocular ovary.

Presl also classifies some of the species described under *Celastrus* (spiny and nonspiny species) under the genus *Catha*, following Don's view. The spiny species are: *Catha buxifolia* (***Gymnosporia buxifolia***), *C. campestris* (***Putterlickia pyracantha***), *C. cymosa* (***Gymnosporia buxifolia***), *C. heterophylla* (***G. heterophylla***), *C. lanceolata* (***G. linearis*** subsp. ***lanceolata***), *C. patens* (***G. buxifolia***), *C. spathyphylla* (***G. nemorosa***) and *C. venenatus* (***G. buxifolia***).

1846. Krauss, C.F.F. von. — *Beiträge zur Flora des Cap- und Natallandes*: 42.

Krauss lists 11 *Celastrus* species, one of which is an additional name (a manuscript name of Bernhard) *C. leptopus* (***G. nemorosa***).

1847. Schlechtendal, D.F.L. von. — *Linnaea* 19: 623—624.

This work is a synopsis of the specimens of southern African plants collected by Ecklon & Zeyher, Zeyher, and Drège. No new names were published.

1854. Pappe, K.W.L. — *Silva capensis*: 9.

Pappe published a description of indigenous forest trees and shrubs of the Cape and their economic uses, notes on their localities and supplied the Afrikaans vernacular names for the first time. The wood of *Celastrus rhombifolius* (***Gymnosporia buxifolia***), the "pendoring", is useful in making musical instruments.

1860. Sonder, O.W. — In W.H. Harvey & O.W. Sonder, *Flora capensis* 1: 452—461.

Sonder provides a description of the genus *Celastrus*, a key to the species and treats two sections: *Putterlickia* and *Eucelastrus*. In section *Putterlickia* he places two species, *C. pyracanthus* (***Putterlickia pyracantha***) and *C. verrucosus* (***P. verrucosa***), both distinguished in his key by the presence of six or more ovules per locule and a raised floral disc. Section *Eucelastrus* is separated into two groups based on the shape of the capsule. The first group is again split into *a* & *b* - *a* = plants unarmed and broad-leaved, *b* = plants armed and narrow-leaved. Under the latter he placed four species: *C. lanceolatus* (***Gymnosporia linearis*** subsp. ***lanceolata***), *C. linearis* (***G. linearis***), *C. polyacanthus* (***G. polyacantha***) and *C. tenuispina* (***G. tenuispina***).

Eight names relevant to the present study are listed in Sonder's second group, which was not further subdivided and comprises spiny and nonspiny species. He differentiates between the species on the basis of width, shape, margins and texture of the leaves.

Sonder formally recognizes the different morphs of *Celastrus buxifolius* and proposes five varieties. He describes three new species: *Celastrus angularis* (***Gymnosporia heterophylla***), *C. polyacanthus* (***G. polyacantha***) and *C. tenuispinus* (***G. tenuispina***). He utilizes three of E. Meyer's names which were *nom. nud.*: *Celastrus lanceolatus*, *C. capitatus* (***G. capitata***) and *C. glomeratus* (***G. heterophylla***).

The further significance of this publication is the fact that Sonder excludes 11 names of Thunberg and E. Meyer from the genus *Celastrus*, transferring them to other genera.

1861. Klotzsch, J.F. — *Botanik* 6: 12.

Klotzsch described a new species, *Celastrus mossambicensis* (***Gymnosporia mossambicensis***), based on a Peters's specimen. Unfortunately Peters's botanical collections in Berlin were destroyed during World War II (Stafleu 1967).

1862. Harvey, W.H. — In W.H. Harvey & O.W. Sonder, *Flora capensis* 2, Addenda ad Vol. 1: 592.

Harvey describes a new species, *Celastrus ruber* (***Gymnosporia rubra***).

1862. Hooker, filius. — In G. Bentham & J.D. Hooker, *Genera plantarum* 1: 365.

Hooker (the younger) elevates the section *Gymnosporia* of Wight & Arnott to genus level.

1863. Bentham, G. — *Flora australiensis* 1: 400.

A new combination, *Gymnosporia montana* (Roth ex Roem. & Schult.) Benth., based on *Celastrus montanus*, is made. This is considered as the type species of *Gymnosporia*, typ. cons. (Farr *et al.* 1979). Bentham states that the Australian species is an Indian and African one, apparently conspecific with the tropical *C. senegalensis* (***G. senegalensis***).

1868. Oliver, D. — *Flora of tropical Africa* 1: 360—364.

Oliver puts *Gymnosporia* (Wight & Arn.) Hook. f. in synonymy with *Celastrus*. Of the 13 spiny and nonspiny species included in this work, *C. andongensis* (not considered in the present study) from Angola was described as new.

Oliver claims that the tropical African species, with the exception of *C. senegalensis* (***G. senegalensis***), appear to be endemic to Africa.

1888. Szyszylowicz, I. von.— *Polypetalae disciflorae Rehmannianae*: 33—37.

In this catalogue of Rehmann's plants, Szyszylowicz classifies *Celastrus verrucosus* and *C. pyracanthus* in the genus *Putterlickia*. He is the first to recognize Hooker's genus *Gymnosporia* for the African spiny members and makes three new combinations: ***G. buxifolia***, ***G. nemorosa*** and ***G. polyacantha*** and describes a new species, *G. woodii* (***G. heterophylla***). Szyszylowicz describes also *Elaeodendron glaucum*, which is an illegitimate homonym antedated by *Elaeodendron glaucum* Persoon (1805), for another taxon.

1891. Kuntze, C.E.O. — *Revisio generum plantarum* 1: 114—115.

Kuntze realizes that Szyszylowicz's name *Elaeodendron glaucum* is illegal and renamed this species *Cassine szyszylowiczii* (***Gymnosporia szyszylowiczii***) - a good species reinstated in the present study.

Kuntze upholds the genus *Celastrus*, also including *Catha* Forssk. and *Gymnosporia* (Wight & Arn.) Hook. f. *Celastrus senegalensis* (***Gymnosporia senegalensis***) and *C. montanus* (***G. senegalensis***) are placed as varieties under *C. buxifolius*.

1892. Loesener, L.E.T. — In A. Engl. & K. Prantl, *Die natürlichen Pflanzenfamilien* 3: 207—208.

Loesener places the genera *Celastrus* L. auct. pro parte, *Catha* Endl., *Eucentrus* C. Presl, *Polyacanthus* C. Presl. in the genus *Gymnosporia* (Wight & Arn.) Hook. f. He furthermore constitutes two subgenera, namely *Eugymnosporia* Loes. (with two sections), and *Scytophyllum* Eckl. & Zeyh. Under *Eugymnosporia* sect. 1. *Spinosae*, Loesener places all the hirtherto described spiny members and under sect. 2. *Inermis* all the nonspiny members. Loesener bases sect. *Spinosae* on the spinescence of the shrubs, presence of long and short shoots (brachyblasts) and leaves fasciculate on the branches. *Gymnosporia* (Wight & Arn.) Hook. f. subgenus *Eugymnosporia* Loes. sect. *Spinosae* Loes. encompasses the genus concept of *Gymnosporia* of this dissertation.

Loesener makes four new combinations in ***Gymnosporia***, affecting FSA species in this publication. In the genus *Putterlickia* Endl. (= *Celastrus* Harv. & Sond. auct. pro parte), Loesener recognizes ***P. pyracantha*** and ***P. verrucosa***.

1893. Loesener, L.E.T. — In A. Engl., *Botanische Jahrbücher* 17: 541—546.

Loesener, in several publications, made the most significant contribution towards the knowledge of the African Celastraceae. He was the first to work with specimens collected from all over the continent. Specimens were collected mainly by Schweinfurth, Schimper, Steudner, Fischer and Stuhlmann. In this publication Loesener describes ***Gymnosporia putterlickioides*** and makes the new combination ***Gymnosporia senegalensis*** (*Celastrus senegalensis* Lam.) with new varieties and formas.

1894. Loesener, L.E.T. — *Bulletin L'Herbier Boissier* 2: 193.

Loesener publishes one new species in this publication: *Gymnosporia schlechteri* (***G. buxifolia***).

1896. Loesener, L.E.T. — *Bulletin L'Herbier Boissier* 4: 429—431.

In this work Loesener publishes three new species, one new variety, two new formas and one new combination in *Gymnosporia*. He based this work totally on Schlechter specimens. Two of the three new species are relevant to the present study: *G. botsabelensis* (***G. tenuispina***) and *G. harveyana* (***G. mossambicensis***). The new variety is *G. heterophylla* var. *stenophylla* (***G. elliptica***). The two formas of *G. senegalensis* var. *inermis* were not upheld by most researchers after Loesener, and are also not recognized in the present study. Loesener makes the combination ***Gymnosporia rubra*** (Harv.) Loes., considering it to be a good species.

1898. Kuntze, C.E.O. — *Revisio generum plantarum* 3: 37.

Kuntze still upholds the genus *Celastrus* and mentions synonyms and localities, but does not describe any new species.

Under *C. angustifolius*, Kuntze places the synonyms *Polyacanthus angustifolius* C. Presl, *C. polyacanthus* Sond. and *Gymnosporia polyacantha* Szyszyl. with the locality Bloemfontein. ***Gymnosporia polyacantha***, as defined in the present study, and to which all the synonyms belong, does not occur in the Orange Free State. Specimens from the Orange Free State previously known under this name are placed in a newly described species, ***Gymnosporia karooica***. This species is endemic to the Orange Free State and northeastern part of the Northern Cape.

1901. Loesener, L.E.T. — In A. Engl., *Botanische Jahrbücher* 28: 153—154.

Loesener describes two new varieties: *Gymnosporia buxifolia* var. *schlechteri* from Komati Poort and *G. woodii* var. *polyantha* from Pondoland. It is not clear to which taxa these names belong, because the types could not be traced. He also makes a new combination, *Gymnosporia glauca* (***G. szyszylowiczii***), with the synonyms *Elaeodendron glaucum* Szyszyl. non Pers. nom. illegit. and *Cassine szyszylowiczii* Kuntze.

1903. Loesener, L.E.T. — *Bulletin L'Herbier Boissier* sér. 2: 823—824.

A new variety and a new species are published: *Gymnosporia capitata* var. *tenuifolia* (***G. tenuifolia***) and *G. dinteri* (***G. senegalensis***). These taxa are based on Dinter specimens collected in Namibia.

1903—1904. Bolus, H. & Wolley-Dod, A.H.— *Transactions of the South African Philosophical Society* 14: 247.

This is the first list of the flowering plants and ferns of the Cape Peninsula. The four relevant taxa in this list now belong to ***P. pyracantha*** and ***G. buxifolia***.

1906. Sprague, T.A. — *Kew Bulletin* 1906: 246.

Sprague describes a new species, *Gymnosporia condensata*, from the Transvaal. It is only another morph of ***G. buxifolia***.

1906. Brown, N.E. — *Kew Bulletin* 1906: 16.

Brown describes *Celastrus concinnus* (***Gymnosporia mossambicensis***), based on Medley Wood specimens from Kwazulu/Natal.

1907. Sim, T.R. — *The forests and forest flora of the Colony of the Cape of Good Hope*: 185—189.

Sim lists three spiny *Gymnosporia* species and two *Putterlickia* species with diagnostic species descriptions, notes on their wood characters and uses, and vernacular names.

He is the first to make a clear distinction between ***Gymnosporia buxifolia*** and *G. angularis* (***G. heterophylla***). These two taxa have been lumped together by most subsequent taxonomists, but kept separate in the present study.

1907. Wood, J. Medley. — *Handbook to the flora of Natal*: 32.

This annotated catalogue is the first attempt towards a regional flora of Kwazulu/Natal. In the list of names under *Celastrus*, seven spiny species are given. Interestingly enough, the name *C. polyacanthus* Sond. is listed, apparently taken from

Flora capensis: 455 (1860) where Sonder cited a specimen of Gueinzius from Port Natal. This species does not occur in Kwazulu/Natal and it could therefore be a misidentification.

1908. Wood, J. Medley. — *Transactions of the South African Philosophical Society* 18: 138.

This is a revised list of the flora of Natal. The same seven names as in Wood (1907) are given, but with localities and voucher specimens. *Celastrus polyacanthus* is again mentioned, but with the statement that Wood himself did not see the Gueinzius specimen [see under Wood (1907)].

1908. Conrath, P. — *Kew Bulletin* 1908: 221.

Conrath describes *Gymnosporia vaccinifolia* (***G. polyacantha*** subsp. ***vaccinifolia***), allied to *Celastrus saxatilis*. Sterile material of this species superficially resembles *C. saxatilis* (***Putterlickia saxatilis***) because of its small leaves, but the two taxa are not closely related.

1908. Loesener, Th. — A. Engl., *Botanische Jahrbücher* 41: 299—303.

Loesener describes *Gymnosporia acanthophora* from Namibia based on a Von Trotha specimen which has apparently been destroyed.

1911—1918. Glover, R. — *Annals of the South African Museum* 9: 206.

Glover lists plants, including one new combination, which were collected on the Percy Sladen Memorial Expeditions to Namaqualand. Three relevant species are listed: ***Gymnosporia buxifolia***, *G. integrifolia* (new combination) (***Gloveria integrifolia***), and *G. lanceolata* (***G. linearis*** subsp. ***lanceolata***).

Glover, in making the new combination *Gymnosporia integrifolia*, was the first to recognize that the Pearson specimens collected in Namaqualand belong to a taxon previously described from the Little Karoo region, namely *Celastrus integrifolius* L.f., despite a disjunction in distribution. In the present study the new genus name *Gloveria* is proposed in recognition of her contributions.

Although the authority for the combination *Gymnosporia lanceolata* was attributed to Glover, *fide* Davison (1927), Loesener had already made this combination in 1896.

1918. Pegler, A. — *Annals of the Bolus Herbarium* 2: 13.

This is an annotated checklist of the plants of the Division of Kentani (Transkei). Four relevant species appear in the list: *Gymnosporia angularis* (***G. heterophylla***), ***G. buxifolia***, ***G. rubra***, and ***Putterlickia verrucosa***.

1919. Schönland, S. — *Botanical Survey South Africa Memoir* 1: 73.

This is an annotated checklist of plants in the Uitenhage and Port Elizabeth districts. Eight relevant species appear in the list, including one new combination, ***G. elliptica***.

1921. Sim, T.R. — *Department of Mines and Industries Memoir* 3: 78.

Under ***Gymnosporia buxifolia***, Sim states that this species is "found throughout South Africa, often as an extension pioneer; hardly ever of timber value". *Gymnosporia vacciniifolia* (***G. polyacantha*** subsp. ***vaccinifolia***) is also mentioned as a Transvaal shrub of no timber value, but it could be used as a sanddune cover.

1921. Bews, J.W. — *An introduction to the flora of Natal and Zululand*: 129.

Bews transfers all the species of *Celastrus* to *Gymnosporia* and lists the same seven species as Medley Wood (1907).

1925. Marloth, H.W.R. — *The flora of South Africa* 2: 153.

Marloth mentions ***Gymnosporia buxifolia*** and states: "... which occurs in almost all parts of the country and would, on account of its strong spines answer well for hedges".He also mentions that ***Putterlickia pyracantha*** is often associated with ***G. buxifolia***, which is widespread in the coastal districts of the Cape.

1927. Davison, J.D. — *Bothalia* 2: 292—338.

This is the first revision of the Celastraceae in southern Africa after *Flora capensis*. Davison deals with two species in *Putterlickia* (***P. pyracantha*** and ***P. verrucosa***) and 17 species in *Gymnosporia*, two of which are new: *G. crataegiflora* (***G. heterophylla***) and ***G. uniflora***. She also decribes two new varieties of *G. angularis*: var. *grandifolia* (***G. grandifolia***) and var. *orbiculata* (***G. heterophylla***). She also makes a new combination: *G. saxatilis* (***Putterlickia saxatilis***).

1932. Fourcade, H.G. — *Transactions of the Royal Society of South Africa* 21: 84.

Fourcade compiles a list of plants found in the divisions of George, Knysna, Humansdorp and Uniondale. No new names are proposed.

1932. Burtt Davy, J. — *A manual of the flowering plants and ferns of the Transvaal with Swaziland* 2: 448.

This publication is the first attempted flora of the Transvaal. Burtt Davy provides a key to 15 *Gymnosporia* species, seven of which are relevant to the present study. He also gives voucher specimens, localities, habitat, information on their distribution and descriptive notes for some species.

1934. Henkel, J.S. — *A field book of the woody plants of Natal and Zululand*: 88—90.

Henkel is responsible for the first comprehensive field book on woody plants in Kwazulu/Natal. He produces a key to and descriptions of the woody species and their distribution (based on habitat) in Kwazulu/Natal. He considers nine species of *Gymnosporia*, based on Davison's (1927) revision.

1939. Fourcade, H.G. — *Report on the Natal forests*: 100.

The wood of *Celastrus buxifolius* (***Gymnosporia buxifolia***) is described by Fourcade as heavy, hard, strong, tough and suitable for tool handles, engraving and turnery.

1942. Loesener, Th. — In A. Engl. & K. Prantl, *Die natürlichen Pflanzenfamilien* 2,20b: 149—152.

This is an important publication on the Celastraceae. Loesener has taken a rather revolutionary view of the delimitation of the genera *Gymnosporia* and *Maytenus*, restricting the former to those species with spines or short shoots. In his complicated key, he uses the following characters to distinguish between the species: shape, length and margins of leaves and hairiness of stems/leaves.

1950. Adamson, R.S. — In R.S. Adamson & T.M. Salter (eds), *Flora of the Cape Peninsula*: 565.

Gymnosporia buxifolia is listed as a good species. *G. rhombifolia* is considered a form of the latter. Three Afrikaans vernacular names are mentioned: *lemoendoring, pendoring*, and *gifdoring*. Under *G. angustifolia* (C. Presl) Bolus & Wolley-Dod, *G. schlechteri* Loes. (***G. buxifolia***) is mentioned, with the following phrase: "recorded once, by Schlechter, from Constantiaberg 50 years ago but not observed since".

Putterlickia pyracantha is also mentioned as occurring on sand at low altitudes along the west coast of the Cape Peninsula.

1952. Miller, O.B. — *Journal South African Botany* 18: 48—49.

This is a catalogue of the woody plants of Botswana. Names included are: ***Gymnosporia buxifolia***, ***G. senegalensis*** and ***G. tenuispina***.

1952. Exell, A.W. & Mendonça, F.A — *Boletim da Sociedade Broteriana* 26: 222—224.

Exell & Mendonça are the first to propose an amalgamation of *Gymnosporia* and *Maytenus* with a widely circumscribed *Maytenus*. They make new combinations in *Maytenus*, placing *G. buxifolia* under *M. cymosa*, because Grisebach (1866) already used the epithet *buxifolia* in *Maytenus*. They describe a new species, *M. angolensis* (excluded in the present study). New name combinations are: *M. putterlickioides* (***Gymnosporia putterlickioides***) and *M. senegalensis* (***G. senegalensis***).

1957. Blakelock, R.A. — *Kew Bulletin* 1957: 37—39.

Blakelock follows Exell & Mendonça's wide generic concept and makes the following new combinations: *Maytenus mossambicensis* var. *mossambicensis* (***Gymnosporia mossambicensis***) and *M. mossambicensis var. ruber* (***Gymnosporia rubra***). Under the latter variety he cites specimens from Kenya, Tanzania, Zanzibar as well as from Kwazulu/Natal. However, he mentions the fact that the specimens from Kwazulu/Natal have red or rosy flowers whereas the flowers of all the other specimens from tropical Africa have been described as white or greenish cream.

1960. Marais, W. — *Bothalia* 7: 381—386.

Marais, following the *Maytenus s.l.* generic concept and a lumper's approach at specific level, includes 15 new combinations in *Maytenus*, eight of which are spiny species.

He notes that the type of *M. cymosa* (Soland.) Exell & Mendonça must have been a plant collected at the Cape of Good Hope and sent to Des Marets, now housed at the Sloane Herbarium (BM), and not the figure in Curtis's *Botanical Magazine*, t. 2070 (see also Dandy 1958). Six names are excluded, because Marais was unsure of their identity. The type specimens of three of these names have been destroyed, namely *Gymnosporia eremoecusa* Loes. (1908), *G. crenulata* Engl. (1888) and *G. acanthophora* Loes. (1908). According to the descriptions and other authenic material examined, he believes that *G. eremoecusa* applies to *M. senegalensis* (***Gymnosporia senegalensis***) and the latter two names to *M. cymosa* (***G. buxifolia***). After seeing the type specimen, *Schlechter 241*, I agree with Marais that *Gymnosporia schlechteri* is the same as ***G. buxifolia***. Marais excludes *G. integrifolia* (***Gloveria integrifolia***) and *G. saxatilis* (***Putterlickia saxatilis***), which he considers to belong to *Putterlickia*.

1965. Robson, N.K.B. — *Boletim da Sociedade Broteriana* 39: 6—25.

In his revision of the Celastraceae for *Flora zambesiaca*, Robson follows Marais and in this publication describes two new species: *Maytenus oxycarpa* (***Gymnosporia oxycarpa***) and *M. pubescens* (***G. pubescens***). He also proposes three new subspecies of *M. heterophylla* (a new combination), including subsp. *arenaria*, subsp. *glauca* (***Gymnosporia glaucophylla*** nom. nov.) and subsp. *puberula*. Subspecies *arenaria* causes some confusion, because the protologue is obviously based on two distinct species. The type material is also a mixture of two taxa. To avoid further confusion, it

was decided in the present study to describe these two species anew as ***G. arenicola*** and ***G. markwardii***, both with newly selected types. Subspecies *glauca* is a distinct taxon and is raised to specific rank in the present study. Subspecies *puberula* is endemic to Zimbabwe and has not been considered in the present study.

In making the new combination *Maytenus heterophylla s.l.* (***G. heterophylla*** p.p.), Robson was the first to note that the four oldest available names published for this taxon would have caused later homonyms if they were used in *Maytenus*: the epithet *buxifolia* had already been used by Grisebach (1866), *multiflora* by Reissek (1861), *elliptica* by Krug & Urban ex Duss (1897), and *cymosa* by Krug & Urban (1904). The oldest legitimate names available are the ten new names published by Ecklon & Zeyher (1834—1835). Robson selected the epithet *heterophylla*, probably the most appropriate name, for this very variable taxon.

Robson places *Gymnosporia integrifolia* (L.f.) Glover (***Gloveria integrifolia***) and *G. saxatilis* (Burch.) Davison (***Putterlickia saxatilis***) in synonymy with *Putterlickia pyracantha*, referring to them as the small entire-leaved "Karroo" form of *P. pyracantha*. This has, however, never been accepted by taxonomists working on the flora of southern Africa and these two taxa were not taken up in Gibbs Russell's (1987) list of plant species in southern Africa, or in the subsequent revision of the list (Arnold & De Wet 1993).

1966. Robson, N.K.B. — *Flora zambesiaca* 2: 355—418.

Although no new species are published, the *Flora zambesiaca* region shares Botswana with the FSA region and is therefore of interest. The work contains an excellent key, meticulous descriptions and synonyms of nine of our species, including ***P. verrucosa***, with notes on habitat, nearest allies, and geographical distribution outside the *Flora zambesiaca* region.

Robson has a very broad species concept of *M. heterophylla* and lumps 22 species from the FSA region and four from tropical Africa under this name. He still upholds his four subspecies.

1967. Edwards, D. — *Botanical Survey of South Africa Memoir* 36: 269.

Although this publication is not a taxonomic one, but a plant ecological survey of the Tugela River basin in Kwazulu/Natal, Edwards's comments on the taxonomy of the *Maytenus heterophylla* complex are very valuable. He recognizes five formas of this species and two distinct undescribed species. His first forma (=*Edwards 744, 753, 1011, 1273, 1491*) belongs to ***Gymnosporia glaucophylla***. The second forma (=*Edwards 731, 732, 1253, 2756*) belongs to ***G. tenuifolia***. The third forma (=*Edwards 958, 1218, 2812*) and fifth forma (=*Edwards 970, 1103*) belong to ***G. buxifolia***. The fourth forma (=*Edwards 2507, 2784*) belongs to ***G. hemipterocarpa***. *Maytenus* sp. (=*Edwards 2800*, *Pentz 216*) belongs to ***G. macrocarpa*** and *M.* sp. (=*Edwards 1562, 2842*) to ***G. devenishii***. *Maytenus mossambicensis* (***Gymnosporia mossambicensis***), *M. nemorosa* (***G. nemorosa***), *M. senegalensis* (***G. senegalensis***) and ***Putterlickia verrucosa*** are also listed as occurring in the Tugela River basin.

1968. Roessler, H. — In H. Merxmüller, *Prodromus einer Flora von Südwestafrika* 77: 3—5.

Roessler follows Robson (1965) and lists three species of *Maytenus* occurring in Namibia: *M. heterophylla* (***Gymnosporia buxifolia***), *M. linearis* p.p. (***G. linearis*** subsp. ***lanceolata***) and *M. senegalensis* (***G. senegalensis***).

1969. Van der Schijff, H.P. — *A check list of the vascular plants of the KrugerNational Park*: 64.

Maytenus putterlickioides (***Gymnosporia putterlickioides***) is mentioned in this publication as a new record for South Africa, based on *Brynard & Pienaar 4263*, collected at Pafuri. Seven species are mentioned, including two new species, subsequently described as *Maytenus oxycarpa* (***Gymnosporia oxycarpa***) and *M. pubescens* (***G. pubescens***).

Putterlickia pyracantha is incorrectly mentioned. These specimens (*Van der Schijff 662*, *663* and *3440*) belong to ***P. verrucosa***.

1971. Guillarmod, A.J. — *The flora of Lesotho*: 207.

Guillarmod lists *Maytenus heterophylla*, with *Gymnosporia buxifolia* as a synonym. ***G. buxifolia*** is the only member of *Gymnosporia* occurring in Lesotho.

1972. Ross, J.H. — *Flora of Natal*: 231—232.

Over fifty years elapsed since Bews's publication in 1921 on the flora of Natal and the publication of Ross's book. This is a revision of Bews's publication and contains a key to the genera and an alphabetical enumeration of the species, synonyms, voucher specimens and distribution data. Seven of our species are mentioned under *Maytenus* and *Putterlickia*. *M. tenuispina,* based on *Strey 9559* from the South Coast, is a misidentification. The specimen belongs to *Maytenus bachmannii* (Loes.) Marais.

1973. Knapp, R. — T*he vegetation of Africa*: 387.

As ecologist Knapp upholds the genus *Gymnosporia* and produces a distribution map of *G. senegalensis* and *G. linearis*, showing the disjunct distribution of *G. linearis*, occurring in southern Africa as well as in Madagascar. However, the specimens in PRE from Madagascar, named *Maytenus linearis*, look quite different from the southern African material. This needs further investigation.

1976. Compton, R.H. — *The flora of Swaziland*: 334—335.

This flora contains keys to species, species descriptions, an information on habitat, flowering times and voucher specimens. Five of our species are mentioned, including *Putterlickia pyracantha*, which is a misidentification - it should be ***P. verrucosa***.

1981. Moll, E.J. — *Trees of Natal*: 185—193.

This is the third attempt at a field guide to the woody plants of Natal, after Henkel (1934) and Moll (1967). Diagnostic characters, habitat, vernacular names, distribution maps and keys, based on vegetative characters, are supplied for over 700 species. Six species, members of the Celastroideae, are treated, including *Putterlickia pyracantha*, with its distribution given as one locality in southern Natal and another along the Zululand coast. In the present study, the specimens of *Putterlickia* from these two areas are treated as ***P. verrucosa***, on account of their prominent verrucose stems, the main

character to distinguish it from ***P. pyracantha***. Under *Maytenus heterophylla* Moll states: "The taxonomy of this 'dumping ground' needs careful study".

1984. Bond, P. & Goldblatt, P. — *Journal of South African Botany, Supplementary* Vol. 13: 224—225.

In this descriptive catalogue of the plants of the Cape flora, the authors list four of the spiny members under *Maytenus* as being present in the region, namely *M. capitata* (***Gymnosporia capitata***), *M. heterophylla* (***G. buxifolia***), *M. nemorosa* (***G. nemorosa***) and *M. polyacantha* p.p. (***G. polyacantha***).

Under *Putterlickia* Bond & Goldblatt mention ***P. pyracantha***, with the geographical distribution as Cape, Transkei and Namibia. The genus *Putterlickia* is restricted to the eastern part of southern Africa and is absent from Namibia.

1984. Gibbs Russell, G.E. *et al.* (ed.) — *Memoirs of the Botanical Survey of South Africa* 48: 89.

Marais (1960) and Robson (1965, 1966) were followed in compiling this list. Only names are given: thirteen of the present study group.

1985. Sebsebe, D. — *Symbolae botanicae upsaliensis* 25: 81—90.

Although this study primarily deals with the *Maytenus* (in a wide sense, including *Gymnosporia*) species of NE tropical Africa and tropical Arabia, with only three of the 17 species represented in the FSA region, it contains valuable information. The macromorphology, palynology, phytogeography and phylogeny are discussed and a useful cladogram is supplied.

Sebsebe follows Robson's view that *Maytenus heterophylla* is an extraordinary variable, widespread species.

1987. Van Wyk, A.E. & Mostert, S.C. — *South African Journal of Botany* 53: 267—270.

A new species of *Putterlickia*, ***P. retrospinosa***, from southern Kwazulu/Natal and Pondoland is described.

1987. Gibbs Russell, G.E. *et al.* (ed.) — *Memoirs of the Botanical Survey of South Africa* 56: 116.

Literature references and synonyms have been added to the previous list of 1984. The same thirteen names are mentioned, following Marais (1960) and Robson (1965, 1966).

1987. Hilliard, O.M. & Burtt, B.L. — *The botany of the southern Natal Drakensberg*: 172.

In undertaking this work to identify the flora of the southern Drakensberg, from Giant's Castle to Bushman's Nek, Hilliard & Burtt describe 125 species and 3 genera previously unrecognized. According to the authors, *Maytenus mossambicensis* is the only spiny member of the Celastroideae that occurs at this high altitude. However, the specimen they cite, *Hilliard & Burtt 15571*, is a new species, described in the present study as ***Gymnosporia devenishii***.

1992. Archer, R.H . — *South African Journal of Botany* 58: 393—396.

A new species, *Maytenus vanwykii* (***Gymnosporia vanwykii***) from southern Kwazulu/Natal and Pondoland, is described.

1992. Moll, E. — *Trees of Natal*: 48—193.

This publication is the third revised edition of Moll's *Trees of Natal* (1981). ***Putterlickia retrospinosa*** and *M. tenuispina* are additional names to the second edition. *Maytenus tenuispina* (***Gymnosporia tenuispina***) does not occur in Natal. This error is probably because of a misidentication of a Strey specimen - see Ross (1972).

1993. Archer, R.H. — In T.H. Arnold & B.C. de Wet (eds), *Memoirs of the Botanical Survey of South Africa* 62: 480—481.

This publication is an extended revision of the previous list of Gibbs Russell *et al.* (1987), with distribution data added. Two additional names have been added to the previous list, *Maytenus putterlickioides* (***Gymnosporia putterlickioides***) and ***Putterlickia retrospinosa***. *Gymnosporia lanceolata* and *G. linearis* were incorrectly placed as synonyms under *Maytenus heterophylla*, instead of under *M. linearis*. This error also occurs in Gibbs Russell *et al.* (1987).

1993. Pooley, E. — *The complete field guide to the trees of Natal, Zululand and Transkei*: 266, 270, 272.

This is a field guide with colour photographs, maps and illustrations of over 750 tree species, occurring from the Usutu River on the Mozambique border in the north to the Great Kei River in the Eastern Cape in the south. *Maytenus heterophylla* s. l., *M. mossambicensis* (***G. mossambicensis***), *M. nemorosa* (***G. nemorosa***), *M. senegalensis* (***G. senegalensis***), ***Putterlickia pyracantha***, ***P. retrospinosa*** and ***P. verrucosa*** are dealt with. *Gymnosporia integrifolia* (***Gloveria integrifolia***) and *Gymnosporia saxatilis* (***Putterlickia saxatilis***) are incorrectly mentioned as synonyms of ***P. pyracantha***.

CHAPTER 3

MATERIAL AND METHODS

3.1 Material

This study is based on live material, herbarium specimens and an extensive survey of the literature.

All herbarium specimens studied were recorded in a database, using the program DataEase. A list of these herbarium specimens and the herbaria where they are housed is provided in Chapter 11. They are arranged alphabetically by the collectors' names and then numerically under each collector. Where possible, quarter-degree grid references (based on Leistner & Morris 1976) are given for every collection.

The herbarium specimens studied, comprise about 3 000 sheets. These were either from the National Herbarium (PRE), or obtained on loan from the following herbaria (acronyms follow Holmgren *et al.* 1990):

B Botanischer Garten und Botanisches Museum Berlin-Dahlem, Berlin, Germany.

BOL Bolus Herbarium, Botany Department, University of Cape Town, Cape Town.

BR Nationale Plantentuin van België, Jardin Botanique National de Belgique, Domein van Bouchout, Meise, Belgium.

COI Botanical Institute, University of Coimbra, Coimbra, Portugal.

G Conservatoire et Jardin botaniques de la Ville de Genève, Switzerland.

GRA Selmar Schönland Herbarium, Grahamstown.

HAL Sektion Biowissenschaften, Martin-Luther-Universität, Halle, Germany.

J C.E. Moss Herbarium, Botany Department, University of the Witwatersrand, Johannesburg.

K	Royal Botanic Gardens, Kew, Richmond, Surrey, England.
KNP	Skukuza Herbarium, Research and Information Department, National Parks Board, Skukuza.
NBG	Compton Herbarium, National Botanical Institute, Cape Town.
NH	Natal Herbarium, National Botanical Institute, Durban.
NMB	Botany Department, National Museum, Bloemfontein.
NU	Botany Department, University of Natal, Pietermaritzburg.
PRU	H.G.W.J. Schweickerdt Herbarium, Department of Botany, University of Pretoria, Pretoria.
S	Botany Department, Swedish Museum of Natural History, Stockholm, Sweden.
SAM	South African Museum Herbarium, National Botanical Institute, Cape Town.
STE	Stellenbosch Herbarium, National Botanical Institute, Stellenbosch.
WIND	National Herbarium of Namibia, Windhoek, Namibia.

Type specimens (originals, micrographs or cibachromes) of most of the 66 names and 36 taxa recognized in this treatment were studied. Also consulted were photographs and microfiche copies of types and other authenic specimens of Thunberg's and LINN Herbaria, housed in the Mary Gunn Library of the National Botanical Institute, Pretoria.

3.2 Methods

The illustrations of eight species, presented in Part 2 of the dissertation, were prepared by Mrs Marietjie Steyn. Herbarium specimens were photographed by Mrs A. Romanowski. All photographs of the stems, flowers, fruits, as well as transverse sections of the leaves were taken by the author.

3.2.1 Macromorphology

Summaries of the diagnostic macromorphological characters examined, are given in the form of tables (Tables 3—13) in Part 2.

Drawings of the seeds with arils were made using an Olympus light microscope combined with a drawing apparatus.

Photographs of the stems, flowers and fruits were taken with a Wild stereomicroscope with camera, using Ilford Pan 125 film.

The descriptive terminology used is based mainly on Stearn (1983) and Radford (1986).

Descriptors used to indicate abundance and frequency of occurrence are based on Schmid (1982), where, for instance, "occasionally" was chosen over "sometimes".

3.2.2 Anatomy

Some of the principal diagnostic leaf anatomical characters examined, are given in the form of tables (Tables 14—17) in Part 2.

For the anatomical investigation, mature leaves of all southern African spiny members of the Celastroideae (previously under *Maytenus s.l.* and *Putterlickia*) were examined. Mostly live material, perserved in formalin-acetic acid-alcohol (FAA) (Johansen 1940), was used. This was supplemented with small portions of dried leaves removed from herbarium specimens. A list of voucher specimens for each taxon studied is supplied in Table 2. Dried material was rehydrated by placing it in distilled water and heating it slowly to boiling point in a waterbath for approximately one hour, before allowing it to cool slowly. These specimens were then fixed in FAA for at least 48 hours.

Small segments of fixed or preserved mature leaf lamina ($\pm$ 2 x 3 mm) were cut from the midrib area, approximately one third of the distance between the junction with the petiole and the leaf apex. These portions were dehydrated, infiltrated and embedded in the monomer mixture glycol methacrylate (GMA) — a plastic monomer. The method introduced by Feder & O'Brien (1968) for material fixed in FAA was basically followed. Embedded material was then transferred to labelled gelatin

capsules and polymerised in an oven at 50°C for 2—5 days to form a hard block. Specimens were then sawn out and correctly orientated, glued to their respective original blocks and trimmed. Transverse sections, 2—5 μm thick, were cut with a glass knife using a Reichert Austria OM U2 ultramicrotome. Sections were placed on drops of distilled water on slides and left for two days on a slide warmer to adhere firmly to the glass, after which they were stained with Schiff's reagent and toluidine blue (TB) — the (PAS/TB) staining method proposed by Feder & O'Brien (1968).

After staining, the mountant entellan (Art. 7961, E. Merck, Darmstadt) was placed on the dried slides and coverslips were applied. A complete set of these permanently mounted slides is housed at the National Herbarium, Pretoria.

Micrographs of tranverse sections were taken with an Olympus Vanox-s microscope, using Ilford PAN F ASA 50 film.

Jeffrey's solution, a mixture of HNO_3Cl and CrO_3, was originally described for the maceration of wood (Jeffrey 1917). This solution proved to be useful as a generally applicable macerating agent (Johansen 1940). Jeffrey's method, as modified by Kiger (1971), was used for maceration of leaf tissues for epidermal and cuticular mounts. Cuticular membranes thus procured were stained with safranin O.

Another maceration method described by Theunissen (1989) was found to be useful in the case of some, but not all, specimens. A 10 x 10 mm piece of leaf lamina was placed in a 60% solution of HNO_3 in a test tube in a fume cupboard and heated over a flame to almost boiling point. The macerated tissues were also stained with safranin O.

3.2.3 Distribution, ecology and distribution maps

Summaries of the number and names of taxa occurring per province and country are given in the form of tables (Tables 18—19) and Figure 47 in Part 2. Occurrence of the spiny members of the Celastroideae in the different biomes of southern Africa is summarized in Table 20.

Data on grid references were extracted from the database (each species as a separate file) and changed to make them compatible for use with the IDRISI-GIS computer program, which was used for generating distribution maps.

3.2.4 Cladistics

For the cladistic analysis, 13 characters were used to define the 12 species groups (Table 21). These were transformed into a data matrix (Table 22) and analysed with the use of the program Hennig 86 (Farris 1988), run on a microcomputer. The implicit enumeration (ie*) which provides exhaustive and minimal options was used to generate the most parsimonious tree.

3.2.5 Taxonomic concepts and arrangement of taxa

A traditional macromorphological approach (Stace 1989), supplemented by evidence from leaf anatomy and the study of most of the taxa in the field, was followed.

Subspecies, as defined by Du Rietz (1930) and Stuessy (1990), is the only infraspecific rank used in this study. Hence, in *Gymnosporia linearis*, *G. szyszylowiczii*, and *G. polyacantha*, subspecific delimitation is proposed where only minor morphological and anatomical differentiation occurs, but distribution is largely allopatric.

The formal taxonomic treatment (Chapter 9) has been compiled mainly according to the Guide for Contributors to *Bothalia* (1994).

Brummitt & Powell (1992) were followed for abbreviations of authors of plant names and Brummitt (1992) for author citation of genera.

Literature references in Chapter 2 follow Stafleu (1967) and Stafleu & Cowan (1976—1988).

For designation of lecto- and neotypes, the most recent version of the *International Code of Botanical Nomenclature* (ICBN) (Tokyo Code) (Greuter *et al.* 1994) was followed. According to Section 2, Article 7.1 and 7.2 of the ICBN, the application of names of taxa of the rank of family or below is determined by means of nomenclatural types and if the type has been destroyed according to Article 9.6 and 9.11, a neotype must be designated as a substitute. This was found neccessary in the case of *Gymnosporia mossambicensis*. Under article 64.1 Note 1 of the ICBN a nomen novum, namely *Gymnosporia glaucophylla*, has been selected.

The numbering of genera is according to De Dalla Torre & Harms (1900—1907).

A summary of the morphological similarities and differences between *Putterlickia*, *Gloveria*, *Gymnosporia* and *Maytenus* are given in Table 23 in Part 2.

CHAPTER 4

COMPARATIVE MACROMORPHOLOGY

4.1 Introduction

The taxonomy of the Celastroideae is based mainly on macromorphological characters, mainly of the stems, leaves and seed. However, comparative taxonomic study of fruit characters such as colour, shape, surface and nature of the pericarp, has been neglected, although it has proved to be the most significant for specific delimitation, especially in the genus *Gymnosporia*. The following have been used in the comparative macromorphological studies: life form, branches, spines, brachyblasts, presence of galls, leaves, inflorescences, flowers, fruits and seed plus aril. Summaries of the diagnostic characters examined, are given in the form of tables (Tables 3—13) in Part 2.

4.2 Results and discussion

4.2.1 Life form

Spiny members of southern African Celastroideae, comprising the genera *Gymnosporia* (reinstated), *Gloveria* (newly described) and *Putterlickia*, are mainly evergreen, spinescent, few- to much-branched, one- to many-stemmed shrubs, less frequently small trees, occasionally dwarf shrublets or very rarely woody climbers (one species only). A summary of the life forms, after Raunkiaer (1934) is given in Table 3.

Plants of most taxa occur singly or in small groups, consisting of male and female plants. Taxa such as *Gymnosporia polyacantha* subsp. *vaccinifolia* and *G. putterlickioides* sometimes grow gregariously, forming impenetrable thickets. *Gymnosporia tenuispina* and *G. rubra* also tend to grow in clumps, but not as dense and impenetrable as in the last-mentioned two taxa.

4.2.2 Branches

Diagnostic stem characters are summarized in Table 4. *Gymnosporia*, *Gloveria* and *Putterlickia* form a natural assemblage in subfamily Celastroideae on account of three common diagnostic characters: (a) the presence of spines, (b) long and short shoots

(brachyblasts) and (c) dichasial inflorescence type. These three characters, together with the sexuality (mainly unisexual), are the main distinguishing characters that separate the reinstated genus *Gymnosporia* from *Maytenus* s. str.

Solid form

Old branches are terete or angular. This is one of the diagnostic characters to distinguish between *Gymnosporia buxifolia* and *G. heterophylla*. Young and old branches of *G. heterophylla* are prominently angular (Figure 1A), hence the specific epithet for one of its synonyms, *G. angularis*. Angular ribbed branchlets are also found in *G. arenicola*, *G. devenishii* and *G. uniflora* (Figure 1B). All the other species have sub-angular to terete branchlets.

Colour of young branchlets

Young branchlets (when alive) are green, grey or reddish to reddish purple. Species with reddish to reddish purple young branchlets are: *Putterlickia saxatilis*, *Gloveria integrifolia*, *Gymnosporia senegalensis*, *G. glauca*, *G. nemorosa* and *G. gariepensis*. The rest of the species have green, grey or brownish branchlets.

Indumentum

Most of the taxa investigated have glabrous branchlets. Exceptions are *Gymnosporia rubra*, *G. putterlickioides* and *G. pubescens* (Figure 1C), all of which have consistently softly hairy branchlets. Puberulous branchlets are occasionally present in *Gymnosporia tenuispina*. *G. polyacantha* subsp. *vaccinifolia* has muricate branchlets — a unique feature in this group (Figure 1D).

Lenticels

Species of *Gymnosporia* all have stems with inconspicuous lenticels — usually only scattered small or large black dots (Figures 2A—2B). *G. macrocarpa* has transverse splits in its bark (Figure 2C). Lenticels are pale yellow dots (blister-like) in *G. nemorosa* (Figure 2D). More prominent, longitudinally orientated lenticels occur in species of *Putterlickia* and *Gloveria* (irregular openings, see Figure 3A). The most prominent eruptions occur in *P. verrucosa*. In the latter species the lenticels develop as white, lontitudinally splitted warts (Figure 3B), hence the specific epithet. Lenticels in older branches of *P. retrospinosa* are also white and verrucose, like those of *P.*

verrucosa. In *P. pyracantha* and *P. saxatilis* the lenticels are not so prominently erupted, being more or less obscured by a waxy layer and clearly not wart-like (Figure 3C—3D). This is a diagnostic character that distinguishes between *P. verrucosa* and *P. pyracantha*.

4.2.3 Spines

Spine characters of the three genera are illustrated in Figure 4 and are summarized in Table 5. The spines in *Gymnosporia*, *Gloveria* and *Putterlickia* are modified axillary shoots which sometimes bear leaves and inflorescences (Loesener 1942). In *Gloveria* there are always more than one node per spine, each node with brachyblasts bearing leaves or scars of previous leaves and inflorescences. The only *Gymnosporia* species that show this phenomenon belong to sections *Tenuispinae* and *Putterlickioides*. Spines in *Gymnosporia* sect. *Tenuispinae* often terminate brachyblasts and bear thin sharp tips. *Putterlickia* species never have more than one node per spine. This is a diagnostic character that distinguishes between *Putterlickia* and *Gloveria*.

Naked or floriferous and/or leafy spines occur in *Gymnosporia* and *Putterlickia*. This character is very variable and not consistent enough to be used diagnostically. Young branchlets very often bear leafy spines, whereas older branches are often without leaves or inflorescences. Leafy/floriferous spines occur, however, more frequently in some taxa than others, for instance in *Gymnosporia tenuifolia* and *G. heterophylla*.

Spines are present most of the time, but nonspiny plants are sometimes encountered in *G. senegalensis*. According to Sebsebe's (1985) observations spines are more numerous in plants growing along roads and in open areas than in plants of the same taxon growing in forest. Spines may also be lacking on some shoots of an otherwise spiny plant.

The spines vary in length from short to very long, up to 100 mm in some taxa, for instance *Gymnosporia arenicola*. They also vary from slender to very strong and robust, especially in those taxa growing in the Little Karoo (*Gloveria integrifolia* and *Gymnosporia szyszylowiczii*). The distal part of the spines is terete in most species, but angular in *Gymnosporia heterophylla*.

Spines are straight and either directed apically or perpendicular to the stem in all the taxa, but those of *P. retrospinosa* usually point backwards (Figure 5A), hence the specific epithet.

Spines are positioned randomly on the plants in no special pattern, with short and long intervals. In *G. szyszylowiczii,* however, the spines are orientated horizontally and divaricately in intervals of 10 mm or less, in a regular pattern.

4.2.4 Brachyblasts

Brachyblasts vary from very well developed to reduced and almost absent as in *Gymnosporia senegalensis*, *G. linearis* and *G. markwardii*.

Axillary brachyblasts are the best developed in *Gymnosporia macrocarpa* (Figure 5B) and *G. szyszylowiczii*.

4.2.5 Galls

Galls, presumably of insect origin, are frequently formed in the stems of some taxa. They have been noted most frequently in *G. buxifolia* (Figure 5C), less often so in the other members of *Gymnosporia* sect. *Buxifoliae*. Galls have not been observed in any of the other species of *Gymnosporia*, but stem galls are found in species of *Putterlickia*.

4.2.6 Leaves

Leaf characters are summarized in Tables 6 & 7.

Stipules

Stipules are very similar in all the taxa investigated (Figure 5D—5E). They are small, sub-persistent (marcescent), subulate, with acute to filiform apices and with fimbriate to ciliolate margins.

Arrangement

Leaves are usually alternate on young stems and borne mostly towards the apices of branchlets. In addition, all species have a fascicled arrangement of leaves in the axils of spines, on the spines themselves, or on the tips of brachyblasts on the stems. *Gymnosporia senegalensis*, *G. linearis* and *G. markwardii* have their leaves alternate on the long shoots and occasionally in fascicles on the spines.

Petiole

In most taxa leaf margins are decurrent on the petiole. Otherwise the petioles are either reduced or rather short (not longer than 6 mm) and channelled above (Figure 5E). Species with distinct petioles (> 1 mm long) are: *G. devenishii, G. grandifolia, G. mossambicensis*, *G. rubra* and *G. vanwykii*.

Shape

Leaf laminas of taxa studied are mainly obovate, oblanceolate or oblong, occasionally elliptic to ovate to rotund or rarely linear to lanceolate (Table 7).

Apices vary from acute to obtuse, round, and emarginate. This character is very variable between species and on the same plant. Some species have leaves that are mucronate and others that are not, on the same plant. Mucronate leaves do, however, occur more frequently in some species than in others, for example in *G. heterophylla*.

Leaf bases are cuneate in most species . The base of the lamina is often round in *Gymnosporia devenishii* and *G. rubra* (Figure 5E).

Size

There is a rough correlation between the size of the leaves and the habitat. Leaves are generally smaller in taxa from arid regions, for example *Gloveria integrifolia*, *Gymnosporia szyszylowiczii and Putterlickia saxatilis*. *Gymnosporia polyacantha*, growing in less dry conditions has slightly bigger leaves. Species with medium-sized leaves tend to grow in moist, shady conditions, often in forest, e.g. *Gymnosporia grandifolia* and *Putterlickia retrospinosa*, the species with the largest leaves. Leaf size is considered as a diagnostic character in subspecific delimitation, e.g. in

Gymnosporia linearis and *G. szyszylowiczii* as well as in the separation of closely related taxa such as *G. karooica* and *G. szyszylowiczii*.

Margin

Leaf margins are entire or irregularly to regularly dentate, serrate or crenate. Species with exclusively entire margins are: *Gloveria integrifolia*, *Gymnosporia capitata*, *G. gariepensis*, *G. karooica* and *G. szyszylowiczii*. Margins in *Gymnosporia elliptica*, *G. glaucophylla*, *G. linearis*, *G. oxycarpa*, *G. polyacantha*, *G. tenuispina*, *G. uniflora* and all the species of *Putterlickia* vary from sub-entire to denticulate, with few teeth apically, or with only rudiments of teeth.

Leaves of *Gymnosporia senegalensis* have regularly, obtusely serrulate or serrulate-crenulate margins, a character state which separates it from all the other species in *Gymnosporia* section *Buxifolia*. If not entire, all these species have serrulate margins with irregularly acute teeth. *Gymnosporia mossambicensis* has margins irregularly rounded-serrulate to acutely incurved-denticulate.

Gymnosporia arenicola is the only species with margins thickened, indurate and revolute (Figure 6C), although leaves of *P. verrucosa* and *P. pyracantha* sometimes have revolute margins. *Gymnosporia capitata* has yellow leaf margins, particularly noticeable in fresh material.

Venation

Venation of the leaves, particularly whether it is obvious, obscure or obsolete in dried material, is a useful diagnostic character. In *Gloveria integrifolia* the venation is obsolete and obscure, where at least the primary secondary veins are obvious, in taxa such as *Gymnosporia capitata*, *G. gariepensis*, *G. karooica*, *G. linearis*, *G. szyszylowiczii*, and *Putterlickia saxatilis*.

Whether the midrib of the lamina is plane or raised above or below, is a diagnostic character. Species with midribs raised above are *Gymnosporia devenishii*, *G. hemipterocarpa*, *G. mossambicensis* and *G. putterlickioides*.

Species with midribs raised below are *Gymnosporia grandifolia* and *G. nemorosa*. The latter has very distinctive pale yellowish raised midribs below, particularly noticeable in dried specimens.

Using the terminology of Hickey (1973), the following venation type is discerned when the adaxial surface of cleared leaves are studied and photographed:

Brochidodromous — *Putterlickia* and *Gymnosporia* species (Figure 6).

Indumentum

Leaf surfaces are glabrous in most taxa. Exceptions are *G. putterlickioides* and *G. pubescens*, the leaves of which are always hairy on both sides, therefore an excellent character to distinguish these two species from all the other species of *Gymnosporia*. G. *tenuispina* occasionally has puberulous leaves. *Putterlickia saxatilis* has papillae on the leaf surface below, but these are not discerniable macroscopically.

Texture and colour

In fresh leaves the texture of the lamina varies from membranaceous, chartaceous or coriaceous to very thick and tough.

In dried material the colour of the leaves varies from yellowish green (*G. tenuifolia*), pale to dark green (*G. devenishii*) or glaucous (*G. glauca, G. senegalensis*, *G. linearis*) to grey (*Gloveria integrifolia, Gymnosporia hemipterocarpa*). The leaves are glossy (*Gymnosporia mossambicensis*, *G. nemorosa*), dull, discolorous (*G. markwardii, G. capitata*) or concolorous. *Gloveria integrifolia* and *Gymnosporia hemipterocarpa* have greyish glaucous leaves, whereas *G. szyszylowiczii, G. senegalensis* and *G. glaucophylla* have glaucous leaves, hence the specific epithet of the last-mentioned species. The leaves of *Gymnosporia oxycarpa*, *G. senegalensis* and *G. tenuispina* are often mottled with brown spots in dried specimens.

4.2.7 Inflorescences

Inflorescence characters are summarized in Table 8. All spiny members of southern African Celastroideae have cymose inflorescences, mostly forming a dichasium, subdichasium or occasionally a monochasium. They are borne axillary, apically on branches or on spines, are solitary or fasciculate, and longer or shorter than the

leaves. The cymes are lax, compact or reduced, the peduncles varying from nearly absent (*G. capitata*) to peduncle puberulous or glabrous, 12—15 mm long (*G. rubra*, Figure 8E), to 25 mm long (*Putterlickia retrospinosa*). There are (1—)7—9(—15) flowers per cyme. Plants flower profusely or sparsely.

Gymnosporia capitata is very distinct in having reduced inflorescences, with the flowers arranged almost in fascicles.

4.2.8 Flowers

Floral characters are summarized in Table 9. Flowers of *Putterlickia* (Figure 7A) and *Gloveria* are bisexual. Nearly all members of *Gymnosporia* investigated have functionally male and female flowers on separate plants (Figure 7B & 7C), or occasionally on the same plant. The exception is *G. putterlickioides* with consistently bisexual flowers (Figure 7D). Species with functionally unisexual flowers are clearly obligatory outbreeders.

Flowers of *Gymnosporia vanwykii* (Figure 7E & 7F; Figure 8A), *G. arenicola* and *G. markwardii* present a form of heterostyly with respect to the length of the exserted stigmas and anthers.

In all taxa investigated the flowers are pentamerous and hypogynous.

Flower size varies from very tiny (± 2 mm in diameter) in *Gymnosporia rubra*, to up to 10 mm in diameter in *G. putterlickioides*, the species with the largest flowers among the taxa investigated.

Pedicels are short, 1—7(—10) mm long, articulate at or near the base, with the floral bracts small and persistent or marcescent.

Pollination

The scent of the flowers varies from fragrant, honey-scented to unpleasant (described as carrion-like by Palmer & Pitman 1972). Numerous insects, but notably bees, bluebottle and other flies, visit the flowers and probably act as pollinators. The flowers display the syndrome of fly pollination (myophily) (Faegri *et al.* 1971). Plants bloom regularly. The flowers are dull in colour, have no depth effect and possess nectariferous discs. The sexual organs are well exposed.

Flowering time

The peak flowering times are summarized in Table 10. Twenty taxa have their peak flowering time in summer, seven taxa in spring, five taxa in autumn and three in winter. The codes used for different seasons are according to Van Wyk & Malan (1988):

spring = August — November;
summer = November — March;
autumn = March — May;
winter = May — August.

Sepals

The sepals are small and equal in size in most species, but unequal in *Putterlickia pyracantha* and *P. verrucosa* where the two exterior sepals are shorter than the interior ones. In *Gymnosporia putterlickioides* the sepals are subcircular, rounded and pubescent on the outside (Figure 8B). The sepals are glabrous, imbricate, more or less triangular (Figure 8C), with the apex acute, margin sub-entire, uneven or laciniate and the venation is obscure.

Petals

The colour of the petals are usually white, cream, yellow or pale green. Pink to red flowers occur in *Gymnosporia rubra*. *Gloveria integrifolia* and *Putterlickia saxatilis* have white flowers which are often red-tinged.

Petals are small (1—7 mm long), imbricate, obovate to oblanceolate, or oblong, erect or spreading. Margins of the petals are sub-entire (Figure 8C), laciniate or revolute in *Putterlickia pyracantha* or reflexed lengthwise in *G. glaucophylla* and *G. polyacantha*.

Androecium

The stamens/staminodes are unicyclic, alternating with the petals, and are attached to the base of the disc. Stamens in functionally male flowers are longer than the pistillodes and are longer or slightly shorter than the petals. Staminodes in functionally female flowers are shorter than the pistil.

Stamens are erect; filaments are 1—2 mm long, subterete, borne opposite shallow sinuses in the margin of the disc; anthers are tetrasporangiate and dithecal, 0.5—1.0 mm long, basifix or subdorsifix, slightly versatile, more or less introrse or latrose, dehiscing by longitudinal slits. The anthers in *G. vanwykii, G. arenicola* and *G. markwardii* are well exserted above the petals (Figure 8E & 8F).

In male and bisexual flowers the anthers are elongate, with numerous fertile pollen grains. The staminodes of functional female flowers have smaller anthers (antherodes), without pollen grains.

Gynoecium

The pistil in functionally female or bisexual flowers is bi-, tri- or tetralocular, with a corresponding number of divergent stigmatic branches on the style. The ovaries are smooth or ridged as in *Gymnosporia devenishii* (Figure 8D). Exclusively bilocular ovaries occur in *Gymnosporia linearis* and *G. markwardii*. In *G. senegalensis*, *G. tenuifolia* and *G. grandifolia* the ovaries tend to be bilocular, but trilocular ovaries are occasionally present. *G. macrocarpa* and *G. pubescens* usually have trilocular ovaries, but occasionally tetralocular ones. The rest of the species mainly have trilocular ovaries. The bilocular condition has probably been derived through reduction from the trilocular state.

Most species of *Gymnosporia* consistently have two ovules per locule. *G. putterlickioides*, however, displays a tendency towards a variation of three or four ovules in combination with two ovules per locule in the same ovary. This phenomenon indicates a presume primitive character and that *G. putterlickioides* could be a link between *Gymnosporia* and *Putterlickia*. *Putterlickia pyracantha, P. verrucosa* and *P. retrospinosa* usually have six or more ovules per locule, rarely as many as 12. *P. saxatilis* and *Gloveria integrifolia* usually have three to six ovules per locule. The number of ovules per locule is one of the principal characters which separate *Putterlickia*, *Gymnosporia* and *Gloveria*.

A quarter or half of the ovary is immersed in and adnate to the disc. The placentation is axile, with ovules ventral hypotropous and arranged in two rows. The style is very short or absent in functionally male flowers, with the stigmas capitate or 2—4-branched.

Disc

A floral disc is an outgrowth of the receptacle, a bowl-shaped structure surrouding the base of the gynoecium (Weberling 1989). In the taxa investigated the disc is nectariferous, usually more shiny than the surrounding floral parts and adnate to the ovary.

The disc is red, contrasting with the surrounding whitish petals in *Gymnosporia putterlickioides*. *Gloveria integrifolia* has a yellow disc mottled with brown spots. The disc is yellow or green in all the other taxa.

The shape of the disc varies from convex, as in *Gymnosporia nemorosa* (Figure 8F) to slightly concave or sometimes flat, with margins crenate or shallowly 5—10-lobed.

4.2.9 Fruits

Diagnostic fruit characters are summarized in Tables 11 and 12. Members of subfamily Celastroideae are distinguished from those of the subfamily Cassinoideae by their dry, dehiscent capsules and seeds enclosed to various degrees by an aril.

The fruit is a simple, dehiscent, multicarpellate, dry capsule which developes from a syncarpous gynoecium. It opens longitudinally, loculicidally to the base or halfway and septifragally. Fruits are borne erect in most species, but are pendulous as in *P. retrospinosa* and *Gymnosporia gariepensis*. The capsules are (2)3(4)-valved, with the valves erect, half-spreading, spreading or reflexed in dehiscence as in *Gymnosporia mossambicensis* (Figure 14F) and *G. vanwykii*. After dehiscence, the inside of the valves is purplish in *Gymnosporia mossambicensis*, bright yellow in all members of *Gymnosporia* sect. *Buxifoliae* and pale yellow or whitish in all the other taxa investigated.

Fruit characters, such as colour, surface, size, shape of capsule, colour of inside of valves, number of valves, and nature of pericarp, are of diagnostic value.

The surface of the capsules are hairy (*Gymnosporia pubescens* and *G. putterlickioides*), rugose (*G. buxifolia*, *G. elliptica*, *G. grandifolia*, *G. heterophylla*,

G. macrocarpa and *G. uniflora*), pitted (*G. arenicola*), veined (*G. oxycarpa*) and smooth in all the other taxa investigated. See Figure 9.

The shape of the capsules are globose (*Gymnosporia* sect. *Buxifoliae*, *G.* sect. *Gymnosporia*, *G. mossambicensis* and *G. pubescens*) triquetrous with sharp angles (*G. capitata*, *G. hemipterocarpa* and *G. polyacantha*), conic-pyramidal (*G. oxycarpa*), pyriform (*G. nemorosa*) and obconic-trigonous with round angles (*Gloveria integrifolia*, *GymnosporiaG. gariepensis*, *G. putterlickioides*, *G. rubra*, *G. tenuispina*, *G. vanwykii* and all the *Putterlickia* species). The valves of the capsules of *G. capitata* and *G. oxycarpa* have very acute apices. See Figures 10—11.

The pericarp of the capsules are distinctly ridged (*Gymnosporia devenishii*), half-ridged (*G. hemipterocarpa*), woody (*G. grandifolia* and *G. macrocarpa*), semi-fleshy (*G. mossambicensis*), coriaceous (most members of *G.* sect. *Buxifoliae*, *G.* sect. *Gymnosporia*) and chartaceous (*Gloveria integrifolia*, *Putterlickia* spp., *G.* sect. *tenuispinae*, *G. polyacantha* and *G. nemorosa*, etc.). See Figure 12.

The number of valves and persistence of styles on capsules in fruiting stage are demonstraed in Figure 13.

4.2.10 Seed and aril

Diagnostic seed and aril characters are summarized in Table 13. Seeds of *Putterlickia, Gloveria* and *Gymnosporia* are ellipsoid, somewhat rugose and glossy, and contain copious endosperm. The colour of the testa varies from pale to dark brown, reddish brown to black (*Gymnosporia polyacantha*).

Seeds of all taxa always have an aril. The aril originates from the integument near the funicle (Cronquist 1981) and is fleshy and glabrous. In some species the arils can be very colourful, or otherwise white or pale yellow, attracting birds. According to Loesener (1942) and Ding Hou (1955) birds eat only the arils, therefore aiding in dispersal of the seed. The aril are almost transparent (*Gymnosporia glaucophylla*), rough (*G. polyacantha*) and smooth in the other taxa. See Figure 14.

The aril covers the seed to various degrees (Figure 14—15). Three conditions occur:

i) aril reduced to a folded rim at the base of the seed;
ii) aril partially covering the seed, halfway or slightly more;
iii) aril covering the seed almost completely.

These different states are of diagnostic value.

The number of ovules per locule varies from 6—12 (*Putterlickia pyracantha*, *P. retrospinosa* and *P. verrucosa*), 3—6 (*Gloveria integrifolia* and *P. saxatilis*) to mainly two per locule in all the species of *Gymnosporia* species (Figure 14). *Gymnosporia putterlickioides* has occasionally three ovules per locule (Figure 15D).

The presence of thick basal arils is taken to be the derived character state and the presence of a complete enclosure of the seed by a colourful aril is considered the primitive state in this study. This is contrary to what Sebsebe (1985) considered as the primitive (pleiseomorphic) and derived states in his study.

CHAPTER 5

COMPARATIVE ANATOMY OF THE LEAF

5.1 Introduction

Delimitation as well as identification of taxa when only vegetative parts are available is difficult and often impossible. Since previous studies on southern African Celastroideae were based mainly on macromorphological characters obtained from herbarium specimens, the aim of the present study was to evaluate the anatomical characters of leaves as an additional source of taxonomic evidence.

The most comprehensive of the early studies on the leaf anatomy of the Celastraceae are those of Solereder (1908), Metcalfe & Chalk (1950, 1979), Den Hartog & Baas (1978) and Pant & Kidwai (1966). The present work represents the most detailed leaf anatomical study yet on the spiny members of the southern African Celastroideae.

Leaves of *Gloveria*, *Gymnosporia*, and *Putterlickia* are consistently simple and entire or with a few marginal teeth, mostly in the distal half, usually obovate, oblong, ovate, rotund, elliptic, linear or lanceolate, but in spite of these superficial resemblances, anatomical variability proved to be quite considerable. Some of the principal diagnostic leaf anatomical characters are summarized in Tables 14—17.

5.2 Results and discussion

5.2.1 Epidermis

Characters of the epidermis are of particular taxonomic as well as phylogenetic interest because they differ conspicuously between species and also assist in the demarcation of sections in the genus *Gymnosporia*. Notable differences exist in the size and shape of the cells, number of cell layers and the presence or absence of trichomes and papillae.

The epidermis is uniseriate, with the cells adaxially larger than abaxially in *Putterlickia* and *Gymnosporia* sect. *Mossambicensis* as well as in *G.* sect. *Nemorosae*. In *Gymnosporia* sections *Putterlickioides*, *Pubescens*, *Polyacanthae* and *Tenuispinae* the epidermis is uniseriate, with the cells of the two epidermises the same size.

Leaves of *Gloveria integrifolia* and *Gymnosporia* sect. *Gymnosporia* have a multiseriate epidermis, consisting of two or three layers. Multiple epidermises are of rare occurrence among dicotyledons (Mauseth 1988).

A multiseriate epidermis is usually considered characteristic of xeromorphic plants. Species investigated with this state occur in relatively arid habitats, thus supporting the notion that there is a correlation between the number of epidermal cell layers and the climatic conditions under which a plant grows.

Unlike a multiseriate epidermis, hypodermises are fairly common (Mauseth 1988). A hypodermis occurs in *Gymnosporia* sections *Buxifoliae* and *Capitatae*. Species of *G.* sect. *Buxifoliae* are characterized by a particularly charateristic hypodermis, varying from a discontinuous layer, interrupted by crystal idioblasts and mesophyll cells, to a more or less continuous zone, one or two cell layers thick (Table 18).

The only two members of *G.* sect. *Buxifoliae* with a two-layered hypodermis, *G. arenicola* and *G. markwardii*, are both endemic or near-endemic to the coastal sand dunes of NE Kwazulu/Natal and southern Mozambique.

Gymnosporia capitata, confined to the Eastern Cape has an adaxial hypodermis of which the cells are radially elongated and arranged in two or three continuous layers. Epidermis cells in this species are extremely small.

The outer tangential epidermis cell walls (as seen in transverse section) are very uneven in *Gymnosporia pubescens*, less so in *G. hemipterocarpa* and even in all the other species.

The size of the epidermis cells varies from very small and thin-walled in *Gymnosporia capitata*, *G. heterophylla* and *G. ellitica,* small and thick-walled in *G. szyszylowiczii* and *G. karooica*, medium-sized and thin-walled in *Gymnosporia* sect. *Mossambicensis* to large in *G.* sect. *Tenuispinae* where the outer epidermal cell walls are distinctly thickened.

Epidermis cells (outer tangential walls) display fine striations over the midrib area on both sides in *Gymnosporia hemipterocarpa* and *G.* sect. *Gymnosporia*.

5.2.2 Stomatal complex

Stoma type

Solereder (1908) mentioned the "lack of a uniform type of stoma" and the absence of any "special subsidiary cells" in the Celastraceae. The mature stoma complex of the Celastraceae has been described by Metcalfe & Chalk (1950) as "usually cruciferous to ranunculaceous". The stomatal structure has, however, not been described in detail by any of these authors. Jansen & Baas (1973) reported anisocytic and cyclocytic stomata in *Kokoona* Thwaites and additional complex types and a tendency towards helicocytic ones in *Lophopetalum* Wight ex Arn. Den Hartog & Baas (1978) coined the term laterocytic for the stomatal pattern in various taxa of the Celastraceae and claimed that it is the most common type found in the family. Cyclocytic and paracytic stomata also occur in a fair number of genera. The latter two types are commonly found in those Celastraceae characterized by a ring of three to eight well-differentiated subsidiary cells which are almost completely covered by the two guard cells, although their outer extremities are usually bare. The placement of the subsidiary cells below the guard cells is comparable with that of certain Magnoliaceae (Pant & Kidwai 1966).

From two to five more or less even-sized subsidiary cells were recorded in the taxa studied. Two cells occur in *Gymnosporia putterlickioides* and five in *G. senegalensis* and *G. linearis*. All the other species have four subsidiary cells. Based on the arrangement of the epidermal cells surrounding the guard cells, stomata can be described as laterocytic.

The anticlinal walls of the "unspecialized" subsidiary cells are thickened in some taxa, notably species of *Gymnosporia* sect. *Buxifoliae* and *G.* sect. *Tenuispinae*. In *G. mossambicensis* and *G. nemorosa* the anticlinal walls of these cells are sinuous, whereas in all the other species they are even.

5.2.3 Mesophyll

Palisade and spongy parenchyma are clearly differentiated in *Putterlickia*, *Gymnosporia* sections *Mossambicensis*, *Nemorosae*, *Putterlickioides* and *G. polyacantha* subsp. *vaccinifolia*, *G. buxifolia*, *G. devenishii*, *G. grandifolia*, *G. heterophylla*, *G. macrocarpa* and *G. uniflora*.

Leaves of *Putterlickia* and *Gymnosporia* sect. *Mossambicensis*, *G.* sect. *Nemorosae*, *G.* sect. *Capitatae*, *G.* section *Polyacanthae* and *G.* sect. *Buxifoliae* are dorsiventral with palisade on the adaxial side. The palisade parenchyma consists of typical cylindrical cells with dense cytoplasm. In *Gymnosporia* sect. *Putterlickioides* and *G.* sect. *Mossambicensis* the palisade parenchyma consists mostly of only a single layer of cells, whereas in others it is two or three layers thick.

The spongy parenchyma varies in compactness and thickness. *Putterlickia saxatilis*, *Gymnosporia karooica* and *G. szyszylowiczii* have a compact spongy mesophyll. This is usually a good indicator of a xerophyte. The other three species of *Putterlickia* are confined to the moister coastal areas and show distinctive large intercellular spaces in the spongy mesophyll. *P. retrospinosa*, a forest species, exhibits the most extensive aerenchyma. This is also the case with forest species such as *Gymnosporia devenishii* and *G. grandifolia*; both species have pronounced intercellular spaces in their spongy parenchyma.

The leaves are isobilateral in *Gloveria integrifolia*, *Gymnosporia* sections *Pubescens*, *Tenuispinae* and *Gymnosporiae*. In all the other taxa investigated the leaves are dorsiventral.

5.2.4. Midrib

Vascular bundle

The basic structure of the midrib (in transverse section) is very similar in all the taxa investigated (Figure 16). In *Gymnosporia* the midrib consists of a single collateral bundle. Collenchyma supports the vascular bundle ad- and abaxially in most species. In transverse section the vascular bundle forms an open arc, halfway surrounded by a sclerenchyma sheath. In *Putterlickia retrospinosa*, *P. pyracantha*, *Gymnosporia mossambicensis* and *G. nemorosa* it is an almost closed arc. The sclerenchyma sheath varies in thickness from slightly to distinctly extended on the abaxial side.

Collenchyma

Gymnosporia tenuispina and *G.* sect. *Gymnosporia* have collenchyma of the annular type (Mauseth 1988), with the cell lumens round in transverse section (Figure 17). All the other species have an angular collenchyma type (Figure 18A) (Mauseth 1988). In

Putterlickia the vascular bundle is surrounded by mesophyll cells or weakly developed collenchyma, usually only one layer thick.

Sclerenchyma

The lumen of the fibres is small and striations in the walls are not clear. Some fibres may have wider dark-coloured pits with a thin wall. This characterictic type of fibre is observed in *Putterlickia retrospinosa* as well as in *Gymnosporia* species like *G. buxifolia*, *G. capitata*, *G. elliptica*, *G. gariepensis*, *G. tenuispina* and *G. vanwykii*. A distinct pit membrane was observed in *Putterlickia retrospinosa* (Figure 18B). A few sclereids occur on the abaxial side of the xylem.

Phloem

In *Gymnosporia* sect. *Gymnosporia* the midrib has a substantial amount of phloem. Relatively less phloem is present in the other species.

Xylem

The metaxylem is arranged in 10—40 radial rows and does not provide any characters of taxonomic significance.

5.2.5 Trichomes

Nonglandular trichomes are present in three species of *Gymnosporia*, being absent in *Gloveria* and *Putterlickia*. In *G. pubescens*, *G. putterlickioides* and *G. tenuispina* the trichomes are uni-, bi- or muticellular where they occur on both surfaces of the lamina. The trichome bases are broadened and inserted between normal epidermis cells (Figures 19—20).

5.2.6 Papillae

The abaxial epidermis cells of *Putterlickia saxatilis* consistently form well developed papillae (Figure 27). Occasionally *P. verrucosa* exhibits a few weakly developed papillae (Figure 26B). Papillae are absent in *P. pyracantha* and *P. retrospinosa*.

5.2.7 Crystal idioblasts

Unicellular idioblasts containing crystals of calcium oxalate are scattered between the hypodermis (Figure 21A) or such cells are frequently embedded in the vascular parenchyma and mesophyll. These crystal idioblasts occur most abundantly in *Gymnosporia szyszylowiczii* subsp. *namibiensis*. Crystal idioblasts are sparse or absent in *G.* sect. *Gymnosporia*. *Gymnosporia pubescens* is the only species with crystal idioblasts in the epidermis (Figure 21B).

5.2.8 Tanniferous cells

Tanniferous cells are absent in *Putterlickia* and *Gloveria*, but occur most abundantly in *Gymnosporia*. Some mesophyll and vascular bundle cells are completely filled with matter which may represent oxidized tanniferous substances [these containing proanthocyanins, according to Cronquist (1981)]. The chemical composition of these tanniferous substances in the mesophyll may be different from those in the epidermal layer as they stained differently with toluidine blue. The tanniferous contents also stained differently in different species, for example dark blue in *Gymnosporia* sect. *Buxifoliae* and *G.* sect. *Capitatae*, greenish brown in *G.* sect. *Polyacanthae* and *G.* sect. *Gymnosporia* and reddish in *G.* sect. *Tenuispinae*. The contents of these cells are either homogeneous or coarsely granular. Three types of tanniferous cells were recognized, designated types A, B and C. Cell type A is without a "cracked" appearance (Figure 22A), as in *Gymnosporia buxifolia*, *G. capitata*, *G.* sect. *Tenuispinae*. Type B has a "cracked" appearance (Figure 23), as in *G. heterophylla*, *G. elliptica*, *G. polyacantha* and *G. senegalensis*. Type C has a granular content as in *G. capitata*, *G. szyszylowiczii* subsp. *szyszylowiczii* and *G. vanwykii* (Figure 31B). All three types may occur in one leaf such as in *G. szyszylowiczii* subsp. *szyszylowiczii* (Figure 22B). Types A and B were also recognized in the Rubiaceae (Tilney 1986, 1988).

5.2.9 Oil droplets

Fresh leaf material of *Gloveria integrifolia* from three different localities in the Little Karoo, preserved in FAA, show very distinctive unstained oil droplets in the palisade and spongy parenchyma, not clearly associated with the vascular bundles (Figure 24). Oil droplets in the parenchyma and associated with the vascular bundle have previously been reported in *Maytenus oleosa* A.E. van Wyk & R.H. Archer and the *M. undata* (Thunb.) Blakelock group (Van Wyk & Archer 1987).

5.3 Anatomical groups and keys

Eleven groups of taxa were demarcated on the basis of shared leaf anatomical characters:

PUTTERLICKIA	GROUP A:	*P. pyracantha, P. retrospinosa, P. verrucosa*
	GROUP B:	*P. saxatilis*
GLOVERIA	GROUP C:	*Gloveria integrifolia*
GYMNOSPORIA		
	GROUP D:	*G. putterlickioides*
	GROUP E:	*G. mossambicensis, G. nemorosa, G. rubra, G. vanwykii*
	GROUP F:	*G. pubescens*
	GROUP G:	*G. polyacantha*
	GROUP H:	*G. capitata*
	GROUP I:	*G. gariepensis, G. oxycarpa, G. tenuispina*
	GROUP J:	*G. arenicola, G. buxifolia, G. devenishii, G. elliptica, G. glaucophylla G. grandifolia, G. hemipterocarpa, G. heterophylla, G. karooica, G. macrocarpa, G. markwardii, G. szyszylowiczii, G.. tenuifolia, G. uniflora*
	GROUP K:	*G. linearis, G. senegalensis*

KEY TO THE GROUPS

1a Epidermal cell size differs ad- and abaxially; leaves hypostomatic 2
1b Epidermal cell size the same on both sides; leaves hypo- or amphistomatic 7
2a Well developed papillae on abaxial epidermis present ..... Group B
2b Papillae on abaxial epidermis absent or with few weakly developed papillae .. 3
3a Trichomes present on both sides of leaf 4
3b Trichomes absent 6
4a Epidermis with crystal idioblasts as well as trichomes; thin-walled ..... Group F
4b Epidermis without crystal idioblasts, only trichomes; trichomes thin- or thick-walled 5
5a Trichomes as well as epidermal cells with thick walls; midrib not raised ..... Group I
5b Trichomes as well as epidermal cells with thin walls; midrib raised on both sides ..... Group D
6a Anticlinal walls of unspecialized epidermis cells often sinuous; palisade often one layer thick ..... Group E
6b Anticlinal walls of unspecialized epidermis cells straight; palisade often more than one layer thick ..... Group A
7a Epidermis uniseriate 8
7b Epidermis multiseriate 10
8a Hypodermis absent 9
8b Hypodermis present 11
9a Epidermal cells small; mesophyll dorsiventral ..... Group G
9b Epidermal cells large; mesophyll isobilateral ..... Group I
10a Tanniferous cells present; oil droplets absent ..... Group K
10b Tanniferous cells absent; oil droplets present in mesophyll ..... Group C
11a Hypodermis discontinuous or continuous, 1 or 2 layers ..... Group J
11b Hypodermis 2 or 3 layers ..... Group H

GROUP A: *Putterlickia pyracantha*, *P. retrospinosa*, *P. verrucosa* (Figures 25—26)

1. Leaf hypostomatic
2. Epidermal cell size differs ad- and abaxially
3. Hypodermis absent
4. Multiseriate epidermis absent
5. Mesophyll dorsiventral
6. Trichomes absent
7. Papillae occasionally present
8. Collenchyma present (only one layer adaxially)
9. Sclerenchyma present
10. Tanniferous cells absent
11. Stomata not sunken
12. Crystal idioblasts scattered in mesophyll
13. Oil droplets absent

GROUP B: *Pyracantha saxatilis* (Figure 27)

1. Leaf hypostomatic
2. Epidermal cell size differs ad- and abaxially
3. Hypodermis absent
4. Multiseriate epidermis absent
5. Mesophyll dorsiventral
6. Trichomes absent
7. Papillae present (abaxially)
8. Collenchyma absent
9. Sclerenchyma present
10. Tanniferous cells absent
11. Stomata not sunken
12. Crystal idioblasts scattered in mesophyll
13. Oil droplets absent

Differences in the four species of *Putterlickia* are tabulated in Table 16.

GROUP C: *Gloveria integrifolia* (Figure 28)

1. Leaf amphistomatic
2. Epidermal cell size the same both sides
3. Hypodermis absent
4. Multiseriate epidermis present
5. Mesophyll isobilateral
6. Trichomes absent
7. Papillae absent
8. Collenchyma absent
9. Sclerenchyma present
10. Tanniferous cells absent
11. Stomata sunken
12. Crystal idioblasts scattered in mesophyll
13. Oil droplets present

GROUP D: *Gymnosporia putterlickioides* (Figure 29A)

1. Leaf hypostomatic
2. Epidermal cell size the same both sides
3. Hypodermis absent
4. Multiseriate epidermis absent
5. Mesophyll dorsiventral
6. Trichomes present both sides
7. Papillae absent
8. Collenchyma of the angular type present
9. Sclerenchyma present or absent
10. Tanniferous cells absent
11. Stomata not sunken
12. Crystal idioblasts scattered in mesophyll
13. Oil droplets absent

GROUP E: *Gymnosporia mossambicensis*, *G. nemorosa*, *G. rubra*,*G. vanwykii* (Figures 30—31)

1. Leaf hypostomatic
2. Epidermal cell size differs ad- and abaxially
3. Hypodermis absent
4. Multiseriate epidermis absent
5. Mesophyll dorsiventral
6. Trichomes absent
7. Papillae absent
8. Collenchyma present or absent
9. Sclerechyma present
10. Tanniferous cells usually absent, occasionally present (types A and C)
11. Stomata not sunken
12. Crystal idioblasts scattered in mesophyll
13. Oil droplets absent

KEY TO THE SPECIES OF GROUP E

1a Collenchyma absent; vascular bundle surrounded by mesophyll ..... ***G. rubra***

1b Collenchyma present; vascular bundle well developed abaxially..... 2

2a Tanniferous cells present in mesophyll ..... ***G. vanwykii***

2b Tanniferous cells absent in mesophyll 3

3a Epidermal cells with anticlinal cell walls thickened ... ***G. mossambicensis***

3b Epidermal cells with anticlinal cell walls thin ..... ***G. nemorosa***

GROUP F: *Gymnosporia pubescens* (Figure 29B)

1. Leaf amphistomatic
2. Epidermal cell size the same both sides
3. Hypodermis absent
4. Multiseriate epidermis absent
5. Mesophyll isobilateral
6. Trichomes present both sides
7. Papillae absent
8. Collenchyma of the angular type present
9. Sclerenchyma absent
10. Tanniferous cells absent
11. Stomata not sunken
12. Crystal idioblasts scattered in mesophyll and epidermis
13. Oil droplets absent

GROUP G: *Gymnosporia polyacantha* (Figure 32)

1. Leaf hypostomatic
2. Epidermal cell size the same both sides
3. Hypodermis absent
4. Multiseriate epidermis absent
5. Mesophyll dorsiventral
6. Trichomes absent
7. Papillae absent
8. Collenchyma absent
9. Sclerenchyma present
10. Tanniferous cells present (type B) or absent
11. Stomata not sunken
12. Crystal idioblasts scattered in mesophyll
13. Oil droplets absent

KEY TO THE SUBSPECIES OF GROUP G

1a Palisade and spongy parenchyma not clearly differentiated; type-B tanniferous cells abundant ..... ***G. polyacantha*** subsp. ***polyacantha***

1b Palisade and spongy parenchyma well-differentiated; tanniferous cells absent .... ***G. polyacantha*** subsp. ***vaccinifolia***

GROUP H: *Gymnosporia capitata* (Figure 33)

1. Leaf hypostomatic
2. Size of epidermal cells the same both sides
3. Hypodermis present
4. Multiseriate epidermis absent
5. Mesophyll dorsiventral
6. Trichomes absent
7. Papillae absent
8. Collenchyma absent
9. Sclerenchyma present
10. Tanniferous cells present (type A)
11. Stomata not sunken
12. Crystal idioblasts scattered in mesophyll
13. Oil droplets absent

GROUP I: *G. gariepensis*, *G. oxycarpa*, *G. tenuispina* (Figures 34—35)

1. Leaf amphistomatic
2. Size of epidermal cells the same both sides
3. Hypodermis absent
4. Multiseriate epidermis absent
5. Isobilateral mesophyll
6. Trichomes usually absent, sometimes present
7. Papillae absent
8. Collenchyma of the annular type present or absent
9. Sclerenchyma present or absent
10. Tanniferous cells present (type A)
11. Stomata not sunken
12. Crystal idioblasts scattered in mesophyll
13. Oil droplets absent

KEY TO THE SPECIES OF GROUP I

1a Collenchyma well developed on both sides of vascular bundle; trichomes occasionally present 2
1b Collenchyma absent; trichomes absent ..... ***G. gariepensis***
2a Sclerenchyma present; trichomes absent ..... ***G. oxycarpa***
2b Sclerenchyma absent; trichomes occasionally present ..... ***G. tenuispina***

GROUP J: *G. arenicola, G. buxifolia, G. devenishii, G. elliptica, G. glaucophylla, G. grandifolia, G. hemipterocarpa, G. heterophylla, G. karooica, G. macrocarpa, G. markwardii, G. szyszylowiczii, G. tenuifolia, G. uniflora* (Figures 36—43)

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1. Leaf amphistomatic
2. Size of epidermal cells the same both sides
3. Hypodermis present
4. Multiseriarte epidermis absent
5. Mesophyll dorsiventral
6. Trichomes absent
7. Papillae absent
8. Collenchyma of the angular type present
9. Sclerenchyma present
10. Tanniferous cells present or absent (types A, B, C)
11. Stomata sunken or not
12. Crystal idioblasts scattered in hypodermis and mesophyll, occasionally in vascular bundle
13. Oil droplets absent

KEY TO THE SPECIES OF GROUP J

1a Hypodermis continuous 2
1b Hypodermis discontinuous 6
2a Hypodermis one layer thick 3
2b Hypodermis two layers thick 5
3a Sclerenchyma weakly developed; spongy parenchyma compact ..... ***G. tenuifolia***
3b Sclerenchyma well developed; spongy parenchyma with intercellular spaces 4

4a Hypodermal cells radially elongated ..... ***G. grandifolia***

4b Hypodermal cells not radially elongated ..... ***G devenishii***

5a Tanniferous cells present ..... ***G. markwardii***

5b Tanniferous cells absent ..... ***G. arenicola***

6a Leaf outline uneven; epidermal cells of midrib with striations .. .. ***G. hemipterocarpa***

6b Leaf outline straight; epidermal cells of midrib without striation 7

7a Tanniferous cells usually abundantly present in mesophyll, absent in vascular bundle 8

7b Tanniferous cells absent, or when present, only sparsely so in vascular bundle and spongy parenchyma 11

8a Type B tanniferous cells present 9

8b Type A tanniferous cells present 10

9a Type B tanniferous cells abundant in mesophyll; epidermal cells very small, with thin outer tangential walls ..... ***G. elliptica***

9b Type B tanniferous cells less abundant in mesophyll; epidermal cells larger with thick outer tangential walls ..... ***G heterophylla***

10a Epidermal cells with thick outer tangential cell walls ..... ***G. glaucophylla***

10b Epidermal cells with thin outer tangential cell walls 11

11a Collenchyma well developed on both sides of midrib ... 12

11b Collenchyma weakly developed on both sides of midrib 13

12a Hypodermis and crystal idioblasts present on both sides ..... ***G. buxifolia***

12b Hypodermis and crystal idioblasts present only adaxially ..... ***G. macrocarpa***

13a Crystal idioblasts abundant in hypodermis and mesophyll; spongy parenchyma compact; mesophyll not differentiated; appear rather isobilateral 14

13b Crystal idioblasts only in hypodermis, very few in mesophyll or absent; spongy parenchyma with intercellular spaces; mesophyll well differentiated; dorsiventral ..... ***G. uniflora***

14a Types A, B and C tanniferous cells present 15

14b Tanniferous cells absent ..... ***G. karooica***

15a Epidermal cells with thick outer tangential cell walls; crystal idioblasts abundant ..... ***G. szyszylowiczii*** subsp. ***namibiensis***

15b Epidermal cells with thick outer tangential cell walls; crystal idioblasts sparse ..... ***G. szyszylowiczii*** subsp. ***szyszylowiczii***

GROUP K: *G. linearis*, *G. senegalensis* (Figures 44—45)

1. Leaf amphistomatic
2. Size of epidermal cells the same both sides
3. Hypodermis absent
4. Multiseriate epidermis present
5. Mesophyll isobilateral
6. Trichomes absent
7. Papillae absent
8. Collenchyma of the annular type present
9. Sclerenchyma present
10. Tanniferous cells abundantly present (type A)
11. Stomata sunken
12. Crystal idioblasts absent or few scattered in mesophyll
13. Oil droplets absent

KEY TO THE SPECIES OF GROUP K

1a Epidrmal layers thick; usually more than two layers over whole lamina .... ***G. senegalensis***

1b Epidermal layers thinner than in above species; usually only two layers thick, with three layers in vicinity of stomata ..... ***G. linearis***

CHAPTER 6

GEOGRAPHICAL DISTRIBUTION AND ECOLOGY

6.1 Introduction

The geographical distribution of all species of *Putterlickia*, *Gloveria* and *Gymnosporia* within the area under study is given under each species. *Gymnosporia arenicola, G. buxifolia, G. glaucophylla, G. markwardii, G. mossambicensis, G. oxycarpa, G. pubescens, G. putterlickioides, G. senegalensis, G. tenuifolia* and *Putterlickia verrucosa* also occur outside the FSA region. Figure 46 and Table 18 show the number of species studied per province and country. Taxa in each province and country are given in Table 19.

6.2 Distribution

Most species studied occur in summer rainfall regions of southern Africa. Rainfall in these regions varies from less than 200 mm annually in the far northwestern parts to more than 1 000 mm along the eastern coastal belt. The highest concentration of taxa occurs in the moister eastern regions of the subcontinent, with 10—18 species per province or country. Six to eight taxa occur in the semi-arid Northern Cape and Namibia. Five taxa occur in the Western Cape in the winter rainfall region, although not really part of the fynbos vegetation. Botswana, the Orange Free State, the North-West Province and PWV have the lowest concentrations of taxa, namely 3 or 4. Only one species occurs in Lesotho, an indication that members of this subfamily do not favour areas at high altitude with a subalpine climate.

Putterlickia has a disjunct distribution, with three species occurring along the eastern coastal areas of southern Africa, and *P. saxatilis* endemic to the Koranna- and Langeberge in the Northern Cape.

Gloveria also has a disjunct distribution, with *G. integrifolia* occurring in the Little Karoo and some populations in Namaqualand.

Species of *Gymnosporia* are widespread on the African continent, although mainly in the moister eastern parts, extending as far north as Spain and eastwards to India, Sri Lanka, Malaysia and NE Australia. The genus also occurs in Madagascar.

In *Gymnosporia* some species show disjunct distributions. Some of the patterns are briefly mentioned below:

Gymnosporia linearis

Gymnosporia linearis subsp. *linearis* occurs in the Eastern Cape and is a outlier of *G.* sect. *Gymnosporia. G. linearis* subsp. *lanceolata* occurs in the lower Orange River Valley in southern Namibia and the Northern Cape.

Gymnosporia polyacantha

Gymnosporia polyacantha subsp. *polyacantha* occurs in the Eastern Cape and *G. polyacantha* subsp. *vaccinifolia* occurs in the Northern Transvaal, North-West Province and PWV, mainly in the Waterberg.

Gymnosporia szyszylowiczii

Gymnosporia szyszylowiczii subsp. *syszylowiczii* occurs in the Eastern Cape, wheras *G. syszylowiczii* subsp. *namibiensis* occurs in southern Namibia along the lower Orange River Valley.

Gymnosporia gariepensis

Gymnosporia gariepensis is a outlier of *Gymnosporia* sect. *Tenuispinae* and has a very restricted distribution in the northern Richtersveld along the lower Orange River Valley. Its nearest relatives are *G. tenuispina* and *G. oxycarpa.* The latter-mentioned species occurs in Northern Transvaal and *G. tenuispina* in Northern Transvaal, North-West Province, PWV and also extending its distribution range into eastern Botswana and southern Orange Free State.

6.3 Ecology

Seven major biomes are encountered in the FSA region (Rutherford & Westfall 1994), namely Fynbos, Nama-Karoo, Succulent Karoo, Grassland, Savanna, Forest and Desert. Spiny members of the southern African Celastroideae are found in six of the biomes, predominantly in the Savanna Biome, occasionally in the other five biomes, but are absent from the Desert Biome. A summary of the occurrence in the different biomes of southern Africa is given in Table 20.

Gymnosporia devenishii and *G. mossambicensis*, both small trees, are the only species that occur in Afromontane forest, either on forest margins or as understorey constituents. *Gymnosporia mossambicensis* also occurs together with *G. rubra, G. grandifolia* and *G. nemorosa* as small trees or shrubs in subtropical lowland and highland forest patches in the Eastern Cape, Kwazulu/Natal and Eastern Transvaal.

Putterlickia retrospinosa, is the only woody liana in the study group and is endemic to the southern Kwazulu/Natal/Pondoland sandstone (Natal Group) region. The species usually grows in rocky places and is found mainly along forest margins and in short shrub forest.

Putterlickia pyracantha occurs in coastal fynbos of the Western Cape and valley bushveld of the Eastern Cape.

Putterlickia verrucosa and *Gymnosporia arenicola* occur in coastal dune forest of Kwazulu/Natal.

Gymnosporia buxifolia, the most successful and widespread species, occupies a variety of habitats in six of the seven biomes of southern Africa. It usually grows as a pioneer in disturbed, open sites such as those along roads, and enters the margins of disturbed forest, but usually disappears inside forest where the competition from other species intensifies.

Gymnosporia hemipterocarpa, *G. macrocarpa* and *G. glaucophylla* occur in the valley bushveld of Kwazulu/Natal, but the latter extends its distribution further into the valley bushveld of Swaziland, Eastern Transvaal and Mozambique.

Gymnosporia capitata, *G. polyacantha* subsp. *polyacantha*, *G. linearis* subsp. *linearis* occur in valley bushveld (Acocks 1988) of the Eastern Cape, while *G. polyacantha* subsp. *vaccinifolia* occurs in mixed bushveld and bankenveld of the highveld and Northern Transvaal.

In southern Africa *Gymnosporia senegalensis* and *G. tenuifolia* are the only species that occur in the savanna of the Kalahari as well as the North-West Province, Northern Transvaal, Eastern Transvaal and Kwazulu/Natal.

In the FSA region three species are confined to the northeastern corner (near the border with Zimbabwe and Mozambique) of Northern Transvaal, namely *Gymnosporia putterlickioides*, *G. pubescens* and *G. oxycarpa*. The first mentioned species grows in dry bushveld, often on termitaria or in riverine areas, whereas *G. pubescens* and *G. oxycarpa* occur in *Colophospermum mopane* savanna.

Although spiny members of Celastroideae predominantely occur in savanna, a few species extend their distribution range into grassland, where they have developed underground stems, probably an adaptation to survive regular fires. Such species are *G. heterophylla*, *G. polyacantha* subsp. *vaccinifolia* and *G. tenuispina*.

Gymnosporia heterophylla grows in rocky places in grassland, usually associated with or in close proximity to forest, but also in the valley bushveld in the Eastern Cape. It has been reported from Witteberg quartzite in the Eastern Cape, Natal Group Sandstone, dolerite and granite outcrops in Kwazulu/Natal and Eastern Transvaal and even on serpentine soil in the Eastern Transvaal.

The four suffrutex species studied occur mainly in coastal grassland or coastal fynbos, subjected to regular burning. These grasslands overlie different geological formations. *G. vanwykii*, a geoxylic suffrutex, occurs on the Natal Group Sandstone of southern Natal/Pondoland. *Gymnosporia elliptica* is confined to coastal grassland in the Eastern Cape and *G. uniflora* to coastal and inland grassland of southern Kwazulu/Natal. *G. markwardii* is endemic to coastal grasslands on recent sands in the Maputaland-southern-Mozambique coastal plain.

Seven taxa occur in three of the five regions of the Karoo Biome (Cowling *et al.* 1986). In the West Coast and Namaqualand region, *Gloveria integrifolia* occurs near

the coast. *Gymnosporia linearis* subsp. *lanceolata* is often associated with watercourses and river banks in the extremely arid Richtersveld and in southern Namibia. *G. gariepensis* occurs in the same arid area, but on the mountains. In the Upper Karoo region *Putterlickia saxatilis* and *Gymnosporia szyszylowiczii* subsp. *namibiensis* occur as small shrubs in the arid northwestern part near the Orange River.

Gymnosporia karooica occurs in the northeastern part in the False Upper Karoo (Acocks Veld Type 36) on dolerite koppies. It has been claimed that this veld type displays the most spectacular of all changes in the vegetation of South Africa (Acocks 1988) in the form of invasion of grassland by elements of the Nama-Karoo Biome.

Two taxa occur in the Little Karoo, namely *G. szyszylowiczii* subsp. *szyszylowiczii* and *Gloveria integrifolia*, both extremely spiny shrubs.

CHAPTER 7

PHYTOGEOGRAPHY

7.1 Introduction

Spiny members of the southern African Celastroideae occur in all six main phytochoria proposed by White (1983) (Figure 47). *Gloveria* and *Putterlickia* are endemic to the southern African region, with interesting intergeneric disjunct distribution patterns (Figure 48).

7.2 Endemism

As far as the spiny members of the Celastroideae are concerned, there are two main centres of endemism on the Afro-Arabian continent:

i) NE tropical Africa and tropical Arabia with 10 out of 16 species (60%) endemic to this region (Sebsebe 1985);
ii) southern Africa (FSA region) where 21 out of 35 species and infraspecific taxa (60%) are endemic.

The first main centre falls mainly within three (Sudanian, the Somalia-Masai and Afromontane Regions) and the second within six of the main phytochoria proposed by White (1983).

In the first centre, species are mostly confined to either the Afromontane Region or Somalia-Masai Region and in the second centre, species are mostly absent from the Afromontane Region, with only one species endemic to it.

Taxa are arranged according to their presence in the phytochoria of White:

ZAMBEZIAN REGIONAL CENTRE OF ENDEMISM -- II

The Zambezian regional centre of endemism comprises parts of Angola, Zambia, Zimbabwe, Mozambique, and in the FSA region includes Northern Transvaal and the North-West Province as well as northern Botswana.
The following taxa of *Gymnosporia* are endemic to this region:

G. oxycarpa
G. polyacantha subsp. *vaccinifolia*
G. pubescens

G. tenuispina is centred in this Region, but also extends to the Kalahari-Highveld Region. A recent record form the Orange Free State (*Du Preez 162*, NMB), collected at Vredefort, could be an indication that this species is extending its distribution further southwards into the Kalahari-Highveld Region.

Although *G. putterlickioides* occurs mainly in this region, it also extends its distribution to the Somalia-Masai Region in southern Ethiopia.

CAPE REGIONAL CENTRE OF ENDEMISM -- V

Gymnosporia elliptica is the only species endemic to this region.

Putterlickia pyracantha is near-endemic to this region, occurring in coastal bushland and thicket (White 1983). Its range extends slightly into the Tongaland-Pondoland Region.

KAROO-NAMIB REGIONAL CENTRE OF ENDEMISM -- VI

The following taxa are endemic to this region:

Gloveria integrifolia
Gymnosporia gariepensis
G. linearis subsp. *lanceolata*
G. szyszylowiczii subsp. *namibiensis*

Gymnosporia szyszyolowiczii subsp. *szyszylowiczii* occurs mainly in this region, extending into the Cape Region.

AFROMONTANE ARCHIPELAGO-LIKE REGIONAL CENTRE OF ENDEMISM -- VIII

Only one species, *Gymnosporia devenishii*, is an endemic to this region. In contrast, the number of endemics to the Afromontane Region in NE tropical Africa is much higher (Sebsebe 1985).

Gymnosporia mossambicensis and *G. buxifolia* are the only other species occurring in this regional centre, although their main areas of distribution are elsewhere.

KALAHARI-HIGHVELD REGIONAL TRANSITIONAL ZONE -- XIV

The following species are endemic to this region:

Gymnosporia karooica
Putterlickia saxatilis

TONGALAND-PONDOLAND REGIONAL MOSAIC -- XV

The following taxa are endemic or near-endemic to this region:

Gymnosporia arenicola (Maputaland)
G. capitata (as well as the Cape Region)
G. hemipterocarpa (Tugela River Basin)
G. linearis subsp. *linearis* (Cape)
G. macrocarpa (Tugela River Basin)
G. markwardii (Maputaland)
G. nemorosa (whole area as well as the Cape Region)
G. polyacantha subsp. *polyacantha* (Cape)
G. uniflora (inland grassland)
G. vanwykii (Pondoland)
Putterlickia retrospinosa (Pondoland)
P. verrucosa (whole area)

Species confined to both the Tongaland-Pondoland and Zambezian Regions are:

G. glaucophylla
G. grandifolia
G. heterophylla
G. mossambicensis
G. rubra
G. tenuifolia

WIDESPREAD SPECIES

Gymnosporia senegalensis occurs in all phytochoria in Africa except the Cape and Afromontane Regions of southern Africa. It is the only *Gymnosporia* species that occurs in the Sahel and Sahara Regions. It also extends to southern Arabia, the Mediterranean Region (southern Spain) and to India.

G. buxifolia occurs in all six phytochoria. It is a pioneer tree, often growing in disturbed sites.

CHARTER 8

PROVISIONAL CLADISTIC ANALYSIS

8.1 Introduction

Despite criticism by Cronquist (1987) and various others, cladistics appears to be one of the best methods for reconstructing phylogenies in an empirical way. However, very few attempts at cladistic analysis have been made in the Celastraceae. In fact, only a preliminary analysis for the NE African species of *Gymnosporia* has hitherto been attempted (Sebsebe 1985). Although not all members of the genus *Gymnosporia* have been considered in the present study, I have found it worthwhile to attempt another preliminary cladistic analysis to establish possible phylogenetic relationships among the southern African species of spiny Celastroideae. Such an analysis also proved to be useful to depict the type and number of apomorphies characterizing each taxon.

8.2 Results and discussion

To analyse possible phylogenetic relationships among the three genera of the study group, a group-character data matrix was compiled, using *Putterlickia* (comprising *P. pyracantha*, *P. retrospinosa* and *P. verrucosa*) as the outgroup. Morphological as well as anatomical characters were used to compile the data matrix. Polarity of character states was determined mainly by comparison with the corresponding character states in the outgroup. *Putterlickia* displayed several putatively primitive character states, such as a trilocular ovary, high number of ovules per locule, hermaphroditic flowers, aril completely covering the seed and rather unspecialized leaf anatomy with a unilayered epidermis where the size differs ad- and abaxially, absence of trichomes, papillae, tanniferous cells and oil droplets. *P. retrospinosa* is considered the most primitive species in this group, with its scandent habit, large leaves, long inflorescences and many ovules.

Characters used for the cladistic analysis of the species groups are given in Table 21. The ie* option using the unweighted data set of Table 22 gave 1 tree with 17 steps and a consistency index of 76 (Figure 49). The strict consensus tree is shown in Figure 50.

Not all the spiny members of *Gymnosporia* were used in this analysis, but it should serve as a basis for further, more comprehensive studies on the genus and all the genera in the subfamily Celastroideae. Sebsebe (1985) used *Maytenus undata*, the only non-spiny species in NE Africa, as the outgroup. He considered the basal position of the aril as the most primitive state, whereas in the present study, with *Putterlickia* as the outgroup, it was considered an advanced state.

The value of this analysis lies in the suggested position of the new genus *Gloveria*. It shows the closest affinity with *Gymnosporia* sect. *Gymnosporia*, mainly because of its anatomical characters. Morphologically, however, it appears to be closer to *Putterlickia*. *Gymnosporia* sect. *Gymnosporia* came out as the most advanced group with reduced number of locules per ovary, and the most complicated leaf anatomy. *Gymnosporia putterlickioides* may be a link between *Gymnosporia* and *Putterlickia*, with primitive characters such as hermaphroditic flowers, seed completely enveloped by an aril and a simple leaf anatomy.

Gloveria came out as a sister group of *Gymnosporia* sect. *Gymnosporia*. They agree in leaf anatomical characters, such as the leaves being hypostomatic, the epidermis multiseriate, the size of epidermis cells the same on both sides of the lamina and the mesophyll isobilateral. Morphologically they differ in *Gloveria* having bisexual flowers, the gynoecium 3-merous, more than two ovules per locule and the aril covering the seed completely. These two groups are allopatric in their distribution pattern. *Gloveria* is confined to the Eastern and Western Cape. In southern Africa *Gymnosporia* sect. *Gymnosporia* occurs in Namibia, Botswana, the northern parts of the Northern Cape, Northern and Eastern Transvaal, Swaziland and Kwazulu/Natal, whereas one outlier of this section, namely *G. linearis* subsp. *linearis*, occurs in the Eastern Cape but not sympatrically with *Gloveria*.

CHAPTER 9

TAXONOMIC TREATMENT

9.1 Key to genera

1a Shrubs or woody climbers; flowers always bisexual; ovules 3—12 per locule; ovary always 3-locular; capsules cream to pink or red, obconic-trigonous; surface smooth and glabrous; pericarp chartaceous; seeds completely enveloped by a well developed aril; aril orange or pink 2

1b Suffrutices, shrubs or small trees; flowers nearly always functionally unisexual with staminodes in female and pistillodes in male flowers; ovules 2(3) per locule; ovary (2)3(4)-locular; capsules variously coloured, obconic-trigonous, triquetrous, globose, pyriform or conic-pyramidal; surface glabrous or hairy, smooth, rugose, veined or pitted; pericarp semi-fleshy, chartaceous, coriaceous, woody or ridged; seeds completely or incompletely enveloped by a well or weakly developed aril, or aril only a basal rim; aril orange, pinkish, yellow or white ..... 3. ***Gymnosporia***

2a Small shrubs; spines always leafy and floriferous, with more than one node per spine; leaves with venation obsolete, margin entire; disc cream, brown-spotted; ovules usually fewer than six per locule; aril pink ..... 2. ***Gloveria***

2b Shrubs or woody climbers; spines occasionally leafy and floriferous, when leafy not more than one node per spine; leaves with venation conspicuous, margin with few teeth in distal half, occasionally subentire; disc green; ovules usually six or more per locule; aril orange ..... 1. ***Putterlickia***

9.2 The genus *Putterlickia* Endl.

46280000 ***PUTTERLICKIA***

Putterlickia *Endl.*, Generum plantarum 2: 1086 (1840); Davison: 336 (1927); N. Robson: 5 (1965); R.A. Dyer: 333 (1975). Type species: *P. pyracantha* (L.) Endl.

Evergreen shrubs (often spreading or straggling) or woody climbers, spinescent, with long shoots and brachyblasts, bisexual, glabrous. *Spines* slender to robust, straight or backward-pointing, axillary, occasionally leafy and floriferous, with only one node, up to 100 mm long. *Branches* angular or terete and reddish brown when

young, becoming terete and grey with age, lenticellate, smooth or verrucose. *Leaves* alternate or fasciculate, subsessile, glabrous; lamina ovate, obovate, oblanceolate-spathulate or broadly elliptic; venation brochidodromous. *Stipules* free, small, subulate, marcescent. *Inflorescence* a lax to dense dichasium or monochasium, in axils of leaves or in clusters on brachyblasts. *Flowers* few to many in a cyme, white, pentamerous, hypogynous, pedicellate. *Sepals* subequal, imbricate, free or united at base, margin ciliolate. *Petals* cream, imbricate in bud, spreading or suberect. *Disc* intrastaminal, single, convex, shallowly 5-crenate. *Stamens* free, subterete; filaments slender, attached to base of disc; anthers basifixed, slightly versatile, latrorse, with separate thecae dehiscing longitudinally. *Ovary* sessile, with quarter to half immersed in and adnate to disc, 3-locular; ovules (4—)6(—12) per locule, placentation axile with ovules ventrally hypotropous and arranged in two rows; style short, cylindric; stigma 3-lobed. *Fruit* a dry capsule, dehiscing loculicidally to base. *Capsules* cream to pink or red, obconic-trigonous, smooth. *Seeds* 6—18, glossy, reddish brown, with fleshy endosperm, completely enveloped by a well developed aril; aril fleshy, orange. Figures 51—58.

A genus of four species endemic to southern Africa. The highest concentration of species is in the moister southwestern and eastern regions of the Western Cape, Eastern Cape, Kwazulu/Natal, Swaziland and Eastern Transvaal, with one outlier in the drier semi-arid region of the Northern Cape.

Key to the species

1a Stems not verrucose 2

1b Stems verrucose 3

2a Leaves usually shorter than 15 mm; pedicels shorter than 5 mm; capsules usually shorter than 12 mm; Northern Cape ..... 4. ***P. saxatilis***

2b Leaves usually longer than 15 mm; pedicels longer than 5 mm; capsules usually longer than 12 mm; Western and Eastern Cape .... 1. ***P. pyracantha***

3a Erect shrubs; spines forward-pointing; leaves usually narrower than 25 mm; Eastern Transvaal, Swaziland, Kwazulu/Natal, Eastern Cape .... 2. ***P. verrucosa***

3b Woody climbers; spines usually backward-pointing; leaves usually wider than 30 mm; Kwazulu/Natal and Eastern Cape 3. ***P. retrospinosa***

1. **Putterlickia pyracantha** (*L.*) *Endl.*, Generum plantarum 2: 1086 (1840); Walp.: 529 (1842); Szyszyl.: 36 (1888); Sim: 188 (1907); Marloth: 153 (1925); Davison: 336 (1927); Codd: 115 (1973); Coates Palgrave: 503 (1981); Pooley: 270 (1993). Type: Cape, Herb. LINN 268.6 (LINN, lecto.; S-LINN iso-lecto., fide Wijnands: 64 (1983); PRE, microfiche!).

Celastrus pyracanthus L.: 197 (1753); Miller: 58, pl. 87 (1760); L.: 285 (1762); Lam.: 661 (1785); Ait.: 272 (1789); Gaertn.: 85 (1791); Thunb.: 42 (1794); Willd.: 1129 (1798); Sims: pl. 1167 (1809); Roem. & Schult.: 426 (1819); Thunb.: 220 (1823); Spreng.: 773 (1824); DC.: 8 (1825); Eckl. & Zeyh.: 119 (1834¾1835); E. Mey.: 123, 137 (1843); Schltdl.: 623 (1846); Sond.: 453 (1860).

Celastrus obtusus Thunb.: 217 (1823); E. Mey.: 78 (1843). Type: Cape, Thunberg in *Herb. Thunberg 5629* (UPS, holo.; PRE, microfiche!).

Celastrus campestris Eckl. & Zeyh.: 119 (1834—1835); Walp.: 533 (1842); Krauss: 42 (1846); Ettingshausen: t. 7, Fig. 7 (1857). *Catha campestris* (Eckl. & Zeyh.) C. Presl: 34 (1844). Type: Zwartkopsrivier [Uitenhage], *Ecklon & Zeyher 937* (GRA! lecto., here designated; S! isolecto.).

Rigid or straggling shrub up to 3 m tall, spinescent, glabrous. *Spines* slender or robust, straight, up to 50 mm long, naked or leafy. *Branches* terete, twigs angular, greyish brown, often covered by a thick whitish grey wax layer, splitting longitudinally and peeling off, revealing pale nonwartlike lenticels. *Leaves* alternate or fasciculate, shortly petiolate, coriaceous, glossy dark green, glabrous; lamina obovate, 13—70 × 8—35 mm, apex rounded, obtuse to emarginate, base cuneate; margin revolute, usually entire and wavy or spinulose-denticulate; venation reticulate, more prominent below than above; petiole 1—4 mm long. *Stipules* subulate, ± 1—2 mm long. *Inflorescence* a lax dichasium or subdichasium; peduncle 10—25 mm long; pedicels 7—10 mm long. *Flowers* white, 6—10 mm diam. *Sepals* ± 1 mm long, unequal, two exterior ones shorter than the three interior ones, broadly triangular, margin laciniate. *Petals* 4—5 mm long, oblong, apex rounded, margin slightly ciliate, reflexed lengthwise. *Disc* thick, fleshy, obsoletely crenate, furrowed. *Stamens* 3 mm long, situated in shallow sinuses of disc. *Ovary* 3-locular; ovules 6—12 per locule; style 1 mm long; stigma 3-lobed. *Capsules* cream to pink or red, obconic-trigonous, smooth, 10—20 mm long. *Seeds* reddish brown, completely enveloped by a well developed aril; aril orange. Figures 51—52.

Common names: false spike-thorn, *basterpendoring*.

Flowering time: November—January.
Fruiting time: February—August.

Diagnostic features: branches smooth, covered by whitish grey wax layer, which splits longitudinally and peels off, revealing nonwartlike lenticels, thus never verrucose; pedicels longer than 5 mm.

Distribution and habitat: *P. pyracantha* occurs in scrub, fynbos and coastal forest along the south-western Cape coast from Velddrif, Melkbosstrand and Cape Town areas to the eastern Cape coast as far north as Tsitsa Falls in the Eastern Cape. It is often assosiated with *Gymnosporia buxifolia*.

Vouchers: *Ecklon & Zeyher 265* (BOL, G, STE); *Jordaan 2304* (K, PRE); *MacOwan 1822* (G, PRE, SAM); *Strey 10686* (NH); *Zeyher 2176* (G, K, P, PRE, S,).

2. **Putterlickia verrucosa** (*E. Mey. ex Sond.*) *Szyszyl.*, Polypetalae Disciflorae Rehmannianae: 36 (1888); Loes.: 208 (1896); Sim: 189 (1907); Pegler: 13 (1918); Davison: 338 (1927); Henkel: 89 (1934); Robson: 357 (1966); Coates Palgrave: 504 (1981); Moll: 185 (1981); Moll: 48, 185 (1992); Pooley: 272 (1993). Type: Cape, Woods between the Keiskamma and Buffels River, *Drège 5613* (S! lecto., lower specimen on sheet here designated; P, TCD?, isolecto.).

Celastrus verrucosus E. Mey.: 142 (1843) nom. nud. ex Sond.: 453 (1860).

Straggling shrub up to 3 m tall, spreading, much-branched, spinescent, glabrous. *Spines* slender or robust, straight, up to 70 mm long, not floriferous, sometimes leafy, sometimes with lenticels. *Branches* terete with angular twigs, reddish or purplish brown, becoming grey-brown and verrucose with prominent whitish wartlike lenticels, each with a longitudinal slit; sometimes with insect galls (locally swollen). *Leaves* alternate or fasciculate, shortly petiolate, coriaceous, glossy grey-green above and paler brown below when dry, glabrous; lamina ovate, obovate to oblanceolate-spathulate, 10—85 × 6—24 mm, apex often emarginate and mucronate, otherwise obtuse to rounded, base cuneate; margin serrulate or spinulose-denticulate, sometimes subentire and undulate with a few teeth, revolute; venation more raised below than

above, principal lateral veins about 7, looping some distance from margin, midrib raised on both sides; petiole 0.5—3.0 mm long. *Stipules* subulate, ± 23 mm long. *Inflorescence* a dichasium or subdichasium, solitary, axillary or on brachyblasts; peduncle 7—40 mm long; pedicels (1—)3—5 mm long. *Flowers* ± 20 in a cyme, creamy white. *Sepals* 1—2 mm long, equal, oblong to suborbicular, apex obtuse to rounded, margin laciniate. *Petals* 2.0—4.5 mm long, oblong, margin uneven or ciliolate, reflexed lengthwise. *Disc* 10-lobed, broad, flat, saucer-like, margin slightly crenate. *Stamens* 2 mm long; anthers small, 1 mm long. *Ovary* 3-locular, 1.5 times as long as style; ovules 6—12 per locule; style 0.5 mm long; stigma subcapitate or 3-lobed. *Capsules* cream to pink, becoming reddish brown when mature, obconic-trigonous, smooth, 15—25 mm long. *Seeds* 2—8, reddish brown, completely enveloped by a well developed aril; aril orange. Figures 53—54.

Common names: false forest spike-thorn, *basterbospendoring*.

Flowering time: July—October.
Fruiting time: September—January.

Diagnostic features: branchlets verrucose with prominently raised, wart-like lenticels — hence the specific epithet; pedicels usually shorter than 4 mm.

Distribution and habitat: *P. verrucosa* occurs in coastal tropical forest, bush clumps or thickets in the Eastern Cape as far south as East London and extends its distribution range eastwards through the Kwazulu/Natal coast as far north as the inland forests of Swaziland and the Kruger National Park (Pretoriuskop and Shabeni) in the Eastern Transvaal. It is also recorded from southern Mozambique.

Vouchers: *Codd 6063 (PRE); Jordaan 512* (PRE); *Pegler 602* (BOL, PRE); *Rudatis 1167* (G, PRE, S); *Schlechter 3008* (GRA, NH, PRE).

3. **Putterlickia retrospinosa** *A.E. van Wyk & Mostert* in South African Journal of Botany 53: 267 (1987); Moll: 48 (1992); Pooley: 272 (1993). Type: Kwazulu/Natal, Umtamvuna Nature Reserve, Beacon Hill, 10.12.1981, *Van Wyk 5281* (PRU! holo.; PRE! iso.).

Putterlickia sp. no. 1 in Coates Palgrave: 504 (1981).

Evergreen woody climber up to 5 m tall, spinescent, glabrous. *Spines* slender or robust, perpendicular to stem or often backward-pointing, up to 100 mm long, naked. *Branches* brown, becoming dark grey to blackish with numerous white verrucose lenticels. *Leaves* alternate or fasciculate, petiolate, coriaceous, dark green and shiny above, paler green and dull below, glabrous; lamina broadly elliptic to broadly obovate, rarely elliptic or ovate, (25—)80—120(—150) × (15—)40—60(—70) mm, apex rounded or retuse, mucronate, base rounded to cuneate; margin subentire or with few teeth in distal half, thick; midrib slightly raised above, principal lateral veins raised or obscure above, slightly raised below; petiole 8—15 mm long. *Stipules* subulate, ± 2 mm long. *Inflorescence* a very lax subdichasium, terminal or axillary, 80—140 mm long; peduncle 30—50 mm long; pedicels 3—5 mm long. *Flowers* many in each cyme, white. *Sepals* ± 1 mm long, green, fleshy, cucullate, subrotund, apex rounded, margin ciliate. *Petals* 3.5 × 2.0 mm, erect or spreading, oblong, apex obtuse, margin irregularly toothed. *Disc* slightly concave, margin shallowly lobed. *Stamens* subterete, 1.5 mm long; anthers 0.5 mm long. *Ovary* 3-locular; ovules (6—)8—10 per locule; style very short; stigma 3-lobed, spreading. *Capsules* whitish green, turning pink or red, obconic-trigonous, smooth, glabrous, pendulous, 30 × 20 mm. *Seeds* 1—3 per locule, ellipsoid, dark reddish brown, 8 mm long, completely enveloped by a well developed aril; aril orange. Figures 55—56.

Common names: Large-leaved false spike-thorn, *grootblaar-basterpendoring*.

Flowering time: October—December.
Fruiting time: January—April.

Diagnostic features: this is the only member of the study group which is a woody climber and with spines that are backward-pointing, hence the specific epithet. It has abundant verrucose lenticels like *P. verrucosa*, but has much larger leaves and relatively larger and more lax inflorescences.

Distribution and habitat: *P. retrospinosa* is endemic to forest and forest fringes of the Natal Group sandstone areas of southern Kwazulu/Natal and Pondoland. It is fairly common throughout most of the sandstone region.

Vouchers: *Abbott 1416* (NH, PRU); *Jordaan 948* (PRE); *Strey 7205* (NH, PRE); *Van Wyk 5292* (PRE, PRU); *Ward 7146* (PRE).

4. **Putterlickia saxatilis** (*Burch.*) *M. Jordaan*, comb. nov. Type: Asbestos Mountains, Griekwa Town, *Burchell 1671* (K! holo.).

Celastrus saxatalis Burch.: 264 (1824). *Gymnosporia saxatalis* (Burch.) Davison: 303 (1927); Loes.: 149 (1942).

Compact, multi-stemmed shrub up to 1.5 m tall, spinescent, glabrous. *Spines* slender, straight, up to 15 mm long, rarely leafy or floriferous. *Branches* terete, greyish brown, with sunken lenticels; brachyblasts axillary. *Leaves* nearly always fasciculate, rarely alternate, subsessile, coriaceous, glaucous, glabrous; lamina obovate, 4—20 × 2—4 mm, apex rounded to subemarginate, base cuneate; margin entire; venation inconspicuous above, prominent below; petiole ± 0.5 mm long. *Stipules* short, subulate. *Inflorescence* a dichasium, terminal or axillary, longer than leaves; peduncle 8—10 mm long, reddish brown; pedicels 5—7 mm long. *Flowers* few in each cyme, yellow, tinged pink. *Sepals* ± 1 mm long, triangular, margin laciniate. *Petals* ± 4 mm long, oblong, margin entire, recurved. *Disc* fleshy, annular, convex. *Stamens* 2.5 mm long; anthers 0.5 mm long. *Ovary* 3-locular; ovules 3—6 per locule; style 1.0—1.5 mm long; stigma 3-lobed. *Capsules* white to pink or red, obconic-trigonous, smooth, 6—10 mm long. *Seeds* 5 mm long, dark brown, completely enveloped by a well developed aril; aril orange. Figures 57—58.

Proposed common names: rock false spike-thorn, *klip-basterpendoring*.

Flowering time: January—August.
Fruiting time: February—October.

Diagnostic features: the small leaves (usually shorter than 15 mm) of *P. saxatilis* are characteristically glaucous and entire to subentire; the capsules are the smallest in the genus and has often only four ovules per locule, while the other three species usually have six or more.

Distribution and habitat: *P. saxatilis* is confined to the Kalahari thornveld and arid bushveld of the Korannaberg, Langeberge, and Asbesberge in Northern Cape, between Kuruman, Campbell, Griekwa Town, Postmasburg, Niekerkshoop and Olifantshoek. Plants often grow among rocks, hence the specific epithet, and are recorded on dolerite ridges in loam soil.

Vouchers: Breukner 1078 (BOL, PRE); *Häfstorm 1153* (PRE, S); *Puff 780415-1/10* (J); *Saaiman 413* (NMB, PRE); *Wilman 1315* (BOL, PRE).

9.3 The genus *Gloveria* M. Jordaan gen. nov.

4628010 ***GLOVERIA***

Gloveria *M. Jordaan*, gen. nov., *Putterlickiae Gymnosporiaeque* similis sed ultra unum nodum fasciculorum in quoque spino; disco maculato; infra sex sed ultra duo ovula in quoque loculo; arillo roseo differt.

TYPE.—*Gloveria integrifolia* (L.f.) M. Jordaan, *vide infra*.

Evergreen, intricately branched, bluish grey, robust shrubs up to 2 m tall, branchlets arching downwards, spinescent, bisexual, glabrous. *Spines* robust, up to 80 mm long, always floriferous and leafy, 2—4(5) nodes of leaves and scars of leaves per spine. *Branches* terete, young branchlets reddish brown, becoming grey, rigid, flexuous, bark splitting longitudinally, lenticels sunken. *Leaves* fasciculate, in axils of spines or more often on brachyblasts on spines, sessile, coriaceous, grey, succulent, glabrous; lamina obovate-cuneate, 10—20 × 3—7 mm, apex obtuse or emarginate, base cuneate; margin entire; venation obsolete; petiole absent. *Stipules* very short, subulate. *Inflorescence* a dichasium, borne on abbreviated branches; peduncle 8—10 mm long, reddish brown; pedicels 4—5 mm long. *Flowers* pink to red outside, cream inside. *Sepals* ± 1 mm long, suborbicular, margin ciliate. *Petals* 2.5—3.0 × 1—2 mm, ovate-oblong, fleshy, margin subentire, incurved, with distinct venation on ventral face. *Disc* fleshy, flat, obsoletely 5-lobed, margin slightly undulate, creamy-white, brown-spotted. *Stamens* 1.0—1.5 mm long; anthers oblong. *Ovary* 3-locular; ovules 3—6 per locule; style 0.5 mm long; stigma obsoletely 3-lobed. *Capsules* red, obconic-trigonous, smooth, chartaceous, 4—6 mm long. *Seeds* dark brown, 3—4 mm

long, completely enveloped by an aril on one side and incompletely on other side; aril pink. Figures 59—61.

A monotypic genus, confined to the winter rainfall region of the Western Cape and Namaqualand.

Etymology: The generic name *Gloveria* commemorates the botanist Ruth Glover (later Mrs Wordsworth), who was on the staff of the Bolus Herbarium *ca.* 1915 (Gunn & Codd 1981). She was the first to recognize the disjunct distribution pattern of the originally described *Celastrus integrifolius* and made the combination in *Gymnosporia*.

1. **Gloveria integrifolia** *(L.f.) M. Jordaan*, comb. nov. Type: Cape of Good Hope, *Thunberg* in *Herb. Thunberg 5610* (UPS, lecto., here designated; PRE, microfiche!).

Celastrus integrifolius L.f.: 153 (1781); L.f.: 237 (1784); Thunb.: 42 (1794); Willd.: 1128 (1798); Thunb.: 219 (1823); Sprengel: 773 (1824); DC.: 8 (1825); Eckl. & Zeyh.: 119 (1834¾1835) (specimen 936). *Catha integrifolia* (L.f.) G. Don: 9 (1832). *Gymnosporia integrifolia* (L.f.) Glover: 206 (1915); Davison: 302 (1927); Loes.: 150 (1942).

Species description as for the genus.

Common names: splint false spike-thorn, *spalkbasterpendoring*, so called because it is used to splint broken legs of stock (*Van der Westhuizen 78/79* in PRE).

Flowering time: October—December.
Fruiting time: December—March.

Diagnostic features: plants have spines with more than one fascicle of leaves or scars of leaves; sessile, glaucous, entire leaves (hence specific epithet) with venation obsolete; ovules 3—6 per locule; disc spotted brown and aril pink.

Distribution and habitat: this distinct species is well known from all the mountains (Langeberg, Warmwaterberg, Anysberg, Touwsberg, Rooiberg, Gamkaberg) in the Little Karoo between Robertson in the west and foothills of the Groot Swartberg at De Rust in the east. Plants grow in karroid broken veld in the Succulent Karoo Biome on Enon conglomerate or the Bokkeveld Series of shale, on sandy loam or clay soil. *G. integrifolia* is also known from a few localities on the west coast of Namaqualand,

growing at sea level from Spektakel and Hondeklipbaai in the north to Brandsebaai in the south.

Vouchers: *Dahlstrand 2299* (J, PRE, STE); *Ecklon & Zeyher 936* (GRA, SAM); *Jordaan 2283* (PRE); *Pillans 17965* (BOL); *Zietsman 971* (NMB).

9.4 The genus *Gymnosporia* (Wight & Arn.) Hook.f.

46270000 *GYMNOSPORIA*

Gymnosporia *(Wight & Arn.) Hook. f.* in Bentham & Hooker, Genera plantarum 1: 365 (1862) emend. Loes. (1942) (*nomen conservandum*). Type species: *Gymnosporia montana* (Roth ex Roem. & Schult.) Benth.: 400 (1863) (*typ. cons.*).

Celastrus sect. *Gymnosporia* Wight & Arn.: 159 (1834).

Gymnosporia Subgen. 1. *Eugymnosporia* Loes. Sect. 1. *Spinosae* Loes.: 207 (1892).

Eucentrus C. Presl: 33 (1844); ex Endl.: 82 (1850).

Polyacanthus C. Presl: 33 (1844).

Small trees, shrubs or rhizomatous suffrutices, spinescent, usually with long shoots and weakly or well developed brachyblasts, dioecious, polygamodioecious or bisexual, glabrous or pubescent. *Spines* slender or very robust, straight, axillary or terminating brachyblasts, occasionally leafy and/or floriferous. *Branches* terete, angular to striate-angular, green, grey, reddish brown to purplish brown, often drooping; lenticels if present, black dots, transverse splits or yellow dots (blister-like); bark smooth or flaking. *Leaves* alternate or fasciculate on brachyblasts, glabrous or puberulous, subsessile or shortly petiolate; lamina linear, lanceolate, elliptic to broadly obovate, ovate or orbiculate; margin entire or with irregular to regular teeth; petiole 1—3 mm long, or rarely up to 10 mm long. *Stipules* free, subulate, marcescent. *Inflorescence* a monochasium, subdichasium, dichasium, or a fasciculate glomerate, few to many-flowers in each cyme, solitary or fasciculate in axils of leaves or branches or on spines; peduncles very short and reduced or up to 20 mm long; pedicels very short and reduced or up to 7 mm long, articulate at or near base.

Flowers pentamerous, hypogynous, mostly functionally unisexual with staminodes in female and pistillodes in male flowers (except *G. putterlickioides* with hermaphrodite flowers). *Sepals* unequal or equal, imbricate in bud, margin fimbriate, ciliate or rarely subentire. *Petals* mostly white, cream, yellow, pale green or occasionally pink or red, imbricate in bud, margin ciliate or laciniate, rarely entire, spreading or reflexed. *Disc* intrastaminal, convex or concave, 5—10-lobed, yellow or red. *Stamens* attached to base of disc; anthers introrse, with 2 thecae, dehiscing longitudinally. *Gynoecium* syncarpous; ovary with quarter to half immersed in disc, (2)3(4)-locular with 2(3) erect, collateral ovules in each locule, funiculus very short or bent; style terete, short or elongate; stigma (2)3(4)-lobed. *Fruit* a dry capsule opening longitudinally, loculicidal and septifragal. *Capsules* yellow to orange, pink to red, light to dark brown; globose, obconic, trigonous, triquetrous, pyriform or conic-pyramidal; smooth to rugose, pitted or veined; pericarp semi-fleshy, chartaceous, coriaceous, woody or ridged. *Seeds* 1—4, glossy, reddish brown or black; aril fleshy or thin, partially to completely covering the seed, or reduced to a rim at base of seed, pinkish, white, yellow, or orange. Figures 62—126.

A genus of about 40 species, extending over most of Africa and Madagascar, as far north as Spain in southern Europe and eastwards as far as India (perhaps as far east as Sri Lanka, Malaysia and Queensland, Australia — see Chapter 1.

Key to sections of *Gymnosporia*

1a Leaves with one or both surfaces puberulous; Transvaal and Zimbabwe 2

1b Leaves with both surfaces glabrous; widespread 4

2a Fascicles of leaves spirally arranged or in zig-zag arrangement on branches; aril reduced to a basal rim; capsules glabrous ..... IX. sect. ***Tenuispinae***

2b Fascicles of leaves not spirally arranged or in zig-zag arrangement on branches, often on spines; aril partially or completely covering the seed; capsules puberulous 3

3a Leafy brachyblasts mostly on spines, few in axils of spines; leaves usually longer than 20 mm; flowers bisexual, large, more than 8 mm in diameter, disc red; capsules orange; aril completely covering the seed ..... I.sect. ***Putterlickioides***

3b Leafy brachyblasts mostly in axils of spines, few on spines; leaves usually shorter than 20 mm; flowers unisexual, small, less than 8 mm in diameter; disc yellow or green; capsules yellow; aril partially covering the seed ..... IV. sect. ***Pubescens***

4a Leafy brachyblasts arranged spirally or zig-zag on stems in axils of spines or often on spines, often with more than one node per spine; spines thin, short, with sharp needle-like tips, often terminating brachyblasts; cymes monochasial; capsules either smooth, chartaceous and obconic-trigonous or veined, woody and conic-pyramidal; aril yellow, reduced to a basal rim, fleshy ..... IX. sect. ***Tenuispinae***

4b Leafy brachyblasts mostly in axils of spines, few on spines; spines blunt, not terminating brachyblast; cymes subdichasial or dichasial; capsules smooth, rugose or pitted, variuosly shaped; pericarp chartaceous, semi-fleshy, coriaceous, woody or ridged; aril thin, pinkish, white, yellow or orange, partially or completely covering the seed 5

5a Compact, rigid shrublets or small shrubs, with leaves in crowded fascicles on short brachyblasts, closely arranged on stems, in axils of spines; leaves entire or subentire; often discolorous; branchlets brown or whitish, not angular-striate; capsules smooth, small, usually shorter than 6 mm, trigonous or triquetrous 6

5b Lax shrublets, shrubs or small trees, with well spaced internodes between fascicles of leaves or brachyblasts; leaves serrate, dentate or crenate with regular or irregular teeth (when entire, leaves glaucous or mottled brown when dry), rarely discolorous; capsules smooth, rugose or pitted, small or large, globose, obconical or pyriform 7

6a Leaves obovate-cuneate, coriaceous, margin yellowish when dry; venation obscure; capsules coriaceous, yellow to orange-red, triquetrous, with apiculate apices; inflorescences many-flowered, arranged in glomerate fascicles ..... VI. sect. ***Capitatae***

6b Leaves oblanceolate or oblong, the veins raised at least on lower surface; capsules chartaceous, reddish brown, triquetrous'without apiculate apices; inflorescences many-flowered, arranged in short pedunculate cymes ..... V. sect. ***Polyacanthae***

7a Leaf margin with irregular teeth on both halves, often sharply serrate; with distinct petioles; branchlets often reddish, glabrous or puberulous; inflorescences very lax, with pendulous capsules; capsules globose or obconical, smooth, white to red; pericarp semi-fleshy; aril orange-yellow, completely covering the seed..... ..... I. sect. ***Mossambicensis***

7b Leaf margin entire, or with regular to irregular teeth only in distal half or both halves, never sharply serrate; with or without petioles; branchlets green, brown or purplish brown, glabrous; inflorescences compact, with capsules not pendulous (peduncles short); capsules globose, smooth, rugose or pitted, red, purplish red, yellow, brown, or white-and-brown; pericarp chartaceous, coriaceous, ridged or woody; aril white, yellow or pinkish, partially covering the seed 8

8a Branchlets smooth, shiny dark-brown with obvious, yellow blister-like lenticels; capsules pyriform, smooth, red, very small; pericarp chartaceous; aril white; seeds black ..... III. sect. ***Nemorosae***

8b Branchlets smooth or rough, dull brown, purplish brown or green; without obvious lenticels, or lenticels black dots or transverse splits; capsules globose, smooth, rugose or pitted, all sizes and colours; pericarp coriaceous, woody or ridged; aril white, yellow or pinkish; seeds reddish brown 9

9a Leaves usually fasciculate on brachyblasts in axils of spines, rarely on spines; plants always with spines; branchlets green or reddish, most frequently angular; leaves entire or with irregular teeth, often only in distal half, pale to dark green, glaucous or bluish grey; capsules 2—15 mm long, (3)4-locular, occasionally 2-locular, smooth, rugose or pitted; pericarp coriaceous, woody or ridged, yellow to bright red, but not dark and deep purplish red, when dark red, half-winged, or green to white with reddish brown patches; aril white or yellow ..... VIII. sect. ***Buxifoliae***

9b Leaves usually alternate on branches, fasciculate on spines; plants sometimes without spines; branchlets reddish purple, terete; leaves entire or margin regularly serrulate, glaucous, often mottled brown when dry, or discolorous; capsules small, shorter than 7 mm, almost consistently 2-locular (rarely 3-locular among the 2-locular ones), smooth; pericarp coriaceous, dark, deep purplish red or brown; aril yellow or pinkish .... IX. sect. ***Gymnosporia***

I. Section *Putterlickioides* M. Jordaan sect. nov.

Gymnosporia sect. **Putterlickioides** *M. Jordaan* sectio nova, affinis sectio *Gymnosporiae* sed spini saepe cum nodis pluribus quam uno fasciculorum vel cicatricum foliorum; folia puberula uno vel ambabus paginis; flores magni, 8—10 mm diametro, bisexuales cum disco rubro; ovula in quoque loculo 2(3); capsulae puberulae, obconicae-trigonae, aurantiacae; semen fere omnino arillo involutum differt.

TYPE.—*Gymnosporia putterlickioides* Loes.

Shrubs or small trees; spines often with more than one node of leaf fascicles or scars of leaves; leaves puberulous on one or both sides; flowers large, 8—10 mm diameter, bisexual with a red disc; ovules 2(3) per locule; capsules puberulous, small, obconic-trigonous, orange; seeds almost completely enveloped by a well developed aril.

This section comprises only one species, ranging from Ethiopia in the north to Northern Transvaal in the south.

1. **Gymnosporia putterlickioides** *Loes.*, in Engl., Botanische Jahrbücher 17: 544 (1893); Loes.: 228 (1921); Burtt Davy & Hoyle: 38 (1936); Brenan: 128 (1949). Type: Tanzania, Handeni, Kiwanda, *Fischer 109* (K, lecto., designated by Sebsebe 1985).

Maytenus putterlickioides (Loes.) Exell & Mendonca: 238 (1953), Exell & Mendonca: 4, t. 28 (1956); Cufodontis: 479 (1958); Wilczek: 120 (1960); Dale & Greenway: 136 (1961); N. Robson: 355 (1966); N. Robson & Sousa: (1969); Van der Schijff: 9 (1969); Coates Palgrave: 501 (1981); Sebsebe: 81 (1985).

Gymnosporia fischeri var. *magniflora* Loes.: 544 (1893) nom. illegit.; Brenan: 127 (1949). Type: Tanzania, Kondoa, Irangi, *Fischer 111* (B, holo.).

Gymnosporia fischeri var. *borumensis* Loes.: 430 (1896); Schinz (1905); Gomes & Sousa: 78 (1936). Type: Mozambique, Boroma, *Menyhart 1156* (Z, holo.).

Shrub, rarely a straggling small tree, up to 3 m tall, often many-stemmed, spinescent and pubescent, occasionally forming impenetrable thickets. *Spines* up to 67(—83) mm long, usually floriferous, terminal or axillary on short shoots, often with scars of leaves or brachyblasts, up to 4 nodes per spine. *Branches* grey to brown, angular, becoming terete, with pale lenticels. *Brachyblasts* short, more frequent on spines than in axils. *Leaves* fasciculate, shortly petiolate, chartaceous, young leaves tinged red-brown, otherwise green, pubescent on one or both sides; lamina elliptic to oblanceolate or obovate, 7—52 × 6—30 mm, apex obtuse to rounded or retuse, base narrowly to broadly cuneate; margin subentire to crenate with minute glands; 3—5 principal lateral veins, midrib raised above and below; petiole 1—3 mm long, pubescent. Stipules subulate, ± 1 mm long. *Inflorescence* a many-flowered dichasium or submonochasium, in clusters in axils of spines or on spines; peduncle 5—15(—30) mm long; pedicels 2—7 mm long. *Flowers* bisexual, 10—25 per cyme, white or cream, large, up to 10 mm diam. *Sepals* 0.75—1.25 × 1.0—1.7 mm, whitish to pale green, ovate to suborbicular, margin toothed. *Petals* 4.0—4.75 × 2.5—3.0 mm, obovate to oblong, margin irregularly ciliolate. *Disc* convex, 5-lobed, red. *Stamens* 2.0—2.75 mm long. *Ovary* hairy, cream, 3-locular, subglobose; ovules 2(3) per locule; style yellow-green, 1.5—2 times as long as ovary; stigma 3-lobed. *Capsules* pink, orange to red, obconic-trigonous, smooth, pubescent, chartaceous, with styles persistent in fruiting stage, 4—6 mm long. *Seeds* 2—4, reddish brown, glossy, 3—4 mm long, almost completely enveloped by a well developed aril; aril reddish, fleshy. Figures 62—63.

Common names: large-flowered spike-thorn, *grootblom-pendoring*.

Flowering time: September—November.
Fruiting time: November—January.

Diagnostic features: distinctive pubescence on all parts of plant; flowers and leaves usually on the spines; spines usually with scars of leaves or brachyblasts, up to four nodes per spine. This species has the largest flowers of all the gymnosporias, up to 10 mm in diameter, and is the only species of *Gymnosporia* known to have bisexual flowers. *G. putterlickioides* can be distinghuished further by its hairy, orange to red, obconic-trigonous capsules. The only other southern African species with hairy fruits is *G. pubescens*, which can be distinguished from *G. putterlickioides* by the globose shape and yellowish colour of its fruit.

Distribution and habitat: *G. putterlickioides* occurs in bushveld, often on termitaria or in riverine areas. It enters the FSA region only in the Northern Transvaal at Pafuri and Punda Maria areas (Kruger National Park), from where it ranges throughout the eastern parts of Africa as far north as Ethiopia, as well as to Angola and Zaïre.

Vouchers: *Archer 392* (KNP); *Brynard & Pienaar 4263* (PRE); *Engelbrecht 6121* (KNP); *Van Rooyen 1406* (PRE, PRU); *Van Rooyen & Bredenkamp 614* (PRE, PRU).

II. Section *Mossambicensis* M. Jordaan sect. nov.

Gymnosporia sect. **Mossambicensis** *M. Jordaan* sectio nova, affinis sectio *Putterlickioides* sed rami,ramunculi pedunculique puberuli vel glabri; folia plerumque non in spinis, sed in brachyblastis brevibus in axillis spinarum vel in ramis fasciculata; laminae costis elevatis, petiolis distinctis et ambobus dimidiis serratis; flores albi vel rubri; capsulae in pedicellis longis pendentes, globosae et subcarnosae vel obconico-trigonae et subcoriaceae, flavidae rubro suffusae, loculicide basin versus dehiscentes; semina omnino arillo aurantiaco-flavo involuta differt.

TYPE.—*Gymnosporia mossambicensis* (Klotzsch) Loes.

Rhizomatous suffrutices, shrubs or small trees; branches, twigs and peduncles puberulous or glabrous; leaves usually not on spines, but fasciculate on branches or in axils of spines; with raised midribs, serrations on both halves of leaves; with distinct petioles; flowers white or red; capsules pendulous on long stalks, globose and semi-fleshy or pyriform and subcoriaceous, reddish when mature; seeds completely enveloped by an orange-yellow aril.

This section is the third largest and is confined to the eastern parts of Africa, from the Eastern Cape in the south to Tanzania in the north as well as to Zanzibar and Madagascar. It comprises three species from southern Africa, but further northwards four other taxa can be included.

Key to the species

1a Shrubs or small trees on forest margins or as forest understorey; Northern and Eastern Transvaal, Swaziland, Kwazulu/Natal, Eastern Cape 2

1b Rhizomatous suffrutices in grassland; southern Kwazulu/Natal and Pondoland .... 4. ***G. vanwykii***

2a Branches, twigs and peduncles puberulous; leaves small, usually shorter than 25 mm; flowers tiny, 2 mm diameter, red; capsule obconic-trigonous, subcoriaceous, inside of capsule valves dull yellow after dehiscence ..... 3. ***G. rubra***

2b Branches (and all other parts) glabrous; leaves usually longer than 25 mm; flowers more than 2 mm in diameter, white; capsule globose, semi-fleshy, inside of capsule valves pink to purple after dehiscence ..... 2 ***G. mossambicensis***

2. **Gymnosporia mossambicensis** *(Klotzsch) Loes.*, in Engl., Botanische Jahrbücher 17: 547 (1893); Hutch.: 463 (1946). Type: Mozambique, Inhambane, Delagoa Bay [Maputo], *Peters s.n.* (B, holo.†); *De Winter 9385*, Transvaal, Mount Sheba Nature Reserve, 22.1.1972 (PRE, neotype!, here designated).

Celastrus mossambicensis Klotzsch: 112 (1862); Oliv.: 362 (1868); Bak. f.: 44 (1911); Eyles: 404 (1917). *Maytenus mossambicensis* (Klotzsch) Blakelock: 37 (1957); Marais: 385 (1960); N. Robson: 362 (1966); Van der Scijff: 64 (1969); Compton: 334 (1976); Coates Palgrave: 498 (1981); Moll: 185, 187 (1981); Moll: 185, 187, 193 (1992); Pooley: 266 (1993).

Gymnosporia harveyana Loes.: 430 (1896); Davison: 313 (1927); Burtt Davy: 448 (1932); Hutch.: 668 (1946). Type: Kwazulu/Natal, Krantzkloof, *Schlechter 3192* (BOL, lecto.!, here designated).

Celastrus concinnus N.E. Br.: 16 (1906); Wood: 138 (1909); Bak. f.: 44 (1911). *Gymnosporia concinna* (N.E. Br.) Bews: 129 (1921). Type: Kwazulu/Natal, Lidgetton, *Medley Wood 1395* (K, lecto., here designated, PRE cibachrome!; NH!, isolecto.).

Much-branched shrub or small tree up to 6 m tall, spinescent, glabrous. *Spines* slender, up to 70 mm long, axillary or terminal on short branches. *Branches* reddish purple to reddish brown with pale lenticels, young branchlets angular, becoming terete.

Brachyblasts up to 4 mm long. *Leaves* alternate or fasciculate, membranous to chartaceous, shiny bright green above, paler below, petiolate, glabrous; lamina ovate or lanceolate to elliptic or subcircular, 10—60(—100) × 6—35(—45) mm, apex acute, shortly acuminate to obtuse or rounded, base subcordate to cuneate; margin irregularly rounded-serrulate to acutely incurved-denticulate almost to base; venation more prominent below than above, midrib raised on both sides; petiole 2—8(—10) mm long. *Stipules* conspicuous, subfiliform, about 2 mm long. *Inflorescence* a dichasium or monochasium, solitary, axillary; peduncle (5—)(7—23) mm long, glabrous; pedicels 2.0—5.5 mm long. *Flowers* white, 2.5—4.0(—5.0) mm diam. *Sepals* 0.4—1.0 mm long, unequal, triangular to semicircular, margin ciliolate to subentire. *Petals* 1.5—2.7 mm long, oblong to oblong-elliptic, margin ciliolate. *Disc* yellow, small, convex, 5-lobed. *Male flowers* with stamens slightly shorter than petals; filaments 0.7—1.0 mm long, slender. *Female flowers* with staminodes much shorter than in male flowers. *Ovary* 3-locular, subglobose; style short; stigma 3-lobed, divergent. *Capsules* white outside, becoming pink to red when mature, globose, smooth, semi-fleshy, with style nonpersistent in fruiting stage, inside of valves pink, becoming purple, 7—13 mm long, pendulous on a long slender stalks. *Seeds* 1—3, reddish brown, rugulose, completely enveloped by a well developed aril; aril orange-red. Figures 64—65.

Common names: black forest spike-thorn, *swartbospendoring*.

Flowering time: all year round.
Fruiting time: all year round.

Diagnostic features: plants glabrous; leaves often with acutely incurved-denticulate margins, glossy dark green above and with distinct petioles, up to 10 mm long; midribs raised on both sides; capsules globose, semi-fleshy, with the inside of valves purple when dehiscent; arils orange-red, completely covering the seeds.

Distribution and habitat: *G. mossambicensis* is fairly widespread on forest margins or as an understorey shrub or small tree in coastal and inland tropical forests in the Eastern Cape as far south as the Uitenhage district, eastwards through Kwazulu/Natal, Swaziland, Eastern and Nothern Transvaal. It also occurs further northwards into Mozambique and tropical East Africa as far north as Tanzania.

Vouchers: *Burtt Davy 332* (BOL, PRE); *Compton 29520* (NBG, PRE); *Esterhuysen 23048* (BOL); *Gerstner 4840* (PRE); *Medley Wood 6336* (NH).

3. **Gymnosporia rubra** *(Harv.) Loes.* in Bulletin L'Herbier Boissier 4: 430 (1896); Pegler: 13 (1918); Bews: 129 (1921); Davison: 309 (1927); Henkel: 91 (1934); Loes.: 150 (1942). Type: Kwazulu/Natal, Nototi River, *Gerrard 54* (K, holo.; PRE, cibachrome!; BM, iso.).

Celastrus ruber Harv.: 592 (1862); Wood: 138 (1909). *Maytenus mossambicensis* var. *rubra* (Harv.) Blakelock: 38 (1957) pro parte quoad syn. *Celastrum rubrum* et *Gymnosporiam rubram* et specim. Kwazulu/Natal.

Much-branched shrub up to 2 m tall, spinescent. *Spines* slender, up to 35 mm long, puberulous. *Branches* slender, scandent, terete, greyish brown; twigs puberulous with rigid white hairs. *Leaves* alternate or fasciculate, membranous or chartaceous, green, petiolate, glabrous; lamina ovate or ovate-rotund, 5—35 × 6—15 mm, apex rounded, base subcordate or rounded; margin serrulate, or acutely denticulate; venation more conspicuous above than below; petiole 2—3 mm long. *Stipules* small, subulate. *Inflorescence* a subdichasium, with cymes on long peduncles, diffuse, longer than leaves; peduncle puberulous or glabrous, 12—15 mm long; pedicels ± 1 mm long. *Flowers* pink or dark red, usually 3—5 per cyme, very small, 2 mm diameter. *Sepals* 0.5 mm long, ovate-triangular, margin ciliolate. *Petals* 1 mm long, subentire, margin wavy, oblong. *Disc* crenulate. *Stamens* 0.4 mm long; anthers short. *Ovary* 3-locular; ovules 2 per locule; style short; stigma 0.5 mm long, 3-lobed. *Capsules* red, smooth, obconic-trigonous, subcoriaceous, 10 mm long. *Seeds* 1—3, pale brown, 6 mm long, completely enveloped by an aril; aril orange, thin. Figures 66—67.

Proposed common names: red-flowered forest spike-thorn, *rooiblom-bospendoring*.

Flowering time: October—April.
Fruiting time: April—July.

Diagnostic features: branches, twigs, spines and often peduncles puberulous; leaves with distinct petioles and subcordate bases; fungi, in the form of black dots, are often

present on the leaves; flowers tiny, 2 mm in diameter, pink to dark red; capsules obconic-trigonous and subcoriaceous.

Distribution and habitat: *G. rubra* occurs as far south as Kei Road in the Eastern Cape, eastwards through Kwazulu/Natal to the Eastern Transvaal. Plants grow in shade in inland or coastal forests, occasionally in bushveld, particularly along rivers.

Vouchers: *Davidson 1555* (J); *Marais 780* (BR, PRE); *Medley Wood 3963* (BOL, NH); *Schlechter 6350* (BOL, GRA, PRE); *Van Wyk BSA 646* (PRU).

4. **Gymnosporia vanwykii** *(R.H. Archer) M. Jordaan*, comb. nov. Type: Transkei, Lusikisiki District, Magwa Falls, *Van Wyk & Matthews 7630* (PRU!, holo.; NH!, PRE!, iso.).

Maytenus vanwykii R.H. Archer: 393 (1992).

Geoxylic suffrutex up to 0.5 m tall, producing several erect shoots from orange-tinged rhizomes, spinescent, glabrous, growing in colonies. *Spines* axillary, leafless or rarely with reduced leaves towards the tips, up to 15 mm long. *Branches* angular and green at first, becoming terete, brown and longitudinally striate when mature. *Leaves* alternate, rarely fasciculate, subcoriaceous, pale green above, whitish green below, petiolate, glabrous; lamina elliptic or elliptic-ovate, (9—)17—25(—40) × (4—)10—23(—32) mm, apex acute to rounded, base attenuate; margin glandular-serrulate; principal lateral veins alternate or opposite, 5—7 pairs, midrib slightly raised above and below; petiole 2—4 mm long. *Stipules* minute, subulate, margin laciniate, marcescent, 0.5—1.0 mm long. *Inflorescence* a dichasium, solitary, axillary; peduncle 3—11 mm long; pedicels 2—4 mm long. *Flowers* white, ± 4.5 × 2.5 mm. *Sepals* pale green tinged with red, triangular, apex acuminate, margin entire or slightly laciniate, 1.0 × 0.8 mm. *Petals* obovate to oblanceolate, erect, margin entire or slightly laciniate, 2.5 mm long. *Disc* concave with shallowly lobed margin. *Male flowers* with stamens longer than petals; filaments 4 mm long; anthers 0.5 mm long. *Female flowers* with staminodes shorter than petals, inserted opposite sinuses below margin of disc, 1.5 mm long. *Ovary* 3-locular; ovules 2 per locule; style 1.5 mm long; stigma 3-lobed, spreading in female flowers, exserted. *Capsules* yellowish green, often tinged red, obconic-trigonous, 7—8 mm long, smooth, semi-fleshy. *Seeds* 1—3, yellowish brown; aril orange-yellow, completely covering the seed. Figures 68—69.

Proposed common names: Pondo dwarf spike-thorn, *Pondo-dwergpendoring*.

Flowering time: mainly November—January.
Fruiting time: February—April.

Diagnostic features: *G. vanwykii* is distinguished from the other two members of this section by its specific habitat, its suffrutex habit, male flowers with stamens exserted and stigma which extends beyond the petals in female flowers.

Distribution and habitat: *G. vanwykii* is a geoxylic suffrutex endemic mainly to the Natal Group sandstone region of southern Kwazulu/Kwazulu/Natal and Pondoland from the Dwessa Nature Reserve, Mazeppa Bay and Manubi Forest in the south to the Umtamvuna Nature Reserve in the north. Plants grow in coastal grassland on acidic sandy soils.

Vouchers: *Abbott 2567* (NH, PRU); *Archer 11* (NH, PRU); *Nicholson 2467* (NH); *Van Wyk 6135* (PRE); *Venter 921* (PRE).

III. Section *Nemorosae* M. Jordaan sect. nov.

Gymnosporia sect. **Nemorosae** *M. Jordaan* sectio nova, affinis sectio *Mossambicensis*; ramuli juveni teretes, rubro-brunnei cum lenticellis laete flavis prominentibus; spinae robustae, nitidae atrobrunneae; folia obscure viridia, in fasciculis in axillis spinarum, raro in spinis; flores albi; capsulae parvae, infra 8 mm longae, pyriformae, chartaceae, dum maturae rubrae; semen nigrescens; arillus albus, semen ex parte tegens differt.

TYPE.—*Gymnosporia nemorosa* (Eckl. & Zeyh.) Szyszyl.

Shrubs or small trees; young branchlets terete, reddish brown, with prominent pale yellow lenticels; spines robust and shiny dark brown; leaves dull green, in fascicles in axils of spines, rarely on spines; flowers white; capsules small, shorter than 8 mm, pyriform, chartaceous, smooth and red when mature; seeds blackish; aril white, partially covering the seed.

This section is represented by only one species, confined to the eastern parts of southern Africa, growing in forest understorey or along forest margins.

5. **Gymnosporia nemorosa** (*Eckl. & Zeyh.*) *Szyszyl.*, Polypetalae Disciflorae Rehmannianae: 35 (1888); Davison: 316 (1927); Henkel: 89 (1934). Type: Cape, Krakakamma, Adow & Olifantshoek [Uitenhage], *Ecklon & Zeyher 938* (SAM, lecto.!, here designated; HAL!, isolecto.).

Celastrus nemorosus Eckl. & Zeyh.: 120 (1834—1835); Walp.: 533 (1842); Sond.: 460 (1860); Kuntze: 37 (1898); Wood: 138 (1908). *Maytenus nemorosa* (Eckl. & Zeyh.) Marais: 385 (1960); N. Robson: 17 (1965); Ross: 231 (1972); Compton: 335 (1976); Coates Palgrave: 498 (1981); Moll: 188 (1981); Bond & Goldblatt: 224 (1984); Moll: 188, 193 (1992); Pooley: 266 (1993).

Celastrus spathephyllus Eckl. & Zeyh.: 121 (1834—1835); Walp.: 534 (1842); Drège: 258 (1847); Ettingshausen: t. 6, Fig. 2,3 (1857). *Catha spathephylla* (Eckl. & Zeyh.) C. Presl: 33 (1844). Type: Cape, Zondagrivier, *Ecklon & Zeyher 950* (S, lecto.!, here designated).

Celastrus leptopus Bernh. apud Krauss: 42 (1846). Type: Cape, Goukamma [George], *Bernhard s.n.* (Herb. Boiss. in G, lecto.!, here designated).

Evergreen, much-branched shrub or small tree up to 5 m tall, some branches drooping, spinescent, glabrous. *Spines* robust, up to 65 (—80) mm long, shiny dark brown, borne on and below flowering branches, rarely leafy and floriferous. *Branches* terete, twigs subangular, reddish brown, becoming greyish brown, with small, pale yellow lenticels. *Leaves* alternate or fasciculate, subcoriaceous, dull green above, paler green below, petiolate, glabrous; lamina obovate or elliptic, 30—65 × 15—35 mm, apex rounded or slightly emarginate, base tapering; margin dentato-serrate; venation distinct, lateral veins about six, midrib prominent on both sides; petiole 2-8 mm long. *Stipules* deltoid, apex long acuminate, 1.5 mm long. *Inflorescence* a lax dichasium, much shorter than the leaves; peduncle 5—25 mm long, slender; pedicels 8—10 mm long. *Flowers* creamy-white, sweet-smelling. *Sepals* suborbicular, apex rounded, margin uneven, 1—2 mm long. *Petals* broadly oblong, margin undulate, 2.0—2.5 mm long. *Disc* fleshy, collar-like round base of ovary. *Male flowers* with stamens as long as or longer than petals; filaments 2—3 mm long; anthers 0.5 mm long. *Female flowers* with staminodes smaller than style and stigmas. *Ovary* 3-locular; ovules 2 per locule; style 0.25—1.00 mm long;

stigmas 3-lobed, oblong, rugose with few hairs, tips hard or swollen. *Capsules* greenish yellow, becoming reddish when mature, pyriform, smooth, chartaceous, 2—4 mm long. *Seeds* 1—3, blackish; aril white, partially covering the seed. Figures 70—71.

Common names: white forest spike-thorn, *witbospendoring*.

Flowering time: August—March.
Fruiting time: December—June.

Diagnostic features: spines shiny dark brown; branches with pale yellow lenticels; leaves glossy dark green above, rather paler below — almost bluish green; capsules small, red, pyriform; aril white, partially covering the blackish seed.

Distribution and habitat: *G. nemorosa* occurs from the Eastern Cape as far south as George eastwards along the coast of Kwazulu/Kwazulu/Natal to Swaziland and as far north as the Barberton district in the Eastern Transvaal. Plants grow as small trees in coastal and inland forest, along forest fringes or on wooded hillsides.

Vouchers: *Compton 32139* (NBG); *Jordaan 2264* (PRE); *Medley Wood 3433, 11408, 11684*, (NH); *Van Jaarsveld 1191* (NBG, PRE); *Zeyher 2184* (P, S, SAM).

IV. Section *Pubescens* M. Jordaan sect. nov.

Gymnosporia sect. **Pubescens** *M. Jordaan*, sectio nova, affinis sectio *Buxifoliae* sed folia fasciculata in brachyblastis brevis in spinarum axillis, raro in spinis; lamina in ambabus paginis puberula; capsulae puberulae, flavae, arillus albus differt.

TYPE.—*Gymnosporia pubescens* (N. Robson) M. Jordaan

Much-branched shrubs; leaves fascicled on short brachyblasts in axils of spines, rarely on spines; leaves puberulous on both sides; capsules puberulous, yellow, globose; aril white, partially covering the seed.

This section is monotypic and confined to the *Colophospermum mopane* savanna, 0--300 m above sea level in the Limpopo area on both sides of the borders between Northern Transvaal, Zimbabwe and Mozambique.

6. **Gymnosporia pubescens** *(N. Robson) M. Jordaan*, comb. nov. Type: Zimbabwe, Beitbridge District, Chikwarakwara, *Wild 5347* (K, holo.; PRE!, SRGH, iso.).

Maytenus pubescens N. Robson: 24 (1965); N. Robson: 367 (1966); N. Robson & Sousa: 16 (1969).

Much-branched shrub up to 2.5 m tall, spinescent, pubescent. *Spines* robust, up to 60 mm long. *Branches* angular, reddish brown and shortly whitish pubescent when young, becoming terete, green and glabrous with age. *Brachyblasts* short. *Leaves* alternate or fasciculate, softly chartaceous, pale green or grey-green, shortly petiolate, shortly pubescent on both sides; lamina obovate to oblanceolate, 5—30 × 5—15 mm, apex rounded to emarginate, base cuneate; margin denticulate to entire; venation slightly prominent on both surfaces; petiole 0.5—2.0 mm long. *Stipules* very short, subulate, ± 0.5 mm long. *Inflorescence* a dichasium, solitary and axillary; peduncle 2—6 mm long, puberulous; pedicels 1—2 mm long, pubescent or puberulous. *Flowers* solitary or 2—7 per cyme, white or cream, 3—4 mm diameter. *Sepals* ± 1 mm long, subequal, ovate to subcircular, rounded, dorsally puberulous, margin ciliolate. *Petals* ± 1.5 mm long, oblong to spathulate, margin ciliolate. *Disc* convex, 5-lobed. *Male flowers* with stamens shorter than petals; filaments 0.7 mm long, slender; anthers short. *Female flowers* with staminodes as long as ovary. *Ovary* 3(4)-locular, ovoid, scarcely immersed in disc; ovules 2 per locule; style as long as ovary; stigma 3(4)-lobed. *Capsules* yellow, globose, smooth, puberulous, coriaceous, with style persistent in fruiting stage, 6—7 mm long. *Seeds* 1—4, reddish brown, glossy, 4 mm long; aril white, partially covering the seed. Figures 72—73.

Proposed common names: hairy spike-thorn, *harige pendoring*.

Flowering time: November—January.
Fruiting time: February—May.

Diagnostic features: leaves and inflorescences mainly on short brachyblasts in axils of spines; leaves with puberulous indumentum on both surfaces; flowers 3—4 mm in

diameter; capsules globose, yellow and hairy. The only other species with hairy leaves and fruit, *M. putterlickioides*, has leaves and inflorescences mainly on the spines, larger flowers (up to 10 mm in diameter) and obconic-trigonous, orange-red fruit.

Distribution and habitat: *G. pubescens* is known only from a few localities in the border area between South Africa, Zimbabwe and Mozambique. In southern Africa it is recorded from the Soutpansberg and Kruger National Park (Pafuri area), in Zimbabwe in the Nuanetsi district, near Malipate, and in Mozambique in the Maråvia district, near Chicoa. Plants grow in *Colophospermum mopane* savanna and in clay soil among rocks on hills.

Vouchers: *Brynard & Pienaar 4500* (PRE); *Codd 5983* (BR, PRE); *Codd & De Winter 5528* (PRE); *Van Rooyen 3120* (PRE); *Van Wyk BSA2018, BSA2026* (PRE, PRU).

V. Section *Polyacanthae* M. Jordaan sect. nov.

Gymnosporia sect. **Polyacanthae** *M. Jordaan* sectio nova, affinis sectio *Nemorosae* sed fruticuli compacti rigidi vel frutices parvi; folia in fasciculis coarctatis in ramis vel in spinarum axillis, raro in spinis; lamina integra vel dentis paucis, viridis, membranacea vel tenue coriacea, in ambabus paginis valde venosa; capsulae dum maturae rubrae, parvissimae, triquetrae; arillo flavo, differt.

TYPE.--*Gymnosporia polyacantha* (Sond.) Szyszyl.

Compact, rigid shrublets to small shrubs; leaves in crowded fascicles in axils of spines, rarely on spines, entire or with few teeth, green, membranous to thinly leathery, venation very obvious on both sides; capsules red when mature, very small, trigonous; seeds black, aril partially covering the seeds.

This section is represented by two taxa and has a disjunct distribution pattern, with populations of the one subspecies in the western parts of the North-West Province, PWV and Northern Transvaal and the other subspecies in the Eastern Cape.

7. **Gymnosporia polyacantha** *(Sond.) Szyszyl.*, Polypetalae Disciflorae Rehmannianae: 33 (1888) (non specim. quad *Rehmann 4080*, Tvl.); Loes.: 207 (1897); Schönland: 73 (1919); Davison: 302 (1927); Loes.: 150 (1942). Type: Cape, Zwartkopsriver [Uitenhage], *Ecklon & Zeyher 946* (SAM, lecto.! here designated; BOL!, HAL!, K, P, isolecto.).

Key to the subspecies

1a Shrubs or small trees growing singly or in groups, never forming impenetrable thickets; branches drooping and inflexed, glabrous; leaves usually longer than 15 mm; Eastern Cape ..... 7a. ***G. polyacantha*** subsp. ***polyacantha***

1b Shrublets with underground rhizomes, or small shrubs, forming impenetrable thickets; branches not drooping, muricate; leaves usually shorter than 15 mm; Northern Transvaal, North-West Province and PWV ..... 7b. ***G. polyacantha*** subsp. ***vaccinifolia***

7a. subsp. **polyacantha**

Celastrus polyacanthus Sond.: 455 (1860); non Wood: 138 (1909); non Bews: 129 (1921); non Eyles: 404 (1917) (Zimbabwe, Victoria, *Eyles 1100*). *Maytenus polyacantha* sensu Marais p.p.: 384 (1960); sensu Robson p.p.: 17 (1965); sensu Coates Palgrave p.p.: 500 (1981); Bond & Goldblatt: 224 (1984).

Celastrus linearis sensu Eckl. & Zeyh.: 120 (1834—1835), non L.f. (1781).

Polyacanthus angustifolius C. Presl: 34 (1844). Type the same as for *Gymnosporia polyacantha*.

Rigid shrub or small tree, up to 3 m tall, spinescent, glabrous; long shoots curving downwards and inwards, giving the plant a weeping habit. *Spines* robust, rarely leafy and floriferous, up to 70 mm long. *Branches* terete, whitish grey, smooth, glabrous. *Leaves* alternate towards ends of branchlets or fasciculate, membranous or very thinly coriaceous, pale green or yellowish green, glabrous, subsessile; lamina oblanceolate or linear-oblanceolate, 10—30 × 2—8 mm, apex obtuse or emarginate, base cuneate; margin entire or slightly serrate; venation more obvious below than above; petiole 1 mm long. *Stipules* subulate, ± 1 mm long. *Inflorescence* a dichasium, shorter than leaves; peduncle up to 6 mm long; pedicels 1.0—1.5 mm long. *Flowers* cream or white. *Sepals* 0.75 mm

long, suborbicular, margin ciliate. *Petals* 1.75—2.0 mm long, oblong, margin uneven, somewhat undulate, reflexed lengthwise. *Disc* yellow, fleshy, annular, margin crenate. *Male flowers* with stamens as long as or longer than petals; filaments 1.75—2.0 mm long. *Female flowers* with staminodes shorter than in male flowers. *Ovary* green, 3-locular; ovules 2 per locule; style 0.25 mm long; stigma 3-lobed, up to 1 mm long. *Capsules* red when mature, triquetrous, smooth, chartaceous, with style persistent in fruiting stage, curled, 4 mm long. Seeds 1—3, black; aril yellow, partially covering the seed. Figures 74—75.

Common names: kraal spike-thorn, *kraalpendoring*.

Flowering time: March—August.
Fruiting time: April—October.

Diagnostic features: weeping habit with long, curved, inflexed branches; branches glabrous, smooth; leaves crowded in fascicles on the stems; capsules very small, smooth, triquetrous; seed black.

Distribution and habitat: *G. polyacantha* subsp. *polyacantha* is confined to a small area in the Eastern Cape, 0—300 m above sea level. It occurs in the Port Elizabeth, Uitenhage, Alexandria, Albany, Fort Beaufort and Graaff-Reinet districts in arid scrub or valley bushveld, semi-karroid and spekboomveld.

Vouchers: *Jordaan 2310* (PRE); *MacOwan 779* (GRA); *Marais 438* (PRE); *Paterson 1079* (BOL, GRA); *Zeyher 956* (BOL, GRA, SAM, STE).

7b. subsp. **vaccinifolia** (*P. Conrath*) *M. Jordaan*, stat. nov. Type: Transvaal, Modderfontein, *Conrath 88* (K, holo.!).

Gymnosporia vaccinifolia Conrath: 221 (1908); Sim: 78 (1921); sensu Davison: 303 (1927), non specimen quad *Pearson 9072* (BOL); Burtt Davy: 448 (1932).

Sensu *Maytenus polyacantha* (Sond.) Marais: 306 (1960) p.p.; sensu Jeppe: 36 (1974) p.p.; sensu Van Gogh & Anderson: 56 (1988); sensu Van Wyk & Malan: 50 (1988).

Small, evergreen, very spiny, compact shrublet or shrub up to 2 m tall, stems erect or spreading; stems spreading by means of rhizomes, forming dense, very thorny, impenetrable thickets. *Spines* slender, occasionally leafy, not floriferous, up to 95 mm long. *Branches* subterete, pallid, glaucous-green or greyish, short ones very abbreviate in axils of spines, muricate. *Leaves* fasciculate, coriaceous, pallid glaucous-green, lighter green below than above, shortly petiolate, glabrous; lamina elliptic, oblanceolate or narrowly obovate, 5—15 × 2.0—3.5 mm, apex obtuse or subemarginate, very often mucronulate, base cuneate; margin minutely glandular-serrate to entire, thickened; venation obvious on both sides; petiole 1—2 mm long, grooved above. *Stipules* subulate. *Inflorescence* a dichasium of many-flowered cymes; peduncle 4—5 mm long; pedicels 1—4 mm long. *Flowers* sweetly scented, white. *Sepals* 0.5-1.5 mm long, suborbicular, submembranous, slightly concave above, margin irregularly laciniate. *Petals* 1.75—2.00 × 1.0—1.5 mm, elliptic or ovate-elliptic, finally patent or slightly deflexed, margin minutely denticulate. *Disc* fleshy, annular. *Male flowers* with stamens as long as or longer than petals; filaments 1.75—2.25 mm long, broader at base; anthers cream. *Female flowers* with staminodes much shorter than petals and shorter than in male flowers. *Ovary* 3-locular; ovules 2 per locule; style very short; stigmas 3-lobed, ± 0.5 mm long. *Capsules* bright orange-red, triquetrous, smooth, chartaceous, style persistent in fruiting stage, 2—3 mm long. *Seeds* 1—3, black; aril yellow, partially covering the seed. Figures 76—77.

Common names: buffalo spike-thorn, *buffelpendoring*. This species is often eaten by buffalo, eland and other game (*Louw 1403* in PRE) and (*Hofmeyr 118* in PRE).

Flowering time: January—May.
Fruiting time: February—September.

Diagnostic features: plants grow gregariously and form impenetrable thickets; leaves crowded on the stems; branches muricate; capsules small, smooth, triquetrous, red.

Distribution and habitat: this taxon occurs in the North-West Province in the Marico, Pilanesberg, Brits, Rustenburg, Potchefstroom and Ventersdorp districts, in the PWV, and northwards as far as Wolkberg in Northern Transvaal and as far east as Sekhukhuniland. It has not been recorded from the Eastern Transvaal. Plants grow on rocky outcrops in mixed bushveld and bankenveld. It has been recorded in sandy loam or sandy clay soil on dolomite or quartzite formations, usually on the edges of bush clumps.

Vouchers: *Gerstner 6481* (PRE); *Gillett 3282* (BOL); *Glen 1922* (J, PRE); *Mogg 23138* (J); *Van Jaarsveld 1800* (NBG).

VI. Section *Capitatae* M. Jordaan sect. nov.

Gymnosporia sect. **Capitatae** *M. Jordaan* sectio nova, affinis sect. *Gymnosporiae* sed frutices rigidi, ramosissimi; brachyblasti in axillis bene evoluti; spinae raro foliaceae; folia coriacea, discoloria, margine sicco flavido, integro; inflorescentiae ad fasciculos multifloros glomeratos reductae; capsulae parvissimae, 2—4 mm longae, coriaceae, triquetrae, apicibus apiculatis.

TYPE.—*Gymnosporia capitata* (E. Mey. ex Sond.) Loes.

Rigid, much-branched shrubs; brachyblasts well developed in axils; spines rarely leafy; leaves coriaceous, discolorous; margin yellowish when dry, entire; inflorescences reduced to many-flowered, glomerate fascicles; capsules very small, 2—4 mm long, coriaceous, triquetrous with apiculate apices.

This section is monotypic and confined to the Eastern Cape.

8. **Gymnosporia capitata** (*E. Mey. ex Sond.*) *Loes.* in Engl. & Prantl, Die natürlichen Pflanzenfamilien 3,5: 207 (1896); Sim: 186 (1907); Schönland: 73 (1919); Davison: 293 (1927); Loes.: 150 (1942). Type: Cape, Near Basche, *Drège s.n.* (HAL, lecto.!, here designated).

Celastrus capitatus E. Mey.: 147 (1843) nomen nudum; Ettingshausen: t. 7, Fig. 7 (1857); ex Sond.: 458 (1860); Ettingshausen: t. 62 (1861). *Maytenus capitata* (E. Mey. ex Sond.) Marais: 384 (1960); Bond & Goldblatt: 224 (1984).

Non *Celastrus rigidus* Thunb.: 220 (1823) [name excluded in Flora capensis 1: 461 (1860) = *Rhigozum brachiatum*. *Zeyher 96*, HAL 071486 = *Dovyalis sp.* det. by Schlechtendal as *C. rigidus* Thunb.].

Celastrus rigidus sensu Eckl. & Zeyh.: 121 (1834—1835) [Bushmansrivierhoogte] *Eckl. & Zeyh. 947* (GRA!, HAL 071484!, P, SAM 43876!); Schltdl.: 624 (1847) [specimen *Zeyher 2178* (P, PRE!)].

Rigid, spreading, small, much-branched shrub up to 2.5 m tall, exceedingly spinescent, glabrous, twigs very short. *Spines* robust, up to 45(—60) mm long, rarely leafy or floriferous. *Branches* terete; young branchlets purple-red, becoming dark grey, striate; bark stripping longitudinally, revealing dark brown underbark and lenticels. *Brachyblasts* well developed, up to 10 mm long. *Leaves* fasciculate, glabrous, coriaceous, discolorous, sessile; lamina obovate, 10—25 × 3—11 mm, apex rounded to emarginate, base cuneate; margin entire, yellowish when dry; venation obscure; petiole more or less absent. *Stipules* subulate, ± 3 mm long. *Inflorescences* reduced cymes, bracts closely congested, appearing as fasciculate glomerules; peduncle more or less absent; pedicels 1.5 mm long. *Flowers* cream, fragrant. *Sepals* ± 1.5 mm long, deltoid, acuminate, margin laciniate. *Petals* ± 2 mm long, oblong, margin subentire. *Disc* fleshy, deeply 5-lobed. *Male flowers* with stamens twice to three times longer than petals; filaments 3.5 mm long. *Female flowers* with pedicels longer than in male flowers, 4 mm long. *Ovary* 3-locular; ovules 2 per locule; style 0.25 mm long; stigma 3-lobed, 0.8 mm long. *Capsules* yellow to bright orange-red, triquetrous with apiculate apices, smooth, coriaceous, styles nonpersistent in fruiting stage, 6 mm long. *Seeds* 1—3, shiny, orange or reddish brown, 3 mm long; aril white, partially covering the seed. Figures 78—79.

Common names: ashen spike-thorn, *vaalpendoring*.

Flowering time: October—April.
Fruiting time: October—June.

Diagnostic features: shrubs with well developed brachyblasts; leaves sessile, coriaceous, discolorous, entire; venation obscure; inflorescences fasciculate glomerules; capsules very small, triquetrous with apiculate apices.

Distribution and habitat: *G. capitata* is confined to valley bushveld along the coast in Eastern Cape from Kaffirkuil River in the southwest, Gouritz River, Gamtoos River, Brak River, Sundays River, Krompoort River, Baviaans River Valley, Bushmans River to Swartkei River Valley and Great Fish River and Kap Valley in the northeast.

Vouchers: *Bayliss 8476* (GRA); *Bohnen 733/2* (PRE); *Flanagan 2585* (BOL, SAM); *Galpin 8086* (GRA, PRE); *Jordaan 2315* (PRE).

VIII. Section *Tenuispinae* M. Jordaan sect. nov.

Gymnosporia sect. **Tenuispinae** *M. Jordaan* sectio nova, affinis sect. *Gymnosporiae* sed frutices laxe ramosi monoecii vel dioecii; folia fractiflexe fasciculata in caulibus in spinarum axillis vel saepe in brachyblastis in spinis; spinae cum nodis pluribus, tenuae, breves, acrae, acuminibus aciformibus, saepe brachyblastos terminantes; folia plerumque glabra, interdum puberula, margine integro vel paucidentato; inflorescentia monochasialis; capsulae flavae vel vivide rubrae, laevigatae, chartaceae, obconico-trigonae, vel lignosae, venosae, concio-pyramidales apicibus apiculatis; arillus carnosus, albus, flavus vel atropurpureus, in annulo seminis basi reductus.

TYPE.—*Gymnosporia tenuispina* (Sond.) Szyszyl.

Laxly branched monoecious or dioecious shrubs; leaves in fascicles in zig-zag arrangements on stems in axils of spines; spines thin, short, sharp needle-like points, often terminating brachyblasts; leaves usually glabrous, occasionally puberulous or mottled green when dry, margin entire or with few teeth; inflorescence a monochasium; capsules yellow to bright red, smooth, chartaceous, obconic-trigonous, or woody, veined, conic-pyramidal with apiculate apices; aril fleshy, white or yellow (dark purple in *G. arbutifolia* Hochst. ex A. Rich. of northern tropical Africa), reduced to a rim at the base of the seed.

This is the largest section, with only three species in southern Africa, 15 from further north in Africa and two from Madagascar. The highest concentration of species is in northeastern tropical Africa, from where the distribution range extends southwards, westwards and eastwards into Africa and Madagascar as far south as eastern Botswana, the old Transvaal provinces, and northern Orange Free State, with one outlier in southern Namibia and the Richtersveld in the Northern Cape.

Key to the species

1a Leaves usually wider than 15 mm, always glabrous; capsules woody, prominently veined, conic-pyramidal with apiculate apices; NE Transvaal (Kruger National Park and adjacent areas) ..... 11. **G. oxycarpa**

1b Leaves usually narrower than 15 mm, occasionally puberulous; capsules chartaceous, smooth, obconic-trigonous; Namibia, Botswana, Northern and Eastern Transvaal, North-West Province, PWV, Orange Free State and the Richtersveld 2

2a Leaves in fascicles on slender brachyblasts, arranged spirally or in zig-zag fashion on stems, or on spines, occasionally puberulous, membranous to chartaceous; Botswana, Northern and Eastern Transvaal, North-West Province, PWV and Orange Free State ..... 9. **G. tenuispina**

2b Leaves in fascicles on thick brachyblasts on the spines, rarely on stems; never puberulous, coriaceous; southern Namibia and the Richtersveld 10. **G. gariepensis**

9. **Gymnosporia tenuispina** *(Sond.) Szyszyl.*, Polypetalae Disciflorae Rehmannianae: 33 (1888); Loes.: 207 (1892); Davison: 306 (1927); Burtt Davy: 448 (1932); Loes.: 150 (1942) Hutch.: 383, 410 (1946): O.B. Miller: 7 (1949), Miller: 49 (1952). Type: Transvaal, Magaliesberg, *Burke 120* (K; lecto., here designated; PRE, cibachrome!).

Celastrus tenuispinus Sond.: 456 (1860). *Maytenus tenuispina* (Sond.) Marais: 384 (1960); N. Robson: 360 (1966); Van der Schijff: 64 (1969); Jeppe: 88 (1974); Van Gogh & Anderson: 56 (1988); Van Wyk & Malan: 124 (1988).

Gymnosporia botsabelensis Loes.: 429 (1896). Type: Transvaal, Botsabelo, *Schlechter 4076* (BOL!, lecto., here designated; G!, GRA!, P, PRE!).

Hardy, deciduous, dioecious or occasionally monoecious, many-stemmed, small shrub up to 1.5 m tall with a straggly, upright habit, spinescent, glabrous, sometimes softly hairy, growing solitary or in colonies. *Spines* slender, axillary or terminating brachyblasts, rarely leafy, up to 20 mm long. *Branches* slightly angular, becoming terete, pale vinous red to greyish brown, without visible lenticels, glabrous or puberulous. *Brachyblasts* prominent on stems. *Leaves* fasciculate with clusters of leaves in zig-zag arrangement on branches, alternate towards tips of branchlets, chartaceous, pale green,

concolorous, shiny when young, petiolate, glabrous or softly pubescent; lamina oblanceolate to narrowly elliptic or linear, 16—70 × 9—17 mm, apex subacute to rounded and mucronate, base cuneate; margin shallowly glandular denticulate to subentire; venation not prominent; petiole 1—3(—7) mm long. *Stipules* subulate, ± 1 mm long. *Inflorescence* a monochasium, solitary, axillary or 2—6 in fascicles on short shoots; peduncle 5—16 mm long; pedicels 2—9 mm long. *Flowers* greenish white, 3—7(—10) per cyme, scented. *Sepals* 1—2 mm long, glabrous or puberulous, triangular-ovate, apex rounded, margin ciliolate. *Petals* 2.0—2.5 mm long, narrowly oblong, margin irregularly ciliolate. *Disc* flat, entire or shallowly 5-lobed. *Male flowers* 5—7 mm diameter, with stamens shorter than petals; stamens 1—2 mm long. *Female flowers* 3—4 mm diam.; staminodes 0.8 mm long. *Ovary* (2)3-locular, subglobose; ovules 2 per locule; style as long as stigmatic lobes; stigma 3-lobed (occasionally 2-lobed). *Capsules* yellowish brown or reddish, obconic-trigonous, truncate, 7—13 mm long, smooth, chartaceous. *Seeds* 1—3, reddish brown, rugose; aril white, reduced to a folded rim at base of seed. Figures 80—81.

Common name: *klapperbos*.

Flowering time: October—February.
Fruiting time: December—May.

Diagnostic features: the characteristic zigzag or spiral arrangement of fasciculate leaves on stems; spines slender with sharp, thin points, often terminate brachyblasts; leaves occasionally with an indumentum; capsules pendulous, yellowish brown or occasionally red-tinged, obconic-trigonous.

Distribution and habitat: this species occurs in the old Transvaal provinces in an area from the Soutpansberg in the north, Botsabelo-Loskop Dam in the east, Vredefort (northern OFS) in the south to the North-West Province and southeastern corner of Botswana, from Serowe to Lobatse in the west. Plants grow in mixed bushveld, thickets or grassland in sandy or stony places, particularly rocky hillsides, on quartzite or granite.

Medicinal use: the roots are stamped, ground and drawn for swollen glands — see *Snyman & Noailles 262* (PRE).

Notes: Ross (1972) cited a specimen, *Strey 9559*, collected on the South Coast of Kwazulu/Natal as belonging to *Maytenus tenuispina*. Moll (1981, 1992) also mentioned *M. tenuispina* as occurring in Kwazulu/Natal. This is, however, a misidentification, because this specimen belongs to *Maytenus bachmannnii* (Loes.) Marais. *G. tenuispina* does not occur in Kwazulu/Natal. *M. bachmannii* has occasionally spines on the lower branches and its aril covers most of the seed.

Vouchers: *Du Preez 162* (NMB); *Glen 2574* (J, PRE); *Hutchinson 2957* (BOL, PRE); *Jordaan 2685* (PRE); *Keet 1283* (STE).

10. **Gymnosporia gariepensis** *M. Jordaan*, sp. nov., *G. tenuispinae* (Sond.) Szyszyl. similis, sed omnino glabro; spinis semper ramos secundarios terminantibus; ramulis juvenibus rubrobrunneis; lamina coriacea, margine semper integra; floribus fructubusque in pedicellis longis pendulis, semper in brachyblastis in ramulis lateralibus secundariis; floribus maioribus, capsulis rubris, viride suffusis, differt.

TYPE.—Namibia, 2817 (Vioolsdrif): Knersberg Peak, (—CB), 1988, *Van Jaarsveld & Leitch 9736* (PRE, holo.; NBG).

Lax, few-stemmed shrubs, up to 3 m tall, spinescent, glabrous. *Spines* small, with sharp points, terminating brachyblasts or bearing brachyblasts or scars of leaves on two to four nodes per spine, up to 40 mm long. *Branches* terete; young branchlets purplish reddish, becoming grey with small, round openings in bark, each containing a sunken lenticel, flaking in uneven white segments. *Leaves* fasciculate or alternate on young branchlets, coriaceous, pale green, subsessile, glabrous; lamina oblong or obovate-oblong, 12—40 × 2—5 mm, apex rounded or subemarginate, base cuneate; margin entire; venation obscure; petiole very short, ± 0.5 mm long. *Stipules* very short, subulate, ± 0.5 mm long. *Inflorescence* a monochasium, slightly longer than leaves, on short abbreviate lateral branchlets; peduncle ± 5 mm long; pedicels 2—4 mm long. *Flowers* not seen. *Capsules* pendulous, upper part red, lower part green, obconic-trigonous, smooth, chartaceous, 9—12 mm long. Seeds ± 5 mm long, reddish brown, rugose; aril yellow, reduced to a rim at base of seed. Figures 82—83.

Proposed common names: Gariep spike-thorn, *Gariep-pendoring*.

Flowering time: probably early spring.
Fruiting time: September—April

Diagnostic features: very laxly branched shrubs; old stems grey and new ones red-brown; spines with sharp points, terminating brachyblasts; leaves coriaceous, small or long and narrow, venation obscure; inflorescences and capsules on short abbreviate lateral branchlets; capsules pendulous, red, smooth, obconic-trigonous.

Distribution and habitat: *G. gariepensis* is confined to a small area in the extreme arid winter-rainfall area of the northern Richtersveld and southernmost part of Namibia. It has been recorded in sandy soil on granite outcrops or quartzitic mountains.

Notes: herbarium material of this new species was apparently first collected in 1918 by Ortendahl (P) at Otseha River, Great Namaqualand (the only flowering specimen). Fifty years later, in 1968, Dave Hardy, horticulturist at the Botanical Research Institute (BRI), Pretoria, collected a specimen in fruit at Ganna Gouriep in the Richtersveld. In 1986 sterile material was collected by Craven at Mara in Namibia. In 1988 Messrs Van Jaarsveld and Leitch of Kirstenbosch, collected fruiting material of this species on Knersberg Peak. The following year, Prof. Jurgens of Germany collected the species (again in fruit) on the Tatasberg. In the same year Prof. A.E. van Wyk collected sterile material at Narudous Poort in Namibia.

Vouchers: *Craven 2644* (WIND); *Hardy 2602* (PRE); *Jurgens 28856* (PRE); *Ortendahl s.n.* (P); *Van Wyk 8798* (PRU).

11. **Gymnosporia oxycarpa** (*N. Robson*) *M. Jordaan*, comb. nov. Type: *Van der Schijff & Marais 3681* (K, holo.; PRE!, iso.).

Maytenus oxycarpa N. Robson: 6 (1965); N. Robson: 360 (1966).

Small shrub up to 1.5 m tall, spinescent, glabrous. *Spines* up to 20 mm long, terminating brachyblasts, with sharp, needle-like points. *Branches* flattened, more or less

angular and purplish brown when young, becoming terete and greyish with age, without lenticels. *Brachyblasts* very short, bearing leaves and inflorescences. *Leaves* fasciculate, membranous to chartaceous, pale green or mottled brown when dry, sessile, glabrous; lamina oblanceolate, 45—70 × 12—30 mm, apex rounded, base cuneate; margin minutely serrulate or entire; venation inconspicuous; petiole absent. *Stipules* subulate, ± 1 mm long. *Inflorescence* a monochasium or subdichasium; peduncle 16—26 mm long; pedicels 7—11 mm long. *Flowers* pale green, 2—4 in each cyme, 6—9 mm diameter. *Sepals* 1—2 mm long, unequal, oblong-lanceolate to triangular, apex acute-subacute, margin ciliolate. *Petals* 3 mm long, lanceolate-triangular to narrowly oblong, margin paler green, irregularly ciliolate. *Disc* narrow, convex, 5-lobed. *Male flowers* with stamens slightly shorter than petals; filaments ± 1 mm long. *Ovary* 3-locular, ovoid; ovules 2 per locule; style 1.5 times as long as ovary; stigma 3-lobed, spreading. *Capsules* yellow tinged red, conic-pyramidal, apices apiculate, with veins prominently raised on valves when dry, woody, 17—23 mm long. *Seeds* 3—6, reddish brown, rugose; aril yellow, reduced to a rim at base of seed. Figures 84—86.

Proposed common names: large-fruit spike-thorn, *grootvrug-pendoring*.

Flowering time: November—March.
Fruiting time: April—May.

Diagnostic features: this species is easily recognized by its exceptionally large, woody capsules with very acute apices and with prominent veins on the valves when dry. The leaves are usually wider than 15 mm and the flowering and fruiting peduncles are quite long, up to more than 10 mm.

Distribution and habitat: known only from two localities, the one in the Northern Transvaal (Kruger National Park, Pafuri area) and the other in Zimbabwe from Tswiza (Nuanetsi district). *G. oxycarpa* grows on red sandy soil in dense *Colophospermum mopane* savanna.

Vouchers: *Archer 400* (PRE, PRU); *Nel 6090* (KNP); *Van Wyk BSA2030* (PRE, PRU); *Wild 4701* (K, PRE, SRGH).

VIII. Section *Buxifoliae* M. Jordaan sect. nov.

Gymnosporia sect. **Buxifoliae** *M. Jordaan* sectio nova, affinis sect. *Gymnosporia* sed ramuli viridi vel purpureo-brunnei rubescentes, saepissime angulares vel striati; folia fasciculata in brachyblastis aegre vel bene evolutis in ramis vel in spinarum axillis, in surculis juvenes solum in spinis; lamina subintegra vel irregulariter dentata, saepe solum in dimidio distali, laete vel atro-viridis, glauca vel caeruleo-grisea; capsulae in pedicellis pro ratione brevibus, globosae, parvae vel magnae, (2)3(4)-loculares, laevigatae, rugosae vel foveolatae, pericarpio coriaceo, lignoso vel porcato; arillus
flavus vel albus, semen ex parte tegens.

TYPE.—*Gymnosporia buxifolia* (L.) Szyszyl.

Shrubs or small trees, often spreading or straggling, or suffrutices; branchlets green or reddish purple-brown, most frequently angular or striate; leaves fasciculate on weakly to well developed brachyblasts in axils of spines, only on spines in young shoots, margins entire or with irregular teeth, often only in distal half, pale to dark green, glaucous or bluish grey; capsules on relatively short stalks, not pendulous, globose, small or large, (3)4-locular, occasionally 2-locular, smooth, rugose or pitted; pericarp coriaceous, woody or ridged, colour yellow to bright red, green to white with reddish brown patches; aril yellow or white, partially covering the seed.

This section is the second largest in the genus and comprises 14 species in southern Africa, with probably three more in tropical Africa. It is widely distributed over the whole of southern Africa and northwards into tropical Africa as far north as Ethiopia.

Key to the species

1a Plants suffrutices, shorter than 0.8 m 2
1b Plants shrubs or small trees, taller than 1 m 3
2a Capsules rugose, white with reddish brown patches; Eastern Cape ..... 14. **G. elliptica**
2b Capsules smooth, yellow to red; Kwazulu/Natal ..... 15. **G. uniflora**
3a Small trees in forest or forest margins 4
3b Shrubs in savanna or grassland 6
4a Leaves with distinct petioles; margin with teeth in both halves; midrib prominently raised above 5
4b Leaves subsessile, margin with few teeth usually only in distal half; midrib not prominently raised above ..... 12. **G. buxifolia**
5a Midrib conspicuously yellow when dry; capsules woody, rugose, white with reddish brown patches, larger than 7 mm ..... 16. **G. grandifolia**
5b Midrib not yellow when dry; capsules prominently ridged, smooth, yellowish, smaller than 7 mm ..... 22. **G. devenishii**
6a Leaf margin entire (only rudiments of teeth) 7
6b Leaf margin crenate or serrate 9
7a Leaves glaucous, wider than 10 mm; young stems reddish purple; disc not dark-coloured; capsules red; aril white ..... 18. **G. glaucophylla**
7b Leaves green, narrower than 10 mm; young stems green or brown; disc dark-coloured; capsules yellow; aril yellow 8
8a Leaves narrower than 5 mm; plants divaricately branched and very spiny; flowers larger than 5 mm; Great and Little Karoo and southern Namibia ..... 20. **G. szyszylowiczii**
8b Leaves narrower than 5 mm; plants randomly branched and with few slender spines; flowers smaller than 5 mm; OFS, Northern Cape ..... 21. **G. karooica**

9a Small shrubs, growing in grassland, often with spreading underground rhizomes, with angular ribbed stems in young and mature stage; leaves becoming smaller upwards and towards ends of twigs ..... 13. **G. heterophylla**

9b Shrubs, growing in valley bushveld, savanna or disturbed places along roads, without underground rhizomes, mature stems terete; leaves on plant more or less the same size 10

10a Leaves bluish grey when dry; branchlets reddish purple; capsules dark red, smooth, semi-ridged..... 23. **G. hemipterocarpa**

10b Leaves green or yellow when dry; branchlets green; capsules not ridged, yellow tinged red and smooth, or white with reddish brown patches and rugose 11

11a Capsules 2-locular (rarely 3-locular in Namibian specimens), yellow tinged red, smooth; often with leaves on spines ..... 19. **G. tenuifolia**

11b Capsules 3-locular, white with reddish brown patches, rugose; rarely with leaves on spines 12

12a Plants distributed widely, often in disturbed places, such as along roads, as pioneer tree or shrub; cymes many-flowered; flowers strongly scented; capsules smaller than 6 mm .... 12. **G. buxifolia**

12b Plants restricted to the Tugela Valley bushveld in Kwazulu/Natal as small shrubs; cymes few-flowered; flowers not strongly scented; capsules larger than 8 mm ..... 17. **G. macrocarpa**

12. **Gymnosporia buxifolia** *(L.) Szyszyl.*, Polypetalae Disciflorae Rehmannianae: 34 (1888); Loes.: 207 (1897); Bolus & Wolley-Dod: 247 (1904); Sim: 185 (1907); Bak. f.: 44 (1911); Glover: 206 (1911); Eyles: 404 (1917); Pegler: 13 (1918); Schönland: 73 (1919); Bews: 129 (1921); Marloth: 153, 107 (1925); Davison: 317 (1927); Burtt Davy: 448 (1932); Steedman: 42 (1933); Henkel: 88 (1934); Eggeling: 41 (1940); Loes.: 152 (1942); Hutch.: 89, 225, 228, 361, 506 (1946); Miller: 35 (1948); Brenan: 127 (1949); Adamson & Salter: 565 (1950); Miller: 48 (1952); Guillarmod: 207 (1971). Type: cult. in Hortus Cliffortianus, Herb. Clifford (BM, lecto., selected by Sebsebe in 1985; sheet 268.5 in herb. Linn., LINN, isolecto., PRE, microfiche!).

Celastrus buxifolius L.: 197 (1753) [Cliff. Hort.: 72 (1737) pro parte excl. Plukenet. Almagest. 234. tab. 202. f. 3 (1696)]; Lam.: 661 (1785); Ait.: 272 (1789); Thunb.: 42 (1794); L. in Willdenow.: 1128 (1798); Thunb.: 220 (1823); Spreng.: 773 (1824); DC.: 8 (1825); Houttuyn: t. 21. f. 1 (1775); Sims: pl.

2114 (1819); Eckl. & Zeyh.: 120 (1834—1835); E. Mey.: 137 (1843); Ettingshausen: 68, Fig. 21—22; t. 5, Fig. 2—5 (1857); Sond.: 459 (1860); Ettingshausen: t. 57 (1861), t. 24, Fig. 12—14 (1877); Kuntze: 115 (1891); Edmonds & Marloth: 59 (1897); Kuntze: 37 (1898) (included var. *laxiflorus* & *empleurifolius*, Kwazulu/Natal); Wood: 138 (1908); Fourcade: 100 (1939). *Catha buxifolia* (L.) G. Don: 10 (1832); C. Presl: 33 (1844).

Celastrus multiflorus Lam.: 661 (1785); Spreng.: 773 (1824); DC.: 8 (1825); Eckl. & Zeyh.: 121 (1834—1835); Oliv.: 364 (1868). *Catha multiflora* (Lam.) G. Don: 10 (1832). Type: cult. in Paris (P-LA, holo.; Lam. Herb. Mus. Paris 1886, PRE, microfiche no. 55!; G!, iso.).

Celastrus cymosus Soland.: t. 2070 (1819); non *Celastrus cymosus* sensu Eckl. & Zeyh.: 121 (1834—1835); Krauss: 42 (1846); Ettingshausen: t. 59, 62 (1861); *Catha cymosa* (Soland.) G. Don: 10 (1832); C. Presl: 33 (1844). *Maytenus cymosa* (Soland.) Exell: 222 (1952), nom. illegit., non Krug & Urban (1904); Exell & Mendonça: 3 (1956); Wilczek: 122 (1960); Marais: 385 (1960); Van der Schijff: 64 (1969); Jeppe: 86 (1974). Type: Desmaretz in Solander's manuscript 261: 34 (BM-SL, holo.).

Celastrus empleurifolius Eckl. & Zeyh.: 121 (1834—1835); Walp.: 534 (1842); Ettingshausen: t. 6, Fig. 6—8 (1857). *Celastrus buxifolius* var. *empleurifolius* (Eckl. & Zeyh.) Sond.: 459 (1860). Type: Cape, Langekloof [George], *Ecklon & Zeyher 953* (GRA, lecto.!, here designated; HAL, HAL 071492!; SAM!).

Celastrus goniecaulis Eckl. & Zeyh.: 120 (1834—1835); Walp.: 533 (1842). Type: Cape, Krakakamma [Uitenhage], *Ecklon & Zeyher 940* (SAM, lecto.!, here designated; HAL, HAL 071494!, isolecto.).

Celastrus humilis Eckl. & Zeyh.: 120 (1834—1835); Walp.: 534 (1842). Type: Cape, Zwartkopsriver, [Uitenhage], *Ecklon & Zeyher 944* (SAM, lecto.!, here designated; GRA!).

Celastrus patens Eckl. & Zeyh.: 120 (1834—1835); Walp.: 533 (1842); Krauss: 42 (1846). *Catha patens* (Eckl. & Zeyh.) C. Presl: 33 (1844). Type: Cape, Chumiberg, *Ecklon & Zeyher 939* (SAM, lecto.!, here designated; GRA!).

Celastrus polyanthemos Eckl. & Zeyh.: 121 (1834—1835); Walp.: 534 (1842); Schltdl.: 624 (1847). Type: Cape, Gamtoosrivier [Uitenhage], *Ecklon & Zeyher 954* (P, lecto., here designated).

Celastrus rhombifolius Eckl. & Zeyh.: 120 (1834—1835); Walp.: 533 (1842); Sond.: 460 (1860). *Gymnosporia rhombifolia* (Eckl. & Zeyh.) Bolus & Wolley-Dod: 247 (1904). Type: Cape, Devils Peak [Cape Town], *Ecklon & Zeyher 941* (SAM, lecto.!, here designated).

Celastrus venenatus Eckl. & Zeyh.: 121 (1834—1835); Walp.: 534 (1842); Schltdl.: 624 (1847); Krauss: 42 (1846); Ettingshausen: t. 54 (1861). *Catha venenata* (Eckl. & Zeyh.) C. Presl: 34 (1844).

Celastrus buxifolius var. *venenatus* (Eckl. & Zeyh.) Sond.: 459 (1860). *Gymnosporia buxifolia* var. *venenata* (Eckl. & Zeyh.) Szyszyl.: 34 (1888); Brenan: 127 (1949). Type: Cape, Zwartkopsrivier [Uitenhage], *Ecklon & Zeyher 952* (SAM, lecto.!, here designated; GRA!; P).

Celastrus buxifolius var. *genuinus* Sond.: 459 (1860) non quad specimen *Drège 6735* (PRE) = *G. heterophylla*. *Gymnosporia buxifolia* var. *genuina* (Sond.) Szyszyl.: 34 (1888); Loes.: 543 (1893); Mildbread: 465 (1912); Brenan: 127 (1949). Type: Cape, Table Mountain, *Ecklon & Zeyher 942* (GRA, lecto.!, here designated).

Celastrus buxifolius var. *laxiflorus* Sond.: 459 (1860). *Gymnosporia buxifolia* var. *laxiflora* (Sond.) Szyszyl.: 34 (1888). Types the same as for *C. patens* and *C. spathephyllus*.

Celastrus buxifolius var. *glomeruliflorus* Sond.: 459 (1860), *nomen nud.*

Gymnosporia schlechteri Loes.: 193 (1894); Marais: 386(1960), species excluded. Type: Cape Town *Schlechter 241* (Z, holo.; PRE, photo!).

Gymnosporia condensata Sprague: 246 (1906); Davison: 305 (1927); Burtt Davy: 448 (1932). Type: Transvaal, Middelburg, Olifant's River, *Hurley 1* (K, holo., PRE, cibachrome!).

Exceedingly variable, evergreen, dioecious shrub or more often a small tree 2—3(—7) m tall, spreading, with terminal branches drooping, spinescent, glabrous. *Spines* slender to very robust, up to 100 mm long, rarely leafy or floriferous, distal part terete. *Branches* subangular and green when young, soon becoming terete and light brown, very often with insect galls. *Bark* light brown when young, afterwards darker and flaking, deeply longitudinally fissured and corky with age. *Brachyblasts* short. *Leaves* fasciculate or alternate on tips of branchlets, glabrous, membranous or chartaceous, dull green, shortly petiolate; lamina obovate, lanceolate-obovate, cuneate-obovate or obovate-rhomboid, 25—45(—80) × (8—)10—20(—25) mm, apex obtuse, rounded, emarginate, base cuneate, narrow, tapering; margin serrulato-dentate or crenulate, teeth very unequal, only in distal half; venation obvious on both sides, 4—7 principal lateral veins, midrib sunken above; petiole 2—5 mm long. *Stipules* subulate, margin fimbriate, ± 1 mm long.

Inflorescence a dense many-flowered dichasium, axillary, slightly shorter than or as long as leaves; peduncle 10—20 mm long; pedicels 2—3(—4) mm long. *Flowers* white or cream, 15—34(—50) per cyme, with unpleasant smell. *Sepals* 0.3—1.0(—1.5) mm long, equal, circular or triangular-lanceolate, apex acute to rounded, margin ciliolate. *Petals* 1.0—3.5 × 1.0—1.5(—2.5) mm, elliptic-oblong to oblong-spathulate, margin laciniate. *Disc* narrow, concave, 5-lobed, 1—2 mm wide. *Male flowers* with stamens shorter than petals; filaments 1.0—2.5 mm long, slender; anthers short. *Female flowers* with staminodes shorter than ovary. *Ovary* 3-locular; ovules 2 per locule; style terete, short, 0.2—0.5 mm long; stigma 3-lobed, spreading. *Capsules* yellow-green, becoming white-grey-brown when dry, globose, rugose, coriaceous, style and stigma occasionally persistent in fruiting stage, 2—5 mm long. *Seeds* 1—4, reddish brown, glossy; aril yellow, partially covering the seed. Figures 87—88.

Common names: common spike-thorn, box-leaf staff-tree, *gewone pendoring*.

Flowering time: September—April.
Fruiting time: July—April.

Diagnostic features: a pioneer shrub or small tree, growing in disturbed places or along forest fringes; young branchlets green, subangular or rather compressed, never angular or striate; inflorescences many-flowered; flowers strongly scented; capsules very small, rugose, white with reddish brown patches.

Distribution and habitat: widely distributed in all provinces and countries in southern Africa, in dry areas, along roads, forest fringes or thornveld; often a pioneer. The distribution range of this species does not seem to extend much further north than Zimbabwe, being replaced by *G. tenuifolia* and other tropical African species which can also be placed in this section. The tropical African species, however, need further investigation. See note under *G. tenuifolia*.

Notes: the wood is heavy, hard, strong, tough, close-grained with close concentric lines of soft tissue. According to Fourcade (1939) the wood is suitable for tool handles, engraving and turnery.

Vouchers: *Abbott 1310* (PRU); *De Lange 402* (NMB); *Jacot Guillarmod 9363* (GRA); *Jordaan 2261* (PRE); *Medley Wood 10097* (NH).

13. **Gymnosporia heterophylla** (*Eckl. & Zeyh.*) *Loes.* in Engl. & Prantl, Die natürlichen Pflanzenfamilien 3,5: 207 (1897); Schönland: 73 (1919); Loes.: 152 (1942); Davison: 317 (1927). Type: Cape, Olifantshoek, Boesmansrivier, *Ecklon & Zeyher 943* (S, isolecto!, designated by Sebsebe, 1985; P, SAM!).

Celastrus heterophyllus Eckl. & Zeyh.: 120 (1834—1835); Walp.: 534 (1842); E. Mey.: 52 (1843), nom. nudum.; Schltdl.: 624 (1847); Sond.: 458 (1860); Ettingshausen: t. 23, Fig. 16 (1857); Kuntze: 37 (1898). *Catha heterophylla* (Eckl. & Zeyh.) C. Presl: 33 (1844). *Maytenus heterophylla* sensu (Eckl. & Zeyh.) N. Robson p.p.: 17 (1965), sensu N. Robson p.p.: 364 (1966), sensu Merxm.: 4 (1968), sensu N. Robson & Sousa p.p.: 13 (1969), sensu Villiers: 30 (1975), sensu Coates Palgrave p.p.: 496 (1981), sensu Moll p.p.: 188 (1981), sensu Troupin: 204 (1982), sensu Bond & Goldblatt p.p.: 224 (1984), sensu Sebsebe: 88 (1985), sensu Hilliard and Burtt: 172 (1987), sensu Sebsebe: 336 (1989), sensu Moll p.p.: 81, 83 (1992), sensu Pooley p.p.: 266 (1993).

Celastrus parvifolius Eckl. & Zeyh.: 121 (1834—1835); Walp.: 534 (1842); Schltdl.: 624 (1847); Ettingshausen: t. 6, Fig. 4, 5 (1857), t. 59, 62 (1861). *Catha parvifolia* (Eckl. & Zeyh.) C. Presl: 34 (1844). Type: Cape, Addo [Uitenhage], *Ecklon & Zeyher 949* (SAM, lecto.!, here designated).

Celastrus glomeratus E. Mey.: 146 (1843), *nom. nud. Celastrus heterophyllus* var. *glomeratus* E. Mey. ex Sond.: 458 (1860). Type: Cape, Between Gekau and Basche *Drège 6730*, (P, lecto., here designated; TCD?).

Celastrus angularis Sond.: 460 (1860); Wood: 138 (1909). *Gymnosporia angularis* (Sond.) Sim: 185 (1907); Pegler: 13 (1918); Schönland: 73 (1919); Davison: 314 (1927); Burtt Davy: 448 (1932); Henkel: 90 (1934). Type: Cape, Vanstadensberg, *Zeyher 2182* (GRA, lecto.!, here designated; G!, P).

Cassine latifolia var. *heterophylla* E. Mey. ex Sond.: 467 (1860). Type: Cape, Woods at Plettenberg Bay *Ecklon & Zeyher 2181* (PRE, lecto.!, here designated; P, Z!).

Gymnosporia woodii Szyszyl.: 35 (1888); Bews: 129 (1921); Loes.: 152 (1942). *Celastrus woodii* (Szyszyl.) Wood: 138 (1909). Type: Kwazulu/Natal, Inanda *Wood s.n.* (K, holo.; PRE, photo!).

Gymnosporia crataegiflora Davison: 314 (1927); Henkel: 90 (1934); Loes.: 152 (1942). Type: Kwazulu/Natal, Inanda, *Medley Wood 212* (K, lecto., here designated, PRE, cibachrome!; BOL!, NH!).

Gymnosporia angularis var. *orbiculata* Davison: 316 (1927). Type: Cape, East London *Galpin 1870* (PRE, lecto.!, here designated; K).

Small dioecious shrub, often with both underground and erect stems, up to 1.5 m tall, spinescent, glabrous. *Spines* slender, up to 40 mm long, distal part angular, occasionally leafy and floriferous. *Branches* angular-striate, both in young and mature stage, twigs grey, sometimes with insect galls. *Leaves* alternate or fasciculate, becoming smaller towards tips, stiff, coriaceous, dull green, shortly petiolate, glabrous; lamina obovate, spathulate or elliptic-lanceolate to suborbiculate, (5—)10—30(—70) × (2—)6—11(—50) mm, apex rounded, obtuse, acute or emarginate, mucronate, base narrowly cuneate; margins spinuloso-serrate, teeth minute, turning black; venation reticulate, distinct below, about 6 principal lateral veins; petiole 1-2 mm long. *Stipules* small, subulate, margin fimbriate, ± 1 mm long. *Inflorescence* a dense dichasium, much shorter than leaves; peduncle very short in Eastern Cape specimens, longer in Eastern Transvaal specimens, (1—)4—7 mm long; pedicels 1.5—3.0 mm long. *Flowers* creamish white, 7—15 per cyme, fragrant. *Sepals* 0.5—1.0 mm long, suborbicular, margin laciniate, green, tinged pink. *Petals* 2—3 × 1—3 mm, elliptic or broadly oblong, margin slightly laciniate, undulate with brown veins down the centre. *Disc* fleshy, annular, with slightly lobed margin, 1 mm diameter. *Male flowers* with stamens shorter than petals; filaments slender, 1 mm long. *Female flowers* smaller than male flowers, with staminodes shorter than ovary. *Ovary* 3-locular; ovules 2 per locule; style 0.25—0.50 mm long; stigma 3-lobed. *Capsules* pale brown with darker reddish brown patches, globose, rugose, coriaceous, styles nonpersistent in fruiting stage, 2—7 mm long. Seeds 1—3, shiny, reddish brown; aril yellow, partially covering the seed. Figures 89—90.

Proposed common names: angular-stemmed spike-thorn, *vierkantstingel-pendoring*.

Flowering time: late August to early December, with another peak May to August.
Fruiting time: January—July.

Diagnostic features: branches angular-striate, not becoming terete with age (hence the specific name *angularis*, a synonym); leaves stiff and leathery, with venation quite obvious and apices mucronate; inflorescences much shorter than the leaves. Different sizes and shapes of leaves may occur on the same plant, usually with larger leaves proximally and smaller ones distally (hence the specific epithet *heterophylla*).

Distribution and habitat: *G. heterophylla* occurs from Grahamstown in the south, extending its distribution range further eastwards through the Eastern Cape, Kwazulu/Natal, Swaziland, the Eastern Transvaal, Mozambique and further northwards into tropical Africa. It often grows in rocky places in grassland associated with forest, and has been recorded from almost any geological substrate, including Witteberg quartzite (Eastern Cape), dolerite, granite, sandstone (Kwazulu/Natal, Eastern Transvaal) or serpentine (Eastern Transvaal).

Notes: in the past often confused with *G. buxifolia* and considered conspecific by Marais (1960) and Robson (1965). The distribution range of *G. heterophylla*, is much smaller than that of *G. buxifolia*, and the two are partly sympatric. They superficially resemble each other in flower and fruit characters, but differ in habit, habitat, branch and leaf characters. Plants of *G. heterophylla* usually are small shrubs which favour rocky places in open grassland and are adapted to fire by having well developed rhizomes. Plants of *G. buxifolia* are mainly small trees favouring disturbed places such as those along roads and disturbed forest fringes. *G. heterophylla* has angular-striate branches and thick, leathery leaves, invariably in different sizes on the plant, while *G. buxifolia* has terete mature branches and more thinly textured leaves, often membranous, and of more or less the same size on the same plant.

Vouchers: *Drège 6735* (PRE); *Jordaan 2322* (PRE); *McClean 266* (NH, PRE); *Medley Wood 633* (BOL, NH, SAM); *Pegler 741* (GRA, PRE, SAM).

14. **Gymnosporia elliptica** *(Thunb.) Schönland* in Botanical Survey South Africa Memoir 1: 73 (1919); Davison 2: 306 (1927); non Henkel: 88 (1934). Type: Cape, Thunberg in *Herb. Thunb. 5599A* (UPS, holo.; PRE, microfiche!).

Celastrus ellipticus Thunb.: 218 (1823); Sond.: 458 (1860).

Sensu *Celastrus integer* Eckl. & Zeyh.: 120 (1834—1835), quad specimen *Ecklon & Zeyher 945*, non *C. integer* Thunb.: 220 (1823); DC.: 8 (1825).

Gymnosporia heterophylla var. *stenophylla* Loes.: 429 (1896). Type: Cape, Gamtoos River, *Schlechter 6043* (BOL, lecto.!, here designated; GRA!, PRE!).

Rhizomatous suffrutex, up to 1 m tall, with erect and spreading stems from underground rootstock, spinescent, glabrous. *Spines* very few, mostly on basal stems, small, slender, up to 15 mm long. *Branches* angular and green when young, becoming terete and greyish with age, often with insect galls on stems. *Brachyblasts* weakly developed. *Leaves* fasciculate or alternate on young shoots, coriaceous, greyish green, shortly petiolate, glabrous; lamina linear-obovate, broadest part in distal half, 25—50 × 4—8 mm, apex obtuse to round, mucronate, base long-tapering; margin with few teeth in distal half, or subentire; venation smooth above, prominently raised and wrinkled below when dry; petiole very short, ± 0.5 mm long. *Stipules* subulate, margin fimbriate, ± 1 mm long. *Inflorescence* a few-flowered dichasium, shorter than leaves; peduncles thick, 4—10 mm long; pedicels white-spotted, 3 mm long. *Flowers* white, 3—9 per cyme, axillary. *Sepals* 0.8 mm long, triangular, imbricate, margin laciniate. *Petals* 2 mm long, oblong, margin uneven. *Disc* fleshy, annular, margin crenulate, 1 mm diameter. *Male flowers* with stamens shorter than petals; filaments 1.5 mm long; anthers 0.4 mm long. *Female flowers* with staminodes shorter than in male flowers. *Ovary* 3-locular; ovules 2 per locule; style terete, short; stigmas 3-branched, spreading, 0.5 mm long. *Capsules* white with reddish brown patches, globose, rugose, coriaceous, inside of valves pale yellow, 3—4 mm long. *Seeds* 1—3, reddish brown, shiny; aril yellow, partially covering the seed. Figures 91—92.

Proposed common names: spotted-fruit dwarf spike-thorn, *spikkelvrug-dwergpendoring*.

Flowering time: November—March.
Fruiting time: March—May.

Diagnostic features: suffrutex habit; plants with very few spines, often without spines on herbarium sheets; leaves thick, long, narrow, obovate-linear and tapering towards apices and bases, with veins wrinkled in dried specimens; capsules rugose, white with reddish brown patches.

Distribution and habitat: *G. elliptica* is restricted to the coastal grassy fynbos between George and Port Elizabeth.

Vouchers: *Drège 8486* (PRE); *Ecklon & Zeyher 945* (SAM); *Jordaan 2294* (PRE); *Olivier 1499* (STE); *Paterson 366* (GRA).

15. **Gymnosporia uniflora** *Davison* in Bothalia 2: 294 (1927); Henkel: 89 (1934). Type: Kwazulu/Natal, Zwaartkop [Pietermaritzburg], *Wylie* com *Medley Wood 10253* (NH, lecto.!, here designated; BOL!, PRE!).

Suffrutex up to 0.8 m tall, with erect and spreading stems from underground rootstock. *Spines* slender, rarely leafy and floriferous, up to 25 mm long. *Branches* striate, green, canescent and angular when young, becoming terete and brown with age. *Brachyblasts* prominent in leaf and spine axils. *Leaves* fasciculate or alternate on young shoots, coriaceous, green, shortly petiolate, glabrous; lamina lanceolate-oblong, elliptic-oblong, broadest in distal half, 15—50 × 3—8 mm, apex acute, obtuse or mucronate, base long-tapering; margin with few teeth or rudiments of teeth in distal half; venation slightly conspicuous above, midrib and principal lateral veins prominent below; petiole very short, 0.5 mm long. *Stipules* subulate, margin fimbriate, ± 1 mm long. *Inflorescence* a few-flowered dichasium, axillary; peduncle stout, 4—10 mm long; pedicels stout, 2—3 mm long. *Flowers* white, 3—7 per cyme. *Sepals* ± 1 mm long, triangular, margin laciniate. *Petals* ± 1.5 mm long, oblong, margin laciniate. *Disc* sulcate, margin crenate. *Male flowers* with stamens shorter than petals; filaments 1 mm long. *Female flowers* with staminodes shorter than ovary. *Ovary* 3-locular, frequently red; style terete, short; stigma 3-lobed, spreading, 1 mm long. *Capsules* with outside yellow at base and remainder red, globose, smooth, transversely striate when dry, coriaceous, inside of valves bright yellow, 4—5 mm long. *Seeds* 1—3, reddish brown, glossy; aril yellow, partially covering the seed. Figures 93—94.

Proposed common names: narrow-leaf dwarf spike-thorn, *smalblaar-dwergpendoring*.

Flowering time: September—December.
Fruiting time: October—March.

Distribution and habitat: *G. uniflora* is restricted to Kwazulu/Natal and Pondoland where it is confined to rocky places on grassland slopes inland in the Muden district, Zwartkop hills (Pietermaritzburg district), Marwaqa Mountains (Bulwer district), Ngeli Mountain and as far south as the Port Shepstone and Bizana districts. It grows in grassland on dolerite or sandstone.

Diagnostic features: suffrutex habit; leaves long, narrow and leathery with only few teeth in distal half; cymes few-flowered; flowers with very short peduncles; ovaries frequently red; capsules yellow-and-red, smooth but transversely striate when dry.

Vouchers: *Abbott 5401* (NH, PRU); *Hildyard 65* (PRE); *Medley Wood 11423* (BOL, K); *Pienaar 424* (PRE); *Van Wyk 10339* (PRU).

16. **Gymnosporia grandifolia** *(Davison) M. Jordaan*, stat. nov. Type: Cape, Pirie Forest, *Galpin 5917* (PRE, lecto.!, here designated; K).

Gymnosporia angularis var. *grandifolia* Davison: 316 (1927).

Sensu *C. buxifolius* L. var. a. *genuinus* Sond.: 459 (1860) quad specimen *Drège 6735* (G!, P).

Small tree up to 7 m tall, with drooping branches, spinescent, glabrous. *Spines* slender or robust, up to 140 mm long, shiny, rarely leavy, rarely floriferous, distal part terete. *Branches* angular at first, becoming terete and grey with age. *Brachyblasts* well developed. *Leaves* fasciculate or alternate on young shoots, coriaceous, green, petiolate, glabrous; lamina obovate, 25—70 × 20—40 mm, apex acute to rounded, mucronate, base cuneate; margin irregularly serrate; venation very distinct below, midrib and principal lateral veins distinctly raised below and drying yellowish; petiole 2—6 mm long. *Stipules* subulate, margin fimbriate, ± 1 mm long. *Inflorescence* a dense, many-flowered dichasium, shorter than leaves; peduncle 3—4 mm long; pedicels 2—4 mm long. *Flowers* white, 9—19 per cyme. *Sepals* 2.0—2.5 mm long, triangular, margin laciniate. *Petals* 3—4 x 1.5—3.0 mm, obovate, margin ciliolate. *Disc* 1.5 mm diameter. *Male flowers* with stamens shorter than petals; filaments 2 mm long; anthers 0.4 mm long. *Female flowers* with staminodes shorter than ovary. *Ovary* (2)3-locular; ovules 2 per locule; style short; stigma 2- or 3-branched, spreading. *Capsules* with outside white, with brown patches, globose, rugose, woody, inside of valves bright yellow, styles nonpersistent in fruiting stage, 7—10 mm long. *Seeds* reddish brown, shiny; aril yellow, partially covering the seed. Figures 95—97.

Proposed common names: large-fruit forest spike-thorn, *grootvrug-bospendoring*.

Flowering time: September—December.
Fruiting time: January—April.

Diagnostic features: *G. grandifolia* is one of the few true forest species of *Gymnosporia* and can further be distinghuised by leaves with a very distinct and raised midrib below, showing yellowish on dried specimens, and capsules longer than 7 mm, often 2-locular, rugose, white with reddish brown patches and with a woody pericarp.

Distribution and habitat: *G. grandifolia* occurs as a forest understorey constituent or on forest margins in coastal or inland regions as far south as East London in the Eastern Cape, northeastwards through Kwazulu/Natal, Swaziland and Eastern Transvaal as far north as Louis Trichart in the Northern Transvaal.

Nomenctural notes: although recognized by Davison (1927) as a variety of *G. angularis*, this species has never received recognition as a distinct taxon in herbaria. Davison gave the diagnostic characters of this taxon as the subterete twigs, not angular and striate, the leaves which are always longer than 20 mm, obovate, with the midrib and lateral veins raised and very distinct below, and suggested that this variety may form a separate species.

Vouchers: *Edwards 2941* (NU); *Flanagan 316* (PRE); *Jordaan 2115* (PRE); *Liebenberg 3133* (P, PRE); *Pegler 1307* (PRE, SAM).

17. **Gymnosporia macrocarpa** *M. Jordaan*, sp. nov., *G. buxifoliae* (L.) Szyszyl. similis sed floribus paucioribus in quoque inflorescentia; capsulis maioribus, pericarpio crasso lignoso differt.

Maytenus sp. sensu Edwards: 269 (1967) quoad specimens *Pentz 216* (PRE), *Edwards 2800* (PRE).

TYPE.—Kwazulu/Natal, 2830 (Dundee): Greytown to Ngubevu, (—CD), 13 April 1977, *Venter 1839* (PRE, holo.).

Shrub up to 2 m tall, many-branched, spinescent, glabrous. *Spines* robust, never leafy or floriferous, up to 40 mm long. *Branches* terete, grey, occasionally with insect galls.

Bark smooth and flaky. *Brachyblasts* well developed, up to 20 mm long. *Leaves* fasciculate, chartaceous, green, shortly petiolate, glabrous; lamina obovate, 15—60 × 10—30 mm, apex round to emarginate, base cuneate; margins serrate; venation more obvious below; petiole ± 0.5 mm long. *Stipules* subulate, margin fimbriate, ± 1 mm long. *Inflorescence* a few-flowered dichasium, much shorter than leaves; peduncle 4—8 mm long; pedicels 1—2 mm long. *Flowers* white, 3—7 per cyme. *Sepals* ± 1 mm long, triangular, margin laciniate. *Petals* 1.5—2.0 × 1 mm, obovate, erect, margin uneven. *Disc* 1 mm diameter, flat. *Male flowers* with stamens slightly shorter than petals; filaments 1 mm long; anthers as long as filaments. *Female flowers* with staminodes shorter than ovary. *Ovary* 3(4)-locular; ovules 2(3) per locule; style very short; stigma 3- or 4-lobed, spreading. *Capsules* pale brown with darker reddish brown patches, globose, rugose, woody, with stalks thickened, partially dehiscent in three or four parts, valves erect, styles nonpersistent in fruiting stage, 12—15 mm long. *Seeds* dark brown, shiny, 4 mm long; aril yellow, partially covering the seed. Figures 98—99.

Proposed common names: Tugela spike-thorn, *Tugela-pendoring*.

Flowering time: September—December.
Fruiting time: January—May.

Diagnostic features: the rugose, woody capsules are the largest of all species in G. sect. Buxifoliae. It can further be distinguished by its very well developed brachyblasts, up to 20 mm long, and restricted geographical distribution.

Distribution and habitat: this species has one of the most restricted range of all the species, occurring only in the grid 2830 and confined to a small area in the Lower Tugela Basin in Kwazulu/Natal. The species occurs in hot, dry thornveld or valley bushveld.

Etymology: the epithet is a compound from the Greek, *macro*, large, and *carpo*, relating to the fruit, alluding to the distinctive large capsules.

Vouchers: *Balkwill et al. 5038, 5087* (J); *Edwards 2800* (PRE); *Pentz 216* (PRE); *Pienaar 408* (PRE).

18. **Gymnosporia glaucophylla** *M. Jordaan*, nom. nov. Type: Mozambique, Namaacha, Lourenco Marques [Maputa], *Barbosa & Lemos 7592* (LISC, holo.; COI!; LMJ; SRGH, photo!, iso.).

Maytenus heterophylla subsp. *glauca* N. Robson: 23 (1965); N. Robson: 367 (1966), excluding *Gerrard 1377* which is *G. heterophylla*; N. Robson & Sousa: 16 (1969); Jansen & Mendes: 30 (1991).

Shrub or rarely a small tree, up to 3 m tall, spinescent, glabrous. *Spines* slender, up to 35 mm long, rarely leafy or floriferous, distal part terete. *Branches* terete, reddish purple when young, becoming grey and eventually cream-white with a rough bark; bark deeply fissured, rhytidome with yellow pigment. *Brachyblasts* short, darker than branches. *Leaves* fasciculate, glabrous, coriaceous, glaucous, concolorous, shortly petiolate; lamina oblong or spathulate, 50—70 × 10—25 mm, apex acute to rounded, base cuneate; margin entire or with rudiments of teeth; venation slightly prominent; petiole ± 0.5 mm long. *Stipules* subulate, margin fimbriate, ± 1 mm long. *Inflorescence* a dichasium; peduncle 6—20 mm long; pedicels 3—4 mm long. *Flowers* white, 7—9 per cyme, with unpleasant smell. *Sepals* ± 1 mm long, triangular, margin laciniate. *Petals* 2—3 × 1.0—1.5 mm, oblong, margin uneven, reflexed lengthwise. *Disc* 1 mm diameter. *Male flowers* with stamens slightly shorter than petals; filaments 1.5 mm long; anthers 0.4 mm long. *Female flowers* with staminodes shorter than in male flowers. *Ovary* 3-locular; ovules 2 per locule; style short; stigma 3-branched, spreading. *Capsules* red, globose, smooth, coriaceous, styles persistent in fruiting stage, 6—10 mm long. *Seeds* shiny, brownish red; aril white, partially covering the seed. Figures 100—101.

Proposed common names: glaucous-leaf spike-thorn, *bloulaar-pendoring*.

Flowering time: this species has two flowering peaks: the one between January and April and the second from May to August.
Fruiting time: March—December.

Diagnostic features: bark deeply fissured, splitting longitudinally to reveal yellow layers in the rhytidome; leaves coriaceous, glaucous with entire to subentire margins; petals reflexed lengthwise; aril almost transparent.

Distribution and habitat: this species occurs from East London in the Eastern Cape, northeastwards through Kwazulu/Natal, Swaziland and Eastern and Northern Transvaal into Mozambique. It grows in open tropical coastal forest and savanna, often in stony places.

Nomenclatural notes: under Article 58.1 (b) of the ICBN a new name, *G. glaucophylla*, is chosen, based on the same type as the rejected name, *G. glauca* [=*Maytenus heterophylla* (Eckl. & Zeyh.) N. Robson subsp. *glauca* N. Robson]. See also notes under *G. szyszylowiczii*.

Vouchers: *Codd 4276* (K, PRE, SRGH); *Compton 31646* (K, NH, PRE); *Edwards 1491* (NU, PRE); *Gerstner 3298* (K, PRE, NH); *Jordaan 2000* (NH, PRE).

19. **Gymnosporia tenuifolia** *(Loes.) M. Jordaan*, stat. nov. Type: Namibia, Grootfontein, *Dinter 695* (not traced).

Gymnosporia capitata (E. Mey. ex Sond.) Loes. var. *tenuifolia* Loes.: 823 (1903).

Small, multistemmed, many-branched shrub up to 3 m tall or small tree up to 5 m tall, trunk up to 100 mm in diameter, with weeping habit, long and short shoots distinct and with different sizes of leaves in each case, spinescent, glabrous. *Spines* slender or robust, often leafy and floriferous, distal part terete, up to 100 mm long. *Branches* subangular and green when young, becoming terete and grey to black with age, occasionally with insect galls. *Brachyblasts* well developed, prominent, up to 10 mm long. *Leaves* fasciculate or alternate at tips of branchlets, chartaceous, yellowish green or glaucous, shortly petiolate, glabrous; lamina obovate, elliptic, 6—30 × 4—15 mm, apex acute, rounded to emarginate, base cuneate or tapering; margin irregularly serrate in distal half; venation reticulate, secondary veins obvious on both sides; petiole 0.5—1.5 mm long. *Stipules* subulate, margin fimbriate, ± 1.5 mm long. *Inflorescence* a dichasium, shorter or more often longer than leaves, often on spines; peduncles 3—15 mm long; pedicels 3—5 mm long. *Flowers* white, 3—9 per cyme, sweetly scented. *Sepals* ± 1 mm long, triangular, margin laciniate. *Petals* 1.0—2.5 mm long, oblong, margin uneven. *Disc* ± 1.5 mm in diameter. *Male flowers* with stamens slightly shorter than petals; filaments 1—2 mm long; anthers short. *Female flowers* with staminodes very short. *Ovary* 2(3)-

locular, strong tendency to be 2-locular; ovules 2 per locule; style 0.8 mm long; stigma 2- or 3-branched, spreading, broad, reflexed, with capitate ends, shorter than style. *Capsules* with outside yellow and tinged pink to bright red, globose, smooth, coriaceous, inside of valves bright yellow, 4—10 mm long. *Seeds* 1—3, reddish brown, shiny; aril yellow, partially covering the seed. Figures 102—103.

Proposed common names: tropical spike-thorn, *tropiese pendoring*.

Flowering time: September—April.
Fruiting time: March—December.

Diagnostic features: plants are branching at ground level, often with long and short shoots, with different sizes of leaves; bark smooth, thin, light brown to light grey; leaves yellowish or glaucous green, relatively thin, with irregular serrations; inflorescences very often on the spines; capsules yellow and bright red, with a smooth surface and very often 2-locular.

Distribution and habitat: together with *G. buxifolia*, it is the most widely distributed species in section *Buxifoliae* in Africa and these two have been treated as one species for a long time. *G. tenuifolia* is widespread in tropical Africa where it replaces *G. buxifolia*. The two species occur sympatrically in Namibia, Northern and Eastern Transvaal, Swaziland, Kwazulu/Natal and Eastern Cape. It occurs in southern Africa from East London in the south, along the Kwazulu/Natal coast, through Swaziland, Eastern and Northern Transvaal, with few populations in Namibia around Grootfontein, Otavi and Omaruru districts. *Gymnosporia tenuifolia* is recorded from red sandy soil on granite and calcrete hillsides. The associated vegetation is predominantly arid savanna or valley bushveld.

Vouchers: Dinter 5708 (BOL, PRE); *Edwards 731* (PRE); *Gerstner 5050* (PRE); *Giess, Volk & Bleissner 5944* (PRE, WIND); *Pooley 808* (NH).

20. **Gymnosporia szyszylowiczii** *(Kuntze) M. Jordaan*, comb. nov. Type: Cape, Grootfontein, *Rehmann 3014* (Z?).

Cassine szyszylowiczii Kuntze: 114 (1891).

Elaeodendron glaucum Szyszyl.: 36 (1888), *nom. illegit.* non Pers.

Gymnosporia glauca (Szyszyl.) Loes.: 154 (1901) *nom. illegit.*

Key to the subspecies

1a Leaves longer than 5 mm; young branchlets green; flowers longer than 2 mm; Great and Little Karoo ..... 20a. subsp. ***szyszylowiczii***

1b Leaves shorter than 5 mmg; young branchlets reddish brown; flowers shorter than 2 mm; Northern Cape and Namibia ..... 20b. subsp. ***namibiensis***

20a. subsp. **szyszylowiczii**

Rigid, divaricately branched, very spiny shrub up to 2.5 m tall, glabrous. *Spines* robust, up to 65 mm long, occasionally leafy or floriferous. *Branches* whitish or green when young, becoming grey with age, terete. *Brachyblasts* well developed, up to 10 mm long. *Leaves* fasciculate or alternate towards tips of branchlets, glabrous, coriaceous, glaucous, shortly petiolate; lamina obovate, 15—25 × 6—10 mm, apex obtuse, base cuneate; margin entire; venation obscure; petiole very short, ± 0.5 mm long. *Stipules* subulate, margin fimbriate, ± 1 mm long. *Inflorescence* a somewhat lax dichasium, axillary, 30—60 mm long, longer than leaves; peduncle flattened, 18—25 mm long; pedicels 3—4 mm long. *Flowers* white, 3—7 per cyme, honey-scented. *Sepals* ± 1 mm long, broadly triangular, imbricate, margin long laciniate. *Petals* 5—7 × 2—5 mm, obovate, margin uneven. *Disc* convex, 2 mm in diameter, 5-lobed. *Male flowers* with stamens slightly shorter than petals; filaments filiform; anthers subglobose. *Female flowers* with staminodes 3—4 mm long. *Ovary* 3-locular; ovules 2 per locule; style short; stigmas 3-branched, flat, bifid at apex, spreading. *Capsules* with outside pale yellow, globose, smooth, coriaceous, dehiscent to more than halfway, valves reflexed, inside of valves bright yellow, styles persistent in fruiting stage, 4—6 mm long. *Seeds* 1—4, dark reddish brown, shiny; aril yellow, partially covering the seed. Figures 104—105.

Common names: orange spike-thorn, *lemoendoring*.

Flowering time: September—February.

Fruiting time: March—August.

Diagnostic features: brachyblasts well developed; leaves entire, wider than 5 mm; inflorescences lax, longer than leaves; flowers relatively large, 5—7 mm long (the largest in this section) with dark centres, contrasting with pale petals.

Distribution and habitat: this taxon is confined to the Succulent Karoo Biome in the Great and Little Karoo in Northern, Western and Eastern Cape. Its distribution ranges from the Beaufort West and Fraserburg districts in the north to the Oudtshoorn district in the southwest and eastwards to the Cradock and Pearston districts.

Nomenclatural notes: this species was first described by Szyszylowicz (1888) as *Elaeodendron glaucum*. Szyszylowicz's specific name is not valid in *Elaeodendron* due to the earlier homonym *E. glaucum* Persoon (1805), based on a different type and occurring in tropical Asia. It was Kuntze (1891) who realized that a new specific name was necessary; he chose to call it *Cassine szyszylowiczii*. Loesener realized that this species must be a *Gymnosporia* and made the combination in *Gymnosporia* (1901), using the older epithet *glaucum*. The latter is, however, a *nom. illegit*.

The type of this species, as published in Szyszylowicz's publications, is *Rehmann 3014*. However, in Z there is a specimen of *Rehmann 3024*, from the same type locality, namely Grootfontein, and annotated as *Eleaodendron glaucum* (presumably in Szyszylowicz's handwriting). The specimen *Rehmann 3014*, stated as the type (not yet traced), could possibly be a typographic error by the author, and *Rehmann 3024*, could well be the type material.

Vouchers: *Galpin 9908* (PRE); *Jordaan 2280* (PRE); *Kensit* (BOL, BOL 56809)(cited incorrectly as *G. polyacantha* by Davison: 302 (1927); *Rehmann 3024* (PRE, Z); *Thorne 51852* (SAM).

20b. subsp. **namibiensis** *M. Jordaan*, subsp. nov., subspeciei typicae similis sed foliis minoribus, plerumque infra 10 mm longis; floribus minoribus, infra 2 mm longis differt.

TYPE.—Namibia, 2818 (Warmbad): Goodhouse Poort, (—CD), 22 June 1989, *Van Wyk 8665* (PRE, holo.; PRU).

Small, slender shrub up to 2 m tall, very spinescent, glabrous. *Spines* slender, up to 40 mm long, rarely leafy or floriferous. *Branches* reddish brown when young, becoming grey with age, terete. *Brachyblasts* well developed, up to 4 mm long. *Leaves* fasciculate, glabrous, coriaceous, glaucous, sessile; lamina obovate, 4—10(—15) × 1—3 mm, apex acute or obtuse, base cuneate; margin entire; venation obscure; petiole absent. *Stipules* subulate, margin fimbriate, ± 0.5 mm long. *Inflorescence* a dichasium, 30—60 mm long, longer than leaves; peduncle 10—15 mm long; pedicels 3—4 mm long. *Flowers* white, 3—9 flowers per cyme. *Sepals* ± 1 mm long, broadly triangular, margin laciniate. *Petals* ± 2 mm long obovate, margin ciliolate. *Disc* convex, darker than petals, but paler than ovary, 2 mm wide, 5-lobed. *Male flowers* with stamens slightly shorter than petals; filaments filiform, 1—2 mm long; anthers subglobose. *Female flowers* with staminodes shorter than in male flowers. Ovary dark-coloured, 2(3)-locular; ovules 2 per locule; style 1.5 mm long; stigmas 2- or 3-branched, spreading, 1 mm long. *Capsules* yellow-red, globose, smooth, coriaceous, 4—6 mm long. *Seeds* reddish brown, shiny; aril yellow, partially covering the seed. Figures 106—107.

Proposed common names: Namibian orange spike-thorn, *Namibiese lemoendoring*.

Flowering time: April—June.
Fruiting time: July—September.

Diagnostic features: smaller leaves than typical species, usually shorter than 10 mm; flowers smaller than typical species, narrower than 2 mm.

Distribution and habitat: this taxon is confined to a small area, from Lüderitz and Maltahöhe districts in Namibia in the north to the Lower Orange River Valley at Goodhouse Poort, Klein Noute and Groot Pellaberg (Northern Cape) in the south. This is a rocky, semi-desert area.

Vouchers: *Gubb KMG 12532, KMG 11028* (PRE); *Muller 1325* (PRE, WIND); *Van Jaarsveld & Patterson 6773* (NBG); *H. & E. Walter 2027* (B, WIND); *Wiss 1845* (WIND).

21. **G. karooica** *M. Jordaan*, sp. nov., *G. buxifoliae* (L.) Szyszyl. affinis, sed foliis subintegris, ovariis rubris, capsulis laevigatis flavis differt; etiam *G. szyszylowiczii* (Kuntze) M. Jordaan similis, sed foliis infra 5 mm latis, in vegetatione "False Upper Karoo" dicta crescente differt.

TYPE.—Orange Free State, 2926 (Bloemfontein): Bloemfontein District, (—AA), *Grey Kollege Herbarium 55* (PRE, holo.; BOL).

Celastrus angustifolius sensu Kuntze: 37 (1898) p.p. quad specimen (OFS: Bloemfontein) nom. nud.

Small, many-stemmed shrub, up to 2 m tall, spinescent, glabrous. *Spines* slender, up to 35 mm long, rarely leafy or floriferous. *Branches* green when young, becoming grey with age, terete. *Brachyblasts* very short. *Leaves* fasciculate or alternate towards tips of branchlets, glabrous, subcoriaceous, pale green, shortly petiolate; lamina linear-lanceolate, 10—40 × 1.5—3.0(—5.0) mm, apex acute to rounded, base cuneate; margin entire; venation not obvious above, primary and secondary veins prominent below; petiole ± 0.5 mm long. *Stipules* dark brown, subulate, margin fimbriate, ± 1.5 mm long. *Inflorescence* a somewhat lax dichasium, slightly shorter or more often longer than leaves; peduncle 10—13 mm long; pedicels 2—3 mm long. *Bracts* dark brown, persistent. *Flowers* white or cream, (3—)—7(—13) per cyme, with unpleasant smell. *Sepals* ± 1 mm long triangular, margin laciniate. *Petals* 2 x 1 mm, oblong, margin subentire. *Disc* 1 mm in diameter, margin undulate. *Male flowers* with stamens slightly shorter than petals; filaments 2 mm long; anthers small, 0.4 mm long. *Female flowers* with staminodes shorter than in male flowers, ovary darker than surrounding disc. *Ovary* 3-locular; ovules 2 per locule; style 1 mm long; stigma 3-branched, spreading. *Capsules* yellow, globose, smooth, coriaceous, styles persistent in fruiting stage, 4—5 mm long. *Seeds* reddish brown, shiny, 3 mm long; aril yellow, partially covering the seed. Figures 107—108.

Proposed common names: Karoo spike-thorn, *Karoo-pendoring*.

Flowering time: September—December.
Fruiting time: January—April.

Diagnostic features: leaves entire, narrower than 5 mm, with distal and proximal half more or less the same width; venation more or less obscure; capsules globose, yellow

with a smooth surface; seeds reddish brown. In herbaria this species is often confused with *G. polyacantha*, also with linear-lanceolate, entire leaves. *G. polyacantha* is readily distinguished by its leaves in compact, crowded fascicles on branches or in axils of spines, the venation very obvious on both sides, the very small, red, triquetrous capsules and black seeds.

Distribution and habitat: *G. karrooica* has a restricted distribution, ranging from Bloemfontein in the southwestern Orange Free State in the north to Colesberg and adjacent part of the central Northern Cape in the south. It is associated with the False Upper Karoo vegetation (Acocks No. 36) of the Karoo Biome. This is a summer rainfall area. Plants grow on rocky hillsides, often on dolerite in loamy soil derived from rocks of the Beaufort Group.

Etymology: the epithet *karooica* refers to the geographic region where this species grows.

Vouchers: *Burrows 1496* (NBG); *Engelbrecht 159* (NMB); *Hanekom 601* (PRE); *Moss 4527* (J); *Zietsman et al. 1261* (PRE).

22. **Gymnosporia devenishii** *M. Jordaan*, sp. nov., *G. buxifoliae* (L.) Szyszyl. affinis, sed foliis distincte petiolatis; capsulis porcatis laevigatis flavis differt.

TYPE.—Kwazulu/Natal, 2730 (Vryheid): Utrecht District, Nauwhoek Farm (—AD), 1 June 1976, *Devenish 1579* (PRE, holo.).

Maytenus mossambicensis sensu Hilliard & Burtt: 172 (1987) quoad specimen *Hilliard & Burtt 15571* (NU).

Maytenus sp. sensu Edwards: 269 (1967) quoad specimen *Edwards 2842* (PRE).

Small tree up to 8 m tall, spinescent, glabrous. *Spines* slender, up to 70 mm long, rarely leafy and floriferous, distal part terete. *Branches* angular and green when young, becoming terete and grey with age. *Brachyblasts* present. *Leaves* fasciculate or alternate towards tips of branchlets, glabrous, subcoriaceous, dark green, petiolate; lamina elliptic

or ovate, 20—27 × 14—18 mm, apex acute, rounded to emarginate, base cuneate or rounded; margin serrate to crenate; venation prominent below when dry, midrib prominently raised on both sides; petiole 2—3 mm long. *Stipules* subulate, apex filiform, margin fimbriate, ± 2 mm long. *Inflorescence* a dichasium, shorter than leaves; peduncles 4—6 mm long; pedicels 2—3 mm long. *Flowers* white, 3—9 per cyme. *Sepals* 0.8 mm long, round, margin ciliolate. *Petals* 1.0—1.5 mm long, oblong, margin uneven. *Disc* wavy, 1.5 mm in diameter. *Male flowers* with stamens slightly shorter than petals; filaments very short; anthers as long as filaments. *Female flowers* with staminodes shorter than in male flowers. *Ovary* ridged, 3-locular; 2 ovules per locule; style short; stigma 3-lobed. *Capsules* yellow or pink, smooth, coriaceous, prominently ridged, with 6—12 slightly imbricate ridges, 5—6 mm long. *Seeds* golden brown, 4 mm long; aril yellow, partially covering the seed. Figures 110—112.

Proposed common names: Klaas's spike-thorn, *Klaas-se-pendoring*.

Flowering time: December—March.
Fruiting time: March—June.

Diagnostic features: *G. devenishii* is very distinct in the genus on account of its unusual ridged capsules; branchlets prominently angular; leaves with very prominently raised midribs on both sides. *G. mossambicensis* and *G. devenishii* are the only species of *Gymnosporia* more or less confined to Afromontane forest. This species has hitherto been confused with *G. mossambicensis* (e.g. *Hilliard & Burtt 15571* cited in Hilliard & Burtt (1987) as *Maytenus mossambicensis* is in fact *G. devenishii*). *G. mossambicensis* can easily be distinghuished from *G. devenishii* by its globose, semi-fleshy capsules, without wing-like ridges.

Distribution and habitat: this is a rare species, largely confined to higher elevations (1800—2042 m) in moist Afromontane forest patches. The known geographical distribution is mainly along the Kwazulu/Natal Drakensberg and mountain outliers from Tonti Forest (Mount Ayliff) and Amanzamyama Forest (Mount Frere) in East Griqualand and Transkei to the most northern spot at Nauwhoek (Utrecht district) and Pongola Bush (Paulpietersburg district) in Kwazulu/Natal. *G. devenishii* grows in shade in forest understorey.

Etymology: the specific epithet honours Mr N.J. (Klaas) Devenish of the farm Nauwhoek in the Utrecht district. As farmer and amateur botanist, he has collected many new species and new records of species.

Note: this interesting species was apparently first collected by O.B. Miller in 1921 at the Amanzamyama Forest in Transkei, followed by an anonymous collector who collected it at Tonti Forest in northern Transkei in 1930. The first collection in Kwazulu/Natal was made by O. West in 1939 at Tabamhlope Forest. Subsequently it was collected at intervals of about ten years, first by D. Edwards (1962) at Kranskop, then K.H. Cooper (1972) at Mt. Alland (farm Keerom) and N.J. Devenish on farm Nauwhoek, Utrecht district and O.M. Hilliard & B.L. Burtt (1982—1983) at Bamboo Mountains and Gxalingenwa Forest in the southern Kwazulu/Natal Drakensberg. A.B. Cunningham collected this species in the Pongola Bush in 1984 (Paulpietersburg district). Recent collections are from the Pongola Bush (and a strong population of this rare species been discovered on the farm Retirement, Utrecht district.

Vouchers: *Anonymous collector J 76196* (J); *Cooper 154* (PRE, NH); *Cunningham 912* (NU); *Jordaan 2699, 2795* (NH, PRE); *Miller 3218* (PRE).

23. **Gymnosporia hemipterocarpa** *M. Jordaan*, sp. nov., *G. buxifoliae* (L.) Szyszyl. affinis, sed ramis primo rubro-purpureis; foliis caeruleo-griseis; capsulis sub-porcatis, laevigatis, flavis differt.

TYPE.—Kwazulu/Natal, 2830 (Dundee): Weenen District, Farm Mkholombe, (—CC), 6 April 1987, *Jordaan 1155* (PRE, holo.; NH).

Much-branched shrub or rarely small tree up to 4 m tall, spinescent, glabrous. *Spines* robust, up to 70 mm long, rarely floriferous, terete. *Branches* reddish brown when young, becoming grey with age, terete. *Brachyblasts* short. *Leaves* fasciculate or alternate towards tips of branchlets, glabrous, subcoriaceous, greyish when dry, shortly petiolate; lamina obovate, 15—40 × 10—20 mm, apex acute to rounded, base cuneate; margin with incisions in distal half; venation not obvious below except for raised midrib in dry specimens; petiole ± 0.5 mm long. *Stipules* subulate, margin fimbriate, ± 1 mm long. *Inflorescence* a dense dichasium, slightly shorter than or as long as leaves; peduncle

reddish purple, 6—12 mm long; pedicels 1—2 mm long. *Flowers* white, 15—19 in a cyme, sweetly scented. *Sepals* 0.8 mm long, triangular, margin laciniate. *Petals* 1—2 mm long, oblong, margin uneven. *Disc* 1.5 mm wide. *Male flowers* with stamens slightly shorter than petals; filaments 1 mm long; anthers short. *Female flowers* with staminodes shorter than in male flowers. *Ovary* 3-locular, half-winged; style very short; stigmas 3-branched, short, broad, flat, spreading. *Capsules* with outside yellow to dark red, half-winged, triquetrous, smooth, coriaceous, inside of valves bright yellow, styles persistent in fruiting stage, 4—5 mm long. *Seeds* reddish brown, shiny; aril thin, yellow, partially covering the seed. Figures 113—114.

Proposed common names: half-winged-fruit pike-thorn, *halfgevlerktevrug-pendoring*.

Flowering time: September—April.
Fruiting time: January—June.

Diagnostic features: leaves greyish, giving the plants a greyish appearance; inflorescences with dark reddish purple axes contrasting with rest of plant; capsules small, dark red and half-winged.

Distribution and habitat: this species is confined to rocky hillsides in valley bushveld or lowland savanna of the Tugela, Black Umfolozi and Pongola River Valleys in Kwazulu/Natal and Swaziland.

Etymology: the epithet is a compound of the Greek *hemipterus*, half-winged, and *carpus*, fruit, alluding to the half-winged pericarp of the capsule.

Vouchers: *Acocks 10146* (NH, PRE); *Archer 350* (PRU); *Compton 26404* (PRE); *Edwards 2507* (NU, PRE); *Gerstner 3199* (NH).

24. **Gymnosporia arenicola** *M. Jordaan*, sp. nov., *G. buxifoliae* (L.) Szyszyl. affinis, sed ramis saepe spinis longissimis armatis; foliis saepe circiter rhomboideis, marginibus interdum induratis nunquam induratis; floribus masculinis staminibus, et femineis stigmate valde exsertis; capsulis rubris, superficie foveolata differt.

TYPE.—Kwazulu/Natal, 2931 (Stanger): Umhlanga Rocks, (—CA), December 1959, *Watmough 400* (PRE, holo.; K, SRGH).

Maytenus heterophylla **subsp.** ***arenaria*** **sensu N. Robson p.p.: 21 (1965) (non specim. quad** ***Barbosa & Lemos 8514*** **(type) and** ***Feely & Ward 22*****), sensu Robson: 366 (1966) p.p., sensu Robson & Sousa: 15 (1969) p.p., sensu Jansen & Mendes: 30 (1991) p.p.**

Gnarled straggling shrub or small tree up to 6 m tall, spinescent, glabrous. *Spines* robust, up to 95 mm long, rarely leafy or floriferous. *Branches* angular and reddish brown when young, becoming terete and grey with age, often with insect galls. *Brachyblasts* very short. *Leaves* fasciculate or alternate towards tips of branchlets, glabrous, coriaceous, green, shortly petiolate; lamina rhombic or obovate, 30—56(—70) × 17—35 mm, apex round to emarginate, sometimes shortly acute, base cuneate; margin indurate, revolute, with irregular teeth only in distal half; venation obvious below, midrib yellow in dry specimens, prominent below; petiole 1—2 mm long. *Stipules* subulate, margin fimbriate, ± 1 mm long. *Inflorescence* a dichasium, shorter than leaves; peduncles 4—6 mm long; *pedicels* 5—8 mm long. *Flowers* white or yellowish, 5—9 flowers per cyme. *Sepals* ± 1.5 mm long, ovate, margin ciliolate. *Petals* 1—3 mm long, triangular, margin uneven. *Disc* 1 mm wide. *Male flowers* with stamens longer than petals; filaments 3 mm long; anthers 0.5 mm long. *Female flowers* with the style and stigmas longer than petals, staminodes shorter than in male flowers. *Ovary* 3-locular; ovules 2 per locule; style 1.5 mm long; stigma 3-lobed, 1 mm long. *Capsules* yellow to orange-red, globose, pitted, coriaceous, styles persistent in fruiting stage, 7—9 mm long. *Seeds* 1—3, dark reddish brown, 3 mm long; aril yellow, partially covering the seed. Figures 115—117.

Proposed common names: dune spike-thorn, *duinpendoring*.

Flowering time: May—December.
Fruiting time: January—July.

Diagnostic features: *G. arenicola, G. markwardii* and *G. vanwykii* are the only species in which the stamens in male flowers and style in female flowers protrude well beyond the petals. The latter two are both suffrutices, whereas *G. arenicola* is a gnarled shrub or small tree. The leaves of *G. arenicola* are coriaceous; the margins indurate and revolute;

midribs yellow and prominent below in dry specimens; the red capsules have a pitted surface; unique among all species of *Gymnosporia*.

Distribution and habitat: this is a species of coastal dunes, occurring along the south and north coast of Kwazulu/Natal, from Port Shepstone in the south northwards to southern Mozambique. Plants grow in dune scrub and forest on sandy acid soils, usually near wet areas.

Etymology: the epithet is a compound of the Latin *arena* = sand, and *cola* = dweller, referring to the specific habitat preference of this species.

Nomenclatural notes: this species has invariably been confused with the newly described species, *G. markwardii*, with which it is sympatric on the sand dunes along the northern Kwazulu/Natal and southern Mozambique coast. Robson (1965) did not distinguish between these two taxa and included material of both under *Maytenus heterophylla* subsp. *arenaria*. Since *G. arenicola* is slightly more widespread, and was therefore associated with *M. heterophylla* subsp. *arenaria*, this error probably effectively concealed the true identity and existence of *G. markwardii*. The type of the name *M. heterophylla* subsp. *arenaria* is in fact a specimen of *G. markwardii*.

Vouchers: *Abbott 2685* (NH, PRU); *Du Toit 2419* (NH); *Johnson 608* (NBG); *MacDevette 265* (NH, PRE); *Pienaar 289* (NH).

IX. Section *Gymnosporia*

Gymnosporia sect. **Gymnosporia**

TYPE.—*Gymnosporia senegalensis* (Lam.) Loes.

Plants occasionally spineless, with leaves alternate rather than fasciculate; brachyblasts very reduced or absent; leaves glaucous and coriaceous, occasionally mottled brown when dry, or discolorous; margin entire or regularly crenate or serrulate; flowers often greenish; capsules consistently 2-locular (rarely 3-locular among mainly 2-locular ones); dark purplish red or brown, small, not exceeding 7 mm in length; aril white or pinkish, partially covering the seed.

This section is widespread in tropical Africa, Madagascar, southern Europe, India and probably also in Sri Lanka, Malaysia and Australia (Queensland). In southern Africa it comprises three species and two subspecies, occurring in the semi-arid savanna of Namibia, Northern Cape (Richtersveld), Botswana, Northern and Eastern Transvaal, Swaziland and Kwazulu/Natal, with one outlier in the Eastern Cape.

Key to the species

1a Rhizomatous suffrutices, rarely taller than 0.8 m ..... 28. ***G. markwardii***

1b Shrubs or small trees, usually taller than 1.5 m 2

2a Leaves oblanceolate to obovate, finely and regularly crenate or serrate, usually wider than 10 mm; branchlets reddish; capsules dark purplish red..... ..... 26. ***G. senegalensis***

2b Leaves linear to lanceolate or lanceolate-oblong, entire, repandly denticulate, or coarsely serrate, usually narrower than 10 mm; branchlets green or white; capsules brown 27 . ..... ***G. linearis***

26. **Gymnosporia senegalensis** *(Lam.) Loes.* in Engl. & Prantl, Die natürlichen Pflanzenfamilien 3,5: 207 (1896), Loes.: 541 (1893); Th. Durand & Schinz: 92 (1896); Th. Durand & H. Durand: 100 (1909); Bak. f.: 44 (1911); Eyles: 404 (1916); De Wild.: 117 (1921); Davison: 320 (1927); Burtt Davy: 449 (1932); Steedman: 41, t. 41 (1933); Burtt Davy & Hoyle: 38 (1936); Loes.: 147, 149, 150 (1942); Perrier: 28 (1946); Miller: 35 (1948), Miller: 48 (1952); Brenan: 126 (1949); Suesseng.: 110 (1951); Pardy: 324 cum tab. (1953); Williamson: 63 (1955). Type: Senegal, cultivated in Paris (P-LA, holo., fide Sebsebe, 1985).

Celastrus senegalensis Lam.: 661 (1785); Spreng.: 773 (1824); DC.: 8 (1825); Walp.: 533 (1842); Richard: 133 (1847); Ettingshausen: t. 5, Fig. 10, 11 (1857); Schweinfurth: 263 (1867); Oliv.: 361 (1868). *Catha senegalensis* (Lam.) G. Don: 10 (1832). *Maytenus senegalensis* (Lam.) Exell: 223 (1952); Brenan: 238 (1953); Exell & Mendonça: 8 (1954); Keay & Blakelock: 624 (1957); Cufodontis: 479 (1958); Wilczek: 121 (1960); Marais: 384 (1960); Dale & Greenway: 136 (1961); White: 218 (1962) pro parte excl. syn. *M. cymosa*; N. Robson: 367 (1966); N. Robson & Sousa: 17 (1969); Van der Schijff: 64 (1969); Compton: 335 (1976); Coates Palgrave: 501 (1981); Moll: 187 (1981); Troupin: 204 (1982); Jansen & Mendes: 41 (1991); Moll: 187 (1992); Pooley: 270 (1993).

Celastrus senegalensis var. *glaucifolius* DC.: 8 (1825); G. Don: 10 (1832). Type: *Herb. G 7883/64* (G, holo.?).

Celastrus phyllacanthus L'Hèrit.: 6 (1788); Willd.: 1128 (1798); Roem. & Schult.: 425 (1819); DC.: 8 (1825); G. Don: 10 (1832); Walp.: 533 (1842). Type: (not yet traced).

Celastrus glaucus R. Br. ap. Salt 1814 nom. nud.

Celastrus montanus Roth ex Roem. & Schult.: 427 (1819); Spreng.: 773 (1824); DC.: 9 (1825); Roxb.: 208 (1832). *Catha montana* (Roth ex Roewm. & Schult.) G. Don: 10 (1832); Walp.: 532 (1842). *Gymnosporia montana* (Roth ex Roem. & Schult.) Benth.: 400 (1863). Type: E. India, *Heyne in Herb. Wallich 4306* (K lecto., fide Sebsebe, 1985).

Celastrus decolor Del.: 100 (1826). *Catha decolor* (Del.) Webb (1854). Type: Sudan, Meroe, *Cailliaud s.n.* (not yet traced).

Celastrus coriaceus Guill. & Perr.: 142, Tab. 36. (1830); Walp.: 533 (1842). Type: Between Bambia and Cape Verde, near Joal, *Perrottet 1834* (P, holo.).

Celastrus europaeus Boiss.: t. 38 (1839—1845); Walp.: 533 (1842). *Catha europaea* (Boiss.) Boiss.: 725 (1845); Loes.: 227 (1921). *Gymnosporia europaea* (Boiss.) Masf.: 176 (1881). *Celastrus senegalensis* var. *europaeus* (Boiss.) Ball: 391 (1878). *Gymnosporia senegalensis* var. *europaea* (Boiss.) Jahandiez & Maire: 474 (1932). Type: Spain, *Boissier s.n.* 1837 (G-Boiss, holo.!).

Gymnosporia eminiana Loes.: 543 (1893). Syntypes: East Africa, *Fischer 169, 210*; *Stuhlmann, ser. 1. n. 4280.*

Gymnosporia baumii Loes.: 291 (1903); Loes.: 230 (1921). *Maytenus baumii* (Loes.) Exell & Mendonça: 6 (1956). Type: Angola, Longa, *Baum 565* (B, holo.!; COI!, BM, K, iso.).

Gymnosporia dinteri Loes.: 823 (1903). Type: Namibia, Waterberg *Dinter 371* (?).

Gymnosporia eremoecusa Loes.: 299 (1908); Loes.: 149 (1942). Type: Namibia, Okahandja *Dinter 218* (SAM!, iso.).

Multistemmed shrubs or trees up to 7 m tall, usually 1—4 m in our region, spinescent, glabrous. *Spines* slender, up to 70 mm long. *Branches* wine-red, glaucous to grey, smooth to lined, becoming terete. *Brachyblasts* only on spines, very reduced. *Leaves*

alternate or fasciculate, coriaceous, concolorous, glaucous, often mottled brown in dry specimens, petiolate, glabrous; lamina elliptic or oblong to obovate or oblanceolate, 32—125 × 12—80 mm, apex acute to rounded, retuse or truncate, base cuneate; margin regularly serrulate or crenulate to crenate; venation varying in prominence on both surfaces; petiole wine-red or tinged pink, 2—17 mm long. *Stipules* minute. *Inflorescence* a dichasium, rarely a submonochasium, solitary, axillary or fasciculate on brachyblasts; peduncle 2—17(—26) mm long; pedicels 0.5—3.0 mm long. *Flowers* cream, or more often greenish white, 3—60 or more in each cyme, sweetly scented. *Sepals* 0.5—1.0 × 0.5—1.25 mm, ovate to triangular, margin ciliolate. *Petals* 1.5—4.0 × 0.75—2.5 mm, elliptic to oblong or oblanceolate, margin ciliolate. *Disc* concave, 5-lobed, 1.00—2.25 mm wide. *Male flowers* with stamens slightly shorter than petals; filaments 0.5—1.5 mm long, slender, arising at the base of the disc; pistillodes small, subglobose, style very short, unbranched. *Female flowers* with staminodes 0.50—0.75(—1.00) mm long. *Ovary* 2(3)-locular; ovules 2 per locule; style as long as ovary; stigmas 2- or 3-branched. *Capsules* with outside pink to red when mature, globose, smooth, coriaceous, inside of valves cream or pale yellow, 3—5(—7) mm long. *Seeds* 1 or 2, dark red to brown, glossy, 3—4 × 2—3 mm; aril white or pinkish, partially covering the seed. Figures 118—119.

Common names: red spike-thorn, *rooipendoring* (*Senegal-pendoring*).

Flowering time: the whole year round.
Fruiting time: mainly July—December.

Diagnostic features: leaves glaucous, margin with numerous closely spaced regular crenations (rounded teeth); ovary nearly always 2-locular (rarely 3-locular ones between 2-locular ones). Similar to *G. glaucophylla* which also has reddish young shoots and glaucous leaves, but differs in having entire or subentire leaves and 3-locular ovaries.

Distribution and habitat: *G. senegalensis* occurs in southern Africa in Namibia, Botswana, Northern and Eastern Transvaal, Swaziland and in Kwazulu/Natal as far south as Stanger. It is also widespread through the whole of tropical Africa as far west as Senegal and northwards to northern Africa, southern Spain and Canary Islands, from where its distribution extends eastwards to Afghanistan, Iran, Pakistan and India. It grows in open bushveld, thickets, coastal dune scrub and wooded grassland, sometimes on river banks.

Economic use: the root is mixed with goat dung as a cure for body ulcers. Roots are cut into pieces, cooked and drunk for body pains (*Snyman & Noailles 234* in PRE).

Vouchers: *Compton 32138* (NBG); *De Winter 3546* (PRE); *Ellery 397* (PRE); *Muller & Giess 403* (PRE, WIND); *Robertson & Elffers 45* (K, PRE).

27. **Gymnosporia linearis** *(L.f.) Loes.* in Die natürlichen Pflanzenfamilien 3,5: 208 (1896); Schönland: 73 (1919); Davison: 305 (1927); Loes.: 149 (1942). Type: Thunberg in *Herb. Thunberg 5621* (UPS, lecto., PRE, microfiche!, here designated).

Celastrus linearis L. f.: 153 (1781); Thunb.: 42 (1794); Roemer: t. 3 (1805); Thunb.: 219 (1823); Spreng.: 773 (1824); DC.: 8 (1825); E. Mey.: 59 (1843); Schltdl.: 624 (1847); Ettingshausen: t. 7, Fig. 10 (1857); Sond.: 455 (1860). *Catha linearis* (L.f.) G. Don: 9 (1832). *Eucentrus linearis* (L.f.) C. Presl: 33 (1844). *Maytenus linearis* sensu (L.f.) Marais: 384 (1960) p.p., sensu N. Robson: 16 (1965) p.p., sensu Coates Palgrave: 497 (1981) p.p.

Celastrus stenophyllus Eckl. & Zeyh.: 122 (1834—1835); Walp.: 534 (1842); Schltdl.: 586, 589 (1847). *Polyacanthus stenophyllus* (Eckl. & Zeyh.) C. Presl: 33 (1844). Type: Cape, Zondagsrivier [Graaff-Reinet], *Ecklon & Zeyher 955* (SAM, lecto.!, here designated; HAL!, P, S!).

Key to the subspecies

1a Leaves usually narrower than 2 mm, linear, often entire; Eastern Cape .... 27a. subsp. ***linearis***

1b Leaves usually wider than 2 mm, lanceolate, often denticulate; Northern Cape and Namibia ..... 27b. subsp. ***lanceolata***

27a. subsp. **linearis**

Greyish white shrubs or small trees up to 3 m tall, spinescent, glabrous. *Spines* slender, up to 50 mm long, often leafy and floriferous. *Branches* terete, whitish or greyish brown, curved, sometimes abbreviate; bark flaking in rectangular pieces. *Leaves* alternate, rarely fasciculate, coriaceous, glaucous-green, shortly petiolate, glabrous; lamina linear or narrowly lanceolate, 25—90 × 2—5 mm, apex acute or obtuse, base

cuneate; margin mostly entire, sometimes denticulate; venation with only midrib conspicuous; petiole 2—3 mm long. *Inflorescence* a subdichasium, axillary, 2—3 times shorter than leaves; peduncle 1—6 mm long; pedicels 1—2 mm long, lengthening in fruit. *Flowers* yellow or green, many in a cyme, sweetly scented. *Sepals* 0.5 mm long, deltoid, margin ciliate. *Petals* 2 mm long, oblong or oblong-ovate, margin ciliate. *Disc* flat, fleshy, saucer-like, margin crenulate. *Male flowers* with stamens slightly shorter than petals; filaments 1.25 mm long. *Female flowers* with staminodes 0.5—1.0 mm long. *Ovary* 2-locular; ovules 2 per locule; style 0.25 mm long; stigmas shortly 2-lobed. *Capsules* shiny chesnut-brown, globose, mucronate, smooth, coriaceous, 3—4 mm long. *Seeds* dark brown, oval-oblong, apiculate, raphe linear; aril white, partially covering the seed. Figures 120—121.

Common names: narrow-leaved spike-thorn, *smalblaarpendoring*.

Flowering time: October—January.
Fruiting time: December—March.

Diagnostic features: the white overall appearance of the plant; spines very often leafy and floriferous; leaves sparsely and laxy arranged on the branches; lamina narrow, linear; margin entire or subentire; appearing one-nerved (only midrib conspicuous).

Distribution and habitat: this species is confined to the Great Karoo and Eastern Cape, mainly to the area between Graaff-Reinet and Somerset East and eastwards to the Uitenhage and Albany districts. It is often associated with river-courses and kloofs in False Karroid Broken Veld.

Vouchers: *Acocks 12009* (PRE); *Brink 624* (GRA, PRE); *MacOwan 1134* (GRA); *Taylor 3732* (STE); *Theron 1149* (PRE).

27b. subsp. **lanceolata** (*E. Mey. ex Sond.*) *M. Jordaan*, stat. nov. Type: Cape, Verleptpram, Gariep, *Drège s.n.* (HAL, HAL 071490, lecto.!, here designated; S!).

Celastrus lanceolatus E. Mey.: 92 (1843) nomen nudum; Ettingshausen: t. 7, Fig. 8, 9 (1857); ex Sond.: 456 (1860). *Catha lanceolata* (E. Mey. ex Sond.) C. Presl: 33 (1844). *Gymnosporia lanceolata* (E. Mey. ex Sond.) Loes.: 207 (1892); Glover: 206 (1915); Davison: 306 (1927); Loes.: 149 (1942).

Glaucous drooping trees up to 6 m tall, spinescent, glabrous. *Spines* robust, on basal coppice shoots, up to 65 mm long, rarely leafy and floriferous. *Branches* terete, greyish white, twigs lax, virgate; bark flaking in rectangular pieces, revealing yellow layers in rhytidome. *Leaves* alternate, rarely fasciculate, coriaceous, glaucous, shortly petiolate, glabrous; lamina narrowly to broadly lanceolate, 30—80 × 5—12 mm, apex acute, more often obtuse to rounded, mucronate, base cuneate; margin subentire to closely denticulate; venation penninerved on both sides; petiole 2—5 mm long. *Stipules* very short. *Inflorescence* a subdichasium, axillary, 4—5 times shorter than leaves; peduncle 1—5 mm long; pedicels 1—2 mm long. *Flowers* yellowish green, many per cyme. *Sepals* 0.5 mm long, deltoid, margin ciliate. *Petals* 1—2 mm long, oblong or ovate, erect, margin ciliate. *Disc* fleshy, saucer-like with a crenulate margin. *Male flowers* with stamens slightly shorter than petals; filaments 0.75 mm long, dilated at base. *Female flowers* with staminodes shorter than ovary. *Ovary* 2-, rarely 3-locular; ovules 2 per locule; style very short; stigmas 2- or 3-lobed. *Capsules* greyish brown, globose, mucronate, smooth, coriaceous, 3 mm long. *Seeds* dark brown, glossy; aril white, partially covering the seed. Figures 122—123.

Proposed common names: Orange River spike-thorn, *Oranjerivier-pendoring*.

Flowering time: July—October.
Fruiting time: October—February.

Diagnostic features: the spines are on basal coppice shoots, rarely leafy or floriferous; leaves long, lanceolate, with denticulate, rather than subentire margins and penninerved venation.

Distribution and habitat: *G. linearis* subsp. *lanceolata* is confined to the Fish River Canyon and Lower Orange River Valley in southern Namibia, Namaqualand and Bushmanland. It is associated with the Orange River Broken Veld (Acocks No. 33), and often recorded from dry river beds.

Vouchers: *Giess 13733 (WIND); Marloth 12386* (STE); *Pearson 9072* (BOL); *Schlechter 11452* (BOL, GRA, P, PRE); *Zietsman 1918* (NMB).

28. **Gymnosporia markwardii** *M. Jordaan*, sp. nov., *G. senegalensis* (Lam.) Loes. similis, sed habitu suffruticoso rhizomatoso; foliis saepe discoloribus; floribus masculis staminibus, et femineis stigmate valde exsertis differt.

TYPE.—Kwazulu/Natal, 2832 (Mtubatuba): Eastern Shores State Forest, St Lucia (—AB), 6 March 1985, *Nicholas & MacDevette 2138* (PRE, holo.; NH).

Maytenus heterophylla subsp. *arenaria* N. Robson: 21 (1965), N. Robson: 366 (1966) pro parte quoad specimens *Barbosa & Lemos 8514* (type) and *Feely & Ward 22*.

Rhizomatous suffrutex with erect, sparsely branched stems, usually not more than 0.8 m tall, rarely up to 1 m tall, forming colonies, spinescent or occasionally without spines, glabrous. *Spines* slender, up to 10 mm long, distal part terete, rarely leafy or floriferous. *Branches* angular and green when young, becoming terete and grey with age, smooth. *Brachyblasts* absent. *Leaves* alternate, rarely fasciculate, coriaceous, glaucous, discolorous when dry, shortly petiolate, glabrous; lamina obovate, 25—42 × 11—32 mm, apex rounded, obtuse, mucronate, base cuneate; margin serrate; venation obscure above, obvious below; petiole 2—3 mm long. *Stipules* very short, subulate. *Inflorescence* a subdichasium, terminally and axillary; peduncle flattened, reddish brown, 3—6 mm long; pedicels 2—3 mm long; bracts prominent, persistent, reddish brown, oblong-triangular, margin fimbriate, apex acute. *Flowers* white to cream, produced in profusion. *Sepals* 1.5 mm long, ovate, margin ciliate. *Petals* 2 mm long, oblong, margin ciliolate, reflexed lengthwise. *Disc* fleshy, annular. *Male flowers* with stamens longer than petals; filaments 1.5—2.0 mm long; anthers 0.5 mm long, versatile. *Female flowers* with style and stigmas longer than petals, protruding. *Ovary* 2-locular; ovules 2 per locule; style 1 mm long; stigmas 2-branched, with bifid apices, 1 mm long. *Capsules* with outside bright red, globose, smooth, transversely striate, coriaceous, inside of valves pale yellow, styles persistent in fruiting stage, 4—6 mm long. *Seeds* 2—4, reddish brown, glossy; aril white, partially covering the seed. Figures 124—126.

Proposed common names: Maputaland dwarf spike-thorn, *Maputaland-dwergpendoring*.

Flowering time: September—April.
Fruiting time: January—July.

Diagnostic features: a rhizomatous suffrutex; sometimes without spines; leaves glaucous and discolorous; flowers with exserted stigmas and anthers.

Distribution and habitat: this species is endemic to Maputaland (northern Kwazulu/Natal and southern Mozambique). It occurs in coastal grassland on acid sandy soil.

Etymology: the specific epithet commemorates Mr M.C. Ward, a young botanist who was tragically killed in a car accident in 1991. At the time of his death he was employed as regional scientist by the KwaZulu Government, and stationed in Maputaland. He was an excellent field botanist and collected many plants in northern Kwazulu/Natal, including many new records for the province.

Nomenclatural notes: see under *G. arenicola*.

Phylogenetic position: the taxonomic affinities of this species are uncertain. Macromorphological characters such as the mostly alternate rather than fasciculate leaves, discolorous glaucous leaves, bilocular ovaries, dark purplish red capsules and seed with a white aril, suggest a strong relationship with species in section *Gymnosporia*. On the other hand, certain leaf anatomical characters, such as the presence of a hypodermis in stead of a multiseriate epidermis, show affinity with section *Buxifoliae*.

Vouchers: *Bourquin 633* (PRE); *Harrison 291* (NH, PRE); *MacDevette 1837* (NH, PRE); *Strey 5000* (PRE); *Ward 1499, 2009, 2561* (NH, PRE).

9.5 Taxa insufficiently known and excluded species

1. **Gymnosporia senegalensis** var. **stuhlmanniana** *Loes.*: 542 (1893). Type: Mozambique, Quelimane, *Stuhlmann, ser. 1, 314* [B; BM (Sketch, fide Robson, 1966)]. No sketch could be traced in BM, according to L. Dreyer, SABLO at Kew, letter dated 7.10.1993. Robson (1966) considered it a synonym of *Maytenus heterophylla* subsp. *arenaria*, which in the present study is spilt into two separate species. Without having seen any original material of this name, it is impossible to decide on its identity.

2. **Gymnosporia buxifolia** *(L.) Szyszyl.* var. **schlechteri** *Loes.*: 153 (1901). Type: Transvaal, Komati Poort, *Schlechter 11787* (not traced). Probably a form of *G. buxifolia*.

3. **Gymnosporia woodii** *Szyszyl.* var. **polyantha** Loes.: 154 (1901). Type: Pondoland, *Beyrich 152* (B, type destroyed).

4. **Gymnosporia acanthophora** Loes.: 299 (1908); Marais: 386 (1960). Type: Namibia, Okatawbaka, *v. Trotha 23a* (B, type destroyed).

5. Tropical African names not included in this study, but used as synonyms under *Maytenus heterophylla* (Eckl. & Zeyh.) N. Robson (1965).

Gymnosporia andongensis (Oliv.) Loes.: 541 (1893). *Celastrus andongensis* Oliv.: 361 (1868). *Maytenus andongensis* (Oliv.) Exell & Mendonça: 222 (1952). Type: Angola, Pungo Andongo *Welwitsch 1353* (LISU, lecto.; COI!, BM, K, cibachrome!, isolecto.).

Gymnosporia brevipetala Loes.: 546 (1893), Loes: 465 (1912), Loes.: 149 (1942); Robyns: 498 (1948). Type: Tanzania, *Fischer 112* (?). *Maytenus brevipetalus* (Loes.) Wilczek: 118 (1960).

Gymnosporia buxifolioides Loes.: 344 (1903); Brenan: 127 (1949). Type: Tanzania, Kinga Mountains *Goetze 1193* (BR, holo.!).

Gymnosporia buxifolia var. *holtzii* Loes.: 301 (1908); Brenan: 127 (1949). Type: Tanzania, Dar-es-Salaam, *Holtz 1090* (B, holo.).

Gymnosporia maranguensis (Loes.) Loes.: 303 (1908); Robyns: 501 (1948); Brenan: 126 (1949). *Gymnosporia senegalensis* (Lam.) Loes. var. *maranguensis* Loes.: 231 (1895). Type: Tanzania, Kilimandsharo, *Volkens 806* (G, lecto.!).

Gymnosporia bequaertii De Wild.: 536 (1913); De Wild.: 105 (1913), De Wild.: 117 (1921). Type: Zaïre, Nieuwdorp, 5.5.1912, *Bequaert 394* (BR, holo.!).

Gymnosporia beniensis Robyns & Lawalree: 269 (1947); Robyns: 498 (1948). Type: Zaïre, Beni, 31.3.1914, *Bequaert 3294* (BR, holo.!).

Maytenus angolensis Exell & Mendonça: 224 (1952); Exell & Mendonça: 4, t. 1 Fig. B (1954). Type: Angola, Unguèria, Chibia, 3.6.1937, *Gossweiler 10983* (BM, holo.; COI!, K, cibachrome!, iso).

CHAPTER 10

DISCUSSION AND CONCLUSIONS

The principal aim of the present study has been the elucidation of the supraspecific and specific classification of the spiny members of the southern African Celastroideae. The taxonomic significance of various characters has been evaluated in the preceding chapters. Macromorphogical, anatomical and ecological evidence provides convincing indicators for the delimitation for genera, sections, species and subspecies.

Because of the many new taxa recognized in this dissertation, it may appear as if a taxonomically revolutionary approarch were followed. I nevertheless believe that the new classification represents the most natural treatment of the group proposed to date.

The present survey provides abundant evidence at both the macroscopic and microscopic levels for the separation of *Maytenus s.l.* into two segregate genera. In addition, possible relationships between certain taxa are indicated and the distinctiveness of certain species and genera is confirmed.

With a view to establishing natural, more homogeneous genera, I support the viewpoint of Loesener (1892) and Ding Hou (1955) that *Gymnosporia* should be reinstated as a genus on its own, comprising all the spiny members of the current genus *Maytenus*. *Putterlickia* and *Gloveria* are also considered as distinct genera.

Characters of diagnostic value were found to support the demarcation of *Gloveria*, *Gymnosporia*, *Putterlickia* and *Maytenus*. The latter is provisionally retained in a strict sense to accommodate all the nonspiny members which have been excluded from the present study.

Maytenus s. str. differs from *Gymnosporia* in its absence of brachyblasts and spines, leaves which are never in true fascicles, inflorescences which are racemose or fasciculate, sessile or pedunculate (very rarely exceeding 2 mm), or with a few secondary peduncles and flowers always bisexual. Plants of *Maytenus s. str.* are mainly small to large forest trees, only a few species remaining low shrubs when growing near the coast or in arid regions, whereas only a few species of *Gymnosporia* are small trees, most not exceeding 8 m in southern Africa. In *Maytenus s. str.* the seeds are completely or almost completely enclosed by an aril, while different

conditions occur in *Gymnosporia*: from completely enclosed to seeds with the aril reduced to a basal rim. Differences between *Maytenus*, *Gymnosporia*, *Gloveria* and *Putterlickia* are listed in Table 23.

Maytenus s. str. are now divided into three complexes, all in need of further taxonomic study:

i) *Maytenus acuminata* complex (comprising *M. abbottii* A.E. van Wyk, *M. acuminata* (L.f.) Loes., *M. cordata* (E. Mey. ex Sond.) Loes. and *M. filiformis* (Davison) A.E. van Wyk comb. nov. ined.);
ii) *Maytenus undata* complex (comprising *M. chasei* N. Robson, *M. lucida* (L.) Loes., *M. oleoides* (Lam.) Loes., *M. oleosa* A.E. van Wyk & R.H. Archer, *M. procumbens* (L.f.) Loes. and *M. undata* (Thunb.) Blakelock *s.l.*);
iii) *M. peduncularis* complex (comprising *M. peduncularis* (Sond.) Loes.).

The delimitation of the genera *Maytenus* and *Gymnosporia* and the generic position of *Celastrus saxatilis* and *C. integrifolius* have remained controversial for over 30 years. The taxonomic position of these two taxa has been resolved by the present study.

The once heterogeneous and taxonomically extremely difficult *Maytenus heterophylla* complex has now been sorted out for the first time. Fifteen distinct species and one subspecies are recognized, which until recently were considered a single extraordinarily variable taxon (Robson 1966).

Putterlickia retrospinosa, the only liana among the plants studied, is considered the most primitive species. It is endemic to southern Kwazulu/Natal/Pondoland. Species of *Rhus* L. are often associated with *Putterlickia* and *Gymnosporia*. Interestingly enough, the only liana in *Rhus*, namely *R. acocksii* Moffett (1988), is also endemic to southern Kwazulu/Natal/Pondoland. All members of the closely related genus *Celastrus*, also belonging to this subfamily, are lianas and could be the basal group in subfamily Celastroideae. However, the genus, does not occur in Africa.

Conclusions

- The spiny members of the subfamily Celastroideae (tribe Celastrales) occur on the African continent, Madagascar, India, Malaysia and the northeastern peninsula of Australia.

- Two genera, namely *Gloveria* and *Putterlickia*, are confined to southern Africa; both display disjunct distribution patterns intergenerically.

- The genus *Gymnosporia*, as delimited and established in the dissertation, is the largest genus in the family Celastraceae in southern Africa.

- There are two centers of endemism of the spiny Celastroideae on the Afro-Arabian continent: (i) in NE tropical Africa/Arabia and (ii) in southern Africa. Sixty per cent of the taxa occurring in NE tropical Africa/Arabia are endemic to that region and sixty per cent of taxa found in southern Africa are endemic to the FSA region.

- The plants included in the study occur in six of the 20 main phytochoria of Africa and Madagascar proposed by White (1983).

- In southern Africa, 12 taxa are endemic or near-endemic to the Tongaland-Pondoland Regional Mosaic, four to the Karoo-Namib Regional Centre of Endemism, three species to the Zambezian Regional Centre of Endemism, two to the Kalahari-Highveld Transitional Zone, one is endemic to the Cape Regional Centre of Endemism and one to the Afromontane Archipelago-like Regional Centre of Endemism.

- The highest concentration of taxa occurs in the eastern, moister, summer rainfall regions of the subcontinent.

- The plants studied are found in six of the seven biomes in southern Africa (Rutherford & Westfall 1994), predominantly in the Savanna Biome and occasionally in the other five biomes, but are absent from the Desert Biome.

- Spiny members of the southern African Celastroideae are mainly shrubs, less frequently small trees (not taller than 8 m), four species are geoxylic suffrutices and only one is a woody climber (liana).

• In southern Africa, the spiny members of the subfamily are represented by three genera, namely *Putterlickia* (4 species), *Gloveria* (1 species) and *Gymnosporia* (32 species, three subspecies and nine sections).

• The Celastroideae is regarded as a taxonomically difficult subfamily because many macroscopic features of the leaves and flowers show considerable similarities between taxa, thus making identification difficult, escpecially in *Gymnosporia* section *Buxifoliae* (in recent years the 15 species proposed have all been lumped under *Maytenus heterophylla*). Fruit characters and the leaf anatomy proved to be valuable sources of taxonomic evidence at specific level.

• The presence of spines, long and short shoots (brachyblasts), fasciculate and alternate leaves on the same plant, and dichasial inflorescences are shared characters between these three genera, which distinguish them from the other genera in the subfamily, thus binding these genera together as a natural assemblage in the Celastroideae.

• Flowers of *Putterlickia* and *Gloveria* are bisexual, whereas *Gymnosporia* has functionally unisexual flowers, except *G. putterlickioides*, which seems to be a link between *Putterlickia* and *Gymnosporia*.

• Macromorphologically, the following characters proved to be of particular taxonomic significance: (i) fruit, seed and aril characters at specific level; (ii) number of ovules per locule and sexuality at generic level; (iii) type of inflorescence and presence of long and short shoots (brachyblasts) to define a natural group at subfamily level.

• Taxonomically the most useful leaf anatomical characters include: (i) the size of epidermal cells ad- and abaxially; (ii) whether the leaves are amphi- or hypostomatic; (iii) mesophyll dorsiventral or isobilateral; (iv) presence or absence of a hypodermis; (v) presence or absence of a uniseriate or a multiseriate epidermis; (vi) presence or absence of trichomes; (vii) presence or absence of papillae; (viii) presence or absence of oil droplets; (ix) well or weakly developed collenchyma; (x) presence or absence, and type of tanniferous cells; xi) stomata raised or sunken.

• The genus *Putterlickia* is characterized by amphistomatic leaves with a dorsiventral structure. Leaves of the genus *Gloveria* are isobilateral and hypostomatic. In

Gymnosporia both amphistomatic and hypostomatic as well as dorsiventral and isobilateral leaves occur.

• Midrib structure is rather similar in *Gloveria* and *Gymnosporia*, but species of *Putterlickia* tend to have the collenchyma above and below the vascular bundle poorly developed.

• Both anatomical and morphological characters were used to propose sections in the genus *Gymnosporia*.

• Both anatomical and morphological character states were used in a provisional cladistic analysis, from which a single parsimonious tree was obtained, with the *Putterlickia* group (comprising *P. pyracantha*, *P. retrospinosa* and *P. verrucosa*) used as the outgroup. *Gymnosporia* section *Gymnosporia* (comprising *G. senegalensis* and *G. linearis*) turned out to be the most advanced group.

• *Maytenus bachmannii* (Loes.) Marais should be transferred to *Gymnosporia* section *Mossambicensis* since it also possesses few spines and an orange aril covering the seed completely.

• The taxonomic position of the Australian species *Maytenus emarginata* (Willd.) Ding Hou should be investigated further, particularly its relationship to members of the genus *Gymnosporia*.

• The generic position of the species of *Gymnosporia* described by Lundell (1985) from South America is doubtful and needs further investigation.

• A taxonomic study of the remaining species of *Gymnosporia* in tropical Africa, Madagascar and India should be undertaken.

• The extension of this study to include the remaining non-spiny species of the other genera in this subfamily, namely *Maytenus, Catha* and *Pterocelastrus*, should be undertaken for the *Flora of southern Africa*, because it will provide additional data for comparison.

CHAPTER 11

SPECIMENS EXAMINED

For each species, all specimens studied are listed with the acronym of the herbaria in which they are housed. Herbarium acronyms follow Holmgren *et al.* (1990). Specimens are alphabetically arranged by the collector's name and then numerically for each collector. Where possible, quater-degree grid references (based on Leistner & Morris 1976) are given for each collection.

Gloveria integrifolia

Bayliss BS/1094, 3321AD (PRE), *Bohnen* 101.02, 3321DC (PRE); 8140, 3321DA (PRE, STE), *Bösenberg & Rutherford* 435, 3017DD (STE), *Boshoff* P234, 3321BC (STE), *Boucher* 1564, 3320DD (PRE, STE), *Britten* 1719, 3322CA (GRA); 3049, 3322CA (GRA), *Burgers* 56, 3319DD (PRE), *Cattell & Cattell* 81, 3321CB (PRE, STE), *Dahlstrand* 977, 3322DA (GRA); 1320, 3322DA (PRE); 2128, 3322DA (PRE); 2299, 3322DA (PRE, STE); 2315, 3322DA (PRE, STE); 3546, 3322DA (PRE), *Ecklon & Zeyher* 936 (SAM), *Esterhuysen* 1387, 3017BB (BOL), *Jordaan* 2282, 3322BC (PRE); 2283, 3322BC (PRE); 2284, 3322BC (PRE), *Laidler* 367, 3321CA (PRE), *Le Roux & Lloyd* 493, 3017BB (STE), *Levyns et al.* 451, 3320CC (STE), *Lloyd* 1082, 3320BC (STE), *Marais* 649, 3319DD (PRE); 672, 3320DC (PRE); 688, 3322CA (PRE), *Mitchell* 173, 3320CC (PRE), *Oliver* 5469, 3321CB (PRE, STE), *Pillans* 17965, 3017AC (BOL); 17966, 3017AC (BOL), *Powrie* 676, 3321DA (STE), *Rycroft* 3022, 3321AD (NBG), *Theron & Studente* 3172, 3319DD (PRE, PRU), *Van Breda* 1708, 3319DD (PRE), *Van Niekerk* 677, 3319DD (BOL), *Van Rooyen* 2026, 3117BD (PRU), *Zeyher* 936 (GRA, SAM43893), *Zietsman & Zietsman* 971, 3017BB (NMB).

Gymnosporia arenicola

Abbott 2674, 2831DC (NH); 2684, 2831DC (NH); 2685, 2831DC (NH, PRU), *Ankiewicz* 15, 2732DA (PRE), *Balsinhas* 3098, 2631DD (PRE), *Barbosa & Lemos* 8514, type, (PRE), *Burger* 6, 3030BD (PRE), *Buthelezi* 466, 2732BC (NH); 675, 2732BC (NH), *Du Toit* 2419, 3030BC (NH, PRE), *Edwards* 122, 2732DA (NU), *Fakude* 19, 2831DD (NH, NU, PRE), *Fokkens* 29, 2832AD (NH), *Forbes & Obermeyer* 75, 2931CC (PRE); 91, 2931CC (PRE), *Garland* SP218, 2732BC (GRA), *Gerstner* 4815, 2732CD (PRE), *Gordon* 219, 2732DA (NH), *Hildyard* 129, 2830CC (PRE), *Johnson* 608, 2931BA (NBG) *Jones* 135, 2732BC (GRA), *Kerfoot*, K7349, 3030CB (J); 7381, 3030CB (J), *Lawn* 1468, 2931BA (NH), *MacDevette* 223, 2832AD (NH, PRE); 238, 2832AD (NH); 265, 2931CA (NH, PRE); 268, 2931CA (NH); 421, 2832AD (NH); 830, 2832AB (NH); 1645, 2831DD (NH); 1651, 2831DD (NH); 1663, 2831DD (NH), *Medley Wood* 10940 (GRA), *Moll* 2924, 2931AD (PRE), *Nicholas* 673, 2831DC (NH); 1384, 2832AB (NH); 1730, 3030BC (NH), *Nichols* 560, 2831DD (NH); 608, 2931CA/CC (NH); 673, 2831DC (NH), *Nicholson* 582, 3030CB (NH); 1201, 3030DA (PRE); 2578, 3030DA (NH, PRE); 46928, 2931CA (PRE), *Noel* 10931 (GRA), *Pegel* NDO64, 2931CC (PRE, S), *Pienaar* 289, 2931CC (NH), *Ross* 1888, 2931CC (NH), *Schlechter* 2862, 2931CC (PRE), *Stewart* 110, 2931AD (NH), *Strey* 5415, 2832AD (PRE); 6766, 2931CC (NH, PRE), *Vahrmeijer* 615, 2732DA (PRE), *Varhmeijer & Tölken* 847, 2732DA (PRE), *Ward* 981, 2732BD (NH, PRE); 2135, 2931BA (NH); 4251, 2930DD (NH, PRE); 4309, 2831DD (PRE), *Watmough* 400, 2931CA (PRE).

Gymnosporia buxifolia

Abbott 566, 3130AA (NH); 1310, 3130AA (NH, PRU); 1475, 3130AA (NH, PRU); 3045, 2828DB (NH); 5497, 3029DA (NH); 5717, 3028CC (PRE); 5722, 3028CC (PRE), *Acocks* 276, 2823CA (PRE); 1425, 2823DC (PRE); 1614, 2822DD (PRE); 1692, 2624CD (BR, PRE); 2111, 2824DA (PRE); 2519, 2820DB (PRE); 131706, 2827BD (PRE), *Acocks & Häfstrom* H831, 2824AC (PRE); 887, 2627CA (PRE); H1038, 2823CD (PRE); H1388, 2724CD (BOL, PRE), *Adams* 102, 2824BB (GRA), *Anderson* 613, 2923BA (PRE), *Balkwill* 366, 3030CC (NU), *Balkwill, Balkwill & Green* 5301, 2830CD (J), *Balkwill & Cadman* 2035, 3030BC (PRE), *Balkwill, Hartley & Reddy* 6926, 2628AA (J); 7046, 2628AA (J), *Balsinhas* 2982, 2630CD (PRE); 3422, 2528AD (BR), *Barnard* 33, 2430 (PRE), *Barrett* 23, 2531DC (PRE), *Bayliss* B35, 3326CB (PRE); B437, 3323DA (PRE); B680, 3325BA (PRE); B769, 3419BA (PRE); B770, 3419BA (PRE); BS5207, 3326BC (BR); B6202, 3326CB (PRE); B7013, 3324CA (PRE), *Behr* 8, 2627BB (NBG); 369, 2627BB (NBG); 549, 2627BB (NBG, PRE); 897, 2627BB (PRE), *Bohnen* 4601, 3421AD (PRE, STE); 7422, 3421AD (PRE), *Bolus Herbarium* 26, 3224BC (BOL), *Bolus* 11748, 3322CA (BOL, BR); BOL56812, 3418AB (BOL), *Bos* 775, 3323CC (STE); 1292, 2330CA (STE), *Bösenberg & Rutherford* 117,

3318AA (STE), *Boshoff* P74, 3321BC (STE), *Botha* 5700, 3325BD (PRE), *Botha & Coetzee* 1589, 2829CB (PRE), *Boucher* 3547, 3318DA (PRE, STE); 3702, 3421AD (STE); 4160, 3318CB (PRE, STE), *Bourquin* PRE46685, 2930CD (PRE); NH53718, 2931CC (NH), *Bradfield* 71, 2117AA (PRE), *Bredell* 2, 2528CA (PRE), *Brink* 475, 3326 (GRA), *Brueckner* 131, 2724CD (PRE); 416, 2524DC (PRE), *Brynard* 282, 3225AD (PRE), *Buitendag* 981, 2530BD (NBG, PRE), *Burgers* 88, 3419BB (PRE); 1483, 3420BC (PRE); 1633, 3420BC (STE), *Burmann* s.n. (G), *Burtt Davy* 1179, 2528CA (PRE); 15137, 2627DB (BOL), *Buthelezi* 148, 2731CA (NH); 336, 2930BA (NH), *Carr* 65, 2424CB (PRE), *Coleman* 156, 2930DD (NH), *Commins* 1006, 3325DB (PRE), *Compton* 3925, 3319DB (NBG); 8628, (NBG); 17762, 3227DB (NBG); 26081, 2631AC (PRE); 26085, 2631AC (NBG); 27019, 2631BD; (NBG); 27107, 2631CA (PRE); 27502, 2631CA (NBG, NH, PRE); 27911, 2631BD (NBG); 28051, 2631AA (NBG, NH, PRE); 28150, 2631CD (NBG, NH, PRE); 29183, 2631CA (NBG, NH); 30542, 2531CD (NBG, PRE); 31159, 2631AD (NBG, NH), *Cooper* 230 (G), *Corby* 3, 3226BD (GRA), *Cotterrell* 127, 3227AC (GRA), *Craven* 316, 2016DC (WIND); 317, 2016DC (WIND); 533, 2016DC (WIND), *Dahlstrand* 978, 3322DA (J); 1491, 3322CB (J, PRE, STE); 2278, 3322DA (STE); 2336, 3322DA (J, STE); 2378, 3322DA (PRE, STE); 2465, 3322DA (J, PRE); 2664, 3226DB (STE); 2781, 3226DB (PRE, STE); 3557, 3322DA (PRE); 3558, 3322DA (PRE), *Daly & Sole* 288, 3326BC (GRA); 2719, 3326BC (PRE), *Deacon* 52, 3325 (GRA), *De Lange* 402, 2727BA (NMB), *Devenish* 124, 2930BB (PRE);1625, 2930BB (NU), *De Winter* 3002, 1917CB (PRE, WIND), *Dieterlen* 75a, 2828CC (GRA, PRE, SAM); 75b, 2828CC (NH, PRE), *Dinter* 936, 1917CB (SAM); 2460 (SAM); 5321, 1917CB (BOL, PRE); 5327, 1917CB (PRE), *Dlamini* 30808, 2631AC (NH); PRE30809, 2631AC (NH); 46677, 2631AC (PRE), *Dohse* 60, 2829CC (NH, PRE), *Dold* 279, 3326DB (GRA), *Drège* s.n. HAL071502, 3222BA (HAL); 6733 (G); A7608 (GRA), *Dreyer* A7621, 3226CB (GRA, PRE), *Drijfhout* 4056, 3318DC (STE), *Du Plessis* 9, 3323AB (PRE); 209, 2528CB (PRU); 710, 2529DB (PRE); *Du Preez* 764, 2827CC (NMB); 1788, 2827CD (NMB); 2016, 2827CC (NMB), *Durst* s.n., 2628AA (J), *Ecklon & Zeyher* 939 (GRA, SAM); 940, 3325CD (HAL, SAM); 941, 3318CD (SAM); 942, 3318CD (GRA, SAM); 944 (GRA, SAM); 951 (SAM); 952, 3325DC (GRA, SAM); 953, 3322CB (GRA, HAL, SAM); 954, 3325CC (SAM), *Edwards* 912, 2830DC (PRE); 958, 2830CC (NU, PRE); 970, 2829CB (NU, PRE); 1103, 2830BC (PRE); 1218, 2830CC (NU, PRE); 2812 (NU, PRE); 3359, 3321AD (BR, PRE, STE); 4022, 2727CA (PRE), *Elmer* 2449, 3326BC (GRA), *Engelbrecht* 657, 2927AD (NMB); 681, 2927AD (NMB); 704, 2927AB (NMB), *Finn* 6237, 3326BC (GRA), *Flanagan* 325, 3227DB (NU, PRE, SAM), *Forbes & Munday* 618, 2628AA (J), *Fourcade* 5840, 3323CA (STE), *Franklin* 32, 2627BA (J), *Galpin* M54, 2428DA (BR, PRE, SAM); 2129, 2428DA (PRE); 2164, 3126DD (PRE); 13812, 2530BB (PRE), *Geldenhuys* 602, 3323DC (STE); 1239, 3325CA (PRE), *Germishuizen* 4088, 3318CD (PRE), *Gerrard & McKen* 621 (NH), *Gerstner* 2321, 2831CD (NH, PRE); 2343, 2831AD (NH); 2418, 2931AB (NH); 2583, 2731CD (NH); 2600, 2831CD (NH); 5530, 2528BA (PRE), *Gibbs Russell* 3366, 3226DD (PRE), *Gibbs Russell et al.* 186, 3222BA (PRE), *Giess* 9726, 2118BB (WIND), *Gillett* 449, 3418AB (STE); 487, 3318CD (STE); 1147, 3420AA (STE); 4589, 3226DD (PRE), *Glen* 1572, 3323DA (PRE); 2285, 2730BC (PRE); 2294, 2730BC (PRE), *Goldblatt* 7975, 3321BD (PRE), *Goossens* 879, 2827DA (PRE); 1190, 2726BC (PRE), *Greuter* 22070, 3320CC (PRE), *Gubb* KMG13269, 2724CA (PRE), *Gueinzius* 100 (G); 402 (G), *Guy* 23, 2832AA (PRE), *Hanekom* 1626, 2626CD (PRE); 1638, 2528CA (PRE); 1895, 2528CA (PRE); 2146, 3420BB (PRE); 2245, 2824AB (PRE), *Harrison* 101, 2831BB (NH, PRE); 434, 2831BB (NH), *Hartley, Reddy & Masilo* 2047, 2628AA (J), *Hean* PRE46779, 2927BB (PRE), *Heinecken* K5, 3423AB (PRE), *Hemm* 394, 2230CD (J), *Henderson* 97, 2830CC (PRE); 124, 2831DB (PRE), *Henrici* 4610, 3225BA (PRE), *Heydorn* 32, 2628AA (STE); 85, 2628AA (STE), *Hilliard & Burtt* 13352, 2929CB (NU); 18171, 2929AD (J, NU, PRE), *Hilner* 342, 3126DD (GRA, PRE), *Hobson* 1012, 3226CA (GRA), *Hoole* G22, 3326AD (GRA); A7614, 3326BC (GRA), *Horn* SKF2280, 3421BA (PRE), *Hugo* 186, 3322AC (STE), *Huse* 7, 2829DD (NH), *Jacobsen* 2097, 2428BC (PRE); 4903, 2530CB (PRE), *Jacobsz* 783, 2829DA (PRE); 1090, 2829AC (PRE), *Jacot Guillarmod* 846, 2927BB (PRE); 2183, 2927BA (PRE); 9363, 3326AD (GRA, PRE), *Jarman & Guy* 415, 2930CB (NU), *Johnson* 1462, 2931AC (NH), *Jones* 8, 3326BC (GRA), *Jooste* 3, 3319CD (STE), *Jordaan* 303, 2831AD (NH); 444, 2531AA (NH); 654, 2731CD (NH, PRE); 2075, 2731CB (NH); 2259, 3318CD (PRE); 2261, 3318CD (PRE); 2262, 3322DC (PRE); 2267, 3421BD (PRE); 2269, 3421AB (PRE); 2270, 3420AA (PRE); 2271, 3420AA (PRE); 2272, 3420AA (PRE); 2278, 3323DD (PRE); 2285, 3322BC (PRE); 2286, 3322BC (PRE); 2300, 3325CD (PRE); 2302, 3325CD (PRE); 2305, 3325BD (PRE); 2306, 3325BD (PRE); 2309, 3325BD (PRE); 2324, 3326BC (PRE); 2326, 3326BC (PRE), *Junod* 579, 2430AB (G); 25591 (PRE), *Keet* 1272, 2528CC (PRE); US13992, 3423AA (STE), *Kemp* 1204, 2631AC (PRE), *Killick* 1022, 2829CB (PRE), *Krauss* 1841, 3420AB (G), *Krige* 1, 2330CB (PRE), *Kroon* 45, 2627DD (PRE), *Kruger* 1287, 3320DD (PRE, STE), *Labrun* 61, 2527CD (J), *Lady Frere Dove* 80, 3127AD (PRE), *Lawn* 415, 2832CC (NH), *Leendertz* 5404, 2528CD (PRE); 5642, 2429AA (PRE); 8259, 2528CC (PRE); 9737, 2527CA (PRE); 10893, 2627DB (PRE), *Leistner* 1511, 2723AA (PRE); 2973, 2827CA (PRE), *Le Roux & Lloyd* 603, 2917CD (STE), *Lewis* 1907, (SAM), *Liebenberg* 2772, 2530BD (PRE); 3135, 3227DA (PRE), *Louw* 745, 2627CA (PRE); 983, 2627CA (PRE); 1518, 3127AC (PRE), *Low* 289, 3318DC (STE), *Lyall* NH58101, 2931CC (NH), *MacDonald* 76/30, 2823BC (NBG, PRE), *Macnae* 1371, 2628AA (J), *MacOwan* 46812, 3326BC (PRE), *Maguire* 2724, 2429AA (J), *Marais* 474, 3228CB (PRE); 495, 3128DC (PRE); 496, 3128DB (PRE); 506, 3127DB (PRE); 510, 3126DD (PRE); 519, 3227AD (PRE); 531, 3326AD (BR, PRE); 537, 3326CB (PRE); 573, 3424BB (PRE); 584, 3421BB (PRE); 585, 3421BA (BR); 586, 3421BB (PRE); 602, 3318CD (BR); 609, 3318CB (PRE); 650, 3320CC (BR, PRE); 651, 3320CC (PRE); 652, 3320CC (PRE); 707, 3323CA (PRE); 716, 3325CC (PRE); 1078, 2927AB (PRE); 1083, 2927BC (PRE), *Marloth* 198, 3318CD (PRE); 7235, 3318CD (PRE); 11864, 3318CD (PRE), *McCabe* s.n., 3224BC (BR, PRE, S), *McDonald* 452, 2731AC (NU), *Medley Wood* 69, 2931CC (PRE); 685, 2930DB (NH); 6382,

2931CC (G); 10097, 2930DD (NH, PRE); 11504, 2930DB (NH); 12813, 2929BA (NH, S); 13178, 2930DD (NH); s.n., 2930DC (G), *Menezes* 6, 2427DA (PRU), *Meyer* 6111, 3326BC (GRA), *Miller* A7619, 3326AD (GRA); A7620, 3326AD (GRA), *Milton* 128, 2830CC (NU), *Moffett* 50, 3322AC (STE); 546, 3322AC (STE), *Mogg* 10333, 2528CA (SAM); 15319, 2528CC (PRE); 15730, 2528CC (PRE); 15818, 2528CA (PRE); 18342, 2628AA (J); 18345, 2628AA (J); 18972, 2628BC; 19137, 2627BD (J); 19381, 2627BB (J); 20096, 2528CC (J, PRE); 20125, 2627DB (J); 20127, 2628BC (J); 20184, 2627BD (J, PRE); 20274, 2627BA (J); 20333, 2627BA (J); 20372, 2627AA (J); 20406, 2628AA (J); 21373, 2627BB (J); 22010, 2627BB (J); 22847, 2627BA (J); 24002, 2628CB (J); 25815, 2627BB (PRE); 30735, 2529AD (J); 31172, 2428DA (J); 35214, 2627BA (J), *Moll* 696, 2929DB (NU); 904, 2930AC (NU); 1840, 2930DB (PRE); 1907, 2930DC (NU, PRE); 4573, 2632CC (NH, S), *Moore* 27, 2527CA (PRE), *Morris* 158, 3320CC (NBG); 374, 3423AA (NBG); 757, 2930DC (PRE); 1117, 2726AC (PRE); 1198, 2726AC (PRE), *Morris & Engelbrecht* 1120, 2626AA (PRE); *Moss* 4530, 2528DA (J); 5572, 2628AA (J), *Muir* 48, 3419BC (PRE), *Mund* 43921, 3322CB (SAM), *Murray* 697, 2626DC (PRE), *Nänni* 119, 3327BB (PRE), *Nicholas* 1648, 3029DA (NH, PRE), *Nicholas & Van den Berg* 1835, 3029BA (NH, PRE), *Nichols* 557, 2931CC (NH), *Noel* 268, 3326BC (GRA), *Obermeyer* 64, 2528CC (PRE), *O'Callaghan* 454, 3420BD (STE); 1238, 3218CC (STE); 1292, 3318AD (STE), *Oliver* 5470, 3321CB (PRE, STE), *Oliver, Tölken & Venter* 556, 2816DB (PRE, STE), *Olivier* 1194, 3325DC (NBG), *Palmer* PRE46842, 3225CA (PRE), *Parsons* 323, 3422AA (PRE, STE), *Paterson* 1188, 3325CB (PRE); 12288, 3325DC (PRE), *Paton* 304, 2828DB (PRE), *Peeters, Gericke & Burelli* 299, 2927AA (J); 304, 2927AA (J, PRE); 525, 2525BD (J, PRE), *Pegler* 58, 3228CB (BOL), *Peyper* 1041, 2927BA (NMB); 1080, 2825BA (NMB), *Phillips* 339, 2528AC (PRE); 722, 2828CC (SAM); 3030, 2528CA (BR, PRE, SAM), *Phillipson* 795, 3226DB (PRE); 873, 3226DB (PRE), *Pienaar* 6, 2528CC (PRE), *Pilkington* 19, 2627AB (J), *Pillans* 10217, 3418AB (BR), *Pole Evans* 21, 3218AB (PRE); 26 (PRE), *Pont* 208, 2727CA (PRE), *Porter* 17, 2627BA (J), *Potgieter* 80, 2828AB (PRE), *Potts* 27262, 2528 (PRE); GUC3280, 2828CA (PRE), *Pretorius* 162, 3119CA (STE); 171, 3119AC (STE), *Prior* PRE46787, 318CD (PRE), *Purcell* 266, 3418AB (SAM); 89653, 3418AB (SAM), *Rabe* 21, 3322DC (STE), *Rattray* 237, 3227CA (GRA), *Rehmann* 232, 3322DD (BR), *Repton* 48, 2528CC (PRE), *Retief* 326, 3326AD (PRE); 1836, 2625CB (PRE), *Retief & Reid* 445, 3223DD (PRE), *Rogers* 6253, 2425DB (G); 11408, 2528CC (BOL, NBG), *Rose Innes* 93, 2527CA (PRE), *Ross* 14, 2830AA (NH), *Rudatis* 237, 2529CD (STE); 660, 3030AD (PRE, STE); 1351, 3030AD (STE); 1401, 3030AD (G), *Rumales* 63, 2829BD (NU), *Rycroft* 2703, 3321AD (NBG); 3081, 3421AD (NBG), *Saaiman* 226, 2823CD (NMB); 516, 3036BB (NMB), *Scharf* 1087, 3325CA (PRE); 1989, 3325CA (PRE), *Scheepers* 1504, 2626AA (BR, PRE, S); 1632, 2727CA (PRE), *Schelpe* 81, 2930CB (NU); 751, 2829CC (NH), *Schlechter* 241, photo, 3318DC (PRE); 1100, 3418AB (GRA); 1375, 3318CD (PRE); 3224, 2930DD (PRE), *Schlieben* 7240, 2329BB (BR, G), *Schmitz* 584, 2927BB (PRE); 4809, 2927BC (PRE); 6278, 2927AB (PRE), *Schoenfelder* S200, 1918CA (PRE), *Scholtz* s.n., 2627BB (J), *Schönland* 720, 3326AD (GRA), *Schrire* 1606, 3030BC (NH); 2298, 2829DA (NH), *Schweickerdt* 1000, 2528CA (PRE), *Sim* 1962, 3227CD (BOL), *Sister Michaelina* 3308, 2426CD (PRE), *Smith* 3254, 2528CA (PRE), *Smook* 1336, 2731BD (BR, PRE), *Smuts* 1148, 3318CD (PRE), *Smyth* 2737, 3326BC (GRA), *Snyman* 68, 2525BD (PRE), *Sprengel* s.n. HAL071503 (HAL), *Stalmans* 704, 2430AB (PRE); 908, 2430AB (PRE); 2802, 2630BB (J), *Staples* 107, 2928 (PRE), *Stielau* 39, 2930CB (NH, PRE), *Story* 3777, 3227CA (PRE), *Strey* 9064, 2930DC (PRE, S); 9972, 2829DB (NH, PRE), *Strydom* 80, 3318AA (PRE), *Sutton* 140, 2725BD (PRE); 709, 2627AA (PRE); 779, 2526DA (PRE); 1032, 2526DA (PRE), *Symons* 478, 2929AD (PRE), *Taylor* 206, 3421BA (NBG); 2102, 2930CD (PRE); 3693, (NBG); 9473, 3418AB (PRE, STE), *Theron* 554, 3124DB (PRE); 912, 3224AC (PRE), *Theron & Studente* 3202, 3319DD (PRE), *Thode* A2622, 3325BC (NH); US9397, 3418AB (STE), *Thorncroft* 3008, 2431AD (PRE), *Thorne* 500006, (SAM), *Thorns* NBG11755, 3018AC (NBG), *Tölken & Hardy* 975, 2118DB (PRE), *Van Breda* 4291, 3218AB (PRE); 4629, 3321BB (STE), *Van der Merwe* 30, 2528CD (PRE), *Van der Walt* 200, 3418AB (STE); 204, 3418AB (STE); 214, 3320CC (STE), *Van der Westhuisen* 165/80, 2817AC (STE); 181/80, 2917CD (STE); 227, 3225DC (PRE), *Van der Zeyde* PRE60139, 2828DB (PRE), *Van Hoepen* 18143, 2828CB (PRE); PRE59906, 2828CB (PRE), *Van Rooyen & Ramsey* 384, 3218CB (PRE, STE), *Van Son* 36588, 3119AC (PRE), *Van Wyk* 366, 3322CA (PRE, STE); 2192, 3319DA (PRE, STE); 2376, 3319DA (STE), *Van Wyk & Theron* 4605, 2230CD (PRE); 4749, 2230CD (PRE), *Venter* 3, 2628CA (J); 620, 2527DC (PRE), *Verdoorn* 507, 2528CC (PRE); 1230 2527DD (PRE), *Viviers* 377, 3320DC (STE), *Von Schlechtendal* s.n. HAL071500 (HAL), *Walgate* NBG11752, 3418AB (NBG), *Wall* 10 3318CD (S), *Walter & Walter* 680, 1918CA (B, WIND); 812 (B); 4108, 2118DD (B, WIND), *Ward* 2132, 2931BA (NH, PRE); 3276, 2831BB (NH, PRE); 4403, 2831BD (PRE); 5308, 2930DD (NH), *Watt* 4441, 2628AA (J); 4583, 2528CC (J); 5324, 2628AA (J); 5325, 2628AA (PRE), *Wells* 3020, 3326AD (PRE, S), *Welman* 548, 2427DB (PRE), *West* 397, 2830CC (PRE), *Westphal* 65, 2230DC (PRE), *Willemse* 3, 34212AD (STE); 3a, 3421BC (STE), *Williams* 68, 2831AC (NH), *Williamson* 92, 2531CA (PRE), *Wilman* 19223, 2824BD (PRE); s.n. NBG98518, 2824DB? (NBG); SAM25342, 2823BC (SAM), *Wilson* 4, 2627BB (J), *Wirminghaus* 1028, 2930AC (NU), *Wurts* 1209, 3321AC (NBG), *Wylie* 23103, 2931CC (NH), *Young* 2313, 2527DC (J), *Zeyher* 227, 3318CD (SAM); 246 (BOL, SAM, STE); 2179, 3325CC (G, PRE); 2182a, 3325CC (G, PRE); 2182b, 3325DC (PRE); 4916, 3318CD (BOL); 14961, 3318CD (SAM); *Zietsman* 69, 2828DA (NMB, PRE); 227, 2725DA (NMB); 430, 2827CC (PRE); 515, 2827CC (NMB, PRE); 1048, 3017BB (NMB, PRE), *Zietsman & Zietsman* 430, 2827CC (NMB); 1048, 3017BB (NMB); 1313, 3225AD (NMB, PRE).

Gymnosporia capitata

Acocks 11895, 3326BB (PRE), *Archibald* 3606/50, 3325BD (GRA); 4280 (GRA); 5540, 3326AC (PRE), *Bayliss* B309, 3326BA (PRE); B6333, 3326BA (PRE); 8476, 3326BA (GRA, PRE), *Bohnen* 7332, 3421AB (PRE, STE); 7705, 3421BD (STE); 7868, 3421BD (PRE, STE), *Bokelmann* 6,PL 21, 3326BC (NBG), *Burrows* 3197, 3326BD (GRA), *Curtis* 207, 3326 (GRA), *Dahlstrand* 2508, 3325DC (STE), *Drège* s.n. HAL071485, 3326BB (HAL); s.n. HAL071491, 3228BB (HAL), *Ecklon & Zeyher* 947, type, 3325DC (GRA, HAL, SAM), *Edwards* 414 (NU), *Flanagan* 2585, 3227DB (BOL, SAM), *Fries, Norlindh & Weimarck* 258, 3325CD (COI), *Galpin* 5931, 3227CD (PRE); 8086, 3126DC (BOL, GRA, PRE), *Gibbs Russell* 3037, 3226DC (GRA, PRE), *Giffen* 318, 3226DD (PRE), *Grobbelaar* 2126, 3325CB (PRE, PRU), *Hall-Martin* 5952, 3325BC (PRE), *Hanekom* 2147, 3420BB (PRE), *Hoole* GRA A7600, (GRA), *Jones* 11, 3326BA (GRA), *Jordaan* 2312, 3325DC (PRE); 2314, 3325DC (PRE); 2315, 3325DC (PRE), *La Cock* 5, 3326BA (GRA), *Marais* 402, 3326BB (PRE), *Mullins* GRA A7603, 3326AD (GRA), *Olivier* 694, 3325CD (PRU), *Osborne* 194, (GRA), *Paterson* 989, 3325DC (PRE); 1035, 3325DC (PRE), *Rogers* 4511, 3227DB (GRA), *Scharf* 1781, 3325CA (PRE), *Sim* 1672 (NU); 1966, 3227CD (BOL, PRE), *Skead* GRA A7601, 3226CA (GRA), *Story* 2101, 3226DC (PRE), *Taylor* 204, 3421BA (NBG); 1285a, 3324DD (PRE), *Van Wyk & Kok* 5846, 3327AC (PRE, PRU), *Zeyher* 2178, 3326DA (PRE).

Gymnosporia devenishii

Anonymous s.n. sub J76196, 3029CD (J), *Cooper* 154, 2930BA (NH, PRE), *Cunningham* 912, 2730BC (NU), *Devenish* 1579, 2730AD (PRE), *Edwards* 694, 2929BA (NU); 2842, 2830DD (PRE), *Hilliard & Burtt* 15571, 2929CB (NU); 17206a, 2929CB (NU), *Jordaan* 2699, 2730AD (NH, PRE); 2745, 2730AD (NH, PRE); 2795, 2730AD (PRE), *Meyer* 206, 2730AD (PRE), *Miller* 3218, 3028DD (PRE), *West* 1377, 2929BA (NH).

Gymnosporia elliptica

Drège 8486, 3325DC (PRE), *Ecklon & Zeyher* 945 (SAM), *Fourcade* 1030, 3424BB (BOL); 1894, 3324CD (BOL, STE); 4907, (BOL, STE), *Galpin* 3881, 3424BB (PRE), *Gillett* 2419, 3325DC (STE), *Jordaan* 2290, 3325DC (PRE); 2291, 3325DC (PRE); 2292, 3325DC (PRE); 2293, 3325DC (PRE); 2294, 3325DC (PRE), 2295, 3325DC (PRE), *Kemsley* 169, 3325DC (GRA), *Marais* 565, 3424BB (BOL, PRE); 717, 3325DC (BR, PRE), *Olivier* 1499, 3325DD (STE), *Paterson* 366, 3325CD (GRA); 1935, 3325CD (GRA, PRE), *Scharf* 1394, 3325CA (PRE), *Schlechter* 5896, (BOL); 6043, type, 3325CC (BOL, GRA, PRE), *Van Wyk* 12217a, 3325CD (PRU).

Gymnosporia gariepensis

Craven 2644, 2717CD (WIND), *Drijfhout* 2969, 2817CA (PRE, STE), *Hardy* 2602, 2817 (PRE), *Jurgens* 28856, 2817AC (PRE), *Van Son* 32415, 3017AD (PRE), *Van Jaarsveld & Leitch* 9736, type, 2817CB (NBG, PRE), *Van Wyk* 8798, 2716BA (PRU).

Gymnosporia glaucophylla

Acocks 10139, 2929BB (PRE), *Aitken & Gale* 24, 2831BB (NU, PRE), *Balkwill* 1429, 2530DD (PRE), *Balkwill, Cadman & Stormanns* 3051, 2732CA (J), *Balsinhas* 3422, 2528AD (PRE), *Bayer* 9/46, 2830BA (NU); 852, 2830BA (NU), *Bayliss* B158, 3327DA (PRE), *Bourquin* 767, 2732CA (PRE), *Brown & Shapiro* 360, 2731AC (PRE), *Buitendag* 576, 2530BD (NBG, PRE); 578, 2530BD (NBG, PRE), *Campbell* 177, 2930CD (NU), *Codd* 4276, 2331DC (PRE), *Coetzee* 1392, 2531CA (PRE), *Comins* 233, 2930AD (NU), *Compton* 26964, 2631CA (NBG, PRE); 27889, 2631BD (PRE); 27904, 2631BD (NBG, PRE); 27911, 2631BD (NH, PRE); 27924, 2631BD (PRE); 28922, 2631CA (NBG, NH, PRE); 28971, 2531CD (NBG, PRE); 30057, 2631BD (NBG); 30058, 2631BD (NBG, NH, PRE); 30805, 2631BC (PRE); 30806, 2631BC (PRE); 30814, 2631AD (PRE); 31646, 2631CA (NBG, NH, PRE); 31752, 2631AD (NBG, PRE), *Crook* 36, 2729 (NH), *Culverwell* 7, 2631BD (PRE); 33, 2631BD (PRE), *Dale* 2079, 2631AD (PRE); 2080, 2631AD (PRE), *Dlamini* s.n. sub NBG71779, 2631AD (NBG), *Edwards* 744, 2929BB (NU, PRE); 755, 2830BA (PRE); 1017, 2730BD (NU, PRE); 1273, 2830DD (NU, PRE); 1491, 2732AC (NU, PRE); 3195, 2731DA (NU, PRE), *Fakude* 54, 2832AA (NU, PRE), *Gale* s.n. sub NU3495, 2829DB (NU), *Galpin* 514, 2531CC (BOL, SAM), *Gandar* s.n., 2831AB (NU), *Gerrard* 1587, 2831CC (NH), *Gerstner* 2246, 2831CD (NH, PRE); 3298, 2831AD (NH, PRE), *Goodman* 588, 2732CB (NU), *Hitchins* 776, 2832AA (PRE), *Hobson* 665, 2832AC (GRA), *Jordaan* 346, 3030CB (NH, PRE); 2000, 2930DB (NH, PRE), *Karsten* s.n. sub NBG84558, 2631DA (NBG, PRE), *Keet* 1501, 2531CB (PRE, STE), *Killick* 585, 2930DA (NU, PRE), *Kirsten* 30807, 2631AD (PRE), *Krynauw* 553, 2531CA (PRE), *Lawn* 716, 2831DD (NH); 918, 2831CD (NH), *Louw* 306, 2526AD (PRE); 312, 2425DD (PRE), *MacDevette* 711, 2731AC (NH); 1977, 2831AD (NH), *Marais* 791, 3030AA (PRE), *Medley Wood* 8299, 2930CD (GRA, PRE); 9364, 2830CB (PRE), *Miller* S/46, 2631AD (PRE); S/115, 2731BD (PRE), *Mogg* 38541, 2529AD (PRE); PRE46782, 2930AC (PRE), *Moll* 2098, 2930DB (PRE),

Nel 52, 2731BC (NH, PRE), *Oates* 321, 2330DA (PRE), *Pole Evans* 34, 2631BD (PRE), *Pooley* 1646, 2632CD (COI, NU), *Porter & Ward* 24, 2731AD (NH); 75, 2731AD (NH), *Repton* 6009, 2731BD (PRE), *Retief* 678, 2528BB (PRE), *Ross* 403, 2930CB (NU), *Rudatis* 1072, 3030BC (STE), *Stirton* 110, 2930CB (PRE), *Strey* 10052, 3030CB (NH, PRE), *Theron* 974, 2529AD (PRE), *Van der Bijl* US14072, 2931CC (STE), *Van der Schijff* 651, 2531AA (KNP, PRE); 3818, 2531CC (PRE), *Van Wyk* 7156, 3030CD (NH); 8171, 2930DB (NH, PRU), *Vassilatos & Mantell* 298, 3030CA (J), *Venter* 1027, 3030CC (PRE); 11909, 2328AD (PRE), *Verdoorn* 1670, 2631BD (PRE), *Ward* 1406, 2832AA (NH); *Wells* 1381, 2930DA (NU); 4444, 2730DD (PRE), *Williams* 62, 2831AC (NH).

Gymnosporia grandifolia

Abbott 2531, 3030CC (PRU); 2631, 3030CC (PRU), *Acocks* 9152, 3227CB (PRE); 13108, 2832AA (PRE), *Anonymous* J76195, 3029CD (J), *Balkwill & Cadman* 1419, 2930CA (PRE), *Bond* SA2, 3227CA (GRA), *Breyer* 24382, 2329BB (PRE), *Codd* 2047, 2832AA (PRE), *Cooper* 273, 3029DC (NH), *De Sousa* 152, 2531CC (PRE), *Dlamini* PRE46681, 2631AC (PRE), *Drège* 6735 (G), *Duckworth* 63a, 3227CB (NH), *Du Plessis* 227, 2329BB (PRU), *Edwards* 2941, 2632CA (NU, PRE), *Fakude* 56, 2832AA (PRE), *Flanagan* 316, 3227DB (PRE); 3608 (SAM), *Galpin* 3292, 3327BB (PRE); 5917, 3227CC (PRE), *Geldenhuys* 239, 3227CB (PRE), *Giffen* 848, 3226DB (PRE); 1818, 3226DD (PRE), *Guy* 100, 2832AA (NU, PRE), *Hitchins* 1, 2832AA (NU, PRE), *Jordaan* 2115, 2430AA (PRE), *Liebenberg* 3133, 3227DA (PRE), *Marais* 466, 3227DB (PRE); 469, 3228AC (PRE); 470, 3228AC (PRE); 484, 3228AD (GRA, PRE); 492, 3128DC (GRA, PRE); 525, 3227AD (PRE), *Medley Wood* s.n. (photo) 2930DB (KEW), *Moll* 822, 2930AC (BR, NU, PRE); 1009, 2930AC (PRE); 1766, 2930CA (PRE); 3524 2930AC (PRE), *Moll & Nell* 5514, 2732AC (NH), *Nicholson* 1247, 3030BC (PRE); A7616, 3227DA (GRA), *Onderstall* 273, 2530BC (NBG, PRE); 2713, 2530BC (PRE), *Osborne* 235, 3227CA (GRA), *Pegler* 1207, 3228AD (BOL, GRA, PRE, SAM), 3075 3228CB (PRE), *Pienaar* 78, 2430AB (PRE), *Pitchford* 3, 3227CB (GRA), *Renny* 170, 2330CD (PRE), *Scheepers* 696, 2330CA (PRE); PRE46723, 2330CA (PRE), *Smook* 524, 2930 (NU), *Stalmans* 75, 2430AB (PRE); 1054, 2430AA (PRE); *Strey* 8643, 3130AA (NU, PRE); 9048, 2930DC (PRE), *Taylor* 2029, 2930CA (PRE), *Thorncroft* 672, 2531CC (PRE); 2007, 2531CC (PRE); ex Herb. Rogers 19167, 2531CC (PRE, SAM, STE), *Von Gadow* 100, 3227 (GRA), *Ward* 1567, 2832AA (GRA, NH, NU, PRE); 2243, 2832AA (PRE), *Wells* 1494, 2930DA (NU); 3149, 3227CA (GRA, PRE).

Gymnosporia hemipterocarpa

Acocks 10146, 2830CC (NH, PRE); 13477, 2830CD (PRE), *Archer* 350, 2830CC (PRU), *Compton* 26404, 2631DC (PRE), *Edwards* 2507, 2830CD (NU, PRE); 2759, 2830CD (PRE); 2784, 2830CD (NU, PRE); 2810, 2930AB (PRE); 2909, 2731BD (NU, PRE); 3198 (PRE); 3299, 2831BD (PRE), *Galpin* 14793, 2830CB (PRE), *Gerstner* 3199, 2731CD (NH); 3580, 2830CB (NH); NH22909 (NH), *Jordaan* 1155, type, 2830CC (NH), *Lawn* 567, 2831DC (NH); 1470, 2831DC (NH), *Moll* 5258, 2831BD (NH, PRE), *Nel* 41, 2731BC (NH), *Pentz* 214, 2830CC (PRE), *Thomson* 10, 2930CB (NU), *West* 1460, 2830CC (PRE).

Gymnosporia heterophylla

Abbott 569, 3130AA (NH); 573, 3130AA (NH); 882, 3030CC (NH); 949, 3030CC (NH); 1079, 3030CC (NH); 1556, 3030CC (NH, PRU); 1639, 3030CC (NH); 2272, 3030CC (NH); 2841, 3130AA (NH); 4587, 3029DA (NH), *Abrahams* A7607, 3326 (GRA), *Acocks* 8916, 3126DB (PRE); 8983, 3226DB (PRE); 16124, 3326BD (PRE); 21249, 3325BD (PRE), *Archibald* 4279 (GRA); 4369, 3326CB (GRA); 5211, 3325BC (GRA), *Arnold* 1442, 2831DC (PRE), *Balkwill, Balkwill & Williamson* 6437, 2530DB (J); 6653, 2530CC (J); 6684, 2530DD (J), *Balkwill & Cadman* 2810, 3030AC (J), *Balsinhas* 3128, 2531CC (PRE), *Batten* 3, Pl. 109, 3327BB (NBG), *Bayliss* 1476, 3326BC (PRE); 2341, 3326BC (NBG); 4737, 3326BC (GRA); BS6671, 3420AA (S); BS 6672, 3420AA (BR); BS6694, 3326BC (BR); BS7055, 3326AD (GRA, S); BS7278, 3323 (BR); BS8756, 3326AA (BR), *Bayliss & Bayliss* 8735, 3326AA (GRA), *Britten* 1857, 3326BC (GRA), *Buitendag* 675, 2530BD (NBG, PRE), *Cherry & Baines* A7605, 3326BC (GRA), *Chief Regional Forest Officer* 46861, 3227CD (PRE), *Clinning* 51, 2329CD (J), *Cloete* 1358, 3128BD (NH), *Codd* 1844, 2831DA (PRE), *Comins* 1253, 3326BC (PRE); 1456, 3227CA (PRE), *Compton* 19129 2531CD (PRE); 19808, 3327BB (NBG); 19834, 3326BD (NBG); 29129, 2531CC (NBG, PRE), *Cunningham* 881, 2731 (NU), *Daly* 213, 3326BC (PRE), *Daly & Cherry* 989, 3326BC (GRA, PRE); 10789, 3326BC (PRE), *Davidson* s.n. J69082, 2430DD (J), *De Souza* 576, 2531CC (PRE), *Drège* 6735, 3228BB (PRE), *Dyer* 75, 3326BC (PRE); 450, 3326BC (PRE), *Ecklon & Zeyher* 943, (S); 948, 3326BC (HAL, SAM); 2181 (Z); 949, 3325DA (SAM); s.n. A7611 (GRA), *Flanagan* 220, 3228CB (PRE, SAM); 474, 3227DB (PRE, SAM), *Forest Officer* 23, 2431CC (PRE), *Fourcade* BOL48839, 3423AA (BOL), *Fourie* 2, 3327BB (STE), *Franks* sub *Medley Wood* 11896, 3030BB (NH), *Galpin* 340, 3326BC (PRE); 515, 2531CC (GRA); 1104, 2531CA (PRE); 1870, 3327BB (BOL, PRE); 2916, 3326BC (PRE); *Germishuizen* 5724, 2531CC (PRE), *Gerrard & McKen* 1376 (NH), *Gerstner* 1916, 2831CD (NU); 2601, 2831CD (NH); 3950, 2830DB (NH), *Gillett* 1230, 3322CC (STE), *Glen* 1290, 2530DD (PRE); 1294, 2530DD (PRE); 1315, 2530DD (PRE); 1316, 2530DD (PRE), *Hartley* s.n. J75780, 2531CC (J), *Haycroft* NH38302, 3030BC (NH), *Haygarth* STE9420, 2930DD (STE); sub Rogers 17194, 2930DD (GRA); 22765,

2930DD (PRE), *Heath* 615, 2631AA (PRE), *Heeg* 158, 3326BC (GRA), *Hildyard* 148, 2831DA (PRE), *Holland* 148, 3325AD (GRA), *Hoole* A7606 (GRA), *Hutchings* 343, 3129CA (PRU), *Jacot Guillarmod* 6775, 3326BC (GRA); 8736, 3326AD (GRA), *Jacot Guillarmod & Brink* 94, 3327BB (GRA), *Johnson* 975, 3325BC (PRE); 1026, 3326AC (PRE); 1240, 3226DB (PRE), *Jordaan* 242, 3030CC (NH); 289, 2531AA (NH); 931, 3129BD (NH); 2320, 3326BC (PRE); 2322, 3326BC (PRE); 2323, 3326BC (PRE); 2325, 3326BC (PRE); 2326, 3326BC (PRE); 2327, 3326BC (PRE), *Keet* 592, 3323CA (STE), *Kerfoot* K6461, 2430DB (J), *Killick* 879, 3227CA (PRE), *King* 484, 2830BD (NH), *Kluge* 159, 2530BD (PRE); 1099, 2530DA (PRE), *Kotsokoane* 25723, 3227CA (PRE), *Lawn* 280, 2831CD (NH); 379, 2831CD (NH), *Liebenberg* 2657, 2530BD (PRE), *Long* 89, 3326AD (GRA); 727, 3325BD (PRE); 1267, 3325BD (GRA, PRE), *Lubke, Everard et al.* 2706, 3227DC (GRA), *MacDevette* 729, 2731AC (NH), *MacOwan* 290, 3326BC (GRA, PRE); 3326BC; 712, 3326BC (BOL, PRE, SAM), *Maguire* 7626/16, 2631AC, (J), *Marais* 367, 3326BC (PRE); 397, 3325BC (PRE); 398, 3325BC (PRE); 1016, 3128DB (PRE), *Martin* 4094, 3326BC (GRA); 8010, 3326BC (GRA), *Matthews* 643, 2430DD (PRE), *Mauve* 4290, 2429BB (PRE), *McClean* 39, 3030CA (NH); 266, 3030CC (NH, PRE); 394, 3030CA (NH, PRE); 519, 3030CB (NH, PRE), *Medley Wood* 212, type, 2930DB (NH, SAM); 579, 2930DB (BOL, SAM); 633, 2931CA (BOL, NH, SAM); 1119, 2930DD (SAM); 1139, 2931CA (NH); 1772, 2930DB (NH); 7859, 2930DD (PRE); 8373, 2931CA (NH); s.n., type, photo, (KEW), *Meeuse* 9679 3228BC (PRE), *Miller* D/174, 3128BD (PRE); 3087, 2531CC (PRE), *Mogg* 5981, 2831DD (PRE); 33032, 2430DD (J), *Momberg* SN11, 2628CA (PRE), *Muller* 2207, 2530DD (PRE); 2284, 2530DD (PRE), *Nänni* 93, 3227DD (PRE), *Nichols* 559, 3030BC (NH), *Nicholson* 1358, 3030CC (PRE); 2396, 3030CC (NH); 2521, 3130AC (NH), *Nicholson* 930, 3129BD (PRE); 1181, 3128BD (PRE); 2521, 3130AC (NH), *Onderstall* 823, 2531CA (PRE), *Paterson* s.n., 3325DC (GRA), *Pegler* 227, 3228CB (PRE, SAM); 741,3228CB (GRA); 1244, 3228CB (BOL, PRE); 3078, 3228CB (PRE), *Phillips* 1418, 3321AD (SAM), *Phillipson* 3387, 3326BC (GRA), *Prosser* 1247, 2530CB (J, NBG, PRE); 1476, 2530DB (J, PRE), *Raal & Raal* 961, 2430DA (PRE), *Rattray* 193, 3327BB (GRA), *Rauh & Retief* 1320, 2430DB (PRE), *Rauh & Schlieben* 9718, 2431CC (PRE), *Richardson* 133, 3326AD (GRA); *Rogers* 2365, 2530CB (PRE); 3418, 3326AD (GRA); 3851, 3326BC (GRA); 11727, 2530CB (BOL); 14872, 2430DD (BOL); 21539, 2430DD (PRE); 23872, 2530BD (PRE), *Rudatis* 305 (STE), 513, 3030AD (PRE); 841 (STE), *Schlieben* 9718, 2431CC (PRE), *Schönland* A7604, 3326BC (GRA); 27254, 3326BC (PRE), *Scott-Shaw* 4366, 3030CD (NH), *Seagrief* 74, 3326 (GRA), *Sim* 1318, 3227CC (BOL, PRE); 1670, 3227CC (NU), *Sister Stephany* 631, 3029DC (BOL), *Stalmans* 695, 2430AB (PRE); 2365, 2530DD (J), *Story* 414, 3226BB (PRE); 2252, 3326BC (PRE); 2600, 3326BC (PRE); 2708, 3326BC (PRE), *Strey* 10674, 3128BB (NH, PRE), *Strey & Schlieben* 7971, 2530AB (PRE), *Swift* 4091, 3326BC (GRA), *Thode* NH4859, 3327BB (NH); STE10813, 3327BB (STE), *Tyson* 1049, 3227CD (SAM), *Van Wyk* 7140, 3029BC (NH); 7219, 3030CC (NH); 8332, 3228BD (PRU), *Van Wyk & Matthews* 7875, 3129BD (NH); 7981, 3129BD (NH), *Venter* 1198, 2831DB (PRE); 9119, 2530DD (PRE), *Wager* 23655, 2531CC (PRE), *Ward* 6344, 3030BC (PRE), *West* 1460, 2830CC (NH), *White* 1119, 2930DD (PRE), *Wilson* 139, 3326BC (PRE), *Wirminghaus* 316, 3326BD (GRA); *Wright* 1717, 3326BC (GRA), *Zeyher* 2181, type, 3326BC (PRE, Z); 2182 (GRA, SAM).

Gymnosporia karooica

Anderson E27, 2925AB (PRE); 235, 3025DA (PRE), *Burrows* 1481, 3026CA (NBG); 1496, 3026CA (NBG); 2115, 3026CA (PRE), *Engelbrecht* 142, 2926AA (NMB); 159, 2926AA (NMB); 533, 2926BC (NMB), *Fourie* 147, 3025DA (PRE), *Gillett* STE57616, 2926AA (STE), *Goossens* 1002, 2827BC (PRE), *Grey Kollege Herbarium* 55, type, 2926AA (BOL, PRE), *Hanekom* 601, 2926 (PRE), *Henrici* 1857, 2925CB (PRE), *Kotze* 771, 2926AA (PRE), *Moss* 4527, 2926AA (J); 4528, 2926AA (J), *Mostert* 69, 2826CD (PRE), *Muller* 29, 2926AA (NBG); 298, 2926AA (NBG); 1088, 3026CA (PRE); 1770, 2826CC (PRE), *Pole Evans* 1611, 2925CB (PRE), *Smith* 975, 2925CB (PRE); 4090, 2925CB (PRE); 5473, 2925CB (PRE), *Southey* 16 *ex Galpin* 5868, 3125AC (PRE), *Theron* 3621, 3125AC (PRE), *Van Jaarsveld* 1765, 2826DB (NBG), *Verdoorn* 927, 2925CB (PRE); 1060, 2925CB (PRE); 1188, 2925CB (PRE), *Werger* 1028, 3025DB (PRE); 1464, 3025DB (PRE), *Zietsman* 79, 2826CD (NMB, PRE), *Zietsman et al.* 1261, 2826CD (NMB, PRE), *Zinderen Bakker* 994, 2827CA (PRE).

Gymnosporia linearis subsp. *lanceolata*

Acocks 15071, 2919AB (PRE); 15640, 2516DD (PRE); PRE46453, 2820CB (PRE), *Barker* 8304, 2820CB (NBG), *Bayer* 1548, 2816DB (NBG), *Botha* 2935, 2820CB (PRE), *Burrows* 2923, 2717CD (GRA), *Carr* 23, 2816BD (PRE), *De Winter & Gies* 6373, 2615CA (BOL, PRE, WIND), *Dinter* 965, (SAM), *Drège* s.n., type, 2817AA (HAL, S), *Giess* 13733, 2616BA (PRE, WIND), *Gubb* 11023, 2820AD (PRE); 11026, 2820CB (PRE), *Hardy* 2589, 2817 (PRE), *Hardy & Venter* 4992, 2816BB (PRE, WIND), *Henning* J39/76, 2618DD (WIND); A98/75, 2618DD (WIND), *Herre* STE12064, 2816BB (PRE, STE), *Kotze* 822, 2821AC (PRE); 849, 2821AC (PRE), *Kraeüsel & Wiss* 2096, 2716DB (WIND), *Lewis* 4984, 2820CB (SAM), *Marloth* 12386, 2816DA (PRE, STE), *Merxmüller & Giess* 32463, 2615CA (PRE, WIND), *Metelerkamp* 301, 2817AD (BOL), *Moss* 10778, 2821AC (J), *Müller* 98, 2618DD (WIND), *Ortendahl* 409a, 2718BC (PRE); 609, 2717CB (PRE), *Pearson* 3101, 2818CD (SAM); 6097, 2816BB (BOL); 9072, (BOL), *Pillans* 5092, 2816BB (BOL); 5261, 2816DA (BOL); 5334, 2816DA (BOL); 6508, 2817AD (BOL); 6572, 2717CB (BOL), *Pole Evans* NH32979, 2820DC (NH); PRE46429, 2820DC (PRE), *Robbertse* 1171, 2817CB (PRE), *Schlechter* RS48, 2818DD (NMB); 11452 (BOL, GRA, PRE), *Taylor* 8432, 2919AB (PRE,

STE), *Theron* 1318, 2820DB (PRE), *Tinley* 98, 2618CB (PRE), *Tölken & Hardy* 672, 2416AB (PRE, WIND), *Van der Schijff* 8038, 2821AC (J, PRE), *Van der Westhuysen* 19, (WIND); 28, 2416AB (WIND); 33, 2416AB (WIND), *Van Jaarsveld* 8828, 2717DA (NBG); 11859, 2817CA (NBG), *Van Jaarsveld & Drijfhout* 5468, 2817AC (NBG, PRE), *Van Wyk* BSA 117, 2820CB (PRE, PRU); 9060, 2816BB (PRU), *Venter* 8083, 2817DC (PRE), *Walter & Walter* 153, 2219CC (WIND); 1681, 2316AD (WIND); 2410, 2719CA (WIND), *Wendt ex Giess* 14737, 2717CA (PRE, WIND), *Werger* 462, 2816BB (PRE), *Zietsman* 1918, 2716DD (NMB); 2125, 2817AA (NMB, PRU), *Zietsman & Zietsman* 619, 2820CB (NMB, PRE).

Gymnosporia linearis subsp. *linearis*

Acocks 12009, 3225CA (PRE), *Bayliss* B479, 3325BC (PRE); 7962, 3326AA (S), *Brink* 624, 3326AB (GRA, PRE), *Drége* s.n. HAL071495, 3223BD (HAL); s.n. PRE24719, 3223BD (PRE), *Du Toit* 158, 3225AD (PRE), *Dyer* 913, 3326AB (PRE), *Ecklon & Zeyher* 946 (HAL); 955, type, 3224BA (HAL, S, SAM), *Esterhuysen* 13272, 3326BB, (BOL), *Galpin* 2979 (PRE), *Gess* GRA A7622,3326BC (GRA), *Grobbelaar* 2917, 3325CA (PRE, PRU), *Herb. Bolus 135,* 3224BC (BOL), *Linger* 2061, 3224AD (PRE), *MacOwan* 1134, 3326BA (GRA), *Mogg* 11602, 3322DC (PRE), *Palmer* 569, 3224BC (GRA), *Salisbury* 342 (GRA), *Taylor* 3732, 3420BA (STE), *Theron* 1149, 3225CB (PRE), *Wall* 8, 3224BC (S), *Wearing* GRA A7623, 3326 GRA), *Zeyher* s.n. HAL071509, 3225BB (HAL).

Gymnosporia macrocarpa

Balkwill & Balkwill 5038, 2830CA (J, PRU); 5087, 2830CA (J), *Balkwill, Balkwill & Green* 5304, 2830CD (J, PRU); 5356, 2830CD (J), *Edwards* 2506, 2830CD (NU, PRE); 2761, 2830CD (PRE); 2800, 2830CD (PRE); 3227, 2930BA (PRE), *Pentz* 213, 2830CC (PRE); 216, 2830CC (PRE), *Pienaar* 408, 2830CD (PRE), *University of Natal Herbarium* 1687, 2830DC (NU), *Venter* 1839, 2830CD (PRE), *Williams* 579, 2830CA (NH, PRE).

Gymnosporia markwardii

Aitken & Gale 16, 2732 (PRE), *Bodenstein* 69, 2632DD (NH), *Bourquin* 633, 2832AD (PRE); 716, 2832AD (PRE), *Buthelezi* 433, 2732BC (NH); 434, 2732BC (NH); 451, 2732BC (NH), *Feely & Ward* 22, 2832BA (NH, PRE), *Harrison* 291, 2832AC (NH, PRE); 466, 2832AC (PRE), *Hobson* 739, 2832AD (GRA); 805, 2832AD (GRA), *MacDevette* 41, 2832AD (NH); 1004, 2832AD (NH); 1837, 2732DA (NH, PRE), *Ngwenya* 286, 2732BC (NH), *Nicholas & MacDevette* 2138, type, 2832AB (NH, PRE), *Phillipson* 3216 2832AD (GRA), *Pienaar* 934, 2732BD (PRE), *Pole Evans* 3607, 2832AD (PRE), *Rodin* 4676, 2632DD (PRE), *Stephen et al.* 1088, 2732BC (PRE), *Strey* 5000, 2732DA (PRE); 5676, 2832AD (PRE); 6805, 2832AD (NH, PRE), *Strey & Moll* 3935, 2632DD (PRE), 3936, 2632DD (NH), *Vahrmeijer & Tölken* 845, 2732DA (PRE), *Van Rhyn* 11, 2832AD (PRU), *Van Wyk* 751, 2732DA (NH), *Van Wyk & Potgieter* 12200, 2732BA (PRU), *Venter* 4896, 2832CC (PRE), *Ward* 358, 2732BC (NH); 1406, 2732BD (NH); 1499, 2632DC (NH); 1723, 2732BD (PRE); 2008, 2732AB (PRE); 2009, 2732AB (NH, PRE); 2561, 2732AB (NH, PRE); 9524, 2832BA (NH).

Gymnosporia mossambicensis

Abbott 1433, 3030CC (NH); 2843, 2731CD (NH); 3319, 3030CD (NH), *Archer* 1025, 2530BC (PRE, PRU), *Balkwill & Cadman* 2227, 3030BC (J); 4859, 2930DB (J), *Balkwill, Cadman & Boik* 2415, 3029DA (J), *Balkwill, Manning & Cadman* 1303, 2930CA (NU), *Bayer* NU52439, (NU), *Bourquin* NH53760, 2930AA? (NH), *Burtt Davy* 332, 2531CC (BOL, PRE); 1965 (BOL); 3506 2730AC (PRE), *Carsten s.n.*, 2631CD (PRE), *Clinning* 76216, 2430DC (J), *Cloete* 1685, 3129BC (NH), *Codd* 3058, 2230CC (PRE), *Coleman* 982, 3029DA (NH), *Compton* 24687 (NBG); 26372, 2631CD (NBG, PRE); 28083 (NBG); 28167, 2631CD (NBG, NH); 29495, 2631CD (NBG); 29497, 2631CD (NBG, PRE); 29520, 2631CD (NBG, NH, PRE); 29904 (NBG); 31922, 2631AC (NBG, PRE); 32029, 2631AC (NBG, PRE); 32367, 2631AC (NBG, PRE); 32426, 2631CD (NBG, PRE), *Cooper* 213, 2531CC (PRE), *De Winter* 9385, 2430DC (PRE), *Devenish* 661, 2730AD (PRE); 1207, 2730AD (BR); 1747, 2730AD (PRE), 2730, 2730AD (PRE), *De Winter & Killick* 8920, 2330CA (PRE), *Dlamini* s.n., 2631AC (PRE), *Edwards* 832 (NU); 1106 (NU); 1309, 2830DB (PRE), *Esterhuysen* 23048 (BOL), *Fisher* 241 (NU); 344, 2930CB (NU), *Galpin* 9644 (BR), *Geldenhuys* 1241, 3325CA (PRE), *Gerstner* 4840, 2731CD (PRE); 5724 (PRE); 5812, 2330CC (PRE), *Glen* 2278, 2730BC (NH, PRE), *Green,* 126 2829DD (NH), *Hearne & De Jager* 7/1975 2430DC (J), *Hemm* 21, 2230CD (J, PRE), *Herman* 732, 2430DB (PRE), *Hilliard & Burtt* 7523 (NU), *Jacobsz* 1767, 2829AD (PRE), *Jordaan* 559, 2731DC (NH, PRE), *Keet* 1473 (STE), *Kerfoot* K7921, 2430DC (J); K8511, 2430DC (J), *Kerfoot, Forrester & Gooyer* 48, 2430DC (PRE), *Khorombi* 1147, 2230DB (J), *Kluge* 926, 2530BD (PRE), *Law* 65, 2930CB (NBG, NU), *Louw* 2408 (STE), *MacDevette* 818, 2930CA (PRE); 1321, 3029DA (NH); 1543, 3029DA (NH, PRE), *Medley Wood* 1395, 2930DB (NH); 6336, type, 2930AC (NH), *Miller* S/230 (PRE); 4453, 3129BC (PRE), *Moll* 817 (BR); 926 (NU); 1763 2930AC (PRE); 2660, 2930 (PRE); 3013, 2929DD (PRE); 3515, 2930 (PRE), *Moss sub Moss* 21046, 2329DD (J), *Moss & Rogers* 486, 2430AA (J), *Muller & Scheepers* 12, 2330CC (PRE), *Nel* 298, 2430DC (NBG), *Ngwenya* 34, 2830DB (NH), *Nicholas* 1799, 3029DA (NH,

PRE), *Nicholas & Button* 1984, 2729DC (NH), *Nicholson* 2233, 3130AA (PRE), *Obermeyer* 586, 2330AA (PRE); 27989, 2530AB (PRE); PRE30059, 2230CC (PRE), *Pegler* 298, 3228 (PRE), *Pole Evans* 3623 (PRE), *Porter & Ward* 66, 2731AD (NH), *Raal & Raal* 1042, 2430DD (PRE), *Rogers* 18114, 2330CB (BOL, J); 22016 (GRA), *Rudatis* 882, 1222 (STE), *Scheepers* 414, 2330CA (PRE), *Schelpe* 25, 2929BB (NU), *Schlechter* 3192, type, 2930DD (BOL), *Schlieben* 7580, 2329BB (BR); 7617, 2329BB (BR), *Schlieben & Strey* 8297, 2329AB (BR, G), *Schrire* 1483, 2930DD (NH); 1556, 2830DD (NH), *Sim* 2485 (BOL), *Smook* 591, 2930AC (NU), *Smuts & Gillett* 3173 (BOL); 3182, (BOL), *Stalmans* 215, 2430AB (PRE); 2502, 2530CC (J), *Stielau* 40, 2930CB (NH, PRE), *Story* 577, 3029DC (PRE), *Strey* 3380, 2431CC (PRE); 7512 (BR); 10482, 2731DD (NH); 210482, 2731DD (NH), *Taylor* 2044, 2930AC (PRE), *Thode* A260, 2830CA (PRE); A1229, 2831CD (NH); 3631, 2930BA (STE), *Van der Merwe* 141, 2531CC (PRE), *Van der Schijff* 3780 2231CA (PRE), *Van Jaarsveld* 463, 2531CA (NBG, PRE), *Van Wyk* BSA2130, 24300DD (PRU); 2290, 2930AA (PRE); 2799, 2930AA (PRE); 2936, 2327DD (PRE); 3635, 2230DA (PRE); 4051, 2230CD (PRE); 6978, 2731CD (PRU); 7542, 3029DA (PRU); 7544, 3029DA (NH); 8531, 2430DD (PRU), *Van Wyk & Hahn* BSA809, 2330AA (PRU), *Venter* 79, 2930CB (PRE); 7862, 2329AB (PRE), *Wells* 1916 (NU), *Williams* 157, 2930DD (NH), *Wirminghaus* 560, 2930AC (NU).

Gymnosporia nemorosa

Abbott 1999, 3030CC (NH, PRU); 3076, 3030CC (NH, PRU); 3372, 3130AA (NH), *Acocks* 8942, 3227CB (PRE); 12786, 3326CA (PRE); 13736, 3325CC (PRE), *Archibald* 5413, 3326CB (PRE), *Acocks & Häfstrom* 891, 3423AB (PRE), *Archer* 554, 3424BB (NBG, PRE), *Bester* 629, 3128BA (PRU), *Botha* 3051, 3423AA (PRE), *Botha & De Villiers* 175, 3423AA (PRE), *Burchell* 3593 (S), *Cloete* 1537, 3228BC (NH), *Compton* 28832 (NBG, PRE); 32139 (NBG), *Cunningham* 863, 2730BD (NU), *De Winter* 8749, 2832AD (PRE), *Devenish* 1265, 2730BA (PRE); 1630, 2730AC (NU); 1737, 2730BA (PRE); 2041A, 2730AD (PRE); 2080, 2730CB (PRU), *Duckworth* 63b, 3227Cb (NH), *Duthie* 16, 3423AA (GRA); 565, 3423AA, (SAM, STE), *Ecklon & Zeyher* 938, type, 3325CD (HAL, SAM), *Edwards* 870, 3227DB (NU); 3335, 2830DD (PRE), *Flanagan* PRE46561, 3227DB (PRE), *Fourcade* 653, 3422AA (BOL); 1050, 3423AB (BOL); 1229 (BOL, GRA, STE); 1404, 3424AB (BOL, STE); 3244a, 3423AB (STE), *Fries, Norlindh & Weimarck* 974, 3325CD (BOL), *Galpin* 8087, 3126DC (PRE); 10857, 3326CB (PRE); 12141, 2931AD (PRE), *Garland* PRE46538, 2929 (PRE), *Geldenhuys* 603, 3323DC (STE); 963, 3424AA (PRE); 1036, 3322DD (PRE); 1086, 3424BA (PRE), *Gibbs Russell* 3921, 3226DD (PRE), *Giffen* 964, 3226DD (GRA, PRE), *Gillett* 1490, 3423AA (STE), *Gordon* 447, 2832AD, *Gordon-Gray* 591, 3228BB (NU), *Green* 106, 2829DD (PRE), *Guy* 69, 2832AA (NH, NU, PRE), *Hoole* Q1, 3326AD (GRA), *Jacot Guillarmod* 8517, 3326AD (GRA), *Johnson* 906, 3326CB (PRE); 964, 3326CB (GRA, PRE), *Jordaan* 35, 2531CA (PRE); 2264, 3322DC (PRE); 2301, 3325CD (PRE); 2303, 3325CD (PRE); 2307, 3325BD (PRE); 2321, 3326BC (PRE); *Keet* 912, 3423AA (GRA); 919, 3423AA (GRA); 2764, 3422BB (PRE); Herb. US13981, 3423AA, (STE) *Kemp* 768, 2631CA (PRE), *Kluge* 44, 2831BD (NH), *Kotze* 449, 3030BB (PRE), *Krauss* 1841, 3422BB (G), *Krynauw* 34, 2423AB (PRE), *Linger* 78, 3423AB (PRE), *Long* 88, 3325DC (PRE), *MacDevette* 2136, 2731CB (NH), *MacOwan* 295, 3326BC (GRA), *Maguire* 7626/199, 2631AA (J), *Marais* 366, 3324CB (PRE); 368, 3326BC (PRE); 404, 3326CB (PRE); 465, 3227DB (PRE); 521, 3227AD (PRE); 523, 3227AD (PRE); 505, 3127DB (PRE); 549, 3326BC (PRE); 689, 3322CD (BOL); 704, 3422BB (PRE); 738, 3228CB (PRE); 781, 3029DD (PRE), *Marsh* 605, 3322DC (STE), *Medley Wood* 1297, 2930DB (BOL); 3433, 2931AD (NH); 11408, 2931CC (NH, SAM); 11684 (NH); 13178, 2930DD (PRE), *Mogg* 11728, 3322DC (PRE), *Moll* 3588, 2930DD (NU, PRE), *Moll & Morris* 668, 2930CB (NU, PRE), *Nichols* 563, 2930DD (NH); 748, 2930DD (NH), *Nicholson* 1434, 3030CA (PRE), *O'Callaghan* 773, 3423AB (PRE, STE), *Olivier* 991, 3325DC (NBG); 1077, 3325DC (NBG, PRE), *Ranger* 296, 3227 (PRE), *Rudatis* 1553, 3030BC (PRE); 1941, 3030AD (G), *Rycroft* 2817, 3423BB (STE), *Schalker* A7625, 3322DC (GRA), *Scharf* 1285, 3325CC (PRE), *Schönland* 3152, 3326BC (GRA), *Sim* 121, 3227CC (PRE); 311, 3227CC (PRE); 1145, 3227CC (BOL); 2324, 3227AD (PRE), *Story* 2692, 3326BC (PRE), *Strey* 10671, 3128BB (NH, PRE), *Thode* 4679, 3030AB (STE); 5387 (STE), *Tyson* SAM 14965, 3227CB (SAM), *Van Daalen* 32, 3322DC (STE), *Van Jaarsveld* 1191, 2631CD (NBG, PRE), *Van Wyk* 6118, 3030CA (PRE, PRU), *Venter* 3766, 2831 (PRE), *Viljoen* 125, 2531CB (NBG, PRE), *Ward* 6999, 2832BA (NU, PRE); 7086, 2832DD (PRE), *Wells* 2653, 3326DA (G), *Wirminghaus* 281, 3326BD (GRA), *Zeyher* 2183 (S, SAM); 2184 (S).

Gymnosporia oxycarpa

Archer 400, 2231CB (KNP, PRU), *Nel* 6090, 2331BA (KNP), *Van der Schijff & Marais* 3681, type, (KNP, PRE), *Van Wyk* BSA2030, 2231CB (PRE, PRU).

Gymnosporia polyacantha subsp. *polyacantha*

Archibald 3708, 3325BD (GRA); 5948, 3325DB (GRA, PRE), *Bayliss* B762, 3326AA (PRE); B779, 3326AA (PRE), *Brink* 363, 3326AD (GRA, PRE), *Coates Palgrave* RUH5986, 3326BC (GRA), *Commins* 1008, 3325DB (PRE), *Ecklon & Zeyher* 946, type, 3325 (HAL, SAM); 956, 3324DB (BOL, GRA, PRE, SAM, STE). *Gibbs Russell* 3920, 3226DC (PRE), *Giffen* 94, 3226DD (PRE), *Hall-Martin* 5967, 3325BC (PRE), *Hobson* 1031, 3225CD (GRA), *Holland* 34, 3325DC (BOL); 342, 3325DC

(GRA), *Johnson* 1000, 3326AC (GRA), *Jordaan* 2308, 3325BB (PRE); 2310, 3325BD (PRE); 2311, 3325BD (PRE); 2313, 3325DC (PRE); 2316, 3325DB (PRE), *MacOwan* 779, 3326BC (GRA), *Marais* 400, 3327AA (PRE); 401, 3327AA (PRE); 431, 3226DC (PRE); 438, 3326AB (PRE), *Olivier* 546, 3325BD (GRA), *Palmer* 1804, 3326BA (GRA); 2587, 3326AC (GRA), *Paterson* 427, 3325DC (GRA); 1079, 3325DC (BOL, GRA), *Ramsay* 4090, 3326BA (GRA), *Smyth* 2547, 3326BB (GRA), *Story* 2669 (PRE), *Zeyher* Fl.Cap. no. 189 (HAL); 2175 (BOL).

Gymnosporia polyacantha subsp. *vaccinifolia*

Barnard & Mogg 784, 2430CC (PRE), *Behr* 284, 2627BB (NBG), *Benecke* 29, 2627BD (J); 36, 2627BD (J), *Burtt Davy* 184, 2527DA (PRE), *Coetzee* 829, 2527DD (PRE), *Cohen* 19, 2628AA (PRE), *Collett* PRE46427, 2428CD (PRE), *Collins* 27249, 2528CA (PRE), *Conrath* 88, type, (K), *Galpin* M55, 2428DA (PRE); 12177, 2530AB (PRE), *Gerstner* 6481, 2527DB (PRE), *Gilfillan* 208, 2628AA (PRE), *Gillett* 3282, 2528CC (BOL); STE32031, 2528CA (STE), *Glen* 1922, 2527AA (J, PRE), *Hofmeyr* 118, 2429AC (PRE); 125, 2429AC (PRE), *Jacobsen* 1860, 2430DC (PRE); 1932, 2428BC (PRE); 2917, 2430DC (PRE); *Krynauw* 1371, 2429BD (PRE), *Labrun* 62, 2527CD (J), *Lambrechts* 14, 2628AD (PRE), *Leendertz* 162, 2528CA (PRE), *Liebenberg* 8825, 2528CD (PRE), *Louw* 1403, 2627CA (PRE); 1417, 2627CA (PRE), *Maguire* J22576, 2429AA (J), *Mogg* 10967, 2528CA (SAM); 13810, 2430CC (PRE); 15069, 2528CD (PRE); 19233, 2627BB (J); 20084 2528CC (J); 20196, 2627BD (J); 20320, 2627BA (J); 20420, 2628AD (J); 23030, 2627AD (J); 23138, 2627BA (J); 23229, 2627BA (J, PRE); 25620, 2628AC (PRE); J36143, 2329DD (J); 36312, 2627BA (PRE), *Pole Evans* 28, 2528CA (PRE0, *Prösser* 1035, 2527DD (J), *Repton* 222, 2528CC (PRE), *Rodin* 3900, 2627BA (PRE), *Smuts* STE 32032, 2528CC (STE), *Sutton* 560, 2627AA (PRE); 1165, 2526DA (PRE), *Taylor* 15, 2627BB (J); 1948, 2430DC (PRE), *Van der Meulen* 444, 2526CA (PRE), *Van Jaarsveld* 1800, 2627BA (NBG), *Venter* 617, 2527DC (PRE); 10710, 2429BB (PRE), *Watt* 5304, 2627BB (J), *Westfall* 1689, 2328DA (PRE).

Gymnosporia pubescens

Archer 393, 2231CB (KNP), *Brynard & Pienaar* 4500, 2231AD (KNP, PRE), *Codd* 5983, 2231AC (BR, KNP, PRE), *Codd & De Winter* 5528, 2231AC (KNP, PRE), *Van der Schijff* 4120, 2231AC (KNP), *Van der Schijff & Marais* 3724 (KNP), *Van Rooyen* 158, 2231AD (PRU); 270, 2231AC (PRU); 374, 2231AC (PRU); 3120, 2230BD (PRE, PRU), *Van Wyk* 2018, 2230BD (PRE); 2026, 2231AD (PRE).

Gymnosporia putterlickiodes

Archer 392, 2231CB (KNP, PRU), *Brynard & Pienaar* 4263, 2231AC (KNP, PRE), *Engelbrecht* 6121, 2431BB (KNP); *Van Rooyen* 1406, 2231CA (PRE, PRU); 2368, 2327DD (PRU), *Van Rooyen & Bredenkamp* 614, 2231CA (PRU).

Gymnosporia rubra

Abbott 90, 3030CC (PRE); 2910,3030CC (NH); 3373, 3130AA (NH), *Arnold* 313, 2531CB (PRE), *Balkwill & Crankshaw* J76214, 3030CA (J), *Brayshaw* 190, 2531CC (NU), *Commins* 1420, 3227DA (PRE), *Davidson* 1555, 3030CA (J), *Kerfoot* K7305, 3030CA (J), *Killick* 4071, 3227DA (PRE), *Lawn* 1965, 2831DC (NH), *Marais* 766, 3129CB (PRE); 780, 3030CC (BR, PRE), *Medley Wood* 3963, 2830CB (BOL, NH), *Miller* PRE5577, 3129CA (PRE), *Moll* 2088, 2930DB (PRE); 4973, 2831 (NH), *Nicholson* 1232, 3030CB (PRE), *Obermeyer* 586, 2330AA (PRE), *Ranger* 135, 3227DA (PRE), *Rogers* 23871, 2531CC (J), *Schlechter* 6350, 3128DB (BOL, GRA, PRE), *Strey* 9622, 3030CC (NH, PRE); 11352, 3030CB (NH, PRE), *Van der Schijff* 5657, 2430DB (PRE, PRU); 6086, 2430DB (PRE, PRU), *Van Wyk* 322, 2430DB (PRE); BSA646, 2531CB (PRU); 3727, 2230DB (PRE); 3774, 2230DB (PRE); 8519, 2430DB (PRU); 9907, 3030CC (PRU), *Viljoen* 3, 2531CB (PRE), *Ward* 5924, 3030BB (NU, PRE), *Williamson* 246, 2531CC (PRE).

Gymnosporia senegalensis

Abbott 3185 (PRU), *Acocks* 11655, 2831CB (NH, PRE), *Allen* 142, 2125AD (J, PRE), *Babich* 6, 1923AC (PRE), *Balkwill, Balkwill et al.* 6887, 2430DB (J, PRU), *Banks* 42, 1821DB (PRE), *Barker* 11, 2531AC (B, J); 12, 2531AC (B, J); 14, 2531AC (B, J), *Barrett* 6, 2531DC (PRE), *Baum* 175, (G); 565, type, (COI); 957 (G), *Biggs* 137, 1923CA (PRE); M622, 1923CA (PRE), *Blenkinson, Young sub Moss* 438, 2428BB (J), *Botha & Braun* 149, 2632AA (PRE); 184, 2631BD (PRE), *Botha & Bredenkamp* 3595, 1920BC (PRE), *Braun* 149, 2632AA (PRE); 184, 2631BD (PRE), *Bredenkamp* 1108, 2431CB (PRE); 1119, 2329DC (PRE); 1135, 2431CB (PRE); 3595, 1920BC (PRE), *Breyer* 27260, 2229DB (PRE), *Buitendag* 71, 2530BD (NBG, S); 73, 2530BD (NBG, STE); 107, 2530BD (NBG); 575, 2530BD (NBG); 577, 2530BD (NBG, PRE); 773, 2530BD (NBG, PRE), *Burger* 335, 2229DC (PRE); 514, 2329BB (PRE), *Camerik* 243, 2326BB (PRE), *Chadwick* 225, 2122DA (PRE), *Codd* 1551, 2731CC (PRE); 4286, 2331DD (KNP); 4339, 2229BC (PRE), *Coetzee* 37, 2417BD (PRE, WIND), *Compton* 18043, 2229

(NBG); 19779, 2531BD (NBG); 27964, 2631DC (NBG, PRE); 27984, 2631AD (NBG, NH, PRE); 28991, 2631AD (NBG); 29033, 2631BD (NBG, PRE); 29223, 2631DC (NBG, PRE); 30724, 2631BD (NBG, PRE); 30728, 2631BD (NH); 30802, 2631BC (PRE); 31029, 2631CD (NBG, NH); 32133, 2631AD (NBG); 32138, 2631BD (NBG), *Craven* 1034, 2116AB (WIND); 1721, 2214BD (WIND); 2289, 2114BA (WIND), *Culverwell* 145, 2632AA (PRE); 885, 2632AC (PRE), *De Winter* 2771, 2017AD (PRE, WIND); 3546, 2417DB (PRE, WIND); 3839, 1718DA (PRE, WIND); 8763, 2329 (PRE); 8976, 2831BB (PRE), *De Winter & Wiss* 4358, 1821BA (PRE), *Dinter* 218, type, (SAM); 2282 (SAM); 2614 (SAM); 3398 (SAM); 3399 (SAM), *Dixon* 1012, 2315BC (WIND), *Edwards* 299, 2830CB (NU, PRE); 875, 2830DA (PRE); 4433, 1820AD (PRE, WIND), *Edwards & Ward* 4518, 1824AA (PRE), *Ellery* 397, 1923AA (J, PRE), *Fourie* 7/125, 2430AB (PRE), *Galpin* M56, 2428DA (PRE); 515, 2531CC (PRE); 12136, 2931AD (PRE); 13525, 2330DC (PRE), *Garlick* 9, 2430AB (PRE), *Geldenhuys* 333, 1719DD (PRE), *Germishuizen* 3247, 2531CC (PRE), *Gerstner* 2344, 2831AD (NH); 2555, 2731BC (NH); 2707, 2831CD (PRE); 3398, 2930DB (NH), *Giess* 10960, 2017AA (PRE, WIND); 11334, 1820CC (WIND); 14860, 1720CC (WIND); 15313, 1915CC (PRE, WIND), *Giess & De Villiers* 14030, 1816D (PRE, WIND), *Giess & Müller* 12312, 2717DA (PRE, WIND), *Giess & Wiss* 3288, 1712AB (WIND), *Gillett* 3037, 2230AC (STE), *Glen* 2751, 2832CA (J, PRE), *Hägelsbach* 32765, 1917BA (PRE), *Hahn* 358, 2229DD (PRU), *Harbor* 6439, 2426AC (GRA); 14066, 2426AC (PRE), *Hardy, Scott & Smith* 1527, 2731BD (PRE), *Harrison* 8, 2832AC (PRE), *Hemm* 781, 2229DD (PRE), *Henderson* 193, 2229DD (PRE), *Hiemstra* 265, 1923 (PRE), *Holt* 258, 2531AC (NH, PRE), *Huntley* 1216, 2429AA (PRE), *Jankowitz* 606, 2017AC (WIND), *Jensen* 28, 2115DC (WIND); 56, 2314 (PRE); 228/1412, 2316AD (WIND); 256, 2315BC (WIND); 347, 2314 (PRE), *Johnson* 36, 2832AB (NBG); 80, 2831DC (NBG); 462, 2431DC (NBG), *Joubert* 320, 2016 (WIND), *Keet* US14006, 2431CC (STE), *Kers* 797, 2117BD (S, WIND), *King* X38, 2125AD (J), *Krynauw* 732, 2430BD (PRE), *Lawn* 890, 2831DC (NH), *Leach* 13108, 2531BC (PRE), *Leendertz* 5655, 2429AA (PRE), *Leistner, Oliver, Steenkamp & Vorster* 195, 1713AC (PRE); 317, 1714AC (PRE); 3298, 2330AA (PRE), *Leistner, Thom & Gillham* 3298, 2330AA (PRE), *Le Roux* 49, 1816DD (WIND); 181, 1918CA (PRE, WIND); 489, 1915BB (WIND), *Liebenberg* 4679, 2218BD (PRE, WIND), *Logan* 8, 2316CC (WIND), *Lombaard* 473, 2430DC (PRE), *MacDevette* 1144, 2832AB (NH, PRE), *Maguire* 1566, 1816CD (NBG); 1623, 1719CD (NBG); 1712, 1821AB (NBG); 1736, 1918CA (NBG); 8072, 2425DA (J), *Mogg* 20880, 2429AA (J); 29725, 2532DC (J); 35907, 2430AB (J); 37034, 2328AC (PRE); 37268, 2329DD (PRE), *Moll* 3625, 2931AA (PRE, S), *Mott* 281, 1725CC (PRE); 340, 2425DB (PRE), *Müller* 620, 1918CA (PRE, WIND), *Müller & Giess* 403, 1820BA (PRE), 610, 1720CC (PRE, WIND), *Murray* 3, 2330AA (J), *Nel* 67, 2329BB (STE); 95, 2330CD (STE), *Nichols* 674, 2632CD (NH), *Oates* 11, 2330DA (PRE); 24, 2330DA (PRE); 47, 2330DA (PRE), *Oliver & Steenkamp* 195, 1713AC (PRE), *Onderstall* 735, 2530BD (PRE); 1138, 2530BD (PRE), *Owen-Smith* 1221, 2717CD (WIND), *Pauw* 248, 2331CA (PRU), *Pearson* 9853, 2115DA (SAM), *Pienaar* 1013, 2230DA (PRE), *Pooley* 875, 2632CD (NH, NU), *Porter* 274, 2431 (J), *Porter & Ward* 133, 2731AD/CB (NH), *Prior* 133, 2631CB (PRE), *Repton* 5958, 2430CB (PRE); 6029, 2731BD (PRE), *Retief* 184, 2431AA (PRE); 434, 2431AA (PRE); 1479, 2017AC (WIND), *Reyneke* 413, 2426CB (PRE), *Robertson* 6502, 2329BD (PRE), *Robertson & Elffers* 45, 1725CC (PRE), *Rodin* 2631, 1715BC (BOL); 9316, 1716 (WIND), *Rogers* 373, 2530BD (GRA); 2611, 2531BD (PRE); 6439, 2426AC (J), *Rutherford* 319, 2017AC (WIND); 498, 2017AC (WIND), *Schmidt* 308, 1816DC (WIND); 326, 1917AD (WIND), *Schönland* 1634, 2226BC (GRA), *Schrire* 1509, 2831DC (NH), *Scott* 286, 2229CD (PRE), *Seydel* 1567, 2215BB (BR), *Shackleton* 698, 2431CA (J), *Smith* 617, 1923AA (PRE); 1739, 1923DA (PRE); 2092, 1923AA (PRE), *Smook* 1302, 2732CC (PRE), *Smuts & Gillett* 3531, 2330DC (PRE), *Snyman & Noailles* 234, 2225BC (PRE), *Soini* 9, 1714DB (WIND), *Stayt* 6, 2329BB (PRE), *Steenkamp* 1, 1823BC (PRE), *Stewart* 81, 2931AD (PRE), *Story* 1559, 2329CB (PRE); 2207, 1920DC (PRE); 5041, 2121DB (PRE); 5207, 1920DC (PRE), *Taylor* 7088, 1824AC (J, PRE), *Theron* 2531,2431CA (PRU), *Thornhill* 272, 2632CD (NH, PRE), *Tinley* 1488, 1821BA (WIND), *Tölken & Hardy* 615, 2615CA (PRE, WIND), *Van der Schijff* 1, 2531AB (KNP, PRE); 664, 2531AA (KNP, PRE), *Van der Spuy* WIND19249, 1816CD (WIND), *Van Heerden* 788, 2430BC (PRU), *Van Son* 28808 (PRE), *Van Wyk* 871, 2832AB (NH), *Venter* 774, 1725CC (PRE); 2034, 2227DD (PRE); 5046, 2832CC (PRE); 5304, 2832CC (PRU); 8833, 2229AB (PRE), *Volk* WIND19230, 2016AD (WIND), *Von Teichman* 230, 2330DA (PRU), *Walter & Walter* 141, 1914DB (B); 343, 1919BA (B, WIND); 1202, 2115AD (B); 2931, 1817CA (B); 4185, 2118AC (B); 4308, 2316 (B), *Ward* 24, 2832AB (NU); 542, 2931BA (NH); 768, 2732AB (NH); 1404, 2832AA (NH); 2354, 2632CD (NH), *Wisura* 2451, 2830DD (NBG).

Gymnosporia szyszylowiczii subsp. *namibiensis*

Brueckner 1074, 2823DC (BOL, PRE), *Gubb* KMG11028, 2922BB (PRE); KMG12532, 2922BC (PRE), *Müller* 1325, 2416CD (PRE, WIND), *Van Wyk* 8643, 2818CD (PRU); 8644, 2818CD (PRU); 8665, 2818CD (PRU), *Walter & Walter* 2027, 2416CB (BR, WIND), *Walter & Walter* 2027, 2416CB (B, WIND); *Wiss* 1845, 2716DB (WIND).

Gymnosporia szyszylowiczii subsp. *szyszylowiczii*

Acocks 14136, 3221BA (PRE); 19136, 3221BA (PRE), *Bayliss* B255, 3321BC (PRE), *Bond* 251, 3322DA (NBG), *Compton* 8756, 3320CA (NBG); 10410, 3321AB (NBG); 20359, 3321BC (NBG), *Dahlstrand* 1442, 3322DA (J, PRE); 2241, 3322DA (J, PRE, STE); 3599, 3322DA (PRE), *Drège* s.n. HAL071501, 3225CB (HAL), *Esterhuysen* 1830, 3320CB (PRE), *Galpin*

9908, 3224BC (PRE), *Henderson* 579, 3324AD (PRE), *Henrici* 4945, 3224BC (PRE), *Hobson* 158, 3225CA (GRA), *Hoffman* 874, 3224DC (GRA), *Jenkins* PRE46855, 3225CA (PRE); PRE46856, 3224DC (PRE), *Jordaan* 2273, 3423CA (PRE); 2274, 3423CA (PRE); 2279, 3322DA (PRE); 2280, 3322DA (PRE); 2281, 3322DA (PRE); 2288, 3322DA (PRE), *Kensit* 1901, 3225BC (BOL), *Linger* 2103, 3224AD (PRE); 2139, 3224BC (PRE), *Maguire* 731, 3224BC (NBG), *Muller* 667, 3225AB (PRE), *Mullins* A7613, 3325BB (GRA), *Palmer* PRE46844, 3225CA (PRE), *Rehmann* 3024, type?, (Z), *Retief* 1231, 3221BB (PRE), *Retief & Reid* 450, 3223DD (PRE), *Rodin* 3413, 3323DD (PRE), *Shearing* 208, 3221BB (PRE); 435, 3221BB (PRE), *Sister Tarcisia* 42, 3224BC (PRE), *Theron* 706, 3224AB (PRE), *Thorne* SAM51852, 3221BA (SAM), *Vlok* 2618, 3222CC (PRE), *Wall* 3420 (S); 3421 (S), *Worsdell* SAM6100, 3321AA? (SAM), *Zietsman & Zietsman* 1642, 3322AB (NMB).

Gymnosporia tenuifolia

Abbott 549, 2732CC (NH, PRU); 4025, 3030CC (NH), *Acocks* 13470, 2830CD (PRE); 13473, 2830CD (PRE), *Balkwill et al.* 1674, 2832AA (PRE); 4481, 2531CB (PRE), *Balkwill & Balkwill* 4481, 2631CB (J); 5067, 2830CA (J), *Balkwill, Balkwill & Green* 5357, 2830CD (J), *Balkwill & Cadman* 3057, 2732CA (PRU), *Balkwill, Cadman & Stormanns* 3057, 2732CA (J), *Bayer* 701, 3129AC (NU), *Bodenstein* 86, 2830DC (NH), *Bredenkamp* 1787, 2431CB (PRE), *Brown & Shapiro* 481, 2731AC (PRE), *Codd* 4276, 2331CD (KNP); 5224, 2531AD (PRE); 6036, 2531AB (PRE); 6082, 2531AD (PRE), *Coetzee* 1048, 2328DA (PRE); 1383, 2532CA (PRE), *Compton* 19679, 3326DA (NBG); 27924, 2631BD (NBG); 29018, 2631AD (NBG); 30062, 2631BD (NBG, NH); 31672, 2631AD (NBG), *Craven* 1147, 2016BC (WIND), *Crosby* 1011, 3228CC (PRE), *De Moor* 2/2, 2632CD (NH), *Dinter* 936 (SAM); 5708, 1917CB (BOL, PRE), *Dlamini* 56652, 2631AD (PRE), *Downing* 478, 2831 (PRE), *Edwards* 731, 2830CC (PRE); 732, 2830CC (PRE); 1253, 2830CD (PRE); 2756, 2930BA (PRE); 2977, 2632CD (NU, PRE); 3196, 2731DA (PRE); 4016, 2229BA (PRE); 4017, 2229BA (PRE); 4018, 2229BA (PRE), *Ellery* 272, 2429CD (PRE), *Gane* 309, 3327BB (GRA), *Gandar* 2, 2831AD (NU), *Gerstner* 3179, 2731DA (NH); 4139, 2732AA (NH); 5050 2831BB (PRE); 6036, 2229DD (PRE); 22893 (NH), *Giess* 14942, 1917CA (WIND), *Giess, Volk & Bleissner* 5944, 2115DA (PRE), *Glen* 1764, 2531CB (PRE), *Govender* 1, 2832AA (NH), *Green* 127, 2829DD (NH); 165, 2829DD (PRE), *Henderson* 102, 2830CC (PRE), *Hitchins* 14, 2832AA (PRE), 746, 2832AA (PRE); 833, 2832AA (PRE); 835, 2832AA (PRE), *James* 13, 2329BB (PRU), *JBG/Matthews* 2988, 2829DD (PRE), *Jordaan* 1143, 2830CC (NH); 2318, 3326DA (PRE), *Karsten* NBG55732, 2631AD (NBG), *Kers* 430, 1918AC (S), *Kluge* 2709, 2731BD (PRE), *Lawn* 534, 2831DC (NH); 919, 2831CD (NH); 2230, 2831DC (NH), *Letty* 48, 2531BB (PRE); 66, 2431DC (PRE), *Ley* 160, 2531CB (PRE), *MacDevette* 1843, 2732CB (NH), *Marais* 355, 2830CD (PRE); 399, 3326BB (PRE); 792, 3030AA (GRA, PRE); 834, 2930DA (PRE); *Matthee* 328, 2429BD (PRU), *Miller* B/360, 2525AB (PRE), *Mogg* 12259, 2528CD (PRE); 29549, 2529CD (J, PRE); 30574, 2529CD (J, PRE), *Moll* 2206, 2931CA (NU, PRE); 3151, 2732CA (PRE); 4440, 2632CC (NH, PRE), *Moll & Nel* 5545, 2732AA (NH, PRE), *Nichol* 8, 3327BB (NBG); 11, 3327BB (NBG), *Nicholas* 1638, 2832AB (NH), *Nicholas* 1638, 2832AB (NH), *Nichols* 792, 2732CD (NH), *Nichols & Porter* 591, 2731AD (NH),*Nicholson* 1726, 3030CB (PRE), *Oates* 6, 2330DA (PRE), *Obermeyer* 33571, 2930CB (PRE), *O'Callaghan* 1002, 3228CC (GRA), *Pienaar* 427, 2830CD (PRE), *Pooley* 808, 2632CD (COI, NH, NU); 1212, 2632CD (NU); 1431, 2632CD (NU), *Repton* 6013, 2731AD (PRE), *Retief* 183, 2431AA (PRE); 275, 2431AA (PRE); 437, 2431AA (PRE); 438, 2431AA (PRE); 439, 2431AA (PRE), *Rogers* 10719, 2230AC (PRE), *Rose Innes* 31, 2527AC (PRE), *Ross* 2002, 2831BB (NH); 2013, 2831BD (PRE), *Rutherford* 141, 2017AC (WIND), *Schrire* 1508, 2831AD (NH); 2179, 2830CD (NH); 2191, 2829DD (NH); 2305, 2829DA (NH), *Schwerdtfeger* 4018, 2116CD (WIND), *Shackleton* 725, 3124CA (J), *Sim* 19139, 2830CD (PRE), *Smith* 360, 2528CB (PRE), *Stephen* 829, 2632CD (PRE), *Strey* 8484, 3129BA (NH, PRE), *Ströhbach* 2158, 1918AD (WIND), *Swartz* 52, 3030AA (PRE, PRU), *Thinges* 1484, 2526CA (PRE), *Thorncroft* 3034, 2531CA (NH), *Tinley* 690, 2930CB (NU); 867, 2632CC (NH); 1044, 2632CD (NH, NU), *Van der Schijff* 717, 2531AB (PRE); 2734, 2531AB (PRE), *Van Wyk* 1660, 3030CC (PRE); 3051, 2230DA (PRE, PRU), *Venter* 1889, 2930DA (PRE); 3742, 2831 (PRE), *Von Gadow* 63, 3227 (GRA), *Walter & Walter* 673, 1918CA (B, WIND); 771, 1918BC (B, WIND); 856, 1917CA (B, WIND); 4018, 2116CD (B), *Ward* 1403, 2832AA (NH); 2008, 2732AB (NH); 2166, 2832AA (NH); 2209, 2832AA (NU, PRE); 2216, 2832AA (PRE); 2243, 2832AA (NH); 2422, 2632CD (NH); 2532, 2732CD (NH, NU, PRE), *Wells* 1267, 2930DA (PRE); 1301, 2930DA (NU, PRE), *White* 10511, 2830CD (PRE), *Wise* 81413, 2732CB (NH), *Young* A596, 2430DA (PRE): A723, 2430DA (PRE), *Zambatis* 286, 2431CD (PRE); 889, 2431DC (PRE); 893, 2431AD (PRE).

Gymnosporia tenuispina

Abel 12, 2525AB (PRE); 95, 2525AB (PRE), *Acocks* 12366, 2527DA (PRE), *Archer* 106, 2328CC (NMB); 539, 2229CC (PRE), *Balkwill & Balkwill* 4315, 2427BD (J), *Barnard* 563 (PRE), *Botha* 2685, 2328CC (PRE), *Bredenkamp* 92, 2526CA (PRE), *Bremekamp & Schweickerdt* 99, 2329AA (PRE0, *Buitendag* 1, 2827DC (PRU), *Burtt Davy* 1730, 2428CB (BOL, PRE), *Codd* 2240, 2528AB (PRE); 2370, 2428BC (PRE); 8859, 2426CB (PRE), *Coetzee* 617, 2527DD (PRE); 865, 2527DD (PRE); 1026, 2428AB (PRE); 1198, 2428CD (PRE), *Cole & Carter* 839, 2526AA (PRE); 852, 2526AA (PRE), *Collins* 7046, 2527CA (PRE), *Dahlstrand* 1914, 2527CA (PRE); 1919, 2429AA (PRE), *De Feijter* 135, 2627CD (PRE), *De Winter* 7671, 2528CA (PRE), *Dehnke* TM31992, 2528CA (PRE), *Drijfhout* 927, 2528CB (PRE), *Du Plessis* 136, 2329BB (PRU), *Du Preez* 162, 2627CD (NMB), *Du Preez & Steenkamp* 84, 2425DB (PRE), *Du Toit* 895, 2327DB (PRE), *Dyer* 3133, 2528CA (PRE), *Fourie*

616, 2529CB (PRE); 2498, 2327DD (PRE); 2721, 2327DD (PRE), *Germishuizen* 276, 2427BC (PRE); 993, 2428AC (PRE); 3695, 2428AD (PRE); *Gerstner* 5289, 2428CD (PRE); 5925 (PRE); 6100, 2329BA (PRE), *Gillett* STE32034, 2528DC (STE), *Gilmore* G7883 2528CC (G), *Glen* 2122, 2427BD (PRE); 2574, 2528AC (J, PRE), *Hansen* 3063, 2325CD (PRE), *Harbor* 9080, 2426AC (SAM), *Herman* 158, 2427DC (PRE), *Huntley* 1300, 2429 (PRE), *Hutchinson* 2581, 2528CA (PRE); 2957, 2526CA (BOL, PRE), *Irvine* 69, 2428BB (PRE), *Jacobsen* 895, 2527CA (PRE); 2028, 2428BC (PRE), *Jeffers* 534, 2527CA (PRE), *Joffe* 250, 2528CB (PRE), *Kassner* 403, 2527CA (BR), *Keet* 1283, 2528CB (PRE, STE), *Kreulen* 619, 2325BC (PRE), *Krynauw* 1415, 2229DC (PRE), *Labrun* 63, 2527CD (J), *Leach & Noel* 112, 2525BA (PRE); 236, 2426AB (PRE), *Leemann* 67, 2528AC (PRE), *Leendertz* 105, 2528CA (BOL); 3227, 2528CA (PRE); 4266, 2526CA (PRE); 7587, 2428CD (PRE); 8260, 2528CA (PRE); 11253, 2526CA (PRE), *Leistner* 507, 2327DC (PRE); 3206, 2426BB (PRE), *Louw* 789, 2425DD (PRE); 1086, 2627CC (PRE), *Lubke* 2999, 2428DA (GRA), *Maguire* 24, 2429AA (J), *Marais* 555, 2428CD (PRE), *Marloth* 9521 (PRE, STE); 11762, 2529CB (PRE), *McAfee* 1913, 2526DB (G), *Menezes* 8, 2427DA (PRU), *Miller* B/544, 2425DA (PRE), *Mogg* 10108, 2528CB (SAM); 22570, 2428CD (J); 23942, 2627CD (J); 30697, 2529AD (J); 31210, 2428DA (J); 33949, 2527BC (J); 36388, 2527DA (J); 37394, 2428BA (PRE); 38073, 2527DD (PRE); J39428, 2527DA (J), *Morris & Engelbrecht* 4, 2726AC (PRE); 25, 2726AC (PRE), *Naudé* 13, 2527CB (PRU), *Nel* 361, 2430DB (NBG, PRE), *Netshisaulu* 1357, 2230CC (PRE), *Obermeyer & Nouhuys* 27683, 2528CB (PRE), *Phalatse* 150, 2525CB (PRE), *Pienaar* 848, 2528AC (PRE), *Pole Evans* PRE46425, 2528CA (PRE), *Raal & Raal* 799, 2327CD (PRE), *Repton* 472, 2528CC (PRE); 1510, 2528CA (PRE), *Reyneke* 449, 2426AD (PRE), *Rogers* 6228, 2525BA (BOL, GRA); 6492, 2426AC (GRA, J, PRE); 20845, 2428AC (PRE); 25047, 2528DA (BOL), *SAGP 4/71*, 2528CD (PRE), *Schlechter* 4076, type, 2529CB (BOL, G, GRA, PRE), *Schrire* 98, 2528BC (PRE), *Selaledi & Sekhaole* 81, 2527AC (PRE), *Smith* 3335, 2528CA (PRE); 6870, 2528 (PRE), *Smuts* PRE46438 (PRE), *Smuts & Gillett* 2089, 2528DC (PRE, STE), *Snyman & Noailles* 262, 2225BC (PRE), *Stirton* 9, 2420DA (NU), *Story* 1657, 2428BC (PRE); 1671, 2429AA (PRE); 4878, 2425BC (PRE); 6073, 2426BB (PRE), *Theron* 744, 2529AD (PRE); 2085, 2327DC (J), *Theron & Marsh* 262, 2427 (PRE), *Thode* A401, 2528CA (NH, PRE); A1371, 2526CA (NH, PRE); 4681, 2529CB (STE), *Turner* 36, 2527CD (PRE), *Van der Meulen* 45, 2526AC (PRE); 1143, 2527BC (PRE), *Van der Schijff* 5285, 2527DB (PRE): 5362, 2329AA (PRE), *Van Jaarsveld* 1869, 2528CD (NBG), *Van Rooyen* 2330, 2327DD (PRE, PRU), *Van Vuuren* 79, 2527DB (PRE), *Van Wyk* 282, 2627CC (PRE); BSA553, 2528CD (PRU); 2457, 2528CA (PRE);) 5686, 2230DA (PRE), *Venter* 1617, 2527CA (PRE), *Westfall* 2054, 2428AD (PRE), *Wild* 4971, 2424BB (PRE), *Young* 2525, 2528CD (J, PRE), *Zeyher* 120, 2527 (SAM).

Gymnosporia uniflora

Abbott 5401, 3029DA (NH, PRU), *Balkwill & Cadman* 2270, 3030CC (J), *Hildyard* 65, 2930CB (PRE), *Medley Wood* 10253, type, 2930CB (BOL, PRE), *Pienaar* 424, 2830CD (PRE), *Pole Evans* 3843, 2930BA (PRE), *Van Wyk & Archer* 10339, 2929DC (PRU).

Gymnosporia vanwykii

Abbott 814, 3030CC (NH, PRU); 1572, 3030CC (NH, PRU); 2521, 3130AA (NH, PRU); 2567, 3030CC (NH, PRU); 2663, 3130AA (PRU); 2755, 3130AA (PRU); 3155, 3030CC (NH); 3220, 3030CC (PRU); 3329, 3130AA (PRU); 3368, 3129BD (NH, PRU); 3446, 3130AA (PRU), *Archer* 10, 3129BC (NH, PRU); 11, 3129BC (NH), *Nicholson* 2467, 3130AA (NH), *Van Wyk* 6135, 3130AA (PRE, PRU); 8333, 3228BD (PRU), *Van Wyk & Matthews* 7707, 3129BC (PRU); 7908, 3129BD (PRU),*Venter* 921, 3129BD (PRE).

Putterlickia pyracantha

Acocks 1124, 3318DC (S); 3792, 3318CB (S); 3914, 3318DC (S), *Admiraal & Drijfhout* 2800, 3325CC (PRE), *Archibald* 715, 3326BB (GRA); 3617b/50, 3325BC (GRA); 4281, 3325BD (GRA), *Bayliss* B1140, 3326AC (PRE); B1421, 3324DD (PRE); B7016, 3326BC (PRE), *Bohnen* 102-05, (PRE); 7331, 3421AB (STE), *Bolus* 1144 (BOL); 3820, 3318CD (BOL); 9289, 3418BB (BOL, PRE), *Bos* 436, 3318DC (STE), *Bosenberg & Rutherford* 174, 3318CB (STE); 255, 3318AA (STE); 483, 3318CB (STE), *Botha* 5742, 3325BD (PRE), *Botha* 5672, 3325BC (GRA); 5742, 3325BD (PRE), *Botha & Boucher* 1791, 3419AC (PRE), *Botha & Coetzee* 1693, 3217DD (PRE), *Boucher* 1791, 3419AC (PRE, STE); 2962, 3318AA (STE), *Boucher & Shepherd* 4406, 3318DA (STE), *Britten* 2405, 3326DA (GRA, PRE); 2847, 3326DB (STE), *Burchell* 301 (S), *Burrows* 2866, 3326DA (GRA), *Christie* 51, 3424BB (PRE), *Coetzee* 1693, 3217DD (PRE), *Comins* 1007, 3325DB (PRE), *Compton* 23369, 3327AA (STE); 23434, 3324DA (STE), *Cowling* 1270, 3424BB (GRA), *Cummings & Weldrick* 17, 3326BA (GRA), *Dahlstrand* 900, 3325DC (PRE), *Deacon* A1173, 3325CD (GRA), *De Villiers* 163, 3318CC (PRE), *De Vos* 298, 3419AC (STE); 427, 3419AC (STE), *Drège* 1139, 3225CB (HAL, S), *Duthie* 991, 3423AA (STE), *Dyer* 2247, 3326BA (PRE), *Ecklon & Zeyher* 935, (GRA, S, SAM); 937, type, (GRA, S), *Erlank* 1, 3318DC (STE), *Esterhuysen* 12845, 3318CD (BOL); BOL56779, 3318CD (BOL), *Flanagan* 136, 3227DB (PRE, SAM), *Fourcade* 570 (GRA); 1088, 3424BB (SAM, STE); 2267,

3324DD (BOL), *Froembling* 538, 3318CD (PRE), *Galpin* 57, 3326BC (PRE); 4859, 3318CD (PRE); 12934, 3318BC (PRE), *Geldenhuys* 237, 3325DB (PRE); 568, 3423AB (PRE); 1254, 3324DA (PRE), *Giffen* 1221, 3326BB (PRE), *Gillett* 1471, 3423AB (STE); 3322, 3418AB (PRE, STE); STE32035, 3418BB (STE); STE32037, 3418BB (STE), *Goldblatt* 1461, 3318CB (PRE), *Grobbelaar* 2119, 3325CB (PRE), *Häfstrom* s.n., 3318CD (S), *Hall* 46, 3326BC (GRA), *Hall-Martin* 5986, 3325BC (PRE), *Henderson* 553, 3325BD (PRE), *Hilnes* 264, 3327BB (GRA, PRE), *Hoffman* 880, 3224DC (GRA), *Hoole* B2, 3326AD (GRA); A7627, 3326AD (GRA), *Horn* SKF2314, 3421AD (PRE), *Hugo* 2114, 3323CD (PRE, STE), *Jacot Guillarmod* 3513, 3326BC (GRA, PRE), *Jessop* 996, 3325DC (GRA), *Joffe* 502, 3218CC (PRE), *Johnson* 999, 3326AC (PRE), *Jones* s.n., 3326AA (GRA, PRE), *Jordaan* 2265, 3421BD (PRE); 2304, 3325BD (PRE); STE28080, 3318CB (STE), *Keet* US14070, 3423AA (STE), *Lewis* SAM67303, 3324DA (PRE), *Lloyd* 86, 3326BC (GRA), *Long* 865, 3325DD (GRA, PRE), *Low* 418, 3318DC (STE), *Lubke, Everard & Avis* 2705, 3227Dc (GRA), *MacOwan* 130, 3326BC (NH); 1174, 3326BC (GRA, PRE, SAM); 1822, 3318CD (G, GRA, PRE, SAM), *Maguire* 580, 3325DC (STE), *Manson* 68, 3323DB (STE), *Marais* 382, 3424BB (PRE); 396, 3325BD (PRE); 443, 3327AA (PRE); 605, 3418AB (GRA, PRE), *Markotter* US14071, 3418BB (STE), *Marloth* 616, 3318CD (PRE), *McDowall* s.n. RUH18935, 3326DA (GRA), *McKinnon* 6, 3318CD (STE), *Miller* A7629, 3326DC (GRA), *Montgomery* 253b, 3318DA (STE), *Moss* 8283, 3318CD (J), *Muir* 1590, 3421AB (BOL, PRE); 5068, 3421AA (PRE), *Muirhead* K43, 3326DA (GRA), *Mullins* A7630, 3326AD (GRA), *Nature Conservation* K13, 3422 (PRE), *O'Callaghan* 448, 3420BD (STE); 450, 3420BD (STE); 726d, 3423AB (STE); 729, 3423AB (STE); 795, 3423AB (STE); 1314, 3318AD (STE); 1347, 3318AD (STE); 1395, 3424BB (STE), *O'Callaghan, Fellingham & Van Wyk* 327, 3421BD (PRE), *Oliver* 5732, 3421BC (STE), *Olivier* 2773, 3425BA (GRA); 2933, 3425BA (GRA), *Osborne* 45, 3227CB (GRA), *Palmer* 416, 3326BA (GRA), *Parker* 3970, 3418BB (BOL); 4303, 3418BB (BOL), *Paterson* 537, 3325DC (BOL, GRA, PRE), *Pegler* 769, 3227DB (BOL), *Phillipson* 302, 3327AC (PRE), *Pillans* 2854, 3318CD (BOL), *Pole Evans* 4330, 3318CD (PRE); PRE46884, 3324DD (PRE), *Scharf* 1291, 3325CC (PRE), *Schlieben* 10228, 3325BD (PRE), *Sidey* 915, 3326AB (S), *Smuts* s.n. STE31663, 3318DC (STE), *Story* 2633, 3326AD (PRE), *Strey* 862, 3318CD (PRE); 10366, 3326DA (NH, PRE); 10686, 3128BB (NH, PRE), *Taylor* 4405, 3423AB (PRE, STE); 7141, 3318DD (PRE, STE), *Taylor & Edwards* 8780, 3326BA (PRE), *Theron* 1085, 3326CB (PRE), *Thode* A636, 3325CD (PRE); A2621, 3325BC (PRE); US5883, 3318CD (STE), *Thompson* 3588, 3318CB (STE), *Van der Merwe* 272, 3318DD (STE), *Van der Walt* 203, 3418AB (STE), *Van Niekerk* A1277, 3326 (GRA), *Van Rensburg* 138, 3318AC (STE), *Van Rooyen & Ramsey* 494, 3218CB (STE), *Van Wyk* 389, 3324DD (STE); 6729, 3325DC (PRE), *Von Schlechtendal* s.n. HAL071504 (HAL); s.n. HAL071737 (HAL), *Wall* s.n., 3318BC (S); 11, 3318CD (S), *White* 2718, 3326DB (PRE); 10623, 3128BB (NH, PRE), *Willemse* 521, 3421BC (STE), *Wolley Dod* 565, 3418BB (BOL), *Young* 226, 3318CD (PRE), *Zeyher* 265, 3325DC (BOL, G, STE); 2176, 3325DC (G, PRE, S); s.n. SAM14968 (SAM).

Putterlickia retrospinosa

Abbott 1416, 3030CC (NH); 1518, 3030CC (NH), *Acocks* 13261, 3129DD (PRE), *Cooper* 93, 3129DA (NH), *Davidson* 2413, 3030CA (J); *Jordaan* 948, 3129BD (NH, PRE); 1061, 3129BD (PRE), *Nicholas & Smook* 2475, 3130AA (PRE), *Nichols* 691, 3030CB (NH), *Nicholson* 398, 3030CB (NH), *Strey* 7143, 3030CB (PRE); 7205, 3130AA (NH, PRE); 7708, 3030CB (NH, PRE); 8291, 3130AA (NH, PRE); 10224, 3129BD (NH, PRE), *Van Wyk* 3336, 3030CC (PRE); 5137, 3030CC (PRE); 5282, 3130AA (PRU); 5288, 3130AA (PRU); 5292, 3130AA (PRU), *Ward* 7146, 3130AA (PRE).

Putterlickia saxatilis

Acocks 445, 2822BA (PRE); 520, 2822DD (PRE); 527, 2922DA (PRE); 553, 2822DD (PRE); 1781, 2822DD (PRE), *Arnold & Musil* 501, 2823AB (PRE), *Brueckner* 1078, 2823DC (BOL, PRE), *Bryant* 1131, 2922BD (PRE); BOL56771, 2723AD (BOL), *Burchell* 1671, type, (K); 2027 (K), *Cooke* A7631, (GRA), *Davidse* 6446, 2822BA (PRE), *Ferrar* 65, 2823DC (PRE), *Hafstrom* 1153, 2823CB (PRE, S), *Henderson* 514, 2722DC (PRE), *Joffe* 702, 2822CB (PRE), *Leistner* 909, 2823CD (PRE); 1605, 2722BC (PRE), *McDonald* 77/74, 2823DC (PRE); 77/75, 2823DC (PRE), *Pole Evans* 37, 2822BC (PRE); 2491, 2822BA (PRE), Puff 780415, 2722DC (J), *Saaiman* 413, 2823DC (NMB, PRE), *Schlieben & Tölken* 11028, 2722DC (G, PRE), *Van der Schijff* 8035, 2822BA (PRE), *Van Wyk* 9084, 2822BA (PRU), *Wilman* 1315, 2822DD (BOL, PRE).

Putterlickia verrucosa

Acocks 8943, 3227CB (PRE), *Alward* 190, 2632AA (PRE), *Aveling* 31, 3327BB (PRE), *Balkwill & Cadman* 2285, 3030BC (J), *Balsinhas* 3067, 2732CA (PRE); 3207, 2732DA (PRE); 3208, 2732DA (PRE); 3225, 2732BC (PRE); 3235, 2732DA (PRE); 3239, 2732DA (PRE); 3247, 2732BC (PRE), *Botha & Van Wyk* 1180, 2732BC (PRE), *Buthelezi* 458, 2732BC (NH), *Codd* 1909, 2832AA (PRE); 6063, 2531AA (KNP, PRE), *Comins* 997, 3227CC (PRE); 1418, 3227DA (PRE), *Cooper* 93, 3129DD (PRE); 115, 2931BA (NH, PRE), *Davidson* s.n., 2732CD (J), *Drège* s.n. (G), *Edwards* 1351, 2931AB (NU, PRE); 2704, 2930DA (PRE), *Flanagan* 606, 3227DB (GRA, PRE, SAM), *Fries & Fries* 3406a, 2930CD (S), *Gerstner* 4975, 2732CC (PRE), *Giffen* PRE57369, 3226DD (PRE), *Goodman* 1157, 2732CA (NH), *Gordon-Gray* 1038, 3128DC (NU), *Groenewald* 28, 2831DD (NH), *Gueinzius* 57 (G, S), *Guy* 27, 2832AA (PRE0, *Harrison* 221, 2832AC (NH, PRE), *Henderson* 132,

2831DA (PRE), *Hilner* 287, 3327BB (GRA), *Hitchins* 610, 2832AA (PRE), *Johnson* 1413, 2930 (NH, PRE), *Jordaan* 512, 2732DA (NH, PRE), *Killick* 888, 3227CA (PRE), *Kotsokoane* 140, 3227CA (J), *MacDevette* 1941, 2931CA (NH), *Marais* 750, 3129CC (PRE); 759, 3129CA (PRE); 1214, 3129BC (PRE), *Medley Wood* 134, 2931CC (BOL); 615, 2930DB (SAM); 11013, 2931CC (NH, S); 12669, 2931CC (NH, PRE); 16485, 2931CC (PRE), *Miller* B/957, 3129DA (PRE), *Mills* 423, 3129DD (NH, PRE), *Mogg* 33815, 3030DA (PRE), *Moll* 1802, 2931CA (PRE); 2160, 2931CA (PRE); 2210, 2732BC (PRE); 2533, 2931AD (PRE); 2728, 2832AD (PRE); 2828, 2832AB (PRE); 2929, 2931AD (PRE); 3174, 2732BC (PRE); 4267, 2632CD (NH, PRE); 4851, 2732BB (NH, PRE, S); 4967, 2831DB (PRE); 5210, 2732BC (PRE), *Moll & Strey* 3984, 2732BC (PRE), *Morris* 579, 2930DA (PRE); 904, 2930DA (PRE), *Moss* 2370, 3226DB (J); 2371, 3226DB (J); 2452, 2930DD (J), *Nel* 383, 2531AC (PRE); 384, 2531AC (PRE), *Nichols* 667, 2931CC (NH), *Nicholson* 731, 3129 (PRE); 2108, 3030AD (PRE); s.n., 2931CA (PRE), *Pegler* 602, 3129CC (BOL, PRE), *Pienaar* 174, 3327BA (PRE), *Prior* 200, 2631CD (PRE), *Ross & Moll* 2180, 2931CA (NH, PRE), *Rudatis* 1167, 3030AD (G, PRE, S, STE); 1509 (PRE, STE), *Schlechter* 3008, 2931CC (GRA, NH, PRE), *Sim* 1665, 3227CD (PRE); 1697, 3227CD (PRE); 1698, 3227CD (PRE); 1699, 3227AD (PRE); 1967, 3227CC (BOL), *Smith* 3641, 3327BB (PRE); 3855, 3327BB (PRE), *Stephen* 420, 2732BC (PRE); 821, 2632CD (PRE); 822, 2632CD (PRE), *Stephen, Van Graan & Schwabe* 1010, 2732BC (PRE); 1044, 2732BC (PRE), *Steytler* 23, 2732CB (PRE), *Story* 2116, 3226CB (PRE); 2375, 3227CA (PRE); 3375, 3227CA (PRE), *Strey* 5035 (PRE); 10194, 3129DA (NH, PRE); 11003, 3030CB (NH, PRE); *Strey & Moll* 3953, 2732BC (PRE), *Thode* US9519, 3327BB (STE), *Tinley* 382, 2732AA? (PRE), *Thode* US6603, 3327BB (STE); US10812, 3327BB (STE), *Vahrmeijer* 648, 2732DA (PRE), *Vahrmeijer & Tölken* 242 (PRE), *Van der Schijff* 662, 2531AA (KNP, PRE); 663, 2531AA (PRE); 3440, 2531AB (KNP, PRE); 3915, 2531AA (PRE), *Van Jaarsveld* 1189, 2631CD (PRE), *Van Wyk* 2504, 2732AB (PRE), *Venter* 3786, 2831DC (PRE); 11472, 2831DA (PRE), *Ward* 545 (PRE); 575, 2931BA (NH); 1361, 2732BA (NH); 1826, 2732BB (NH, PRE); 3663, 2832AB (PRE); 7084, 2832DD (NH); 7121, 2732CD (PRE), *Weeks* J32038, 3030CB (J), *Wells* 1266, 2930DA (PRE), *West* 1951, 3030CB (NH), *Willox* 16, 2732CA (PRE), *Wormald* 127, 3327BB (GRA), *Wylie* NH23184, 3030BB (NH).

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SUMMARY

A TAXONOMIC REVISION OF THE SPINY MEMBERS OF SUBFAMILY CELASTROIDEAE (CELASTRACEAE) IN SOUTHERN AFRICA

by

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The present study constitutes a taxonomic account of all the spiny members of southern African Celastroideae, in recent years referred to the genera *Maytenus* Molina and *Putterlickia* Endl. Taxonomic decisions were based on a detailed study of the comparative morphology, distribution and ecology, and phytogeography of more than 3 000 herbarium specimens from 20 herbaria, as well as extensive field work. Leaf-anatomical studies of all the species were conducted, and proved to be a valuable additional source of evidence for the delimitation of taxa. An extensive historical review and a bibliography are provided. The phylogeny of the species groups is portrayed in the form of a cladogram.

In the taxonomic treatment, each species is described in detail, accompanied by nomenclatural notes, common names, flowering and fruiting time, diagnostic features, information on distribution and habitat and voucher specimens. Keys for the identification of all taxa are provided. One neotype and 29 lectotypes were selected.

The reinstatement of the genus *Gymnosporia* (Wight & Arn.) Hook. f. for the spiny members of *Maytenus* is proposed. Nine new sections, seven new species, one new subspecies, and eight combinations in the genus *Gymnosporia* are proposed. A new genus, *Gloveria*, endemic to southern Africa, is described. A new combination in *Putterlickia* is proposed. In this study 37 infrageneric taxa are recognized: four species in *Putterlickia*, one species in *Gloveria* and 26 species and six subspecies in *Gymnosporia*.

recognized: four species in *Putterlickia*, one species in *Gloveria* and 26 species and six subspecies in *Gymnosporia*.

The following taxa are described as new: the genus *Gloveria*; new sections in the genus *Gymnosporia*: *Buxifoliae*, *Capitatae*, *Mossambicensis*, *Nemorosae*, *Polyacanthae*, *Pubescens*, *Putterlickioides*, *Tenuispinae*; new species: *Gymnosporia arenicola*, *G. devenishii*, *G. gariepensis*, *G. hemipterocarpa*, *G. karooica*, *G. macrocarpa*, *G. markwardii* and a new subspecies: *G. szyszylowiczii* subsp. *namibiensis*.

New combinations and statuses proposed are: *Putterlickia saxatilis* (Burch.) M. Jordaan, *Gloveria integrifolia* (L. f.) M. Jordaan, *G. grandifolia* (Davison) M. Jordaan, *G. linearis* (L. f.) Loes. subsp. *lanceolata* (Thunb.) M. Jordaan, *G. oxycarpa* (N. Robson) M. Jordaan, *G. polyacantha* (Sond.) Szyszyl. subsp. *vaccinifolia* (P. Conrath) M. Jordaan, *G. pubescens* (N. Robson) M. Jordaan, *G. szyszylowiczii* (Kuntze) M. Jordaan subsp. *szyszylowiczii*, *G. tenuifolia* (Loes.) M. Jordaan and *Gymnosporia vanwykii* (R.A. Archer) M. Jordaan. One nomen novum, namely *Gymnosporia glaucophylla* M. Jordaan, is proposed.

Important diagnostic characters at specific level include habit, solid form of mature branches, colour of branchlets; leaf margins, size and venation; sexuality; capsule shape, texture, colour, size and surface of pericarp; seed colour; number of ovules per locule; number of locules in fruit; degree to which the aril covers the seed; colour of aril; and geographical distribution.

Diagnostic anatomical characters include: the size of epidermal cells; whether the leaf is amphistomatic or hypostomatic; presence or absence of a hypodermis; presence or absence of a multi- or uniseriate epidermis; presence or absence of trichomes and papillae; presence or absence of oil droplets in mesophyll and epidermis, and different types of scattered tanniferous cells.

The thesis also presents 23 tables and 126 figures, including line drawings of eight species and seed of all species, photographs of herbarium specimens, flowers and fruits, transverse sections of the leaves, distribution maps and a cladogram.

OPSOMMING

'N TAKSONOMIESE HERSIENING VAN DIE DORINGRIGE LEDE VAN DIE SUBFAMILIE CELASTROIDEAE (CELASTRACEAE) IN SUIDER-AFRIKA

deur

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Januarie 1995

Hierdie studie behels 'n taksonomiese hersiening van al die doringrige lede van die Suider-Afrikaanse Celastroideae, wat tans geklassifiseer word onder die genusse *Maytenus* Molina en *Putterlickia* Endl. Taksonomiese besluite is gebaseer op 'n uitvoerige studie van die vergelykende morfologie, verspreiding en ekologie, en fitogeografie van meer as 3 000 herbariumeksemplare van 20 herbariums sowel as uitgebreide veldwerk. Blaar-anatomiese ondersoeke van al die spesies verskaf 'n bykomende bron van getuienis vir die omgrensing van taksons. 'n Uitgebreide historiese oorsig en bibliografie word verskaf. Die filogenetiese verwantskappe word in die vorm van 'n kladogram aangetoon.

In die taksonomiese behandeling word elke spesie in besonderhede beskryf. Die nomenklatuur, volksname, blom- en vrugtyd, diagnostiese kenmerke en inligting oor die verspreiding en habitat, sowel as kontrole-eksemplare word verskaf. Sleutels tot al die taksons word verskaf. Een neotipe en 29 lektotipes is gekies.

Die herinstelling van die genus *Gymnosporia* (Wight & Arn.) Hook. f. vir die doringrige lede van *Maytenus* word voorgestel. Nege nuwe seksies, sewe nuwe spesies, een nuwe subspesie, en agt kombinasies in die genus *Gymnosporia* word voorgestel. 'n Nuwe genus, *Gloveria*, endemies aan Suider-Afrika, word beskryf. 'n Nuwe kombinasie in *Putterlickia* word voorgestel. In hierdie studie word 37 infrageneriese taksons erken: vier spesies in *Putterlickia*, een spesie in *Gloveria* en 26 spesies en ses subspesies in *Gymnosporia*.

Die volgenge taksons word as nuut beskryf: die genus *Gloveria*; nuwe seksies in die genus *Gymnosporia*: *Buxifoliae*, *Capitatae*, *Mossambicensis*, *Nemorosae*, *Polyacanthae*, *Pubescens*, *Putterlickioides*, *Tenuispinae*; nuwe spesies: *Gymnosporia arenicola*, *G. devenishii*, *G. gariepensis*, *G. hemipterocarpa*, *G. karooica*, *G. macrocarpa*, *G. markwardii* en 'n nuwe subspesie: *G. szyszylowiczii* subsp. *namibiensis*.

Nuwe kombinasies en statusse wat voorgestel word, is: *Putterlickia saxatilis* (Burch.) M. Jordaan, *Gloveria integrifolia* (L. f.) M. Jordaan, *G. grandifolia* (Davison) M. Jordaan, *G. linearis* (L. f.) Loes. subsp. *lanceolata* (Thunb.) M. Jordaan, *G. oxycarpa* (N. Robson) M. Jordaan, *G. polyacantha* (Sond.) Szyszyl. subsp. *vaccinifolia* (P. Conrath) M. Jordaan, *G. pubescens* (N. Robson) M. Jordaan, *G. szyszylowiczii* (Kuntze) M. Jordaan subsp. *szyszylowiczii*, *G. tenuifolia* (Loes.) M. Jordaan en *Gymnosporia vanwykii* (R.A. Archer) M. Jordaan. Een nomen novum, naamlik *Gymnosporia glaucophylla* M. Jordaan, word voorgestel.

Belangrike diagnostiese kenmerke op spesievlak, sluit in: die groeivorm, soliede vorm van volwasse takke, kleur van takkies; blaarrande, blaargrootte, bearing; seksualiteit; vorm van kapsule, tekstuur, kleur, grootte en oppervlak van die perikarp; saadkleur; aantal saadkoppe per saadhok; aantal saadhokke; tot watter mate die arillus die saad bedek; kleur van die arillus; en geografiese verspreiding.

Diagnostiese anatomiese kenmerke sluit in: die grootte van die epidermisselle; of die blaar amfistomaties of hipostomaties is; die aan- of afwesigheid van 'n hipodermis, 'n meer- of eenlagige epidermis, trigome, papille, en oliedruppels in die mesofil en epidermis; en verskillende tipes verspreide tannienbevattende selle.

Hierdie verhandeling bevat ook 23 tabelle en 126 figure, wat lyntekeninge van agt spesies en saad van al die spesies, foto's van herbariumeksemplare, blomme en vrugte, dwarssneë van die blare, verspreidingskaarte en 'n kladogram insluit.

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CURRICULUM VITAE

Marie Jordaan (née Prins) was born in Pretoria in 1948. She was educated at Hendrik Verwoerd Hoërskool and after matriculating in 1965, enrolled at the University of Stellenbosch to be awarded a B.Sc. degree three years later. She worked for one year as technician at the Research Institute for Diary Products at Irene. She requested a transfer to the Botanical Research Institute in Pretoria, where she was employed as a technician involved in the identification of the woody genera of the southern African flora. After her marriage in 1971, she was transferred to the Botanical Research Unit in Stellenbosch, working on the Cape flora. Her botanical career was interrupted when her two sons were born and raised. In 1981 she resumed her career at the Botanical Research Unit in Durban, where she worked on the Natal flora. Since 1987 she has been employed at the National Botanical Institute in Pretoria, where she was transferred after she had been widowed in 1985. She worked on various plant families in the National Herbarium. Since her time in Durban she has developed a particular interest in the Celastraceae, which has led to an honours degree at the University of Pretoria, awarded in 1992.

PART 2

■ TABLES AND FIGURES ■

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TABLE 1. Summary of the history of taxonomic treatments of spiny members of the southern African Celastroideae (name of taxa recognized in the present study in bold)

X = Genus in which taxon was described and in which epiphet is still used
# = Genus in which taxon was described, but now a synonym
@ = Genus in which taxon is proposed to be placed

Author/s & year	New taxon basionym = X@	*Celas-trus*	*Gymno-sporia*	*May-tenus*	*Putter-lickia*	*Glo-veria*	Synonym of
Linnaeus 1753	**buxifolia**	X	@				
	pyracantha	X			@		
Linnaeus fil. 1781	**integrifolia**	X				@	
	linearis	X	@				
Lamarck 1785	**senegalensis**	X	@				
	multiflorus	#	@				**G. buxifolia**
L'Héritier 1788	*phyllacanthus*	#	@				**G. senegalensis**
Solander 1819	*cymosus*	#	@				**G. buxifolia**
Burchell 1824	**saxatilis**	X			@		
Ecklon & Zeyher 1834--1835	*campestris*	#			@		**P. pyracantha**
	empleurifolius	#	@				**G. buxifolia**
	goniecaulis	#	@				**G. buxifolia**
	heterophylla	X	@				
	humilis	#	@				**G. buxifolia**
	nemorosa	X	@				
	parvifolius	#	@				**G. heterophylla**
	patens	#	@				**G. buxifolia**
	polyanthemos	#	@				**G. buxifolia**
	rhombifolius	#	@				**G. buxifolia**
	spathephyllus	#	@				**G. nemorosa**
	stenophyllus	#	@				**G. linearis**
	venenatus	#	@				**G. buxifolia**
Krauss 1846	*leptopus*	#	@				**G. nemorosa**
E. Meyer 1843 ex Sonder 1860	*angularis*	#	@				**G. heterophylla**
	capitata	X	@				
	lanceolata	X	@				
	polyacantha	X	@				
	tenuispina	X	@				
	verrucosa	X			@		
Klotzsch 1861	**mossambicensis**	X	@				

(continue next page)

(Table 1 continued)

Author/s & year	New taxon basionym = X@	*Celas-trus*	*Gymno-sporia*	*May-tenus*	*Putter-lickia*	*Glo-veria*	Synonym of
Harvey 1862	*ruber* (**rubra**)	X	@				
Szyszylo-wicz 1888	*woodii*		#@				**G. heterophylla**
Kuntze 1891	**szyszylowiczii** (*Cassine*)#		@				
Loesener 1893	**putterlickioides**		X@				
Loesener 1894	*schlechteri*		#@				**G. buxifolia**
Loesener 1896	*botsabelensis* *harveyana* *heterophylla* var. *stenophylla*		#@ #@ #@				**G. tenuispina** **G. mossambicensis** **G. elliptica**
Loesener 1903	*dinteri* *capitata* var. **tenuifolia**		#@ @				**G. senegalensis**
Sprague 1906	*condensata*		#@				**G. buxifolia**
N.E. Brown 1906	*concinnus*	#	@				**G. mossambicensis**
Conrath 1908	*vaccinifolia*		#@				**G. polyacantha** subsp. **vaccinifolia**
Davison 1927	*crataegiflora* *angularis* var. **grandifolia** *angularis* var. *orbiculata* **uniflora**		#@ X@ #@ X@				**G. heterophylla** **heterophylla**
Robson 1965	*arenaria* p.p. *glauca* **pubescens** **oxycarpa**		#@ @ @ @	X X X X			**G. arenicola** **G. glaucophylla**
Van Wyk & *Mostert* 1987	**retrospinosa**				X@		
Archer1992	**vanwykii**		@	X			

Note: Only publications in which new taxa have been described are mentioned.

TABLE 2. Material studied for leaf anatomy

Taxon	Voucher specimens	Herbarium	FAA collection
Gloveria integrifolia	K.A. Dahlstrand 2299	PRE	
	E. Esterhuizen 1387	BOL	
	G. Germishuizen (Anysberg)	PRE	
	M. Jordaan 2282	PRE	PRE
	N.S. Pillans 17965	BOL	
	N. v. Rooyen 2250	PRE	
Gymnosporia arenicola	O. Kerfoot K7381	J	
	G. Nichols 608	NH	
	J.H. Ross 1888	PRE	
	C.J. Ward 4251	PRE	
Gymnosporia buxifolia	A325 A. Abbott 1310	PRU	PRU
	M. Jordaan 2267	PRE	PRE
	M. Jordaan 2309	PRE	PRE
	M. Jordaan 2326	PRE	PRE
	M. Jordaan 2677	PRE	PRE
	M. Jordaan (Songimvelo)	PRE	PRE
	M. Jordaan (NBI, WITS)	PRE	PRE
	A.O.D. Mogg 30775	J	
Gymnosporia capitata	M. Jordaan 2312	PRE	
	M. Jordaan 2314	PRE	PRE
Gymnosporia devenishii	Anonymous J076196	J	
	N. Devenish 1579	PRE	
	D. Edwards 2842	PRE	
	M. Jordaan 2680	PRE	
Gymnosporia elliptica	M. Jordaan 2292	PRE	
	M. Jordaan 2294	PRE	PRE
	M. Jordaan 2295	PRE	PRE
Gymnosporia gariepensis	N. Jurgens 28856	PRE	
Gymnosporia glaucophylla	R.H. Compton 27904	PRE	
	D. Edwards 755	PRE	
	M. Jordaan 2472	PRE	
	E. Moll 2098	PRE	
	I.M. Retief 439	PRE	
	P. Swartz (Pongolo)	PRE	
Gymnosporia grandifolia	A319 A. Abbott 1412	PRU	PRU
	A758 A. Abbott 1412	PRU	PRU
	D. Edwards 2941	PRE	
	R. Thorncroft 2007	PRE	
	A1057 A.E. van Wyk	PRU	PRU
Gymnosporia hemipterocarpa	R.H. Compton 26404	PRE	
	E. Moll 5258	PRE	
Gymnosporia heterophylla	Balkwill *et al.* 6437	J	
	H.G. Flanagan 220	PRE	
	M. Jordaan 2322	PRE	PRE
	R. Scott-Shaw 4366	PRE	
	A1660 A.E. Van Wyk 1023	PRU	PRU
	J. Medley Wood 212	PRE	
Gymnosporia karooica	Glen Kollege 55	PRE	
	C.E. Moss 4527	J	
	C.E. Moss 4528	J	
Gymnosporia linearis	Merxmüller & Giess 3246	PRE	
subsp. *lanceolata*	C.E. Moss 10778	J	
	K.L. Tinley 98	PRE	
Gymnosporia linearis	R.D.A. Bayliss 479	PRE	
subsp. *linearis*	N. Grobbelaar 2917	PRE	
Gymnosporia macrocarpa	Balkwill *et al.* 5356	J	
	D. Edwards 2800	PRE	
	D. Edwards 3227	PRE	

(continue next page)

(Table 2 continued)

Gymnosporia markwardii	Feely & Ward 22	PRE	
	A.O.D. Mogg 28833	J	
	R.G. Strey 5000	PRE	
Gymnosporia mossambicensis	M. Jordaan 2674	PRE	PRE
	NBI-Garden, PRETORIA	PRE	PRE
	D.G. Stielau 40	PRE	PRE
Gymnosporia nemorosa	M. Jordaan 2301	PRE	
	B. Maguire 199	J	
	Moll & Morris 668	PRE	
	H. Rudatis 1553	PRE	
	Zeyher 82	S	
Gymnosporia oxycarpa	Van der Schijff & Marais 368	PRE	
Gymnosporia polyacantha	M. Jordaan 2308	PRE	PRE
subsp. *polyacantha*	M. Jordaan 2310	PRE	PRE
Gymnosporia polyacantha	M. Jordaan (Mabalinge)	PRE	PRE
subsp. *vaccinifolia*	A. Lambrechts 14	PRE	
	C.C. Liebenberg 8825	PRE	
Gymnosporia pubescens	N. v. Rooyen 3120	PRE	
Gymnosporia putterlickioides	G. Henn 944	PRE	
	N. v.Rooyen & Bredenkamp	PRE	
	N. v. Rooyen 1406	PRE	
Gymnosporia rubra	T.H. Arnold 313	PRE	
	O. Kerfoot K7305	J	
	F.A. Rogers 23871	J	
Gymnosporia senegalensis	E. Buitendag 73	PRE	
	B. de Winter 8976	PRE	
	B. Ellery 397	J	
	P.A. Smith 617	PRE	
G. szyszylowiczii	A. Breukner 1074	PRE	
subsp. *namibiensis*	A. Gubb 12532	PRE	
	M. Jordaan 2629	PRE	PRE
	M. Muller 1325	PRE	
szyszylowiczii	M. Jordaan 2273	PRE	PRE
subsp. *szyszylowiczii*	M. Jordaan 2288	PRE	PRE
Gymnosporia tenuifolia	Balkwill *et al.* 5351	J	
	E. Kers 430	S	
	C.M. Shackleton 725	J	
	R.G. Strey 8484	PRE	
	H. & E. Walter 673	B	
Gymnosporia tenuispina	P. Burgoyne 1583	PRE	PRE
	J. Burtt Davy 1736	PRE	
	G. Germishuizen 993	PRE	
	R. Leendertz 514	PRE	
	R.H. Westfall 2054	PRE	
Gymnosporia uniflora	2105 Abbott 5401	PRU	PRU
	Balkwill & Cadman 2270	J	
	C. Hildyard 65	PRE	
Gymnosporia vanwykii	A. Abbott 2567	PRE	
	A.E. van Wyk 7707	PRU	PRU
Putterlickia pyracantha	A. Jacot Guillarmod 351	PRE	
	M. Jordaan 2265	PRE	PRE
	H.C. Taylor 440	PRE	
Putterlickia retrospinosa	5282 A.E. van Wyk	PRU	PRU
	A.E. van Wyk 513	PRU	
	A.E. van Wyk 8332	PRU	
utterlickia saxatilis	133-1336(Olifantshoek)	PRU	PRU
	M. Jordaan 2552	PRE	PRE
	C. Puff 780415	J	
Putterlickia verrucosa	J.P.H. Acocks 8943	PRE	
	A. Balsinhas 3067	PRE	
	NBI Garden PRETORIA	PRE	PRE

TABLE 3.1. Definition of life forms in spiny members of the southern African Celastroideae and key to abbreviations used in **Table 3.2**, after Raunkiaer (1934)

Habit	Height	Life form	Abbre - viation
Small trees	2--8 m	microphanerophytes	MIP
Shrubs	< 2 m	nanophanerophytes	NP
	2--8 m	microphanerophytes	MIP
Woody dwarf shrubs	.25--.70 m	frutescent chamaephytes	FC
Lianas		phanerophytic lianas	PL

TABLE 3.2. Life forms among southern African Celastroideae

Taxon	MIP(trees)	MIP(shrubs)	NP	FC	PL
Gloveria					
integrifolia			X		
Gymnosporia					
arenicola	X	X			
buxifolia	X	X			
capitata			X		
devenishii	X				
elliptica				X	
gariepensis			X		
glaucophylla	x	X			
grandifolia	X				
hemipterocarpa	x	X			
heterophylla			X		
karooica			X		
linearis subsp. *lanceolata*	X	x			
linearis subsp. *linearis*		X			
macrocarpa			X		
markwardii				X	
mossambicensis	X	X			
nemorosa	X	X			
oxycarpa			X		
polyacantha			X		
pubescens			X		
putterlickioides	x	X			
rubra			X		
senegalensis	X	X			
szyszylowiczii			X		
tenuifolia	x	X			
tenuispina			X		
uniflora				X	
vanwykii				X	
Putterlickia					
pyracantha		X			
retrospinosa					X
saxatilis			X		
verrucosa		X			

TABLE 4. Diagnostic stem characters in spiny members of southern African Celastroideae (Figures 1--3)

Taxon	Stem characters										
	Lenticels			Solid form of stems			Colour of stems		Indumentum of stems		
	Verrucose	Black or yellow dots	Absent	Mature stems terete	Mature stems angular	Young stems angular	Young stems red/purple	Young stems green/brown/grey	Glabrous	Hairy	Muricate
Gloveria											
integrifolia		X		X			X		X		
Gymnosporia											
arenicola			X	X		X	X		X		
buxifolia			X	X		X		X	X		
capitata			X	X			X		X		
devenishii			X	X		X		X	X		
elliptica		X		X		X		X	X		
gariepensis			X	X			X		X		
glaucophylla			X	X			X		X		
grandifolia			X	X		X		X	X		
hemipterocarpa			X	X			X		X		
heterophylla			X		X	X		X	X		
karooica			X	X				X	X		
linearis			X	X				X	X		
macrocarpa			X	X				X	X		
markwardii			X	X		X		X	X		
mossambicensis			X	X		X	X		X		
nemorosa		X		X		X	X		X		
oxycarpa			X	X		X	X		X		
polyacantha											
subsp. *polyacantha*			X	X				X	X		
subsp. *vaccinifolia*			X	X				X			X
pubescens			X	X		X	X			X	
putterlickioides			X	X		X		X		X	
rubra			X	X		X		X		X	
senegalensis			X	X			X		X		
szyszylowiczii											
subsp. *namibiensis*			X	X			X				
subsp. *szyszylowiczii*			X	X				X	X		
tenuifolia			X	X		X		X	X		
tenuispina			X	X		X		X		X	
uniflora			X	X		X		X	X		
vanwykii			X	X		X		X	X		
Putterlickia											
pyracantha		X		X		X		X	X		
retrospinosa	X			X			X		X		
saxatilis		X		X				X	X		
verrucosa	X			X		X	X		X		

TABLE 5. Diagnostic spine characters in spiny members of southern African Celastroideae (Figures 4--5)

Taxon	Spine characters								
	Nature		Nodes		Size			Distal part	
					Length in mm up to				
	Spines straight	Spines backward pointing	One node per spine	> One node per spine	<20	20--50	>50	Angular	Terete
Gloveria									
integrifolia	X			X			X		X
Gymnosporia									
arenicola	X		X				X		X
buxifolia	X		X				X		X
capitata	X		X			X			X
devenishii	X		X				X		X
elliptica	X		X		X				X
gariepensis	X			X					X
glaucophylla	X		X			X			X
grandifolia	X		X				X		X
hemipterocarpa	X		X				X		X
heterophylla	X		X			X		X	
karooica	X		X			X			X
linearis	X		X			X			X
macrocarpa	X		X			X			X
markwardii	X		X		X				X
mossambicensis	X		X				X		X
nemorosa	X		X				X		X
oxycarpa	X			X	X				X
polyacantha	X		X				X		X
pubescens	X		X				X		X
putterlickioides	X			X			X		X
rubra	X		X			X			X
senegalensis	X		X				X		X
szyszylowiczii									
subsp. *namibiensis*	X		X			X			X
subsp.*szyszylowiczii*	X		X				X		X
tenuifolia	X		X				X		X
tenuispina	X		X		X				X
uniflora	X		X			X			X
vanwykii	X		X		X				X
Putterlickia									
pyracantha	X		X			X			X
retrospinosa		X	X				X		X
saxatilis	X		X		X				X
verrucosa	X		X				X		X

TABLE 6. Diagnostic leaf characters (size, margin, venation) in spiny members of southern African Celastroideae (Figure 6)

Taxon	Leaf characters*											
	Size							Margin				Venation	
	Length in mm			Width in mm									
	3-10	10-50	>50	<6	6-15	15-25	>25	En-tire	Den-tate	Ser-rate	Cre-nate	Ob-vious	Ob-so-lete
Gloveria													
integrifolia	X	x		X				X					X
Gymnosporia													
arenicola		X	x			X	x			X		X	
buxifolia		X	x		X	X				X	X	X	
capitata		X		x	X			X					X
devenishii		X				X				X	x	X	
elliptica		X		X				X	x			X	
gariepensis		X		X				X					X
glaucophylla		X	x		x	X		X				X	x
grandifolia		X	X			X	X			X		X	
hemipterocarpa		X			x	X				X		X	
heterophylla	X	x		X	X	x				X		X	
karooica		X		X	x			X	x				
linearis													
subsp. *lanceolata*		X	x		X			X	x				X
subsp. *linearis*		X	x	X				X	x				X
macrocarpa		X	x		x	X	x			X		X	
markwardii		X			x	X	x			X		X	
mossambicensis		X	X		X	X	x		x	X		X	
nemorosa		X	x			X	x		X	X		X	
oxycarpa			X			X	x	X	x			X	x
polyacantha													
subsp. *polyacantha*		X		X	x			X		X		X	
subsp. *vaccinifolia*	X	x		X				X		X		X	
pubescens	X	x			X			x	X			X	
putterlickioides	X	X			X	X	x				X	X	
rubra	X	x			X					X		X	
senegalensis		X	x		x	X	x			X	X	X	
szyszylowiczii													
subsp. *namibiensis*	X			X				X				x	X
subsp.*szyszylowicii*		X			X			X				X	
tenuifolia	x	X			X					X		X	
tenuispina		X	x		X			X	x			X	
uniflora		X		X				X	x			X	
vanwykii		X			x	X	x			X		X	
Putterlickia													
pyracantha		X	x		X	X	x	X	X			X	
retrospinosa		x	X				X	X	X			X	
saxatilis	X	x		X				X					X
verrucosa		X	x		X	X		X	X			X	

* X = Strong tendency towards character state
x = Occasional occurrence of character state

TABLE 7. Diagnostic leaf characters (indumentum, colour, shape) in spiny members of southern African Celastroideae

Taxon	Leaf characters*									
	Indumentum		Colour in dry specimens			Shape				
	Glabrous	Hairy	Green	Glaucous	Grey	Linear	Lanceolate	Oblong obovate	Elliptic	Rotund/ovate
Gloveria										
integrifolia	X				X			X	x	
Gymnosporia										
arenicola	X		X					X		
buxifolia	X		X					X	X	x
capitata	X		X					X		
devenishii	X		X						X	X
elliptica	X		X				X	X		
gariepensis	X		X					X		
glaucophylla	X			X				X		
grandifolia	X		X					X		
hemipterocarpa	X				X			X		
heterophylla	X		X					X	x	X
karooica	X		X			x	X			
linearis										
subsp. *lanceolata*	X			X			X			
subsp. *linearis*	X			X		X				
macrocarpa	X		X					X		
markwardii	X		X					X		
mossambicensis	X		X				X		X	X
nemorosa	X		X					X	X	
oxycarpa	X		X					X		
polyacantha	X		X					X	x	
pubescens		X	X					X		
putterlickioides		X	X					X	X	
rubra	X		X							X
senegalensis	X			X				X	X	
szysylowiczii	X			X				X		
tenuifolia	X		X					X	x	
tenuispina	X	x	X				x	X	x	
uniflora	X		X				x	X	x	
vanwykii	X		X						X	X
Putterlickia										
pyracantha	X		X					X		
retrospinosa	X		X					X	x	x
saxatilis	X			X				X	x	
verrucosa	X		X					X		x

* X = Strong tendency towards character state
x = Occasional occurrence of character state

TABLE 8. Diagnostic inflorescence characters in spiny members of southern African Celastroideae

Taxon	Inflorescence characters*											
	Number of flowers per cyme		Type of inflorescence			Peduncle length in mm			Indumentum of peduncle		Pedicel length in mm		
	Few 1-5(7)	Many (7)9-15	Lax cyme	Com-pact cyme	Re-duced cyme	<5	5-20	>20	Gla-brous	Pu-beru-lous	<2	2-7	>7
Gloveria													
integrifolia		X		X			X		X			X	
Gymnosporia													
arenicola		X		X		X			X			X	
buxifolia		X		X		X	x		X			X	
capitata		X			X	X			X		X		
devenishii		X		X		X			X			X	
elliptica		X		X		X	x		X			X	
gariepensis		X	X				X		X			X	
glaucophylla		X		X			X		X			X	
grandifolia		X		X		X			X			X	
hemipterocarpa		X		X			X		X		X		
heterophylla	x	X		X		X			X		x	X	
karooica		X		X			X		X			X	
linearis		X		X		X			X		X		
macrocarpa	X			X		X	x		X		X		
markwardii		X		X		X			X			X	
mossambicensis		X		X			X		X			X	
nemorosa		X		X			X		X				X
oxycarpa		X	X				X		X				X
polyacantha		X		X		X			X		X		
pubescens		X		X		X				X	X		
putterlickioides		X		X			X	x		X		X	
rubra	X			X			X		x	X	X		
senegalensis		X		X		x	X		X		x	X	
szyszylowiczii		X		X			X		X			X	
tenuifolia	X	x		X		x	X		X			X	
tenuispina		X		X			X		X			X	
uniflora	X			X		X	x		X			X	
vanwykii		X		X			X		X			X	
Putterlickia													
pyracantha		X		X			X		X				X
retrospinosa		X	X					X	X			X	
saxatilis	X	x		X			X		X			X	
verrucosa		X		X			X	x	X			X	

* X = Strong tendency towards character state
x = Occasional occurrence of character state

TABLE 9. Diagnostic floral characters in spiny members of southern African Celastroideae (Figures 7--8)

Taxon	Floral characters*														
	Sexuality		Colour		Disc colour		Flower diameter in mm			Number of ovules per locule			Number of locules pe ovary			Stamens longer than petals
	Unisexual	Bisexual	Tinged red/red	Yellow/cream white	Red	Green	<2	2-6	>6	2	4-6	>6	2	3	4	
Gloveria																
integrifolia		X	x	X		X		X			X			X		
Gymnosporia																
arenicola	X			X		X		X		X				X		X
buxifolia	X			X		X		X		X				X		
capitata	X			X		X		X		X				X		
devenishii	X			X		X		X		X				X		
elliptica	X			X		X		X		X				X		
gariepensis	X			X		X		X		X				X		
glaucophylla	X			X		X		X		X				X		
grandifolia	X			X		X		X		X			X	x		
hemipterocarpa	X			X		X		X		X						
heterophylla	X			X		X		X		X				X		
karooica	X			X		X		X		X				X		
linearis	X			X		X		X		X			X			
macrocarpa	X			X		X		X		X				X	x	
markwardii	X			X		X		X		X			X			X
mossambicensis	X			X		X		X		X				X		
oxycarpa	X			X		X		X		X				X		
polyacantha	X			X		X		X		X				X		
nemorosa	X			X		X		X		X				X		
pubescens	X			X		X		X		X				X	x	
putterlickioides		X		X	X				X	X	x			X		
rubra	X		X			X	X			X				X		
senegalensis	X			X		X		X		X			X			
tenuifolia	X			X		X		X		X			X	x		
tenuispina	X			X		X		X		X				X		
uniflora	X			X	X	x		X		X				X		
vanwykii	X			X		X		X		X				X		X
Putterlickia																
pyracantha		X		X		X			X			X		X		
retrospinosa		X		X		X			X			X				
saxatilis		X	x	X		X		X			X			X		
verrucosa		X		X		X			X			X		X		

* X = Strong tendency towards character state
x = Occasional occurrence of character state

TABLE 10. Peak flowering times in spiny members of southern African Celastroideae

Taxon	Flowering time*			
	Spring	Summer	Autumn	Winter
Gloveria				
integrifolia	X			@
Gymnosporia				
arenicola		@	x	X
buxifolia	X	x		@
capitata		X	x	
devenishii		X		
elliptica		X	x	@
gariepensis			X	
glaucophylla		@	x	X
grandifolia	X	@		x
hemipterocarpa		X	x	
heterophylla	x	@		X
karooica	X	x	@	
linearis				
subsp. *lanceolata*	X			x
subsp. *linearis*	x	X		
macrocarpa		X	x	
markwardii		X	x	
mossambicensis	x	X	@	
nemorosa		X	x	@
oxycarpa		X		
polyacantha				
subsp. *polyacantha*	@		x	X
subsp. *vaccinifolia*		X	x	
pubescens		X		
putterlickioides	X			
rubra		X	x	@
senegalensis		@	x	X
szyszylowiczii				
subsp. *namibiensis*		@	X	x
subsp. *szyszylowiczii*	@	X	x	
tenuifolia	@	X	x	@
tenuispina		X		
uniflora	X			
vanwykii	x	X		
Putterlickia				
pyracantha	x	X		@
retrospinosa	x	X		
saxatilis		@	X	x
verrucosa	x	X		@

* X = high peak time
x = lower peak time
@ = occasionally

TABLE 11. Diagnostic fruit characters (colour, size, number of valves) in spiny members of southern African Celastroideae (Figure 13)

Taxon	Fruit characters*											
	Colour (outside)			Colour (inside)			Size			Number of valves		
							mm					
	Brown white	Yellow pink, red	Dark purple	Green off-white	Yellow	Purple	<6	6-12	>12	2	3	4
Gloveria												
integrifolia		X		X			X				X	
Gymnosporia												
sect. Buxifoliae												
arenicola		X			X			X			X	
buxifolia	X				X		X				X	
devenishii		X			X		X				X	
elliptica	X				X		X				X	
glaucophylla		X			X			X			X	
grandifolia	X				X			X		X	x	x
hemipterocarpa		X			X		X				X	
heterophylla	X				X		X				X	
karooica		X			X		X				X	
macrocarpa	X				X				X		X	x
szyszylowiczii		X			X		X				X	
tenuifolia		X			X		X	x		X	x	
uniflora		X			X		X				X	
sect. Capitatae		X			X		X				X	
sect. Gymnosporia												
linearis	X			X			X			X		
markwardii			X	X			X			X		
senegalensis			X	X			X			X		
sect. Mossombicensis												
mossambicensis		X				X		X			X	
rubra		X		X				X			X	
vanwykii		X		X				X			X	
sect. Nemorosae		X		X			X				X	
sect. Polyacanthae		X		X			X				X	
sect. Pubescens		X		X				X			X	x
sect. Putterlickioides		X		X			X				X	
sect. Tenuispinae												
gariepensis		X		X				X			X	
oxycarpa	X			X					X		X	
tenuispina		X		X				X			X	
Putterlickia												
pyracantha		X		X					X		X	
retrospinosa		X		X					X		X	
saxatilis		X		X				X			X	
verrucosa		X		X					X		X	

* X = Strong tendency towards character state
x = Occasional occurrence of character state

TABLE 12. Diagnostic fruit characters (surface, pericarp, shape) in spiny members of southern African Celastroideae (Figures 9--12)

Taxon	Fruit characters*										
	Surface		Pericarp				Shape				
	Hairy/ smooth X	Rugose X pitted veined	Semi- fles- hy	Char- ta- ceous	Co- ria- ce- ous	Woody/ ridged	Glo- bose	Obco- nic- trigo- nous	Tri- que- ter	Py- ri- form	Co- nic pyr mid
Gloveria											
integrifolia	X			X				X			
Gymnosporia											
sect. **Buxifoliae**											
arenicola		**pitted**			X		X				
buxifolia		X			X		X				
devenishii	X					**ridged**					
elliptica		X			X		X				
glaucophylla	X				X		X				
grandifolia		X				**woody**	X				
hemipterocarpa	X					**ridged**			X		
heterophylla		X			X		X				
karooica	X				X		X				
macrocarpa		X				**woody**	X				
szyszylowiczii	X				X		X				
tenuifolia	X				X		X				
uniflora	X				X		X				
sect. **Capitatae**	X				X				X		
sect. **Gymnosporia**											
linearis	X			X			X				
markwardii	X			X			X				
senegalensis	X			X			X				
sect. **Mossambicensis**											
mossambicensis	X		X				X				
rubra	X		X					X			
vanwykii	X		X					X			
sect. **Nemorosae**	X			X						X	
sect. **Polyacanthae**	X			X					X		
sect. **Pubescens**	**hairy**				X		X				
sect. **Putterlickioides**	**hairy**			X				X			
sect. **Tenuispinae**											
gariepensis	X			X				X			
oxycarpa		**veined**				**woody**					X
tenuispina	X			X				X			
Putterlickia											
pyracantha	X		X					X			
retrospinosa	X		X					X			
saxatilis	X		X					X			
verrucosa	X		X					X			

* X = Strong tendency towards character state
x = Occasional occurrence of character state

TABLE 13. Diagnostic seed and aril characters in spiny members of southern African Celastroideae (Figure 15)

Taxon	Seed and aril characters									
	Seed colour			Aril colour				% Aril covers seed		
	Dark/ pale brown	Red-dish brown	Black	Rose pink	Oran-ge	Yel-low	White	Aril covers seed ± 100%	Aril covers seed ± 60%	Aril ba-sal rim
Gloveria										
integrifolia	dark			X				X		
Gymnosporia										
sect. **Buxifoliae**										
arenicola		X				X			X	
buxifolia		X				X			X	
devenishii		X				X			X	
elliptica		X				X			X	
glaucophylla		X					X		X	
grandifolia		X				X			X	
hemipterocarpa		X				X			X	
heterophylla		X				X			X	
karooica		X				X			X	
macrocarpa		X				X			X	
szyszylowiczii		X				X			X	
tenuifolia		X				X			X	
uniflora		X				X			X	
sect. **Capitatae**		X					X		X	
sect. Gymnosporia										
linearis		X					X		X	
markwardii		X					X		X	
senegalensis		X		X			x		X	
sect. Mossambicensis										
mossambicensis		X			X			X		
rubra	pale				X			X		
vanwykii	pale				X			X		
sect. Nemorosae			X				X		X	
sect. **Polyacanthae**			X			X			X	
sect. Pubescens		X				X			X	
sect. **Putterlickioides**		X			X			X		
sect. Tenuispinae										
gariepensis		X				X				X
oxycarpa		X				X				X
tenuispina		X				X				X
Putterlickia										
pyracantha		X			X			X		
retrospinosa		X			X			X		
saxatilis		X			X			X		
verrucosa		X			X			X		

TABLE 14. Principal diagnostic leaf anatomical characters of genera of spiny members of the southern African Celastroideae

Character	*Gloveria*	*Gymnosporia*	*Putterlickia*
Hairs	absent	absent or present	absent
Epidermal papillae	absent	absent	often present
Differentiation of mesophyll into palisade and spongy parenchyma	indistinct	distinct or indistinct	distinct
Leaves (stomata)	amphistomatic	hypo- or amphistomatic	hypostomatic
Position of stomata	sunken	raised or sunken	raised
Relative size of epidermal cells ad- and abaxially	similar	different or similar	different
Symmetry of the mesophyll	isobilateral	dorsiventral or isobilateral	dorsiventral
Collenchyma around vascular bundle	absent	nearly always present, both adaxially and abaxially	occasionally absent
Tanniferous cells	absent	usually present	absent
Oil droplets in mesophyll cells	usually present	absent	absent

TABLE 15. Principal diagnostic leaf anatomical characters of sections of *Gymnosporia*

Character state	Section								
	Pul.	Mos.	Nem.	Pub.	Pol.	Cap.	Ten.	Bux.	Gym.
Hairs uni- or multicellular	+	-	-	+	-	-	+-	-	-
Leaves dorsiventral	+	+	+	-	+	+	-	+	-
Leaves isobilateral	-	-	-	+	-	-	+	-	+
Distinct differentiation of mesophyll into palisade and spongy parenchyma	+	+	+	-	+	+	-	+	-
Leaves hypostomatic	+	+	+	-	-	-	-	-	-
Leaves amphistomatic	-	-	-	+	+	+	+	+	+
Size of epidermal cells differs ad- and abaxially	-	+	-	-	-	-	-	-	-
Epidermis uniseriate	+	+	+	+	+	+	+	+	-
Epidermis multiseriate	-	-	-	-	-	-	-	-	+
Hypodermis	-	-	-	-	-	+	-	+	-
Tanniferous cells	-	-+	-	-	-	+	+	-+	+
Crystal idioblast in epidermis	-	-	-	+	-	-	-	-	-

Pul. = *Putterlickioides* Pub. = *Pubescens* Ten. = *Tenuispinae*
Mos. = *Mossambicensis* Pol. = *Polyacanthae* Bux. = *Buxifoliae*
Nem. = *Nemorosae* Cap. = *Capitatae* Gym. = *Gymnosporia*

\+ = character state present or positive
\- = character state absent or negative

TABLE 16. Principal diagnostic leaf anatomical characters of *Putterlickia* species (Figures 25--27)

Taxon	Character state			
	Epidermal papillae	Cutinized epidermis	Collen-chyma	Spongy parenchyma
P. pyracantha	always absent	absent	present abaxially	somewhat dense
P. retrospinosa	always absent	present	absent	aeren-chymatous
P. saxatilis	always present	present	absent	dense
P. verrucosa	occasional-ly present abaxially	present	present abaxially	somewhat dense

TABLE 17. Principal diagnostic leaf anatomical characters of species of *Gymnosporia* section *Buxifoliae* (Figures 36--43)

Taxon	Character state					
	Hypo-dermis discon-tinuous	Hypo-dermis one layer	Hypo-dermis two layers	Hypo-dermis radially elongated	Tannins present	Stomata sunken
arenicola		X				
buxifolia	X				X	
devenishii		X				
elliptica	X				X	
glaucophylla	X				X	X
grandifolia		X		X		
hemipterocarpa	X					
heterophylla	X				X	
karooica	X					
macrocarpa	X					
szyszylowiczii	X					
tenuifolia		X				
uniflora	X				X	

TABLE 18. Number of species occurring per province or country

Province or **Country**	*Gloveria*	*Gymnosporia*	*Putterlickia*	Total
Botswana	-	4	-	4
Lesotho	-	1	-	1
Namibia	-	6	-	6
RSA				
Eastern Cape	-	14	3	17
Eastern Transvaal	-	10	1	11
Kwazulu/Natal	-	16	2	18
Northern Cape	1	6	1	8
Northern Transvaal	-	11	-	11
North-West Province	-	4	-	4
Orange Free State	-	3	-	3
PWV	-	4	-	4
Western Cape	1	3	1	5
Swaziland	-	9	1	10

TABLE 19. Taxa arranged according to province or country

	Kwazulu/Natal	Eastern Cape	Northern Cape	Western Cape
1.	*Gym. arenicola*	*Gym. buxifolia*	*Glov. integrifolia*	*Glov. integrifolia*
2.	*G. buxifolia*	*G. capitata*	*Gym. buxifolia*	*Gym. buxifola*
3.	*G. devenishii*	*G. devenishii*	*G. gariepensis*	*G. capitata*
4.	*G. glaucophylla*	*G. elliptica*	*G. karooica*	*G.szyszylowiczii*
5.	*G. grandifolia*	*G. grandifolia*	*G. linearis*	subsp. *szyszylowiczii*
6.	*G. hemipterocarpa*	*G. heterophylla*	subsp. *lanceolata*	*P. pyracantha*
7.	*G. heterophylla*	*G. linearis*	*G. szyszylowiczii*	
		subsp. *linearis*	subsp. *namibiensis*	
8.	*G. macrocarpa*	*G. mossambicensis*	*G. szyszylowiczii*	
9.	*G. markwardii*	*G. nemorosa*	subsp. *szyszylowiczii*	
10.	*G. mossambicensis*	*G. polyacantha*	*P. saxatilis*	
		subsp. *polyacantha*		
11.	*G. nemorosa*	*G. rubra*		
12.	*G. rubra*	*G. szyszylowiczii*		
		subsp. *szyszylowiczii*		
13.	*G. senegalensis*	*G. tenuifolia*		
14.	*G. tenuifolia*	*G. vanwykii*		
15.	*G. uniflora*	*P. pyracantha*		
16.	*G. vanwykii*	*P. retrospinosa*		
17.	*P. retrospinosa*	*P. verrucosa*		
18.	*P. verrucosa*			

	Eastern Transvaal	Northern Transvaal	Swaziland
1.	*Gymnosporia buxifolia*	*Gymnosporia buxifolia*	*Gymnosporia buxifolia*
2.	*G. glauca*	*G. grandifolia*	*G. glaucophylla*
3.	*G. grandifolia*	*G. heterophylla*	*G. grandifolia*
4.	*G. heterophylla*	*G. mossambicensis*	*G. hemipterocarpa*
5.	*G. mossambicensis*	*G. oxycarpa*	*G. heterophylla*
6.	*G. nemorosa*	*G. polyacantha*	*G. mossambicensis*
		subsp. *vaccinifolia*	
7.	*G. rubra*	*G. pubescens*	*G. nemorosa*
8.	*G. senegalensis*	*G. putterlickioides*	*G. senegalensis*
9.	*G. tenuifolia*	*G. senegalensis*	*G. tenuifolia*
10.	*G. tenuispina*	*G. tenuifolia*	*Putterlickia verrucosa*
11.	*Putterlickia verrucosa*	*G. tenuispina*	

	Namibia	Botswana	North-West/PWV	OFS
1.	*Gymn. buxifolia*	*G. buxifolia*	*G. buxifolia*	*G. buxifoliaa*
2.	*G. gariepensis*	*G. senegalensis*	*G. polyacantha*	*G. karooica*
3.	*G. linearis* subsp. *lanceolata*	*G. tenuifolia*	subsp. *vaccinifolia*	*G. tenuispina*
4.	*G. senegalensis*	*G. tenuispina*	*G. tenuifolia*	
5.	*G. szyszylowiczii* subsp. *namibiensis*	Lesotho	*G. tenuispina*	
6.	*G. tenuifolia*	*G. buxifolia*		

TABLE 20. Occurrence of spiny members of Celastroideae in the different biomes of southern Africa. The **Savanna Biome** comprises 46.16%, **Nama-Karoo Biome** 26.05%, **Grassland Biome** 16.52%, **Succulent-Karoo Biome** 5.35%, **Fynbos Biome** 3.36% and **Forest Biome** 0.01% of southern Africa (after Rutherford & Westfall 1994).

Taxon	Savanna	Nama-Karoo	Grassland	Succulent Karoo	Fynbos coastal	Forest
Gloveria						
integrifolia	X			X		
Gymnosporia						
sect. **Buxifoliae**						
arenicola						T
buxifolia	X	X	X	X	X	A/T
devenishii						A
elliptica					X	
glaucophylla	X					
grandifolia						T
hemipterocarpa	X					
heterophylla	X		X			
karooica		X				
macrocarpa	X					
szysylowiczii						
subsp. *namibiensis*		X				
subsp. *szyszylowiczii*	X	X				
tenuifolia	X					
uniflora			X			
sect. **Capitatae**	X					
sect. **Gymnosporia**						
G. linearis						
subsp. *lanceolata*		X		X		
subsp. *linearis*	X					
G. markwardii			X			
G. senegalensis	X	X				
sect. **Mossambicensis**						
G. mossambicensis						A/T
G. rubra						T
G. vanwykii			X			
sect. **Nemorosae**						T
sect. **Polyacanthae**	X					
sect. **Pubescens**	X					
sect. **Putterlickioides**	X					
sect. **Tenuispinae**						
G. gariepensis				X		
G. oxycarpa	X					
G. tenuispina	X		X			
Putterlickia						
pyracantha	X				X	
retrospinosa						T
saxatilis		X				
verrucosa						T

A = Afromontane forest **T** = Tropical coastal/inland forest

TABLE 21. Presumed primitive and advanced character states used for the provisional cladistic analysis. The character numbers correspond to those in the data matrix (Table 22)

	Primitive = 0	Advanced = 1	2
1.	Spines absent	Spines present	
2.	Leaves hypostomatic	Leaves amphistomatic	
3.	Size of epidermal cells differs ad- and abaxially	Size of epidermal cells the same ad- and abaxially	
4.	Leaves bilateral	Leaves isobilateral	
5.	Multiseriate epidermis absent	Multiseriate epidermis present	
6.	Papillae absent	Papillae present	
7.	Hypodermis absent	Hypodermis present	
8.	Flowers bisexual	Flowers unisexual	
9.	Ovary 3-locular	Ovary 2(3)-locular	
10.	Ovules many, 3--12 per locule	Ovules few, mainly 2 per locule	
11.	Ovules 6 or more per locule	Ovules <6 per locule	
12.	Aril wholly covering the seed	Aril partially covering the seed	Aril a rim at base of seed
13.	Capsules glabrous	Capsules hairy	

TABLE 22. Data matrix for species groups (12) with *Putterlickia* as the outgroup. Character states correspond to those in Table 21 and cladogram (Figure 49)

Species group (number of species in brackets)	Characters states												
Putterlickia													
Putterlickia (3)	1	0	0	0	0	0	0	0	0	0	0	0	0
P. saxatilis (1)	1	0	0	0	0	1	0	0	0	0	1	0	0
Gloveria (1)	1	1	1	1	1	0	0	0	0	0	1	0	0
Gymnosporia													
G. sect. *Putterlickioides* (1)	1	0	0	0	0	0	0	0	0	1	1	0	1
G. sect. *Mossambicensis* (3)	1	0	0	0	0	0	0	1	0	1	1	0	0
G. sect. *Nemorosae* (1)	1	0	0	0	0	0	0	1	0	1	1	1	0
G. sect. *Pubescens* (1)	1	1	1	1	0	0	0	1	0	1	1	1	1
G. sect. *Polyacanthae* (2)	1	0	1	0	0	0	0	1	0	1	1	1	0
G. sect. *Buxifoliae* (15)	1	1	1	0	0	0	1	1	0	1	1	1	0
G. sect. *Capitatae* (1)	1	0	1	0	0	0	1	1	0	1	1	1	0
G. sect. *Tenuispinae* (3)	1	1	1	1	0	0	0	1	0	1	1	2	0
G. sect. *Gymnosporia* (4)	1	1	1	1	1	0	0	1	1	1	1	1	0

TABLE 23. Summary of morphological similarities and differences between four genera of southern African Celastroideae

Character	*Putterlickia*	*Gloveria*	*Gymnosporia*	*Maytenus s. str.*
Geographical distribution	eastern parts of southern Africa	Little Karoo and Nama-qualand	Africa, Madagascar S. Europe, India Malaysia, Sri Lanka NE Australia	eastern parts of Africa, Madagascar, S. America, Australia
Habit	shrubs or climbers	shrubs	shrubs, suffrutices or small trees	shrubs, small to medium-sized trees
Brachyblasts & spines	present	present	usually present	absent
Number of leaf and/or inflorescence nodes on spines	only one node	always more than one node	usually only one node, occasionally more (sect. *Tenuispinae* and *G. putterlickioides*)	—
Leaf margins	mostly entire, or with few teeth in distal half	always entire	entire or with teeth in distal or both halves	entire or with teeth
Lamina surface	always glabrous	always glabrous	glabrous or puberulous	always glabrous
Leaf venation	brochidodro-mous	obsolete	cladodromous	cladodromous
Inflorescence	dichasium	dichasium	monochasium or dichasium	axillary, race-mose, fasciculate or solitary
Sexuality of flowers	bisexual	bisexual	mainly unisexual (exc. *G. putterlickioides*)	bisexual
Flowers	pentamerous	pentamerous	pentamerous	pentamerous (except *M. abbottii*)
Flower colour	cream	cream, tinged red	cream, white, yel-low, greenish, red	cream, white, red, yellow, green
Margins of petals	ciliate	entire or ciliolate	entire or ciliolate	ciliate or entire
Ovary	3-locular	3-locular	(2)3(4)-locular	2--4-locular
Locule	(3--)6(--12)-ovulate	3--6-ovulate	mainly 2-ovulate (exc. *G. putterlickioides*)	2-ovulate
Capsule surface	smooth and glabrous	smooth and glabrous	smooth, glabrous, rugose, pitted, veined or puberulous	smooth and glabrous
Pericarp	semi-fleshy	chartaceous	semifleshy, charta-ceous, coriaceous, woody or ridged	chartaceous or coriaceous
Aril colour	orange	pinkish	orange, pinkish, yellow or white	orange, yellow or white
Percentage of seed covered by aril	100%	100%	100%, 60%, 30% or only a rim at the base	100% or almost
Aril surface	always glabrous	always glabrous	always glabrous (southern Africa)	glabrous or occa-sionally hairy (*M. abbottii*)
Seed-coat	without post-chalazal vas-cular bundle	without post-chalazal vas-cular bundle	without postchalazal vascular bundle	occasionally with postchalazal vascular bundle (*M. abbottii*)

■ FIGURES ■

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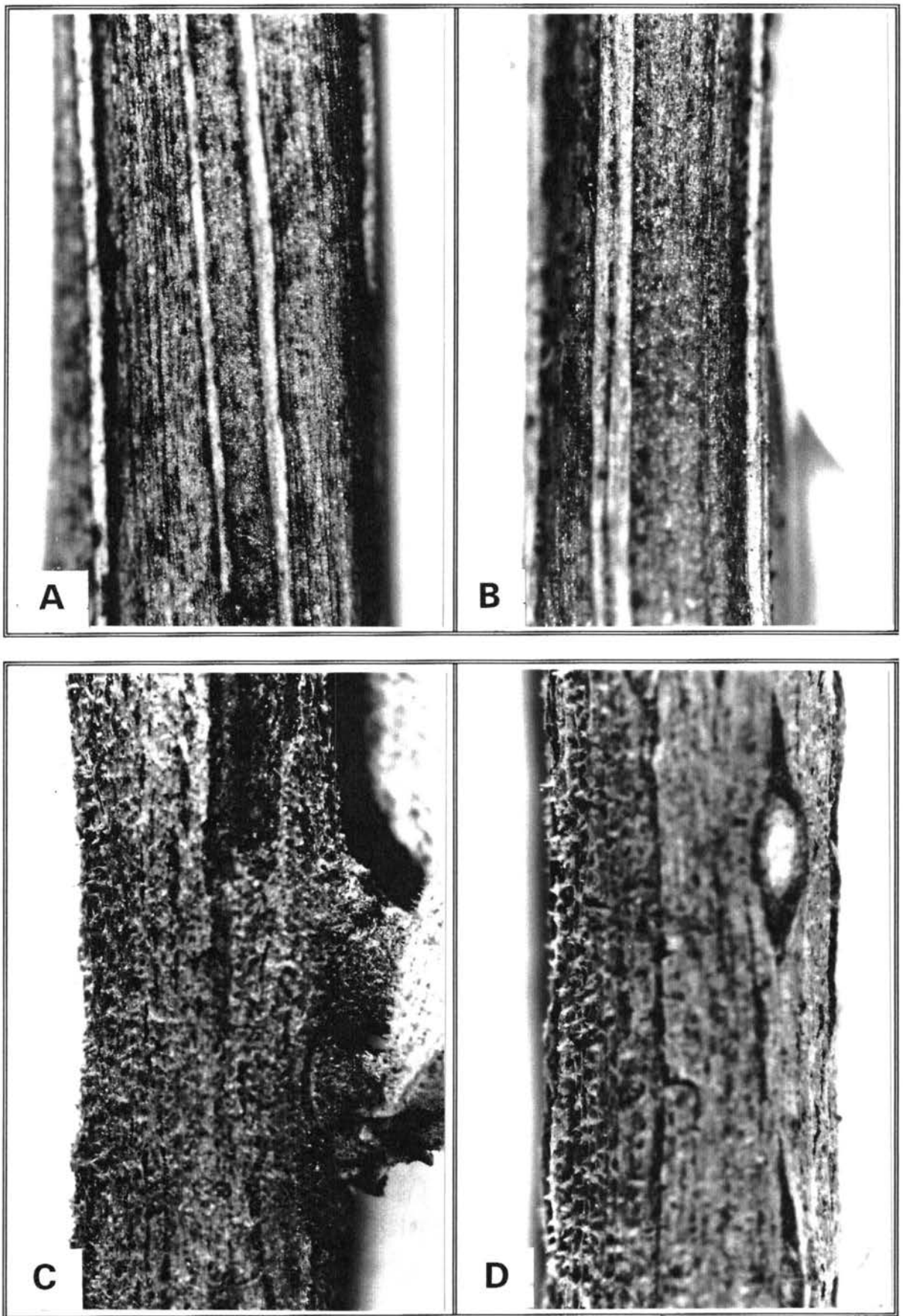


FIGURE 1.—Branches. **A**, *Gymnosporia heterophylla*: angular ribbed; **B**, *G. uniflora*: angular ribbed; **C**, *pubescens*: pubescent; **D**, *G. polyacantha* subsp. *vaccinifolia*: muricate. Magnification A = x20; B = x16; C, D = x12.5.

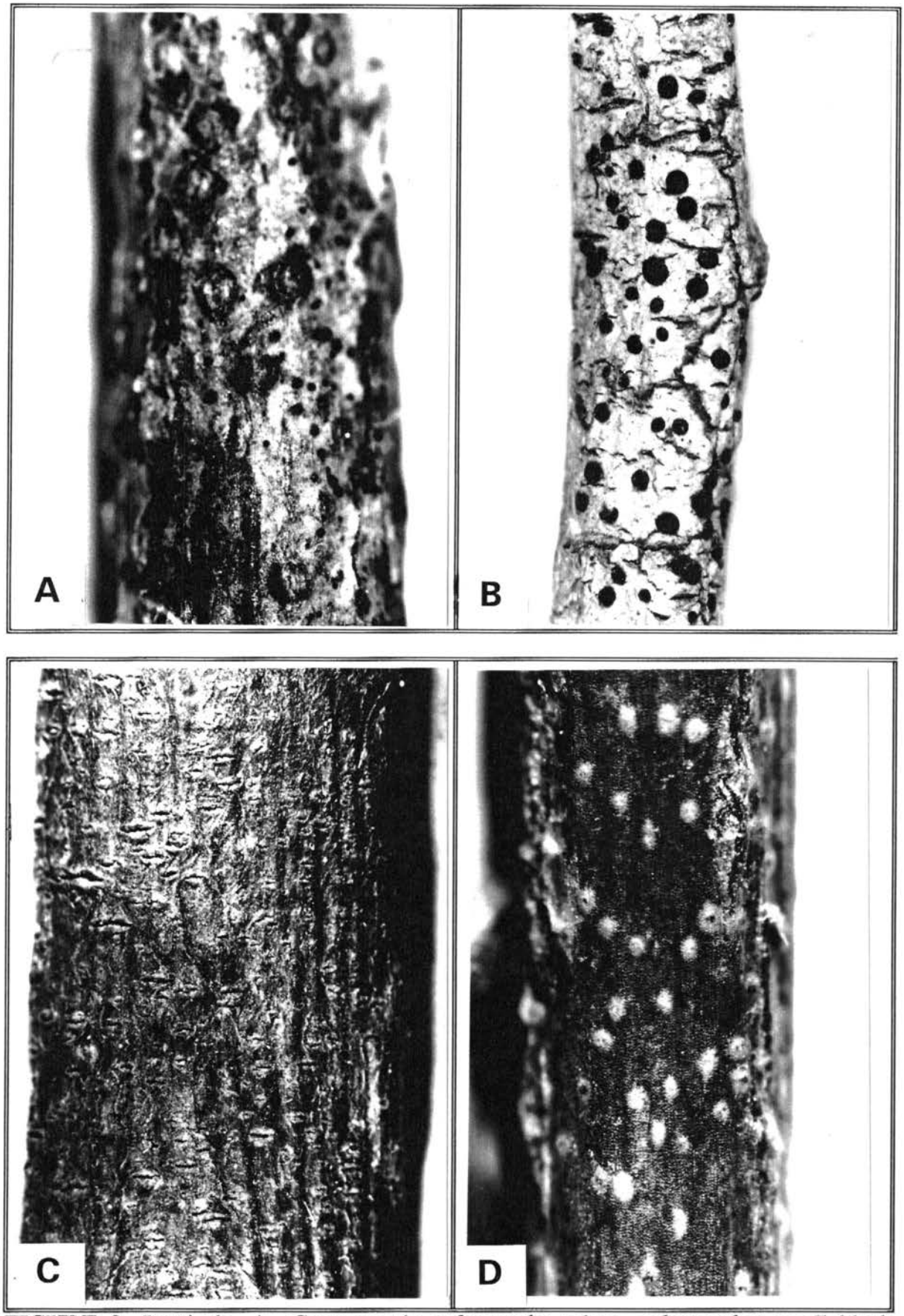


FIGURE 2—Lenticels. **A**, *Gymnosporia polyacantha* subsp. *polyacantha*: small black dots; **B**, *G. elliptica*: large black dots; **C**, *G. macrocarpa*: transverse splits; **D**, *G. nemorosa*: yellow dots (blister-like). Magnification A = x16; B = x10; C = x6.3; D = x20.

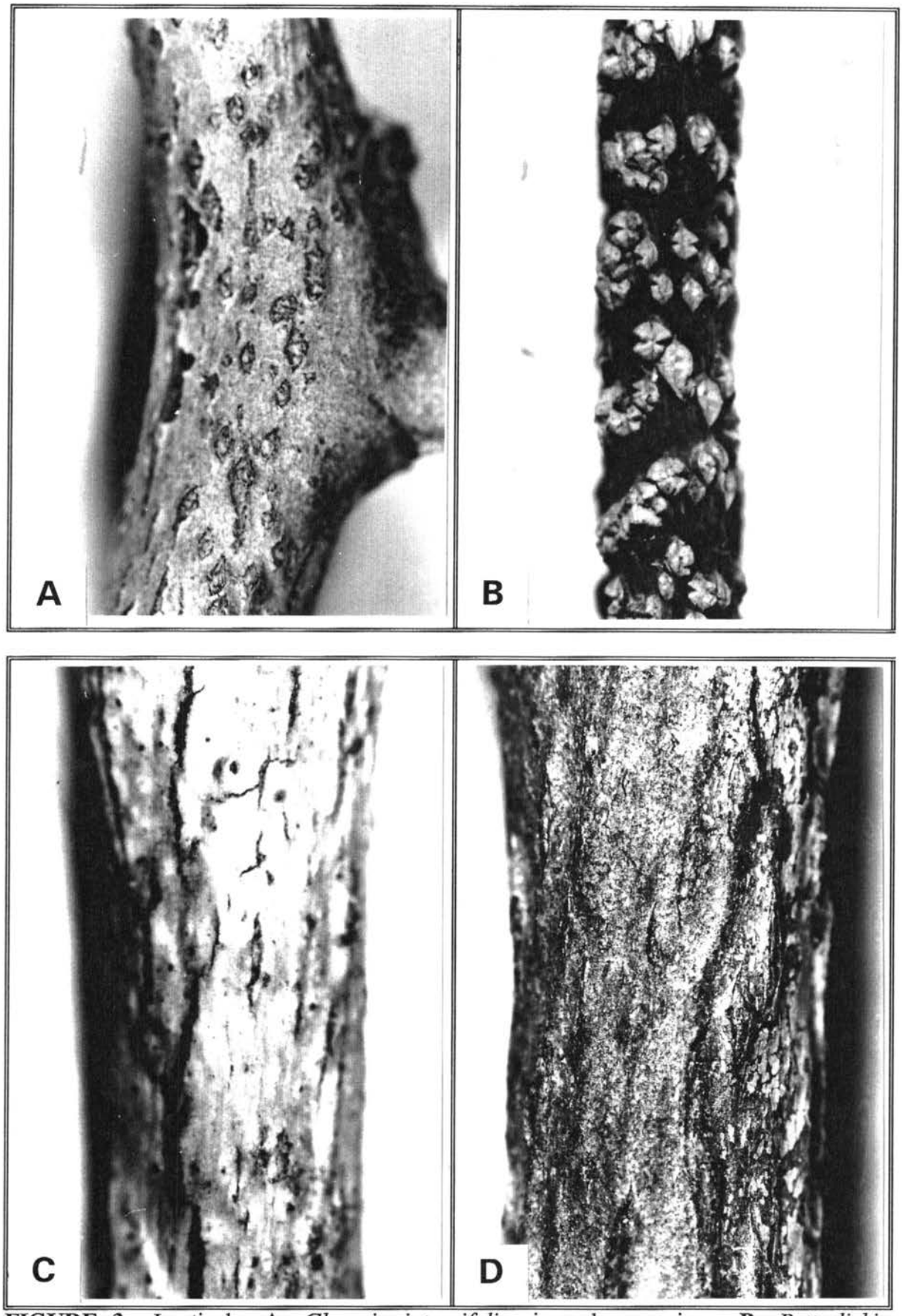


FIGURE 3.—Lenticels. **A**, *Gloveria integrifolia*: irregular openings; **B**, *Putterlickia verrucosa*: verrucose; **C**, *P. pyracantha*: black dots; **D**, *P. saxatilis*: obscure. Magnification A = x10; B = x11.3; C = x12.5; D = x16.

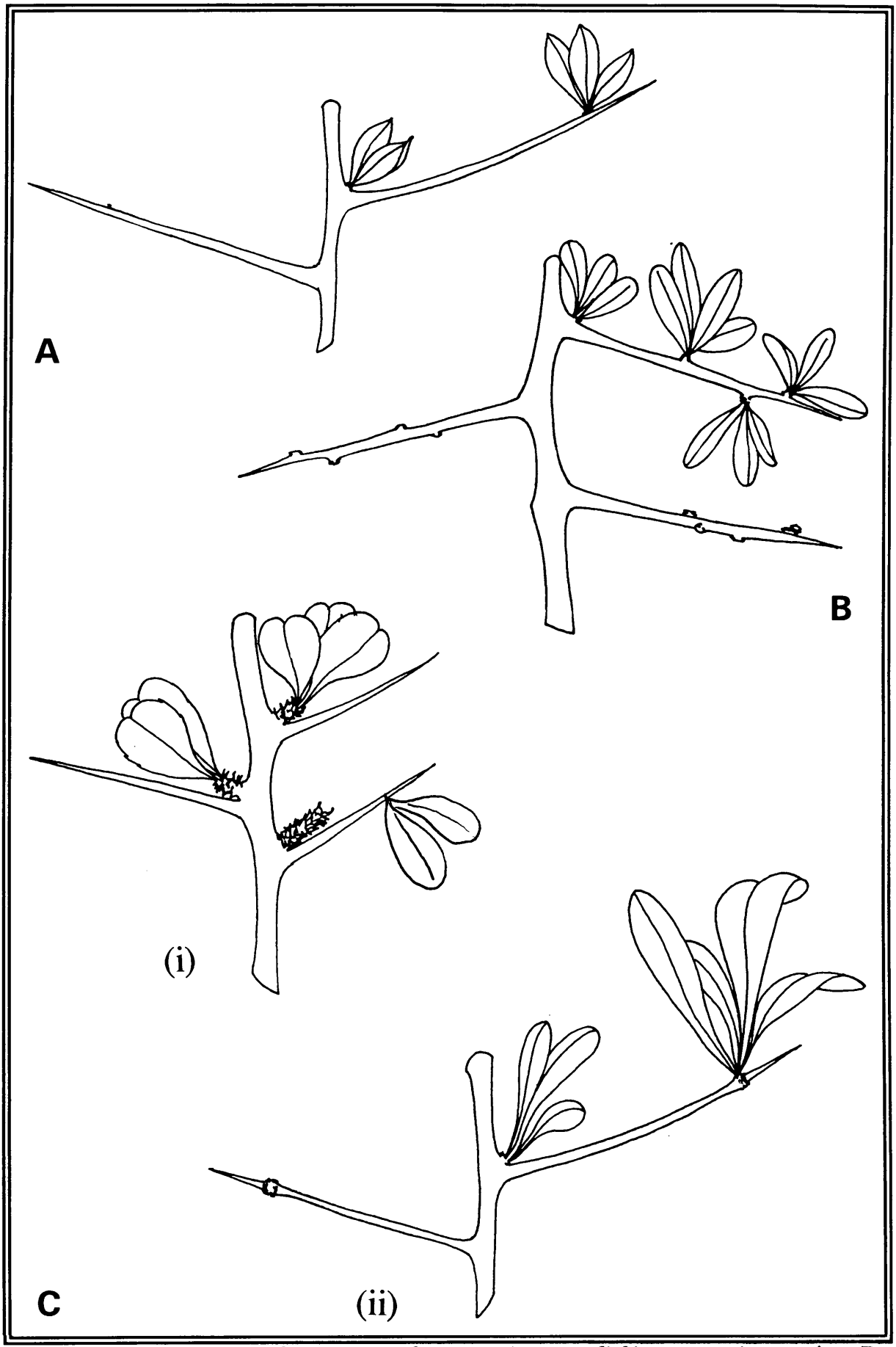


FIGURE 4.—Spine and leaf characters of genera. **A**, *Putterlickia*: one node on spine; **B**, *Gloveria*: more than one node on spine; **C**, *Gymnosporia*: (i) leaves mainly on brachyblasts or only one node on spine; (ii) spine terminates brachyblasts.

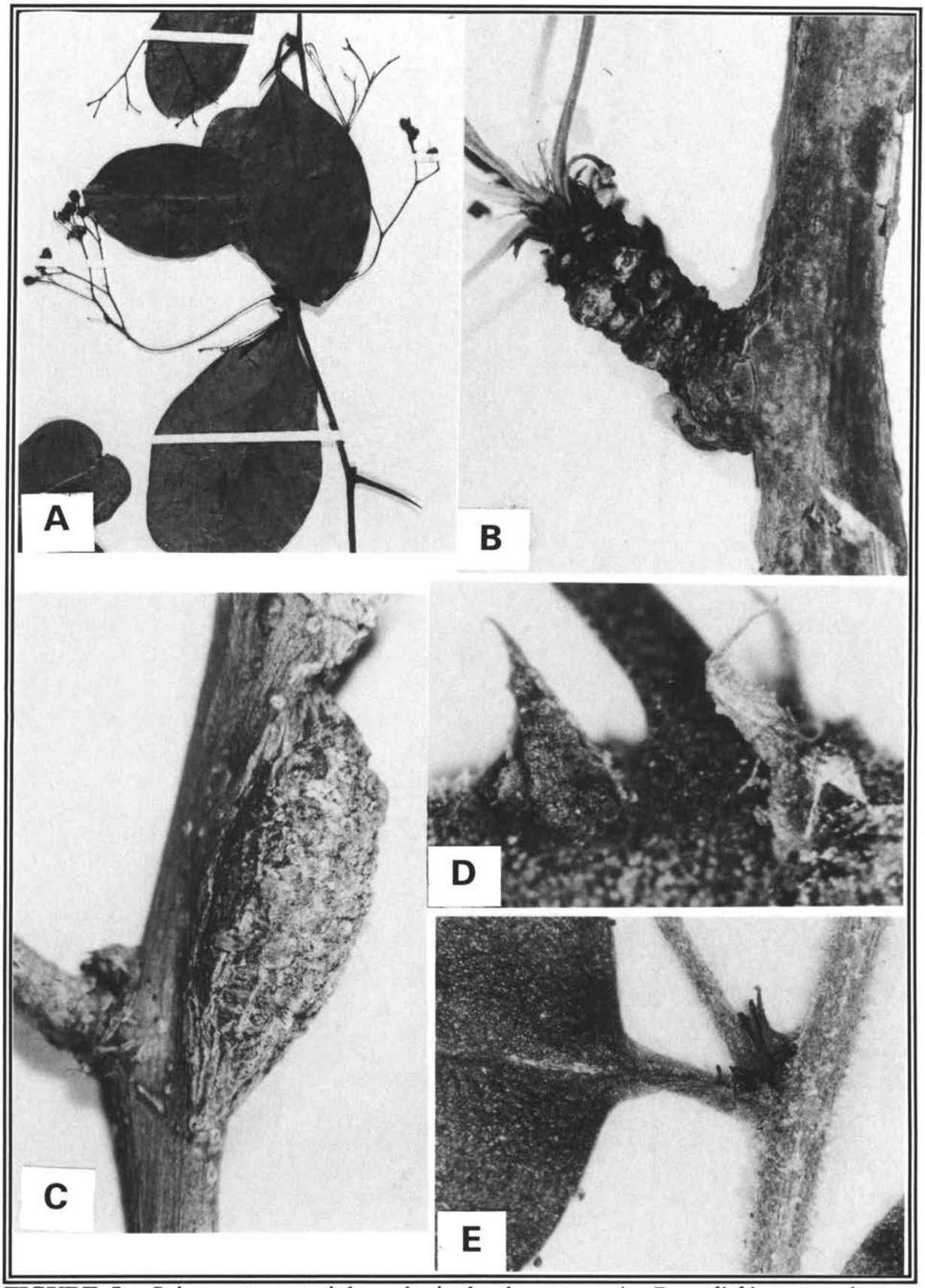
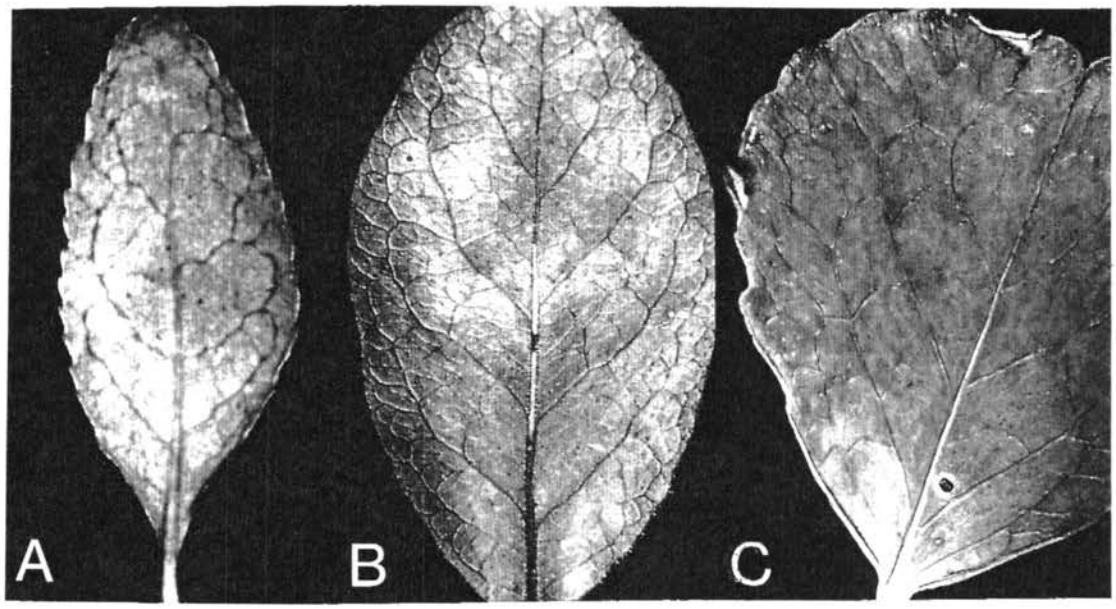


FIGURE 5.—Spine, stem, petiole and stipule characters. **A**, *Putterlickia retrospinosa*: spines backward pointing; **B**, *Gymnosporia macrocarpa*: brachyblast well develope; **C**, *G. buxifolia*: gall on stem; **D**, *G. polyacantha* subsp. *vaccinifolia*: stem muricate, stipules typical; **E**, *G. rubra*: stem hairy, stipules typical and petiole cannelled. Magnification A = x0.5; B = x4; C = x6.3; D = x25; E = x20.



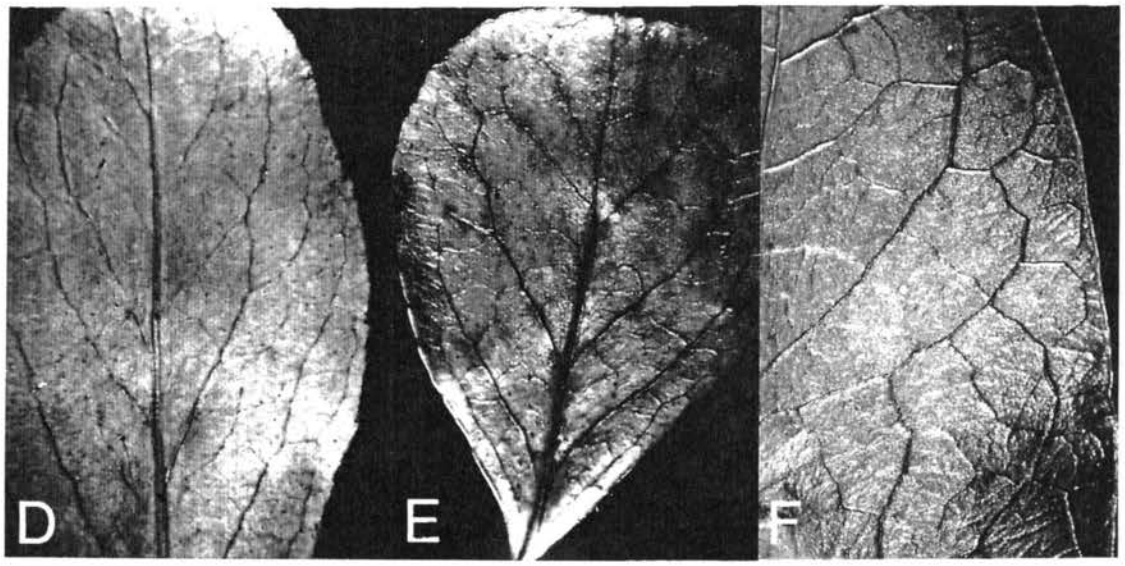


FIGURE 6.—Leaf venation: brochidodromous. **A**, *Gymnosporia devenishii*; **B**, *G. putterlickioides*; **C**, *G. arenicola*, note the indurate margin; **D**, *G. senegalensis*; **E**, *G. nemorosa*; **F**, *Putterlickia retrospinosa*. Magnification A = x6. B—F = x±1.

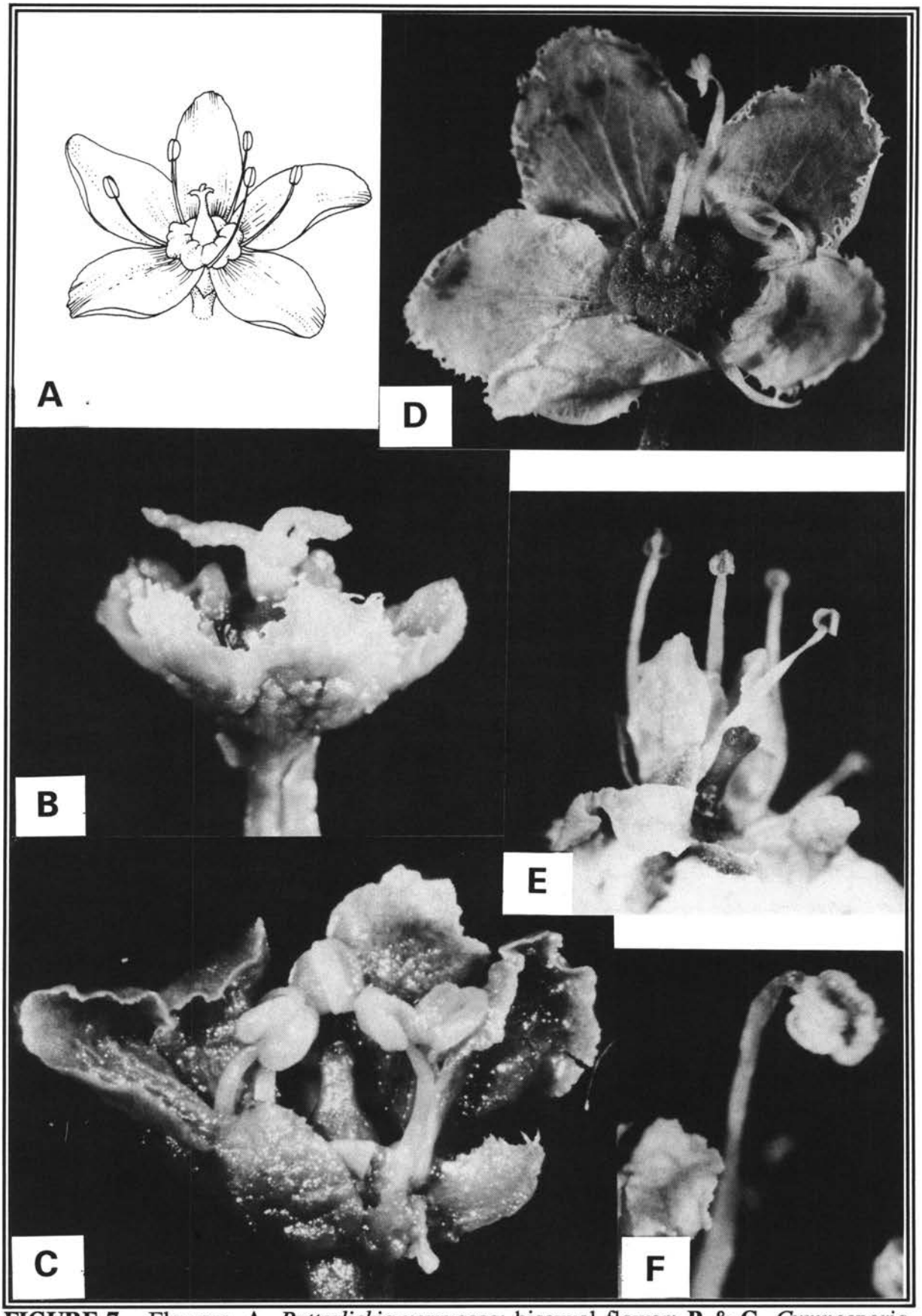


FIGURE 7.—Flowers. **A**, *Putterlickia verrucosa*: bisexual flower; **B** & **C**, *Gymnosporia glaucophylla*: unisexual flowers; **B**, female flower; **C**, male flower; **D**, *G. putterlickioides*: bisexual flower; **E** & **F**, *G. vanwykii*: male flowers with stamens much longer than petals. Magnification A = x8; B = x16; C = x20; D = x8; E = x12.5; F = x32.

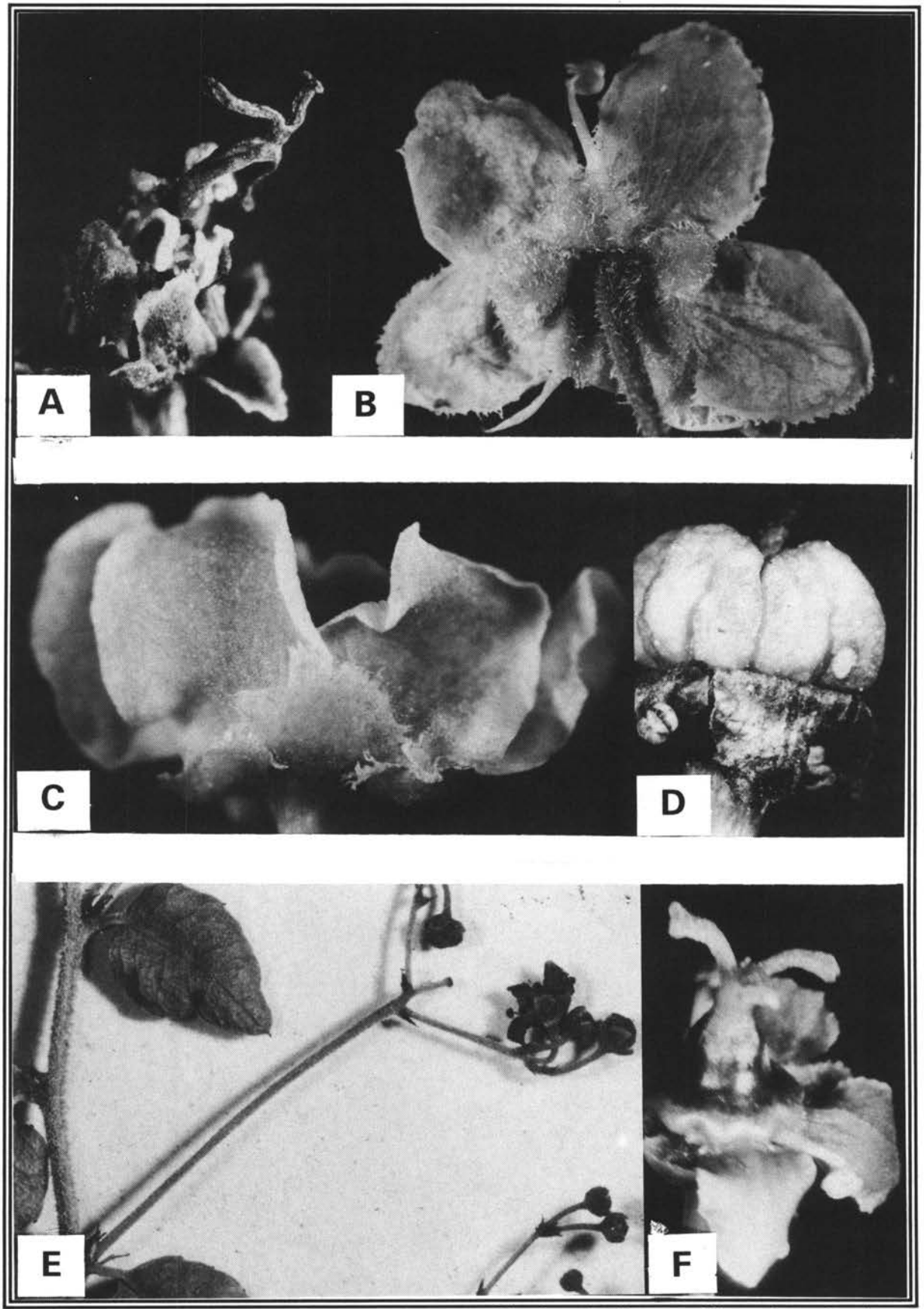


FIGURE 8.—Flowers. **A**, *Gymnosporia vanwykii*: female flower with style and stigma much longer than petals; **B**, *G. putterlickioides*: sepals subcircular, rounded, pubescent outside; **C**, *G. szyszylowiczii* subsp. *namibiensis*: sepals triangular; **D**, *G. devenishii*: ovary ridged; **E**, *G. rubra*: inflorescence with long peduncle; **F**, *G. nemorosa*: female flower with ovary smooth and disc concave. Magnification A, C = x20; B = x8; D = x12.5; E = x6.3; F = x20.

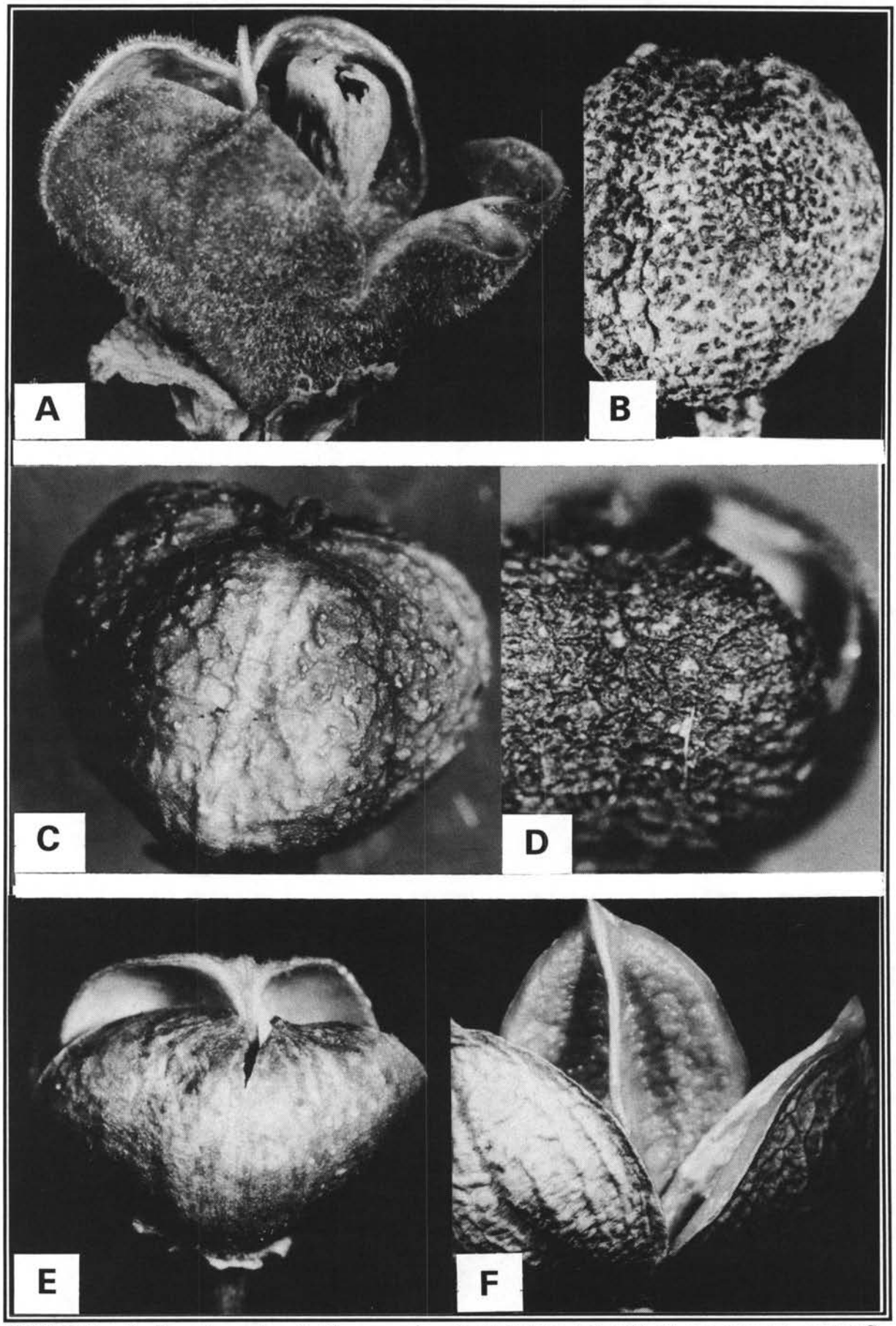


FIGURE 9.—Surface of capsules. **A**, *Gymnosporia putterlickioides*: hairy; **B**, *G. macrocarpa*: rugose; **C**, *G. arenicola*: pitted; **D**, *G. elliptica*: rugose; **E**, *G. karooica*: smooth; **F**, *G. oxycarpa*: veined. Magnification A, C = x8; B, F = x0.5; D = x16; E = x10.

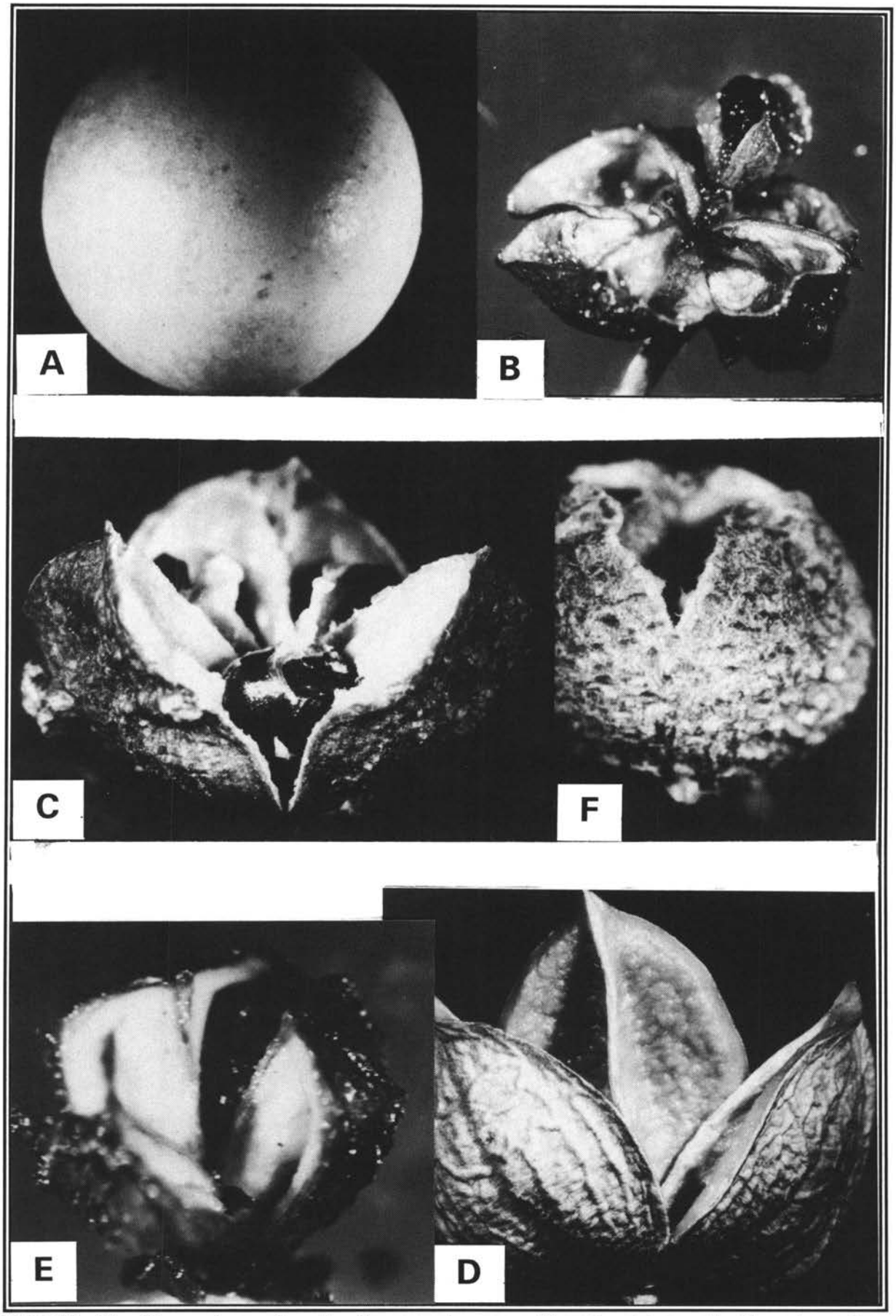


FIGURE 10.—Shape of capsules. **A**, *Gymnosporia mossambicensis*: globose; **B**, *G. polyacantha*: triquetrous with sharp angles and round apices; **C**, *G. capitata*; triquetrous with acute apices; **D**, *G. buxifolia*: globose; **E**, *G. hemipterocarpa*: triquetrous with sharp angles (semi-ridged); **F**, *G. oxycarpa*: conic-pyramidal with acute apices. Magnification A = x16; B, E = x10; C, D = x12.5; F = x0.5.

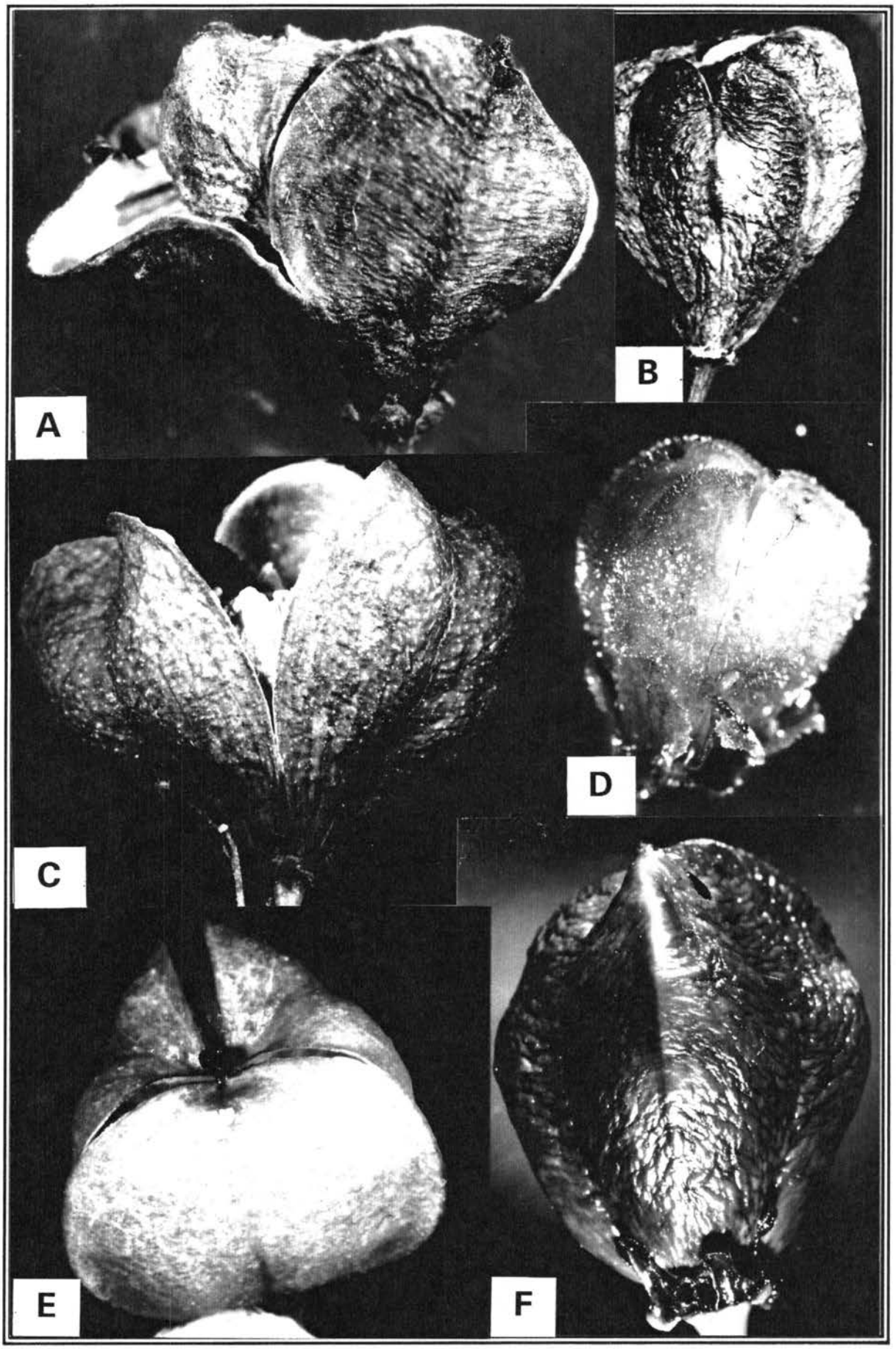


FIGURE 11.—Shape of capsules. **A**, *Gymnosporia nemorosa*: pyriform; **B—F**, obconic-trigonous with round angles; **B**, *Putterlickia retrospinosa*; **C**, *Gymnosporia rubra*; **D**, *G. putterlickioides*; **E**, *G. tenuispina*; **F**, *Putterlickia verrucosa*. Magnification A = x10; B, F = x0.5; C = x6.3; D, E = x8.

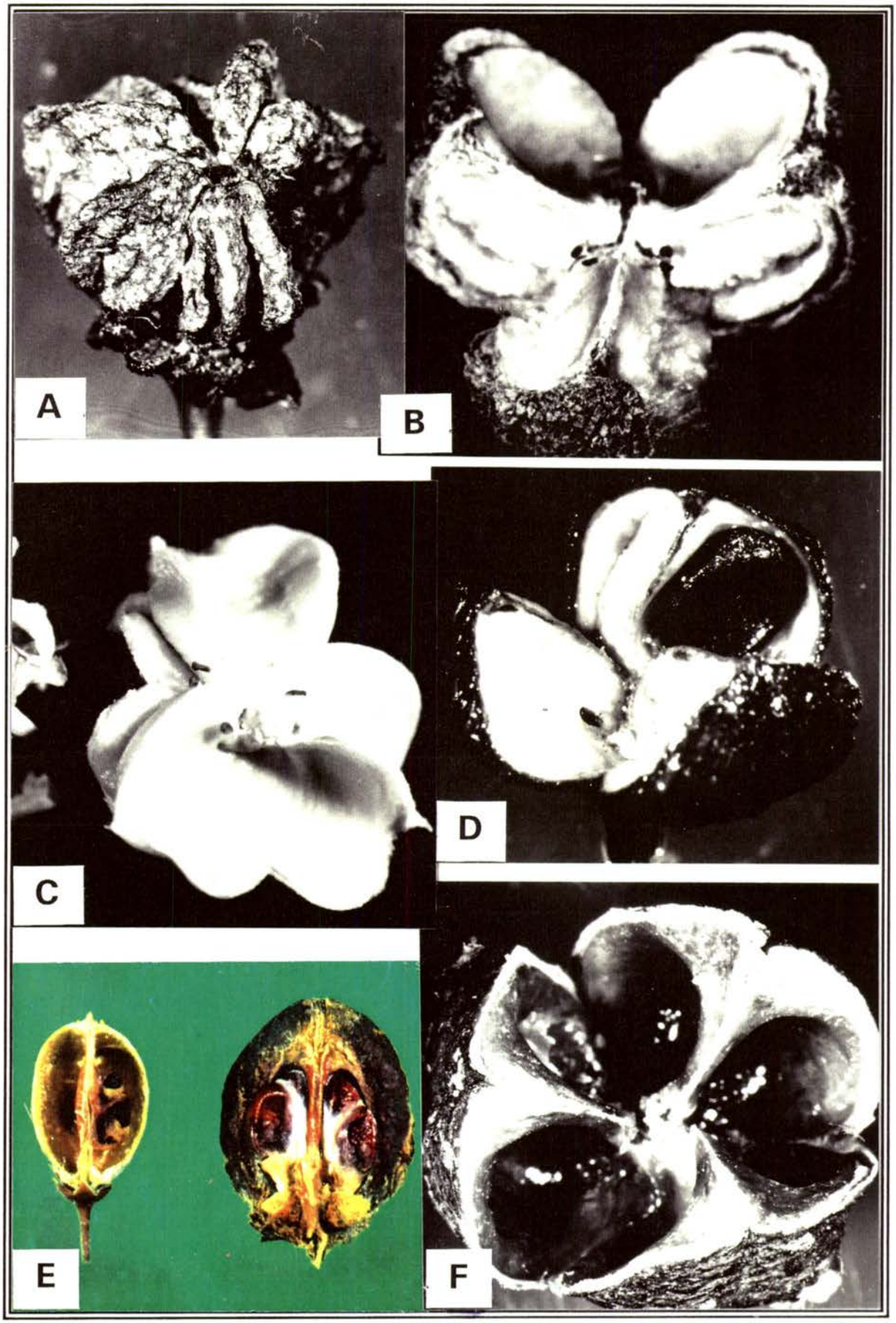


FIGURE 12.—Pericarp of capsules. **A**, *Gymnosporia devenishii*: ridged; **B**, *G. grandifolia*: woody; **C**, *G. szyszylowiczii*: coriaceous; **D**, *G. hemipterocarpa*: coriaceous, semi-ridged; **E**, *Gloveria integrifolia*: chartaceous (left), *Gymnosporia macrocarpa*: woody (right); **F**, *G. mossambicensis*: semi-fleshy. Magnification A, C, D = x8; B, F = x6.3; E = x0.5.

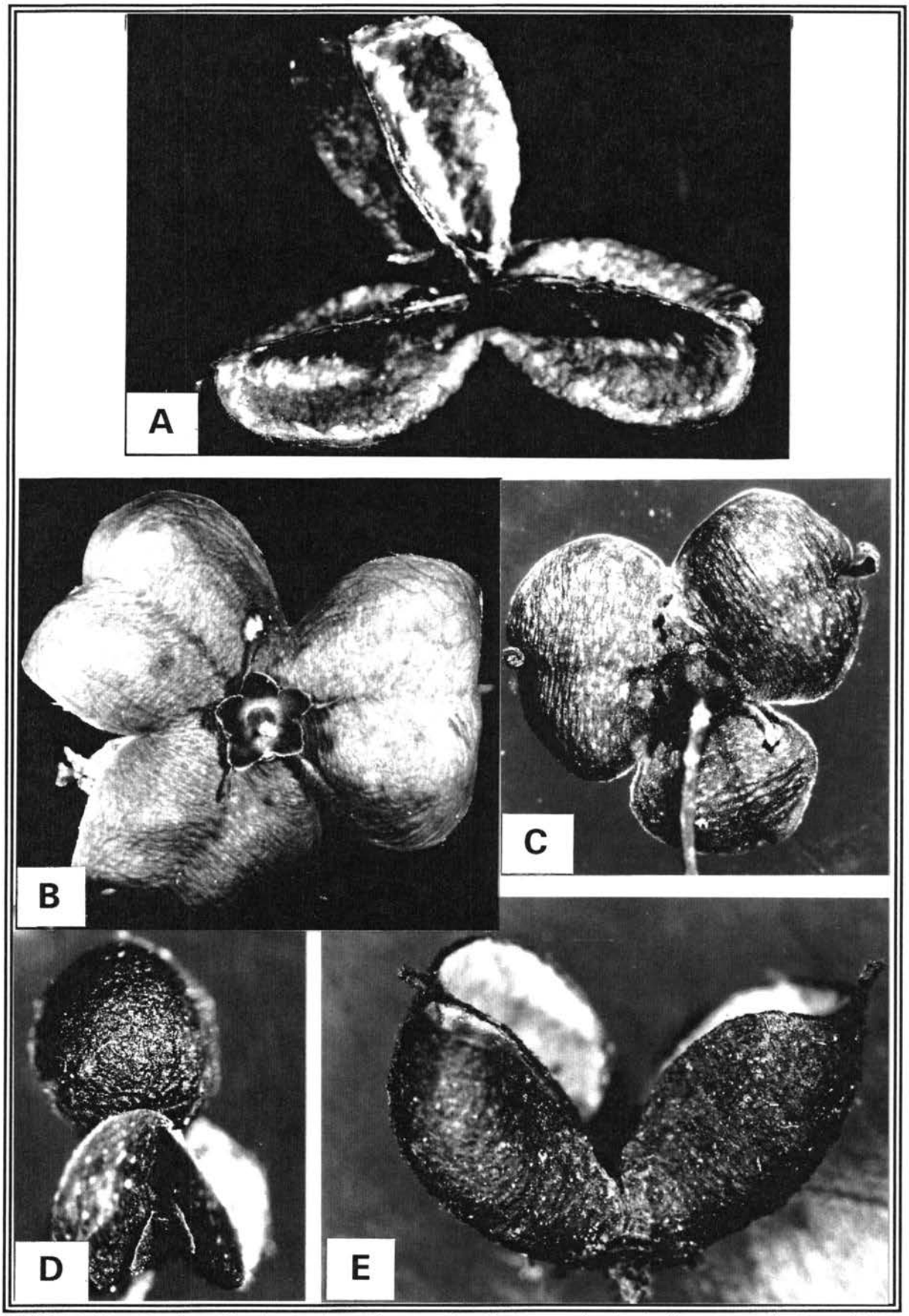


FIGURE 13.—Number of valves and persistence of style on capsules in fruiting stage. **A**, *Putterlickia verrucosa*: trilocular, style nonpersistent; **B**, *Gloveria integrifolia*: trilocular, style persistent, not curled; **C**, *Gymnosporia polyacantha* subsp. *vaccinifolia*: trilocular, style persistent, curled; **D**, *G. senegalensis*: bilocular, style persistent; **E**, *G. markwardii*: bilocular, style persistent, not curled. Magnification A = x0.5; B = x5; C, E = x10; D = x12.5.

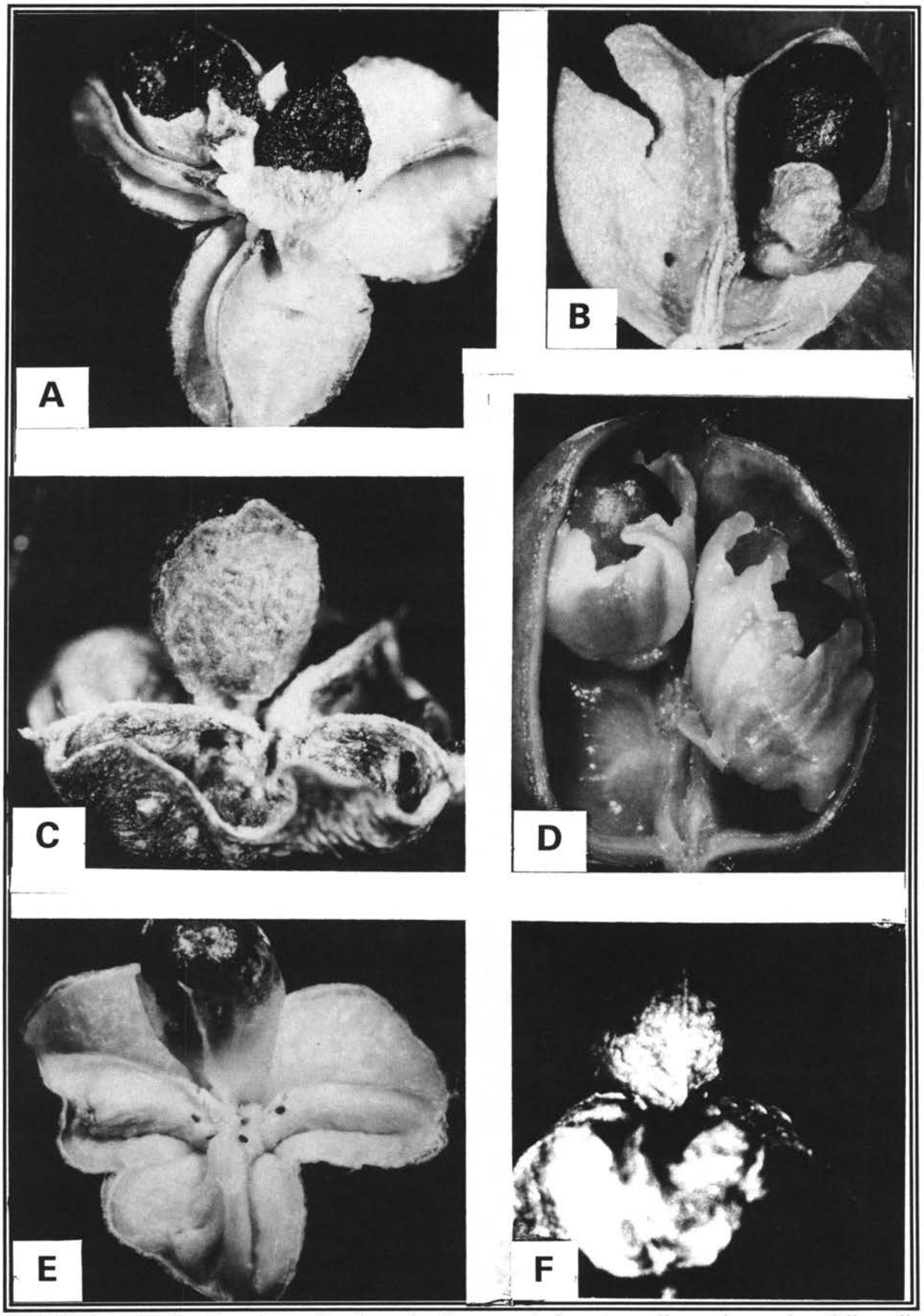


FIGURE 14.—Seed, arils and capsule valves. **A**, *Gymnosporia karooica*: aril covering seed partially, aril smooth, valves spreading; **B**, *Gymnosporia tenuispina*: aril reduced to a rim at base; **C**, *G. polyacantha*: aril covering seed incompletely, aril rough, valves spreading; **D**, *Putterlickia saxatilis*: aril covering seed almost completely, aril smooth; **E**, *Gymnosporia glaucophylla*: aril covering seed partially, aril almost transparent, valves spreading; **F**, *G. mossambicensis*: aril covering seed completely, loculicidally dehiscent to the base, valves reflexed. Magnification A, F = x8; B, D, E = x6.3; C = x12.5.

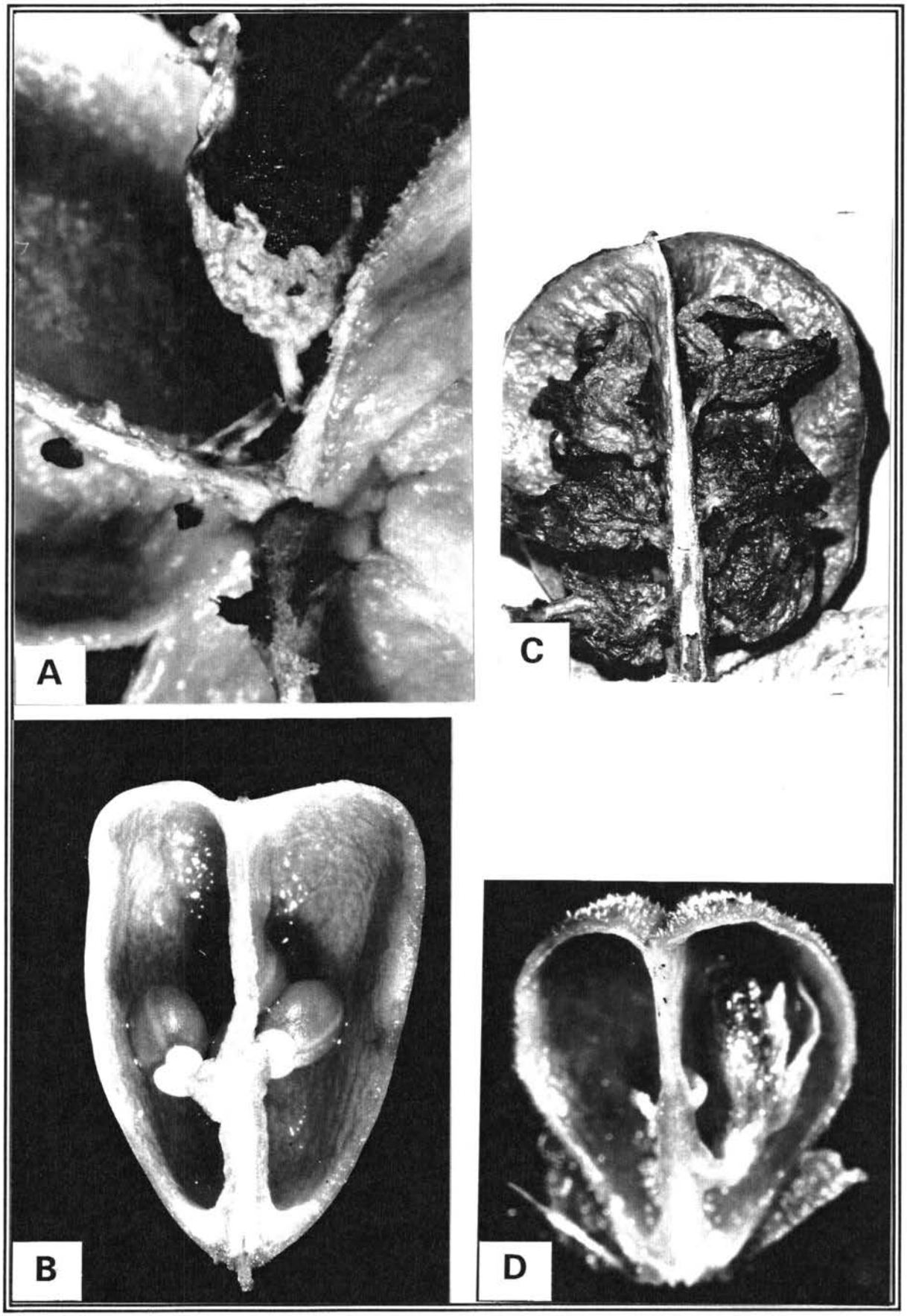
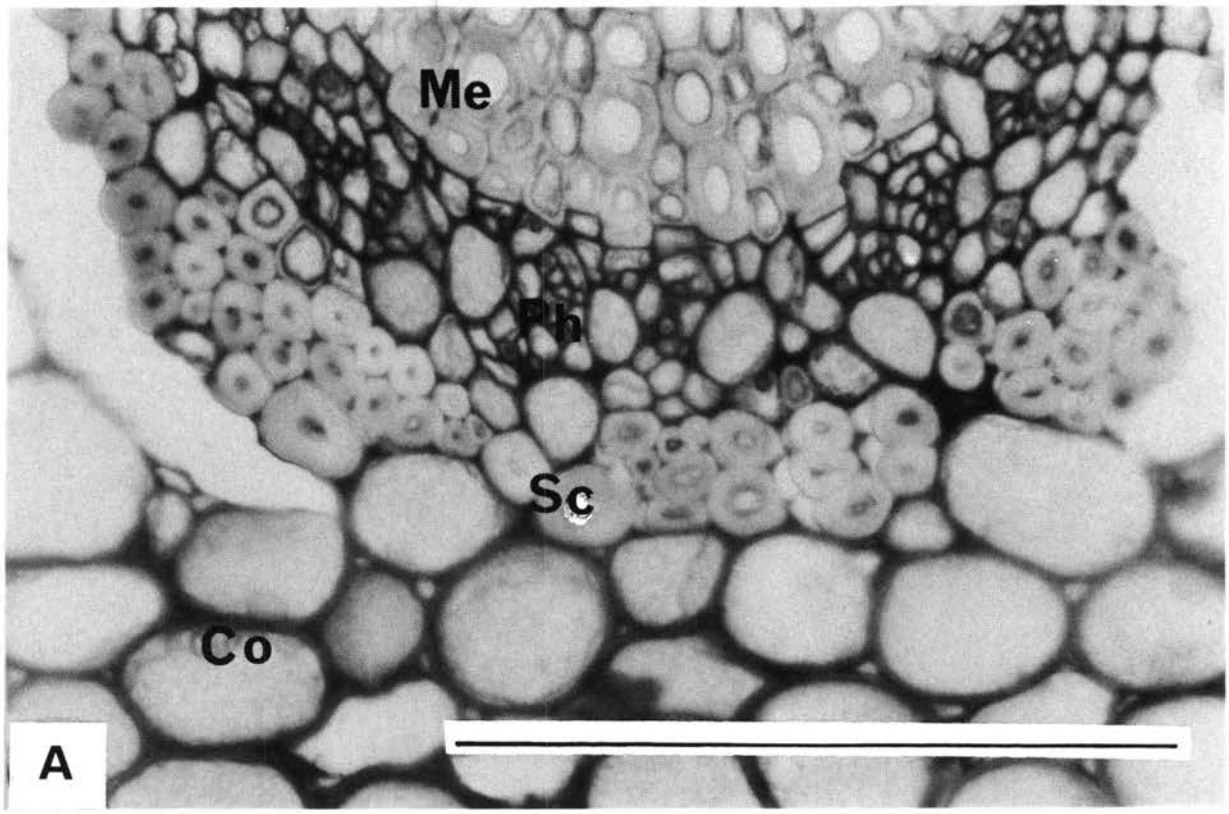


FIGURE 15.—Seed, aril and number of ovules per locule. **A**, *Gloveria integrifolia*: aril covering seed completely on one side and incompletely on other side, four ovules per locule; **B**, *Gymnosporia tenuispina*: aril reduced to a rim at the base, two ovules per locule; **C**, *Putterlickia verrucosa*: aril covering seed completely, six ovules per locule; **D**, *Gymnosporia putterlickioides*: aril covering seed completely, occasionally three ovules per locule. Magnification A = x2; B = x6.3; C = x0.5; D = x10.



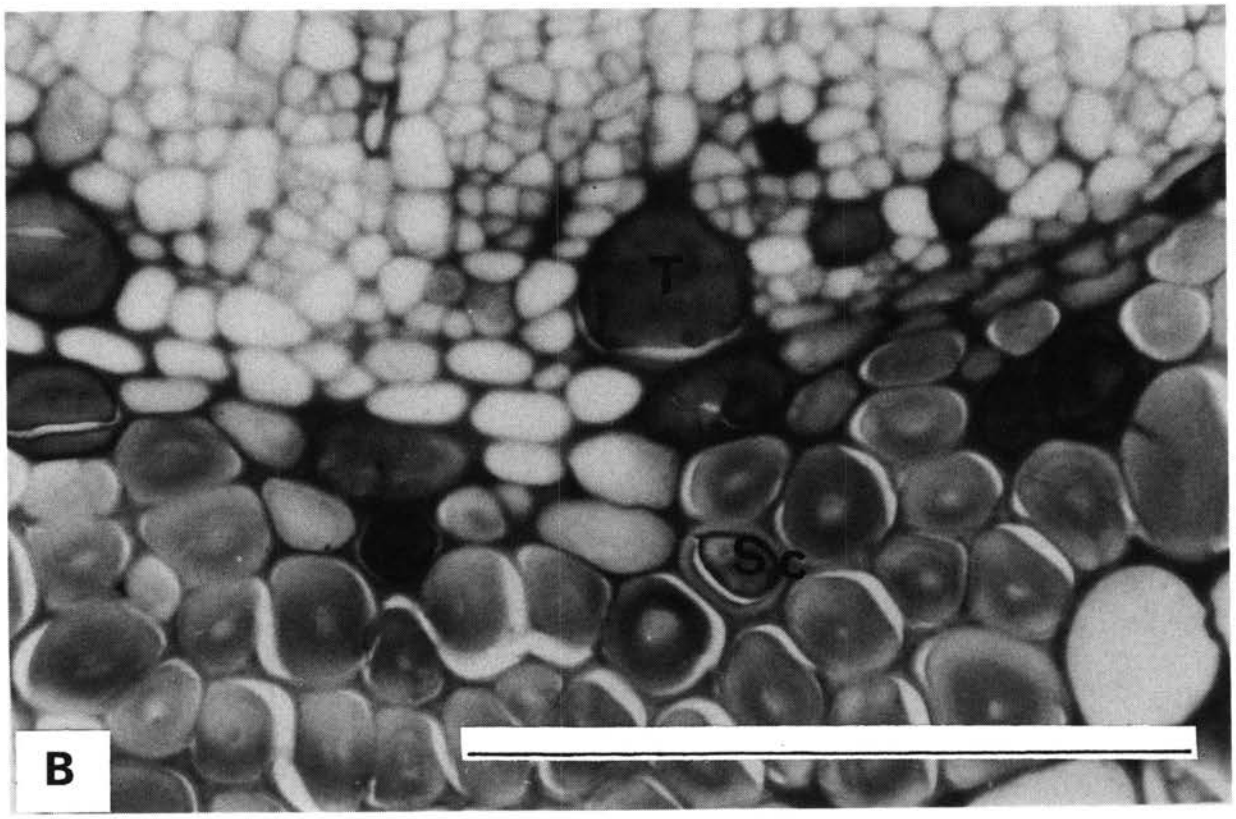


FIGURE 16.—Typical midrib. **A**, *Gymnosporia mossambicensis* (*Jordaan 2674*): **Me** = metaxylem; **Ph** = phloem; **Sc** = sclerenchyma; **Co** = collenchyma. **B**, *G. elliptica* (*Jordaan 2292*): **T** = tanniferous cells in phloem; **Sc** = sclerenchyma. Scale bar: 10 μm.

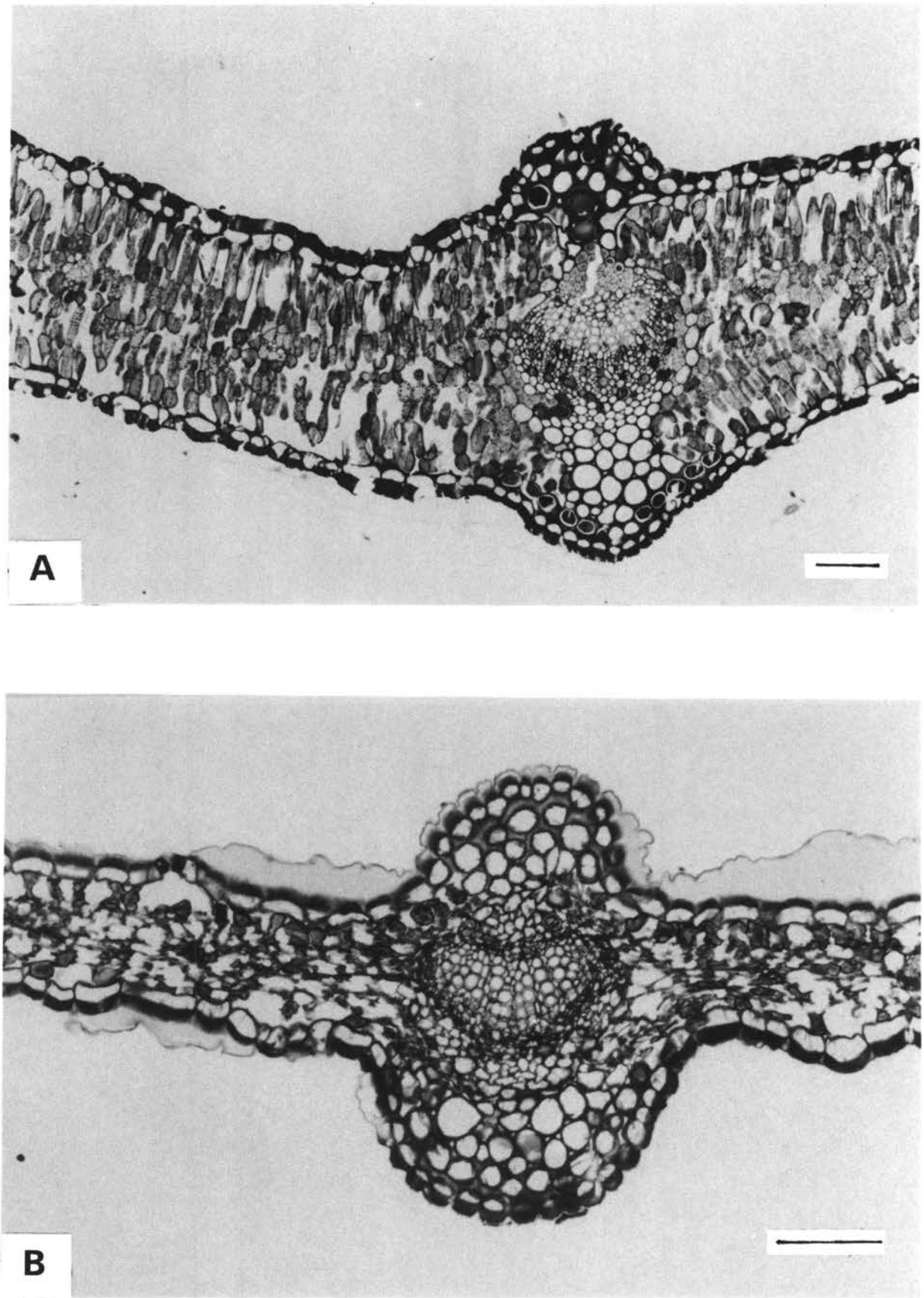


FIGURE 17.—Annular collenchyma of *Gymnosporia tenuispina*. **A**, (*Germishuizen 993*); **B**, (*Burgoyne 1583*). Scale bar: 10 μm.

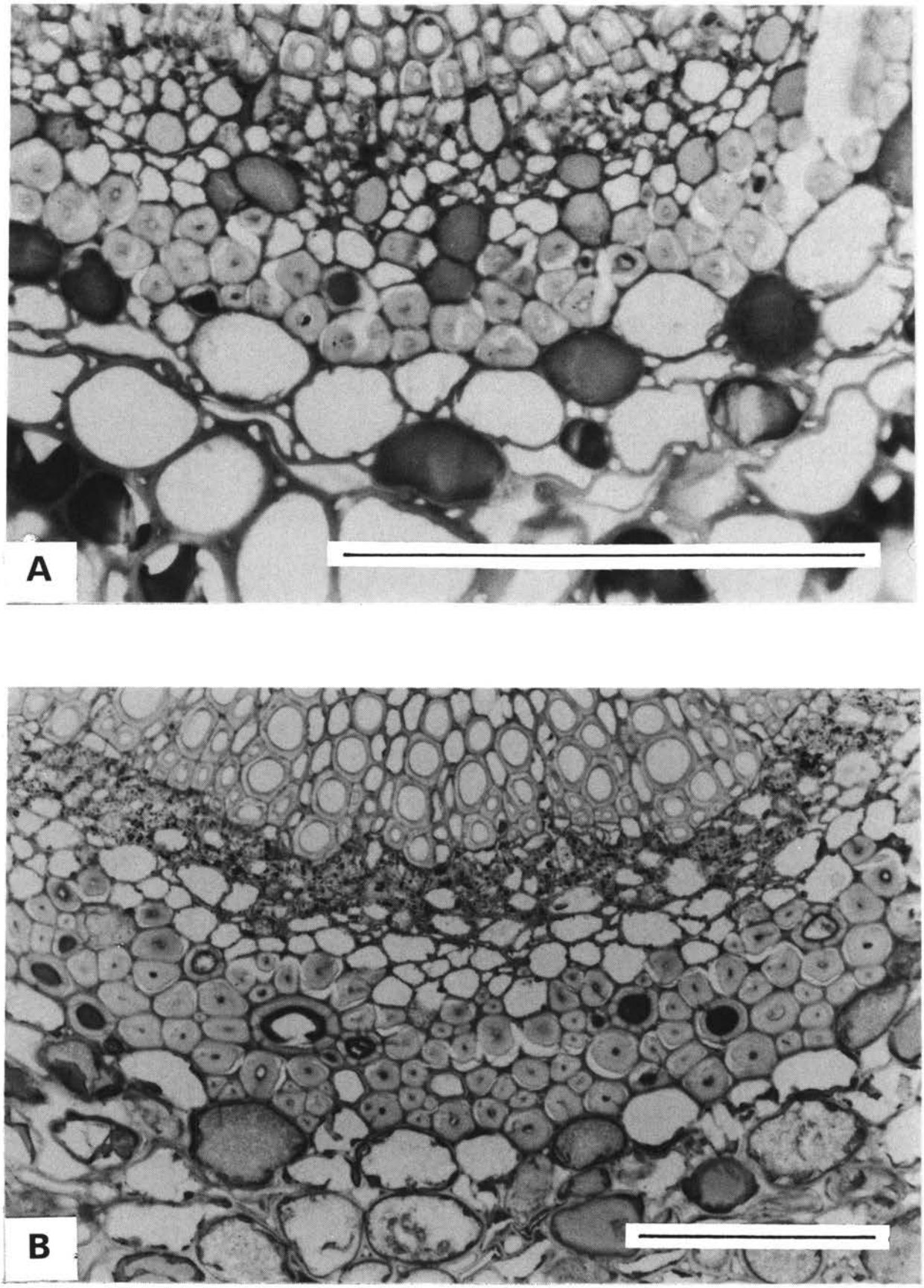


FIGURE 18.—Angular collenchyma and sclerenchyma. **A**, *Gymnosporia vanwykii* (*Abbott 2567*); **B**, *Putterlickia retrospinosa* (*Van Wyk 8332*). Scale bar: 10μm.

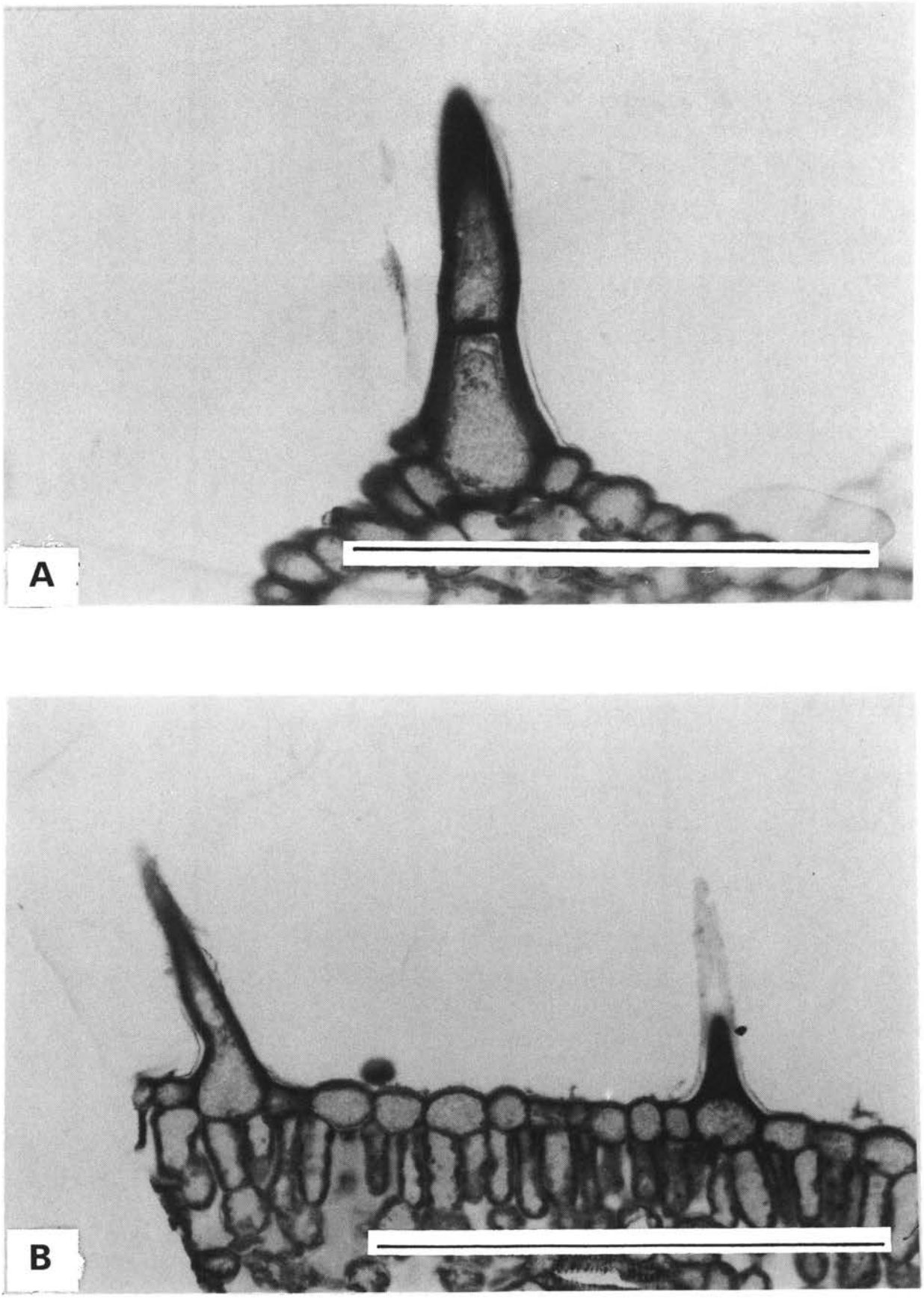


FIGURE 19.—Trichomes of *Gymnosporia putterlickioides* [*Bredenkamp & Van Rooyen* (KNP)]. **A**, bicellular trichome; **B**, unicellular trichome. Scale bar: 10 μm.

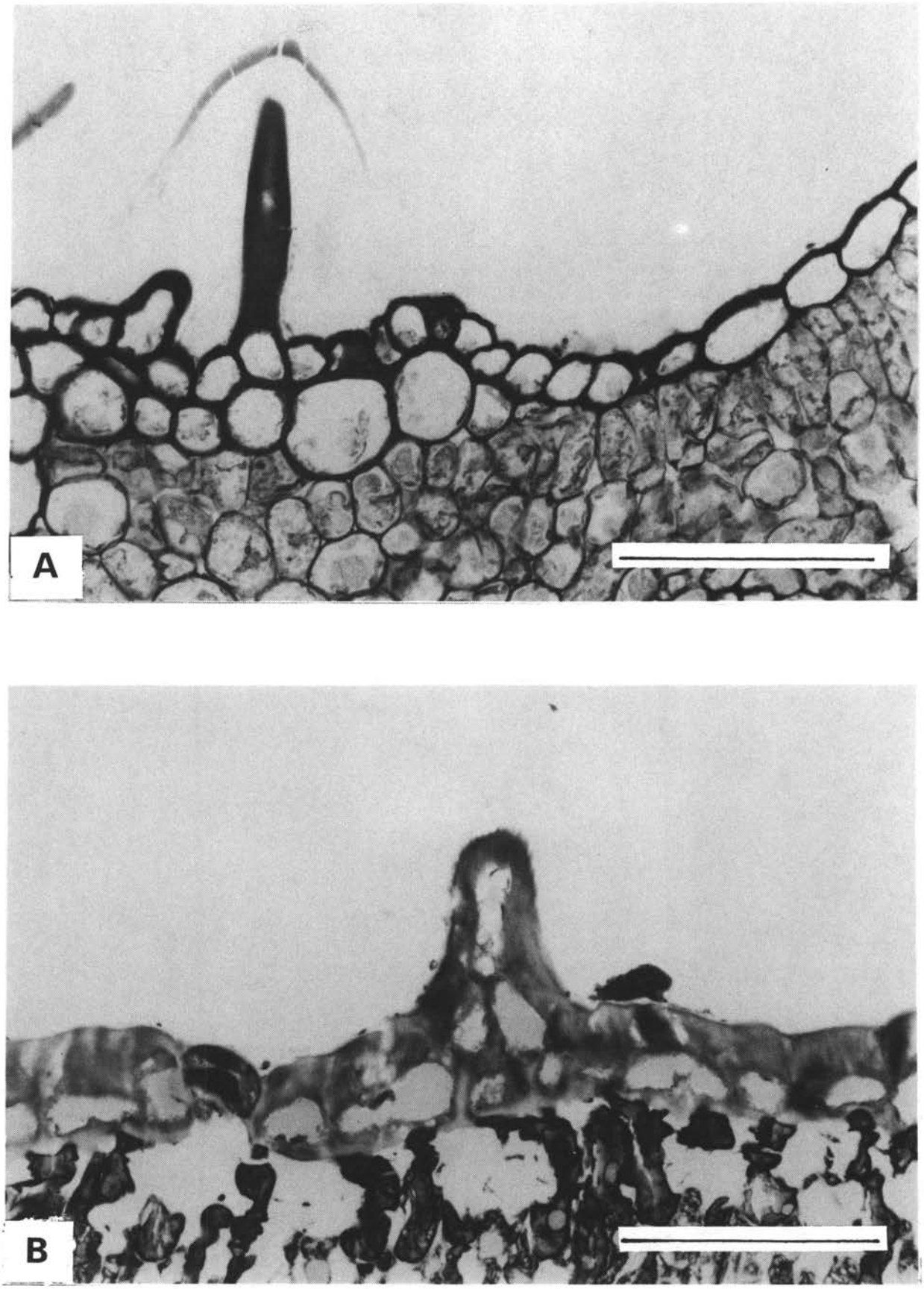
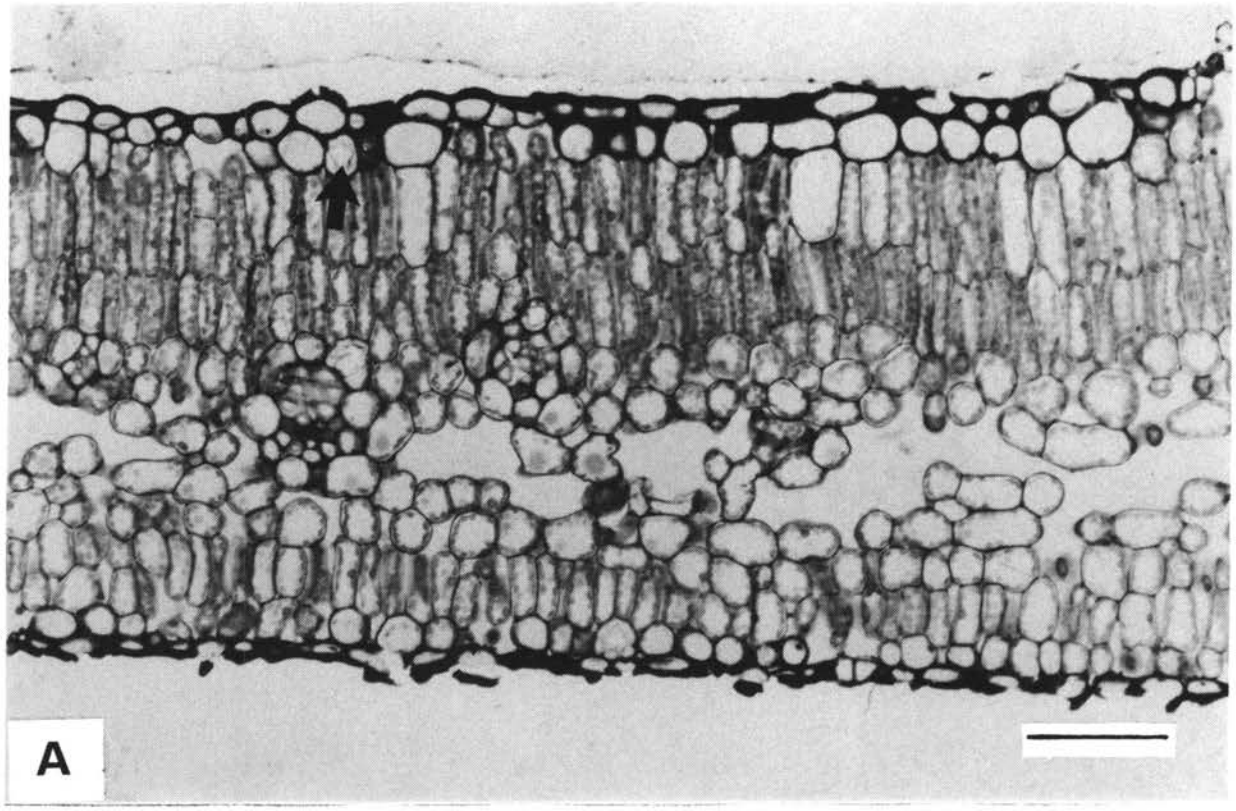


FIGURE 20.—Trichomes. **A**, unicellular trichome of *Gymnosporia pubescens* (*Van Rooyen 3120*); **B**, tricellular trichome of *G. tenuispina* (*Burgoyne 1583*). Scale bar: 10 μm.



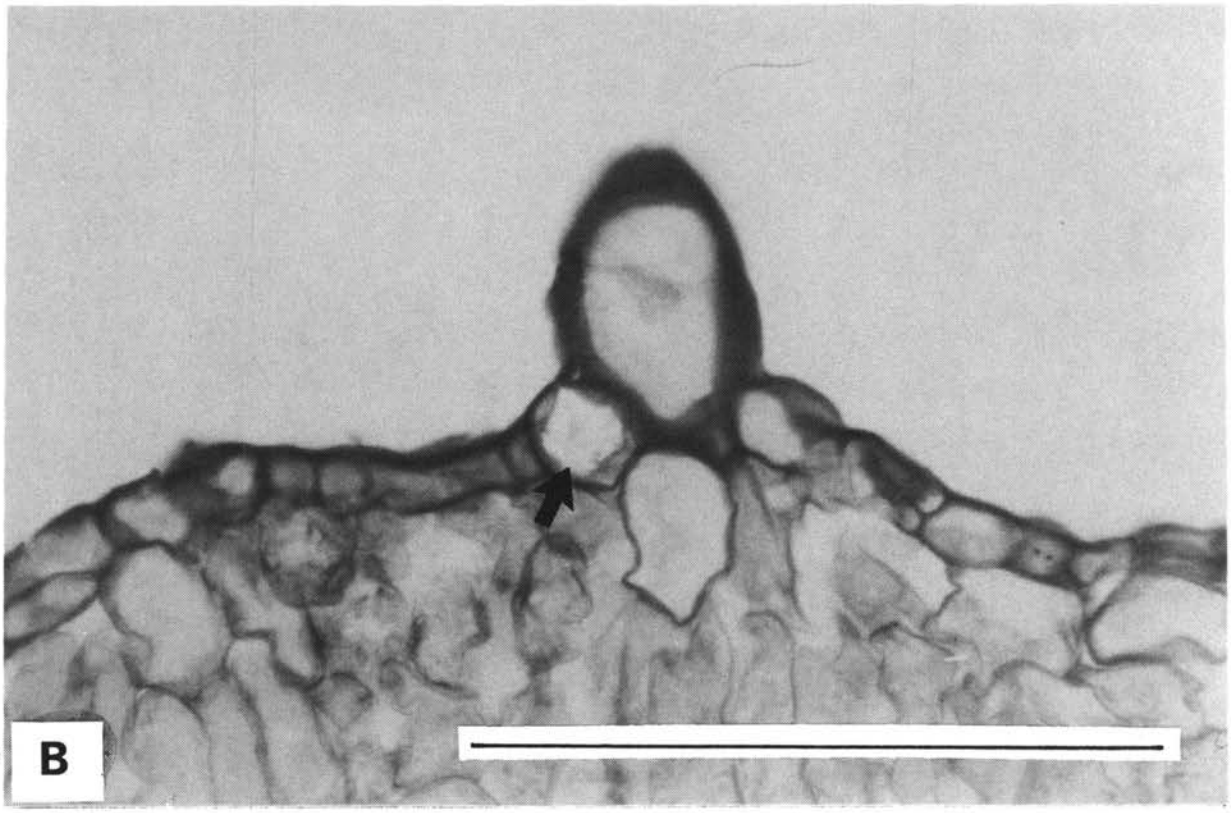


FIGURE 21.—Crystal idioblasts (arrows). **A**, scattered between hypodermal cells of *G. buxifolia* [*Jordaan* (NBI, WITS- garden)]. **B**, in epidermal cells of *Gymnosporia pubescens* (*Van Rooyen 3120*); Scale bar: 10 μm.

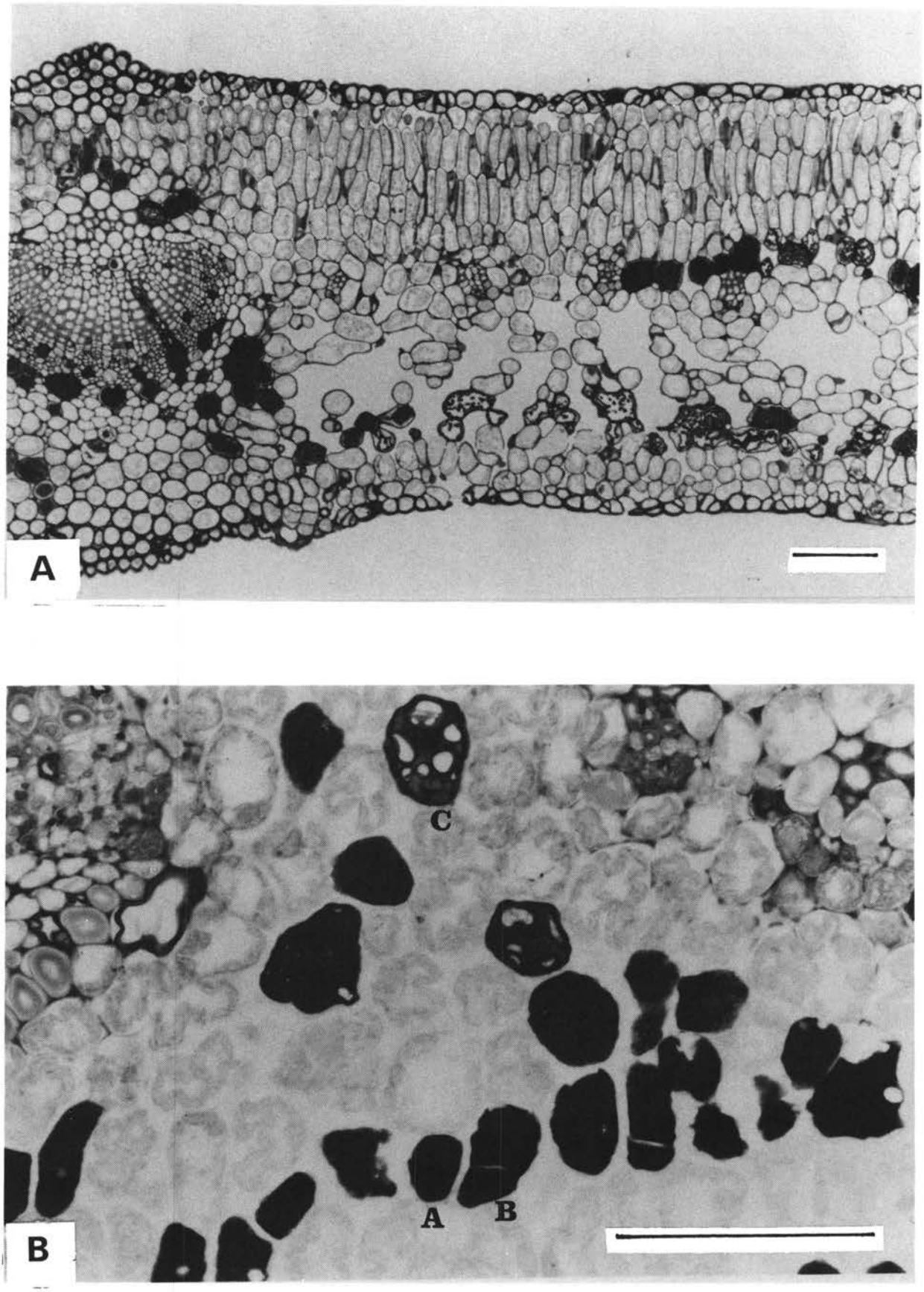


FIGURE 22.—Tanniferous cells. **A**, type A as in *Gymnosporia buxifolia* (*Jordaan 2309*); **B**, types A, B & C as in *G. szyszylowiczii* subsp. *szyszylowiczii* (*Jordaan 2288*). Scale bar: 10μm.

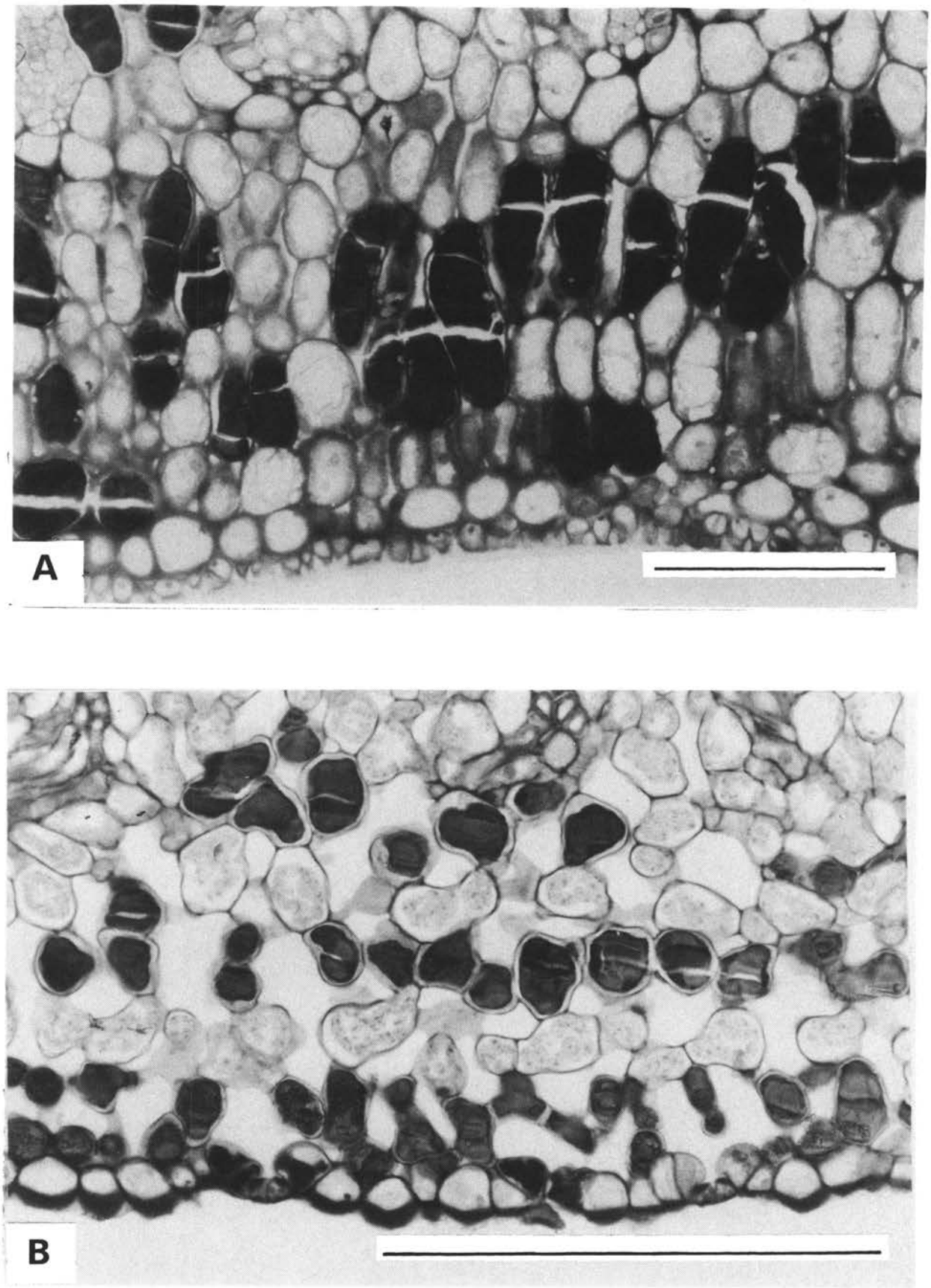


FIGURE 23. Type B tanniferous cells. **A**, *Gymnosporia elliptica* (*Jordaan 2292*); **B**, *G. polyacantha* subsp. *polyacantha* (*Jordaan 2308*). Scale bar: 10 μm.

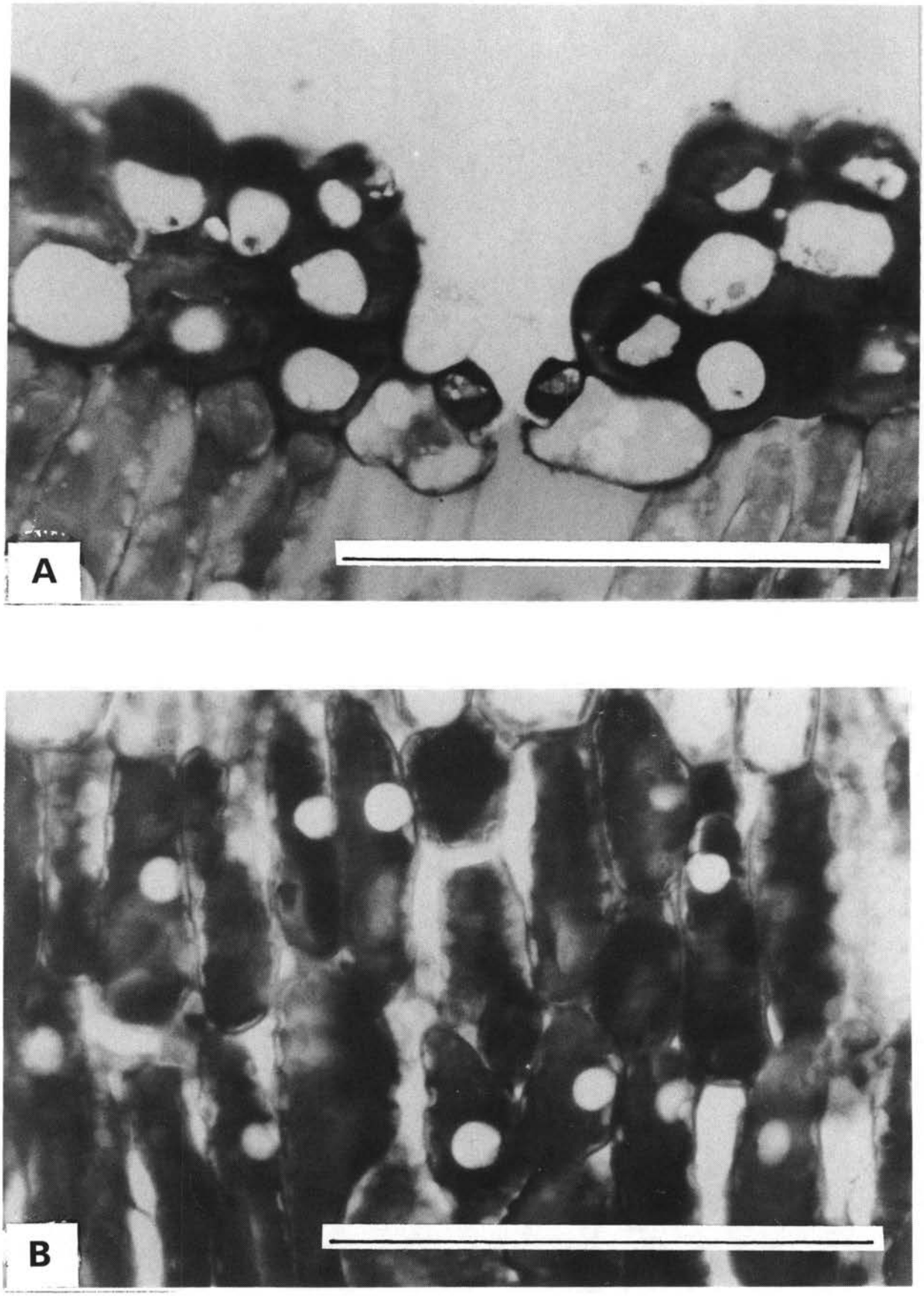


FIGURE 24.—Unstained oil droplets in epidermis and palisade parenchyma of *Gloveria integrifolia*. **A**, note the asymmetry of the guard cells (*Jordaan 2282*); **B**, *Germishuizen*, Anysberg. Scale bar: 10 μm.

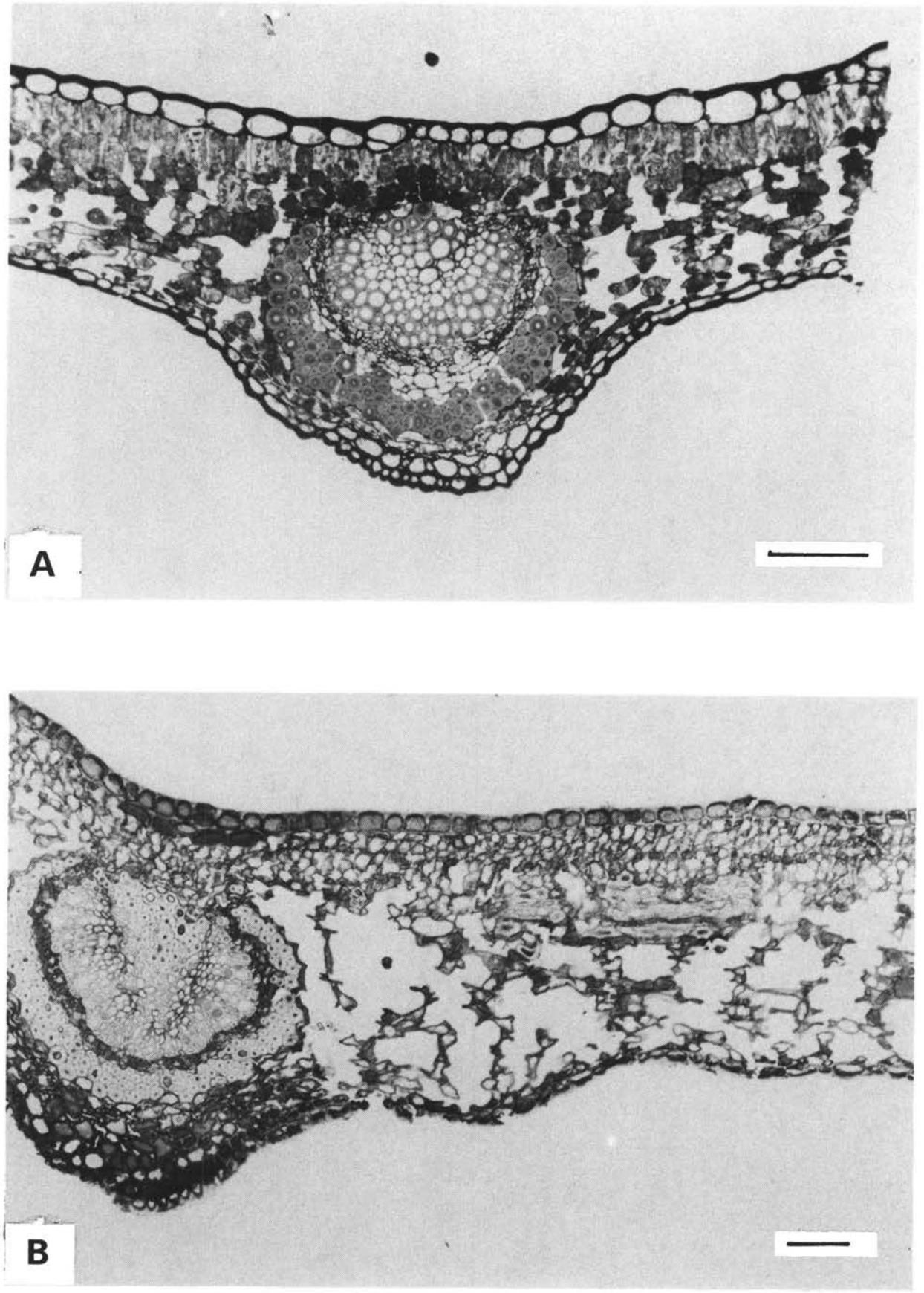


FIGURE 25.—Transverse sections of lamina. **A**, *Putterlickia pyracantha* (*Jacot Guillarmod 3513*); **B**, *P. retrospinosa* (*Van Wyk 5137*). Scale bar: 10 μm.

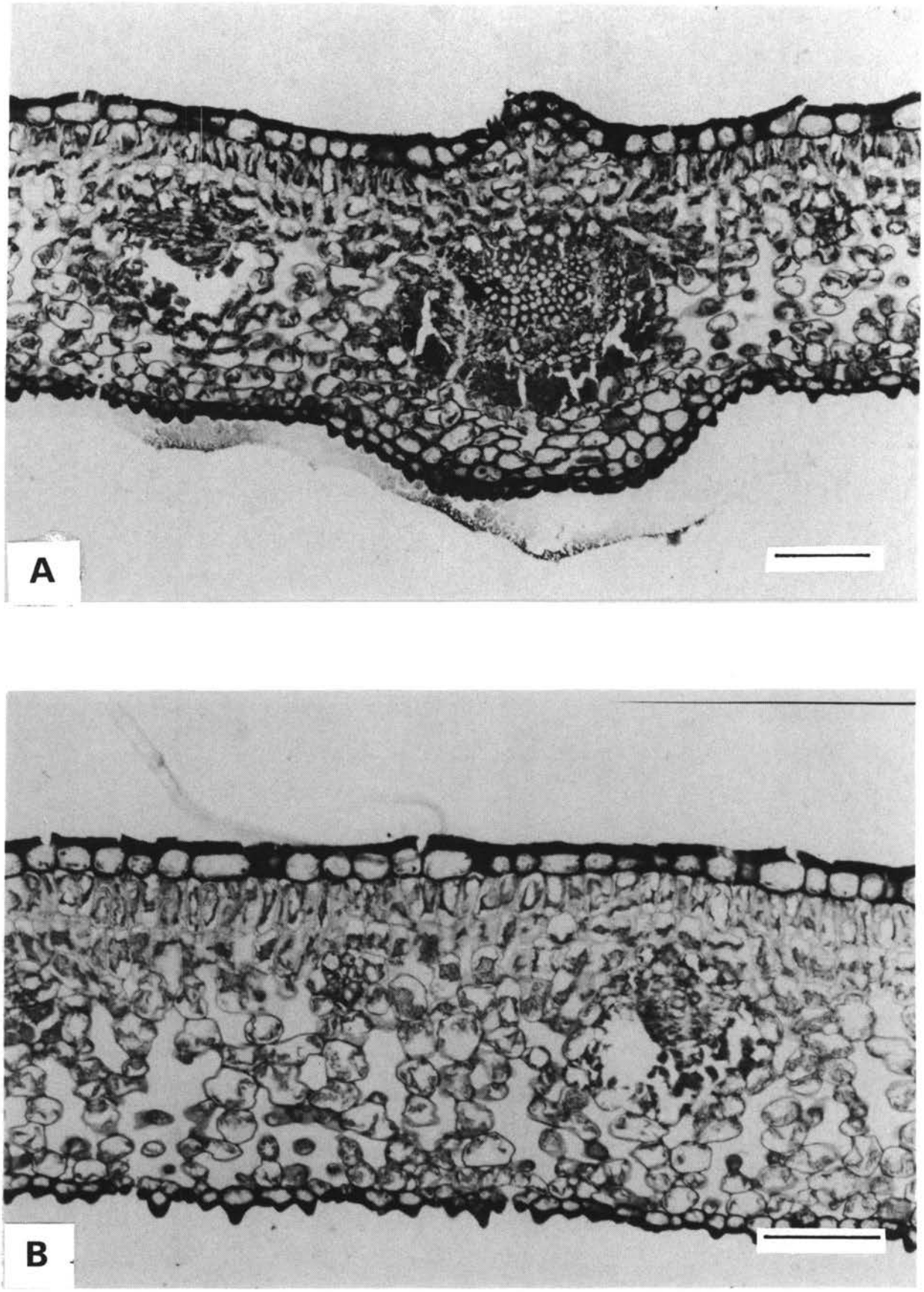
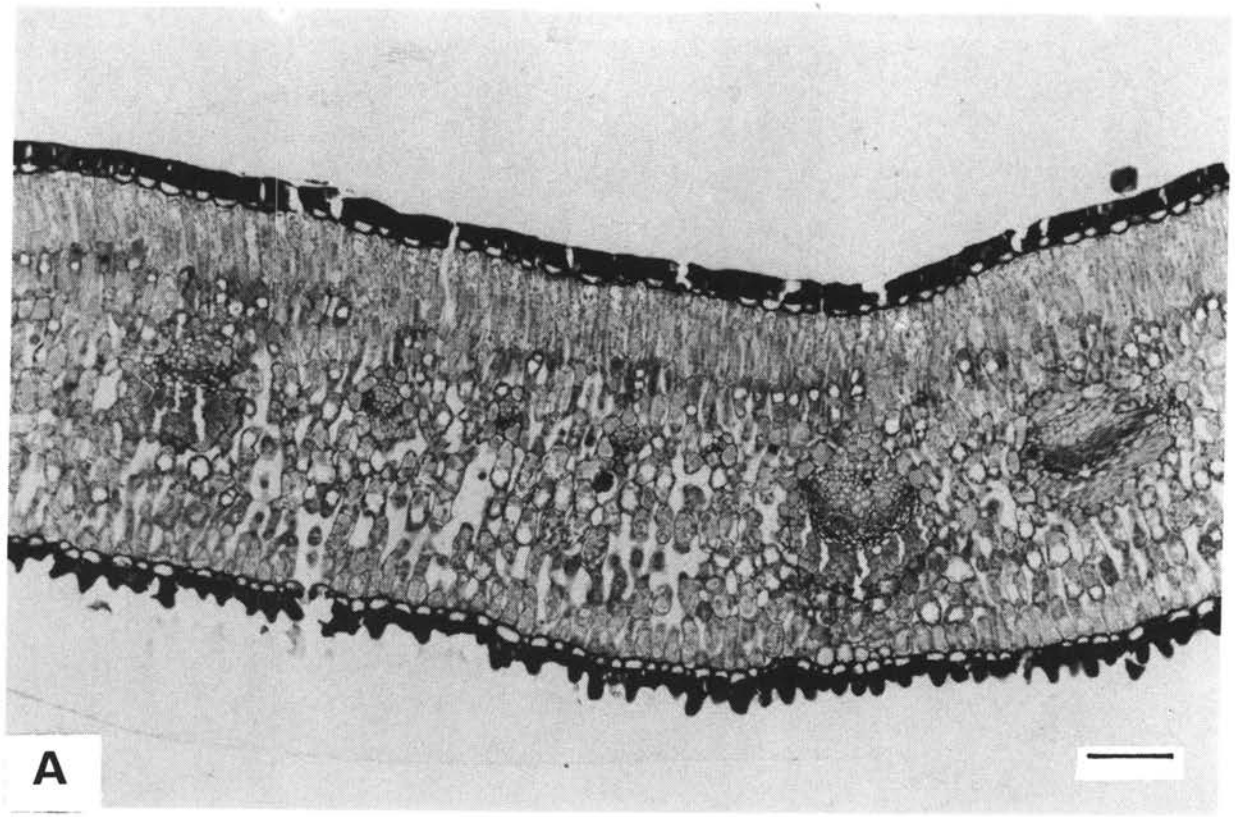


FIGURE 26.—Transverse sections of lamina. **A—B**, *Putterlickia verrucosa* (*NBI, Pretoria- Garden*). Scale bar: 10 μm.



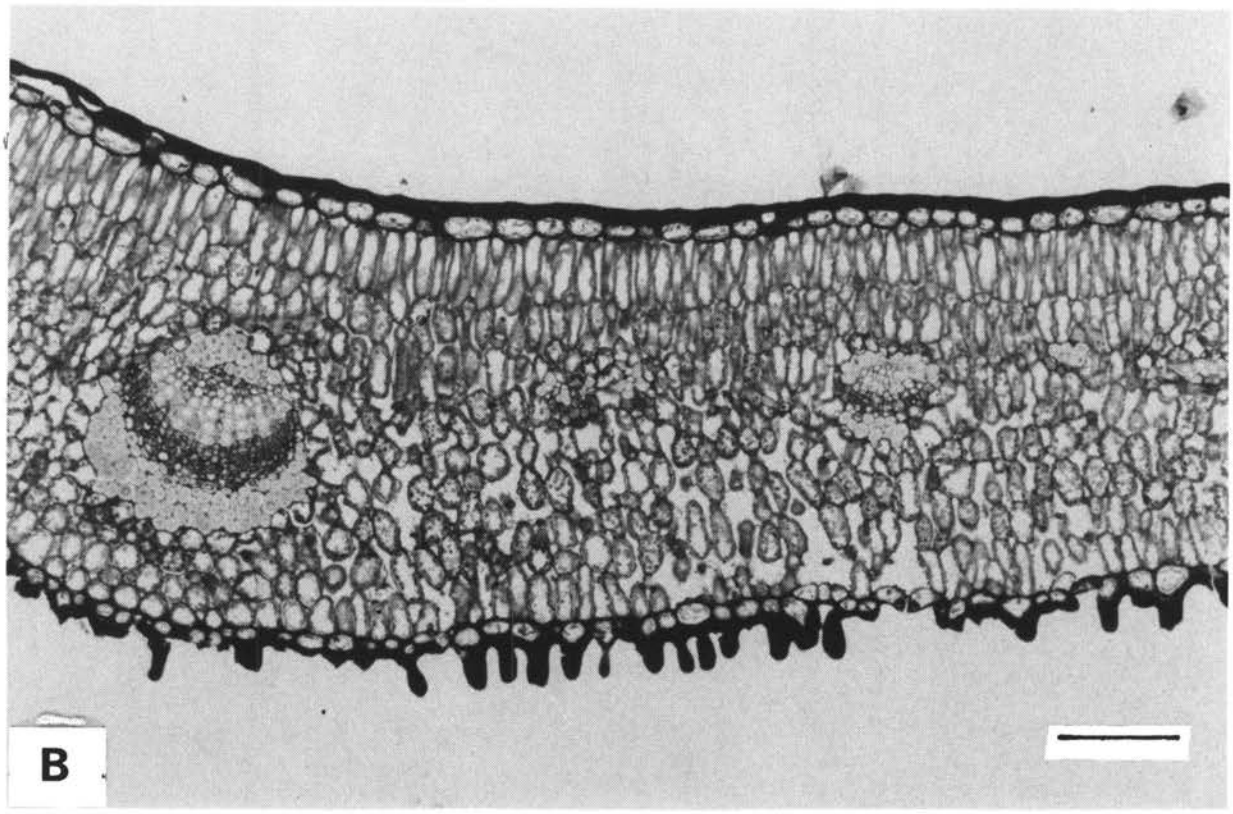
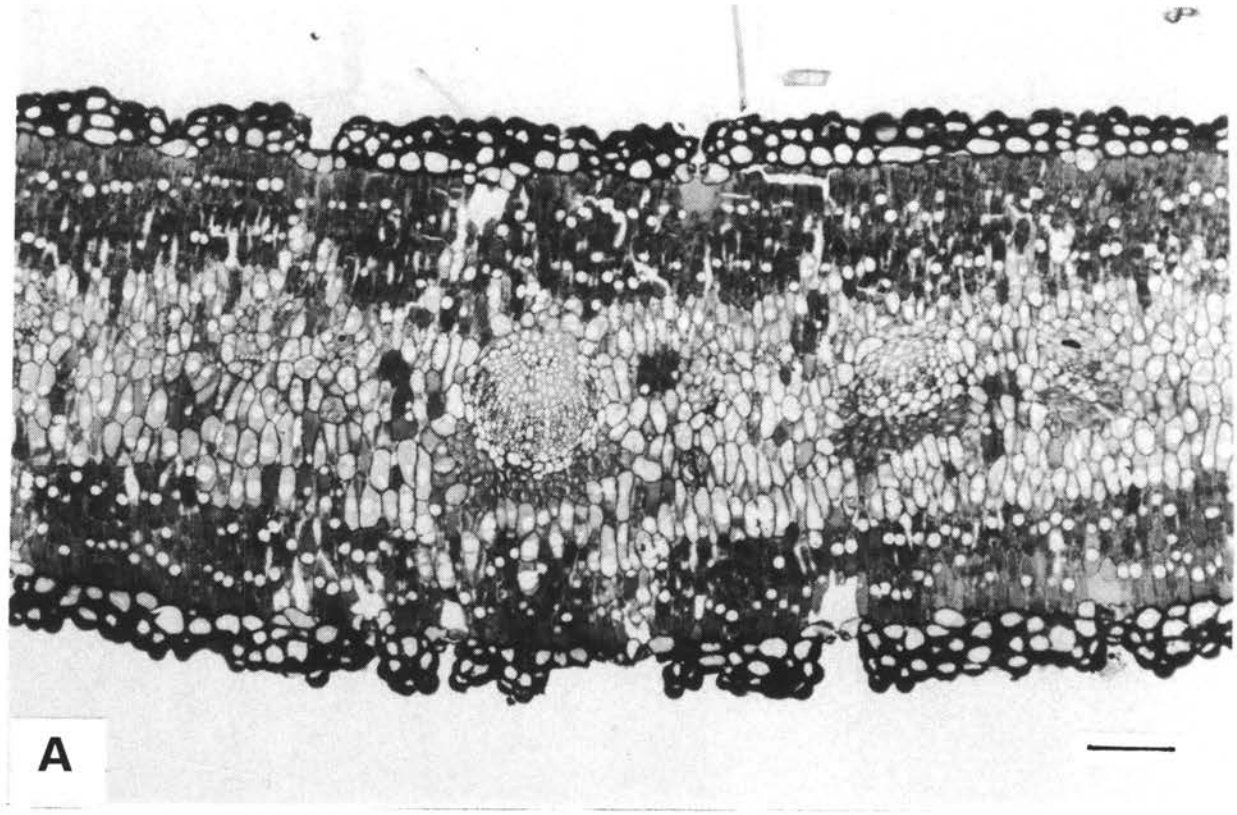


FIGURE 27.—Transverse sections of lamina of *Putterlickia saxatilis*. **A**, [*1336* (PRU)]; **B**, [*Puff 780415*]. Scale bar: 10 μm.



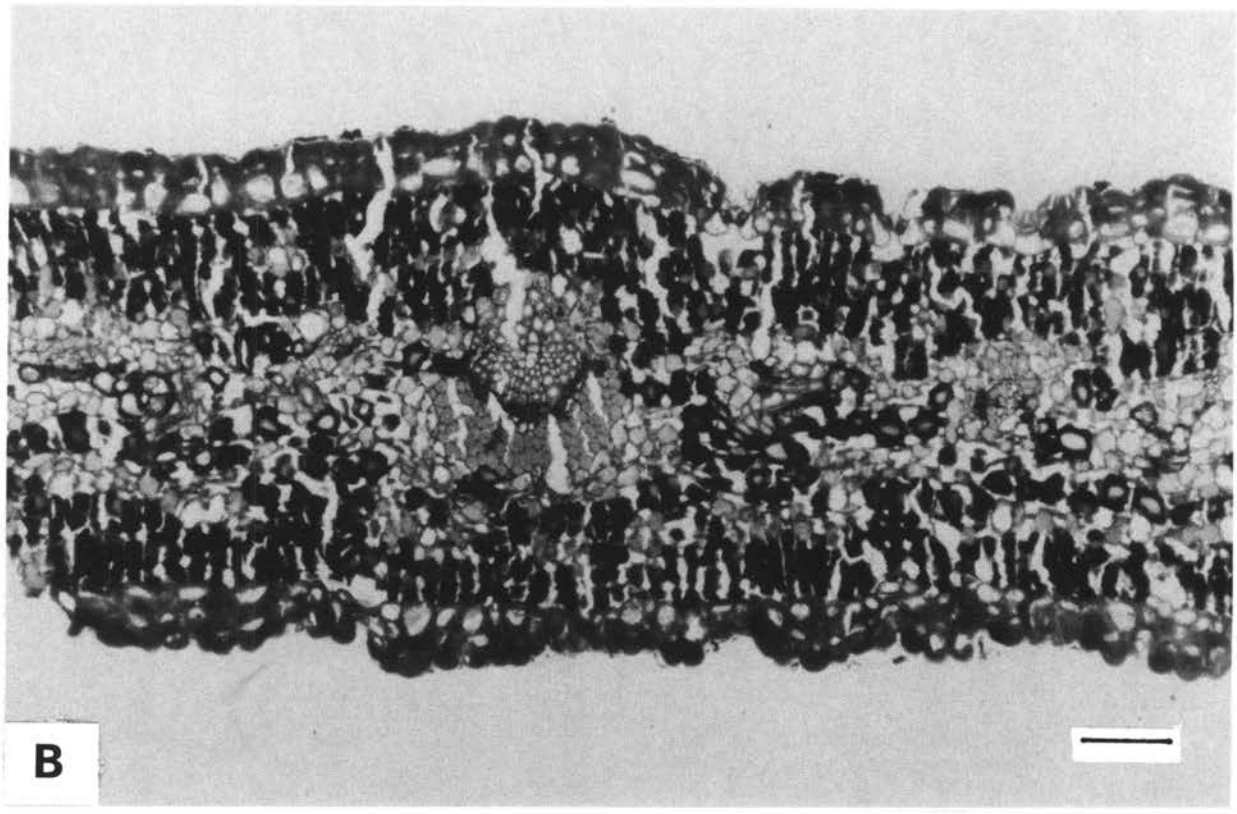


FIGURE 28.—Transverse sections of lamina of *Gloveria integrifolia*. **A**, (Little Karoo) (*Jordaan 2282*); **B**, (Namaqualand) (*Pillans 17965*). Scale bar: 10 μm.

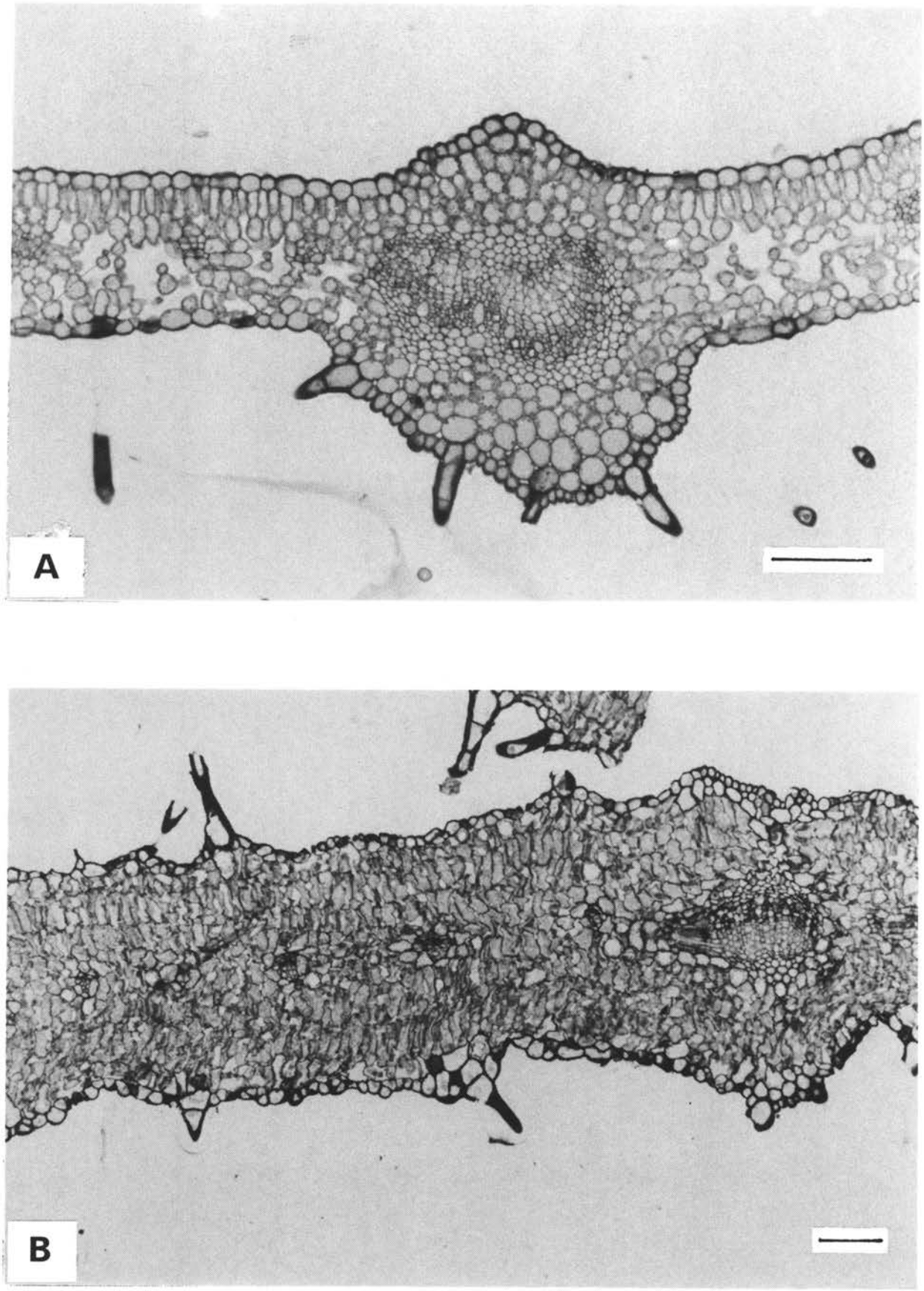


FIGURE 29.—Transverse sections of lamina. **A**, *Gymnosporia putterlickioides* [*Bredenkamp & Van Rooyen* (KNP)]; **B**, *G. pubescens* (*Van Rooyen 3120*). Scale bar: 10 μm.

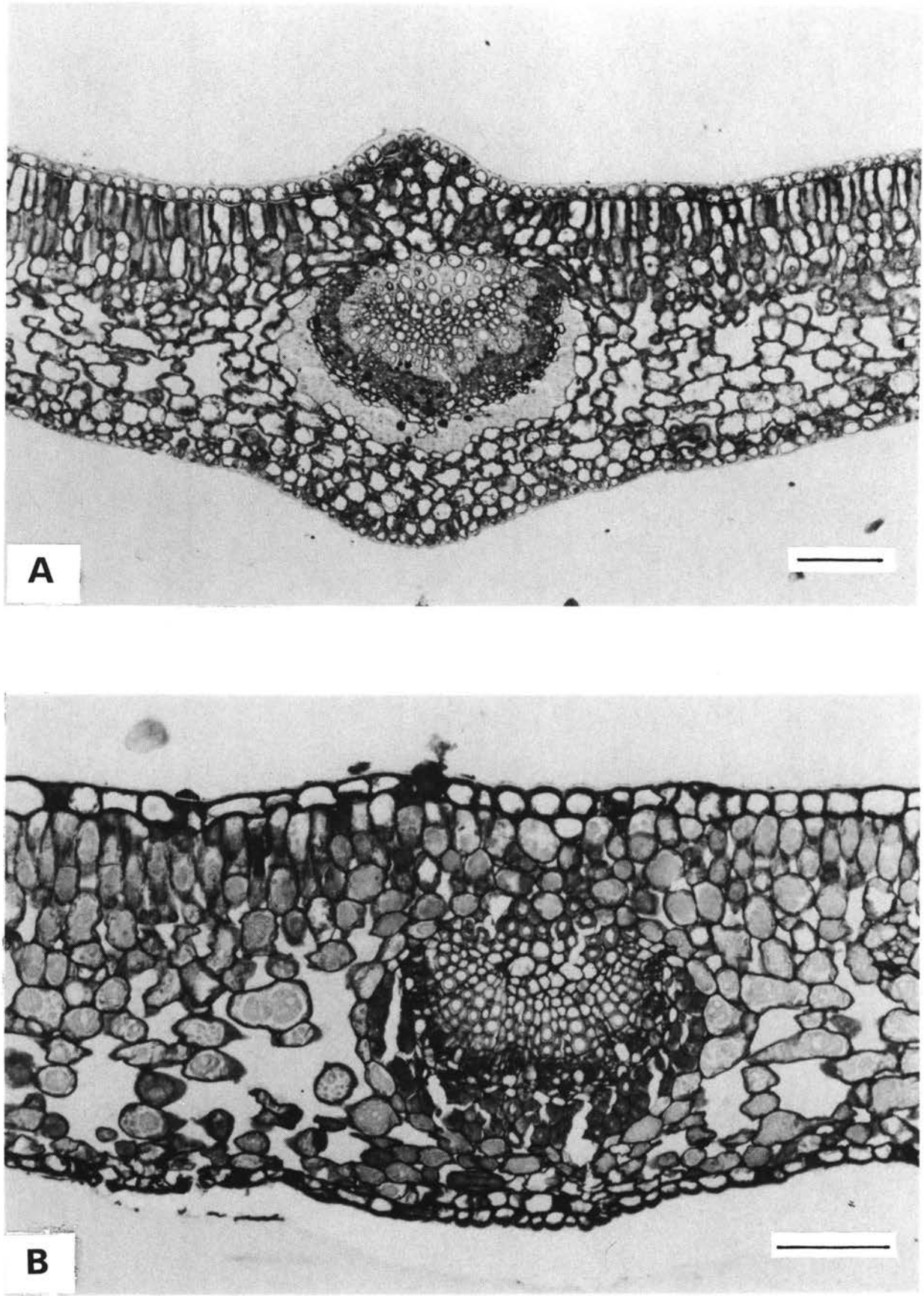


FIGURE 30.—Transverse sections of lamina. **A**, *Gymnosporia mossambicensis* (*NBI, Pretoria-Garden*); **B**, *G. nemorosa* (*Maguire 199*). Scale bar: 10 μm.

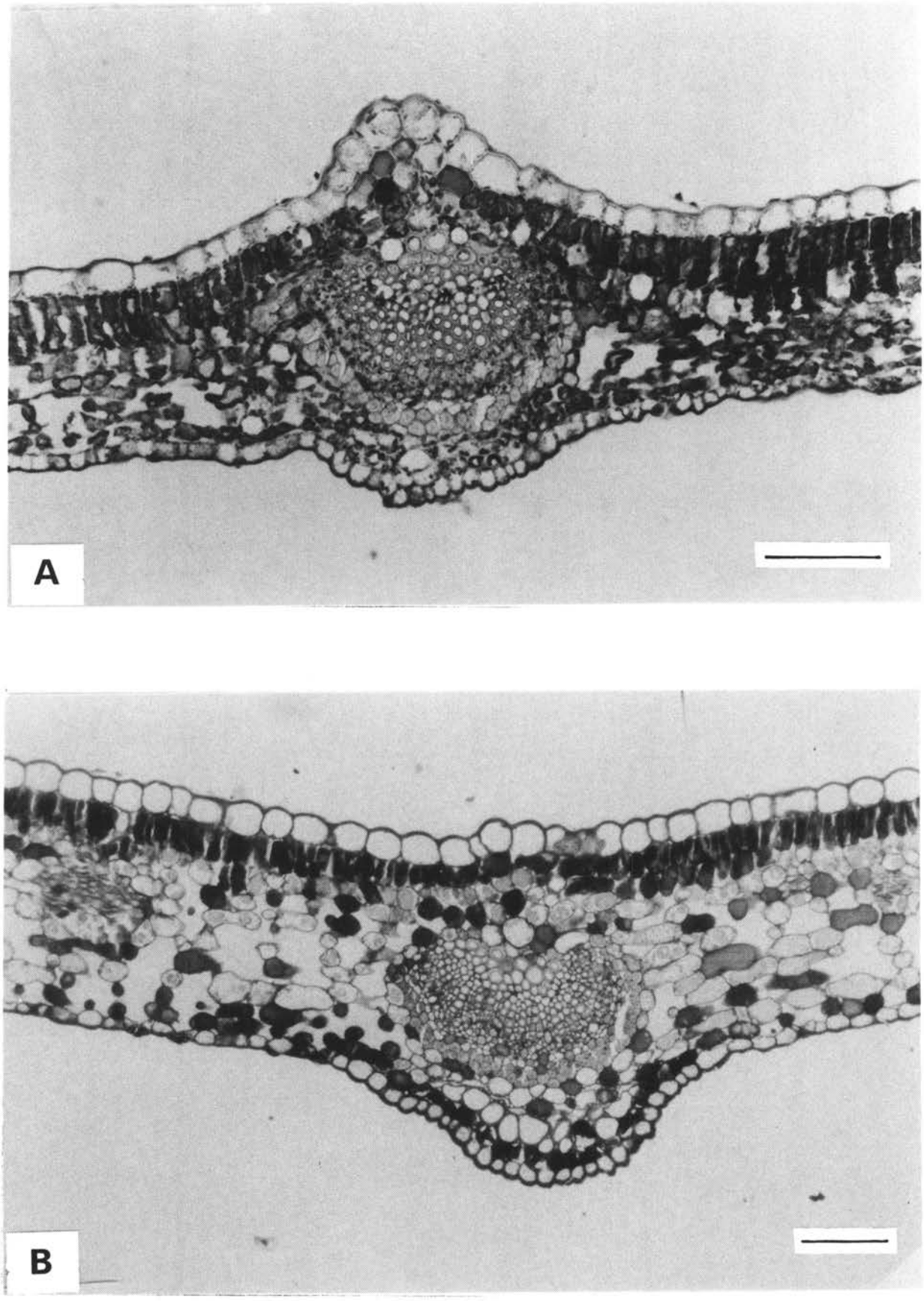


FIGURE 31.—Transverse sections of lamina. **A**, *Gymnosporia rubra* (*Rogers 23871*); **B**, *G. vanwykii* (*Abbott 2567*). Scale bar: 10 μm.

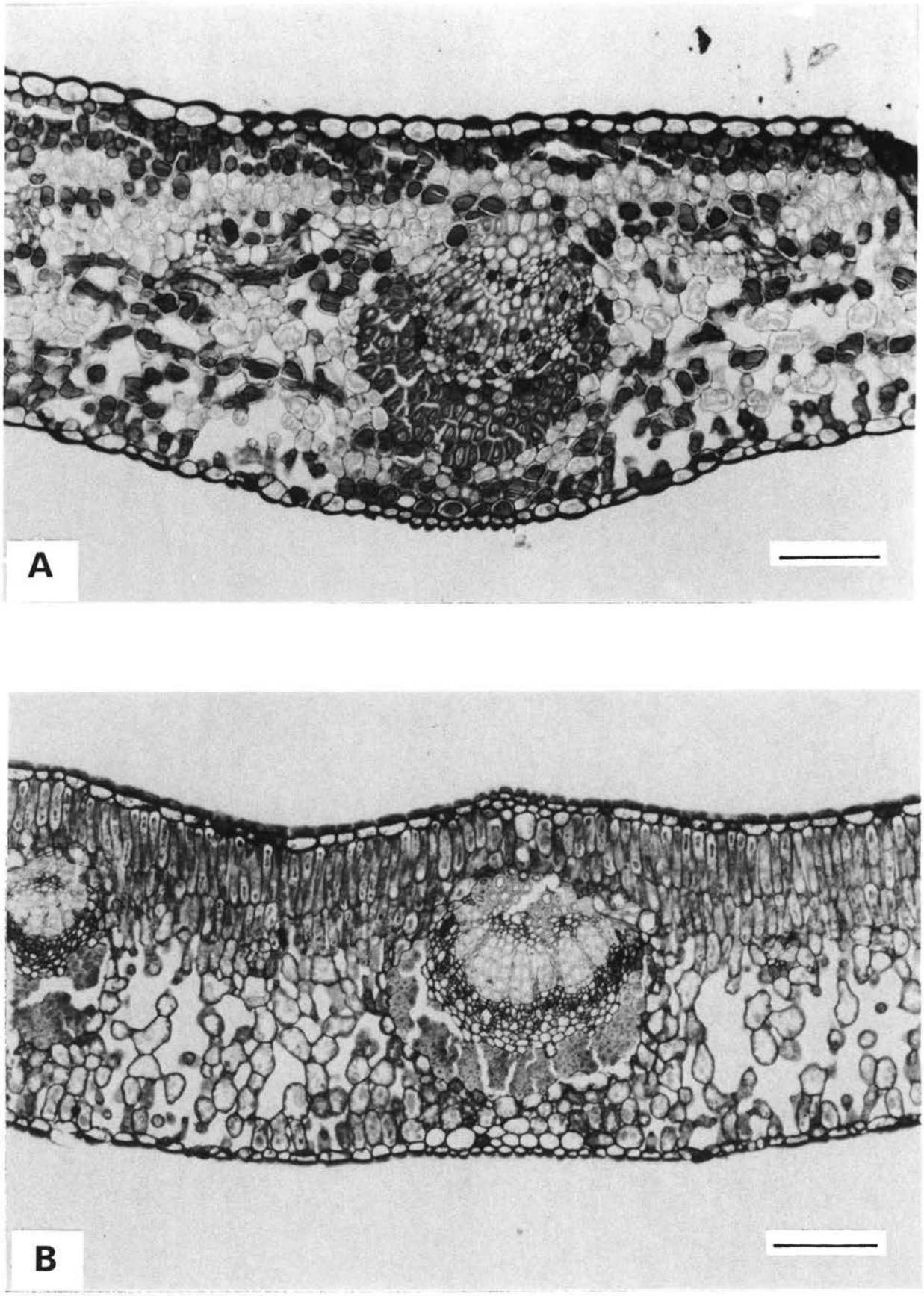
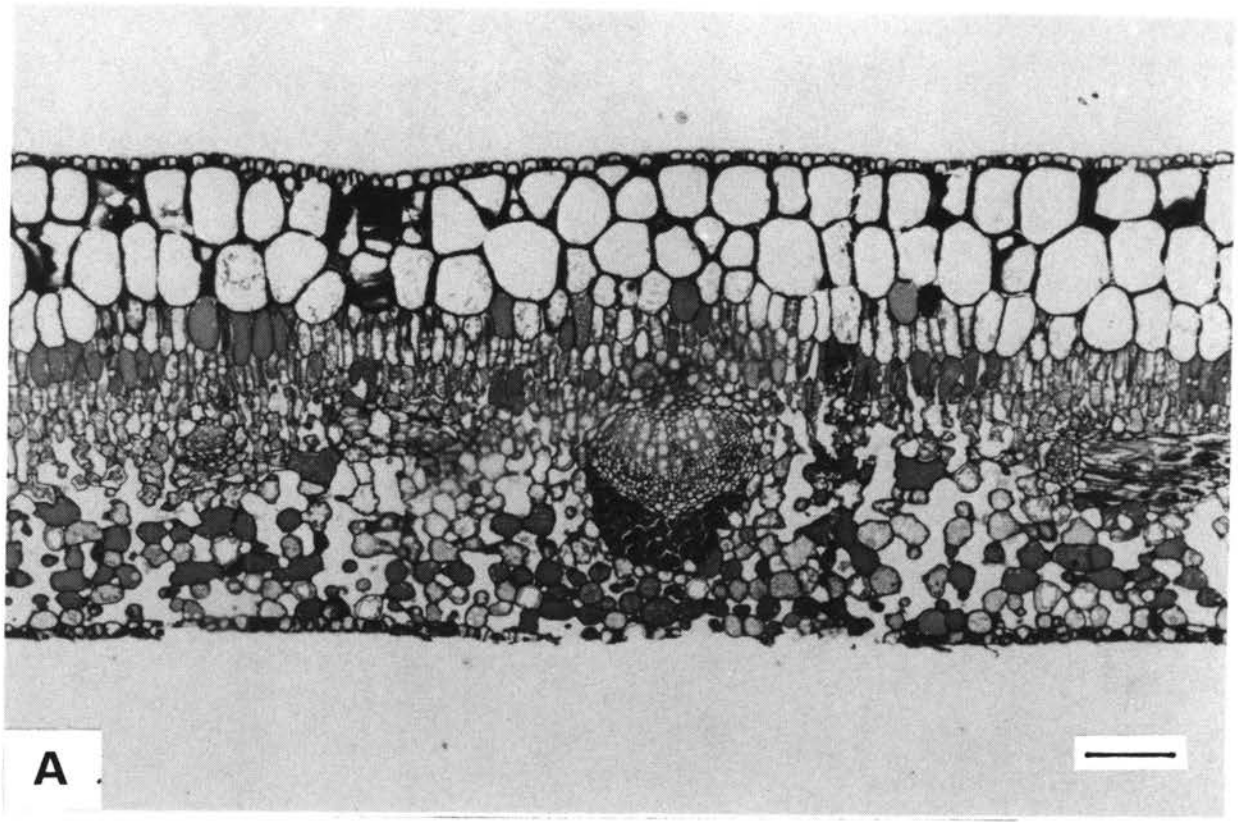


FIGURE 32.—Transverse sections of lamina. **A**, *Gymnosporia polyacantha* subsp. *polyacantha* (*Jordaan 2308*); **B**, *G. polyacantha* subsp. *vaccinifolia* [*Jordaan* (Mabalinge)]. Scale bar: 10 μm



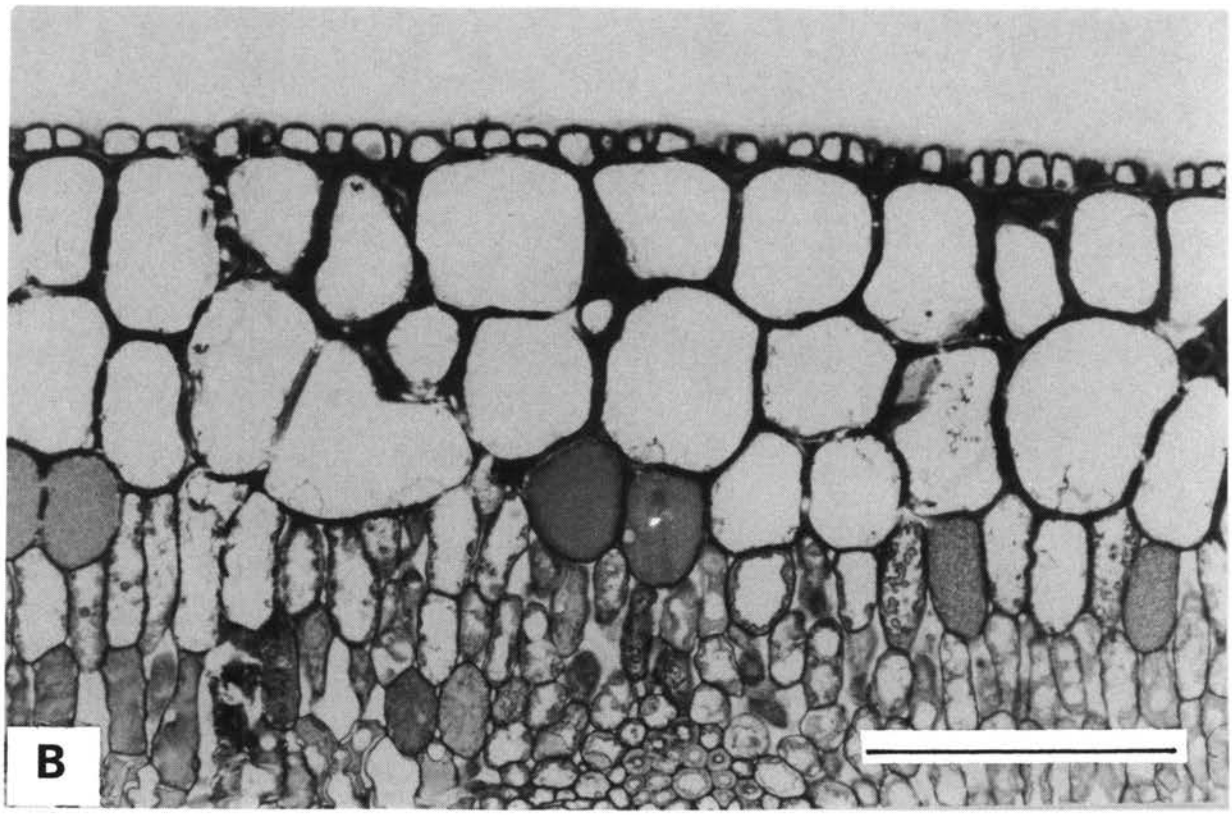


FIGURE 33.—Transverse sections of lamina. **A—B**, *Gymnosporia capitata* (*M. Jordaan 2314*); **B**, adaxially epidermis and hypodermis more or less 3-layered. Scale bar: 10 μm.

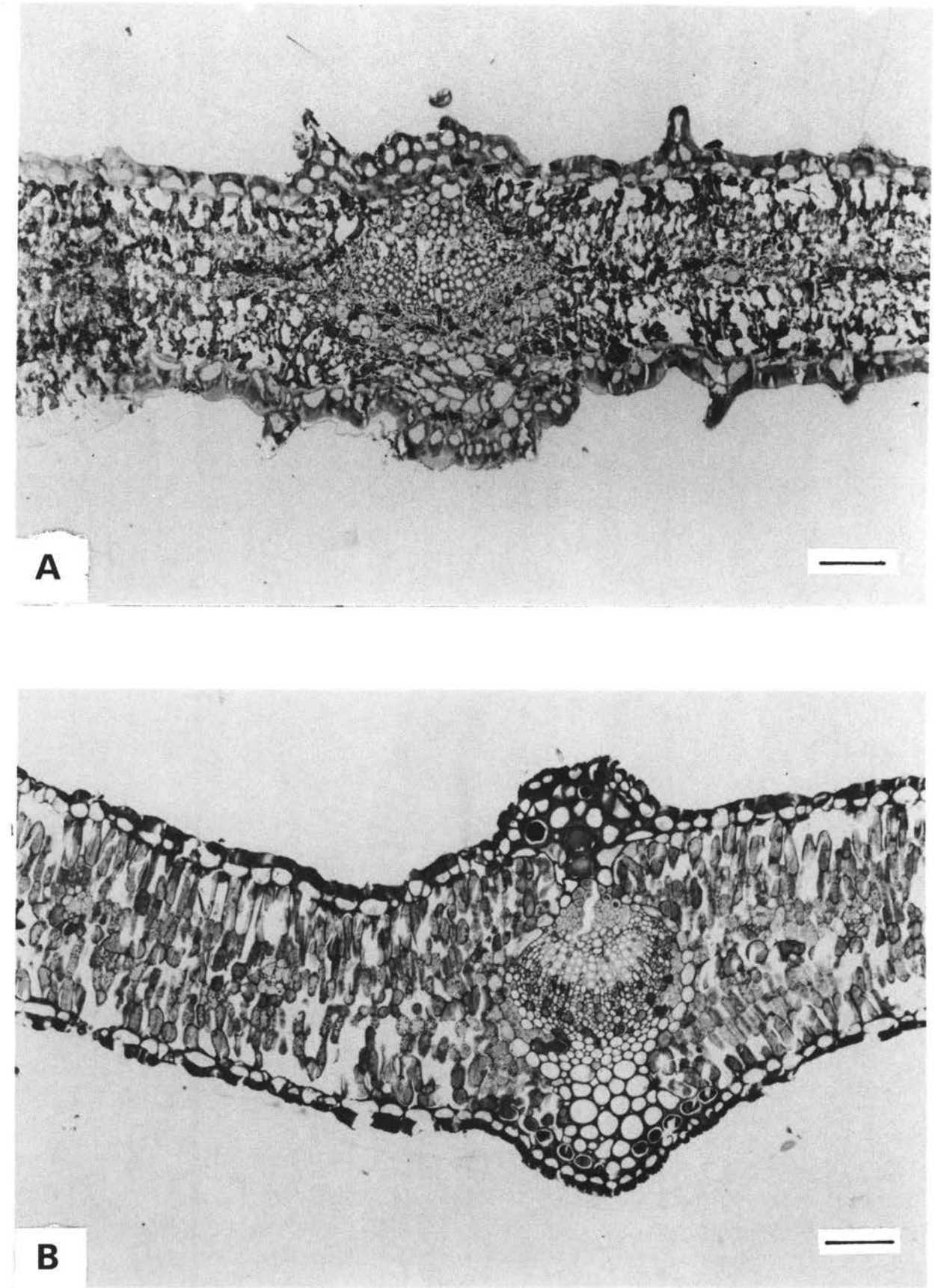


FIGURE 34.—Transverse sections of lamina. **A**, *Gymnosporia tenuispina* (with trichomes) (*Burtt Davy 1730*); **B**, *G. tenuispina* (without trichomes) (*Burgoyne 1583*). Scale bar: 10 μm.

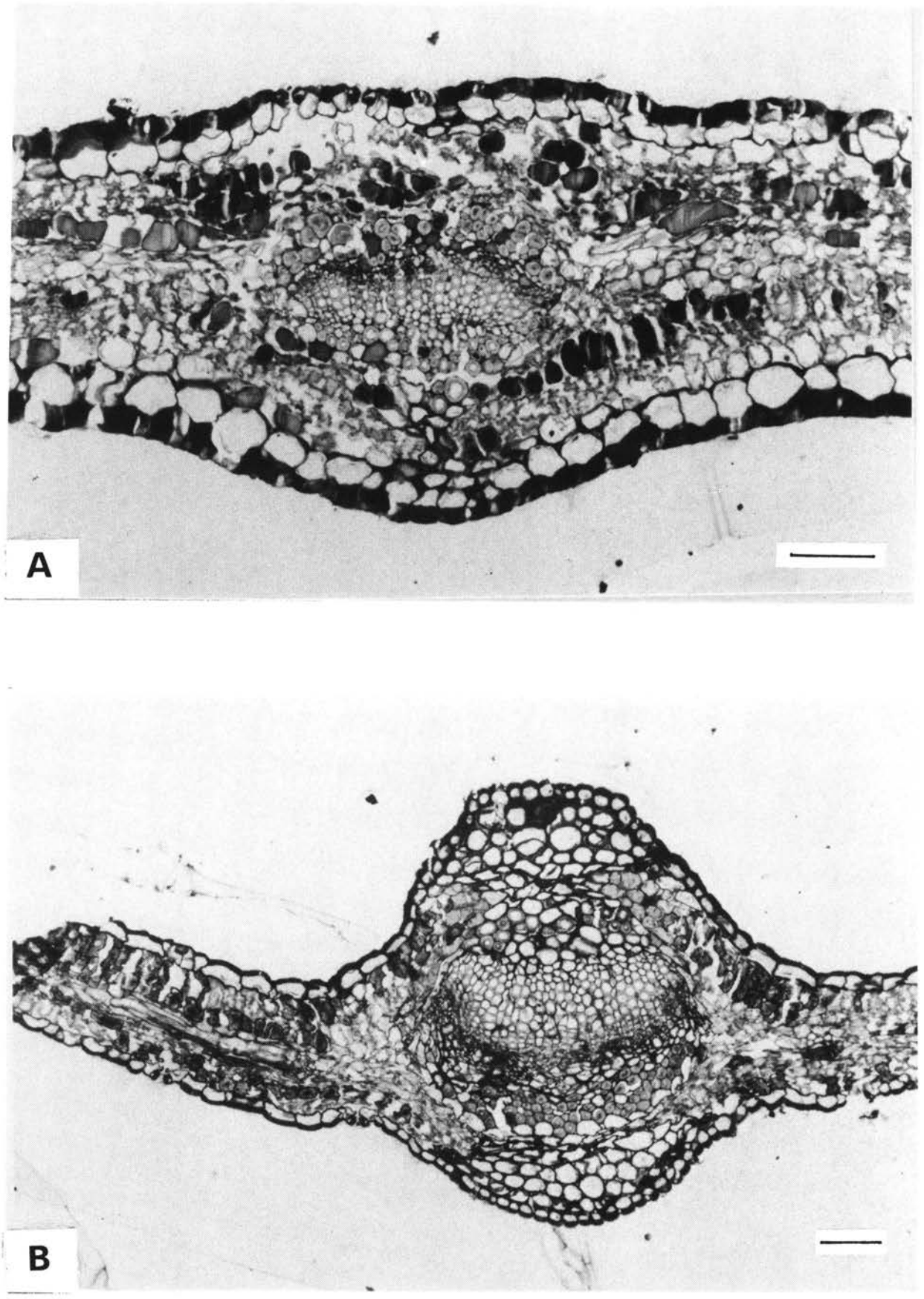
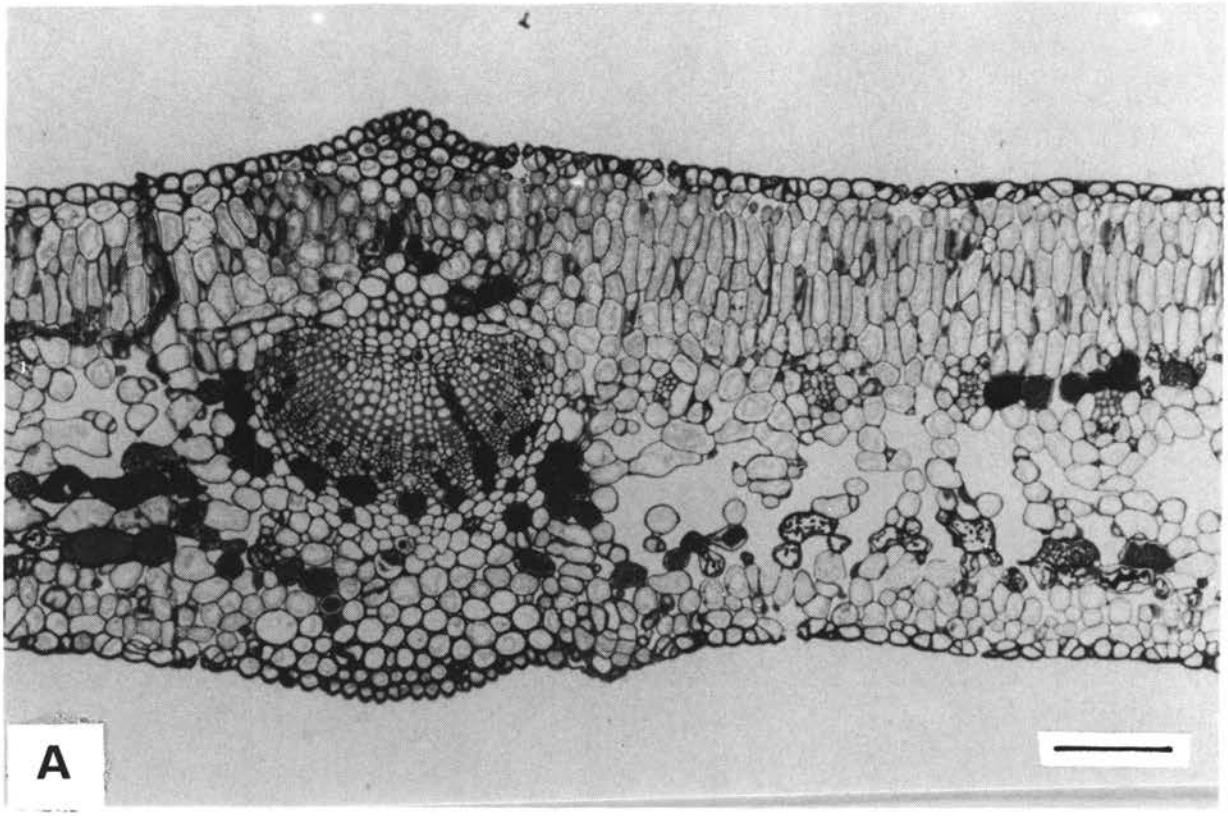


FIGURE 35.—Transverse sections of lamina. **A**, *Gymnosporia gariepensis* (*Jurgens 28856*); **B**, *Gymnosporia oxycarpa* (*Van der Schijff & Marais 3681*). Scale bar: 10 μm.



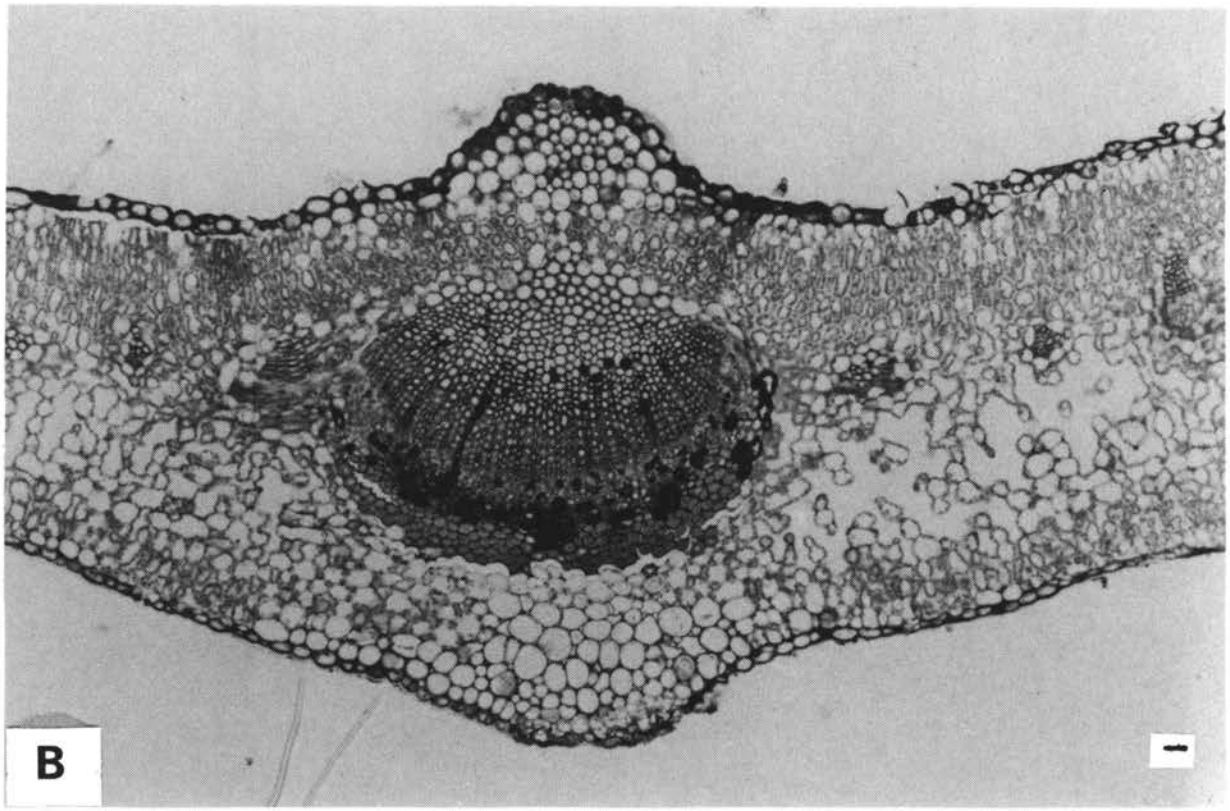


FIGURE 36.—Transverse sections of lamina. **A**, *Gymnosporia buxifolia* (*Jordaan 2309*); **B**, *G. buxifolia* (*Jordaan 2326*). Scale bar: 10 μm.

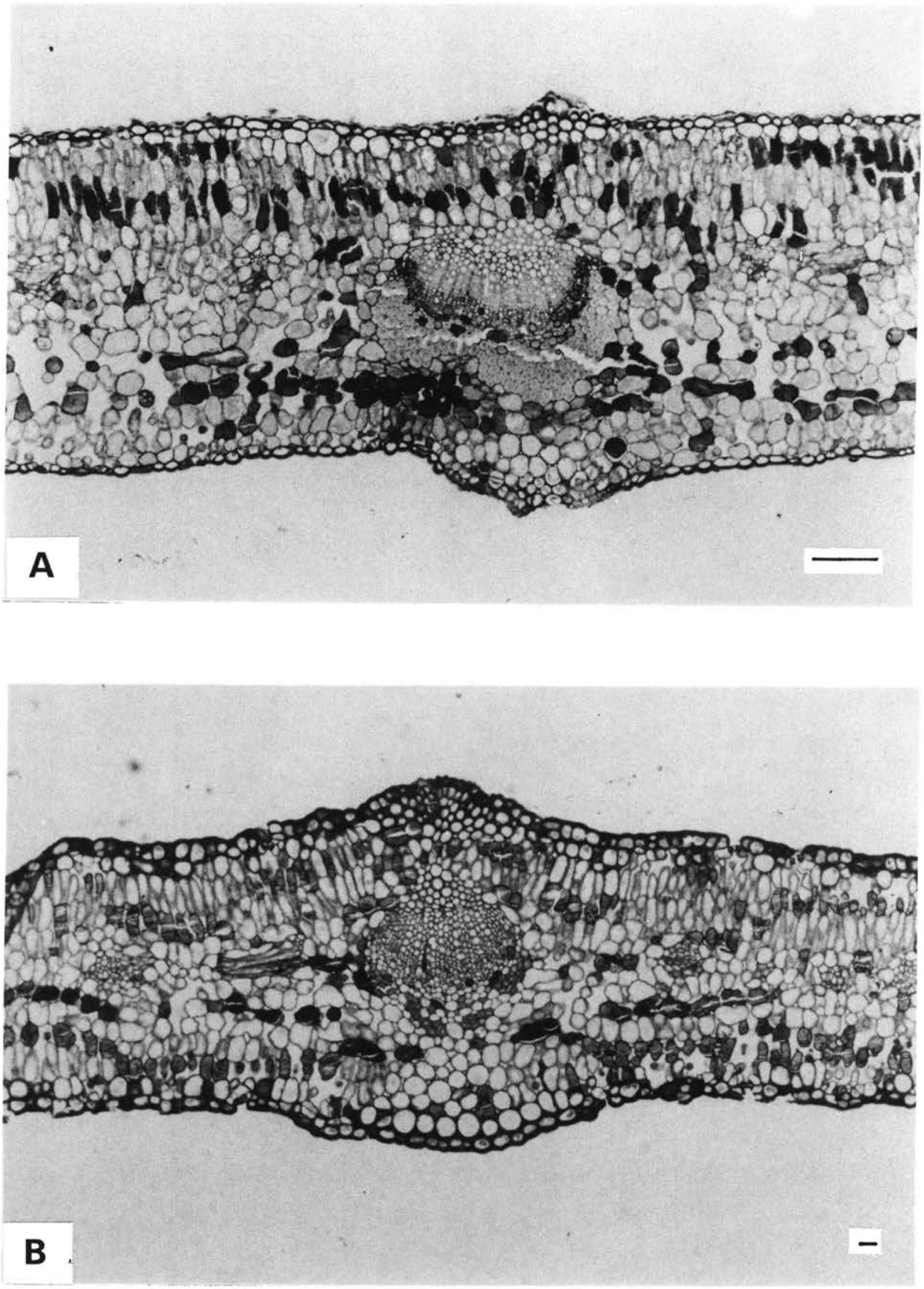


FIGURE 37.—Transverse sections of lamina. **A**, *Gymnosporia heterophylla* (*Jordaan 2323*); **B**, *G. heterophylla* [*7156*, Uvongo (PRU)]. Scale bar: 10 μm.

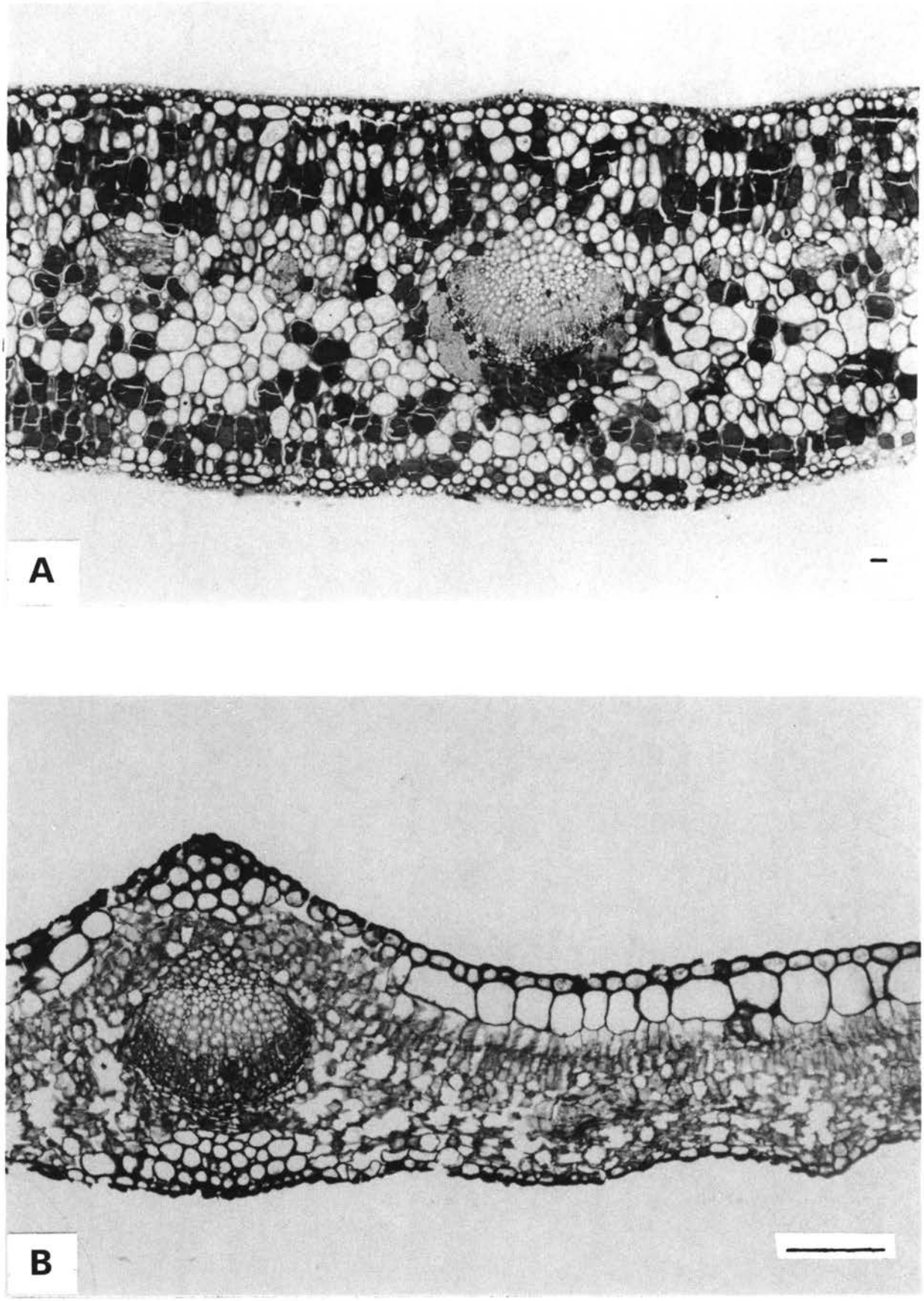


FIGURE 38.—Transverse sections of lamina. **A**, *Gymnosporia elliptica* (*Jordaan 2294*); **B**, *Gymnosporia tenuifolia* (*Walter 673*). Scale bar: 10 μm.

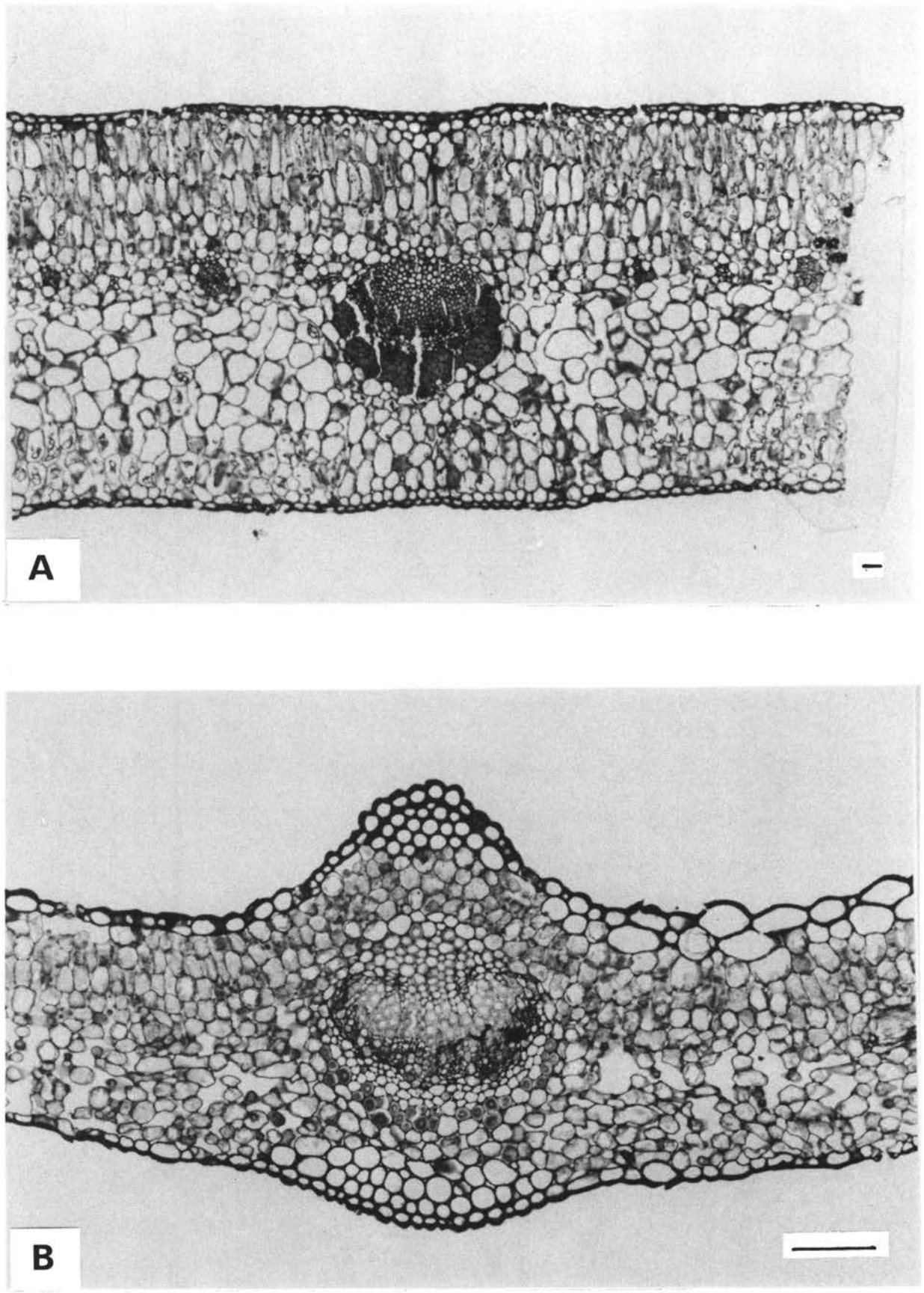


FIGURE 39.—Transverse sections of lamina. **A**, *Gymnosporia uniflora* (*Balkwill & Cadman 2270*); **B**, *Gymnosporia macrocarpa* (*Balkwill 5356*). Scale bar: 10 μm.

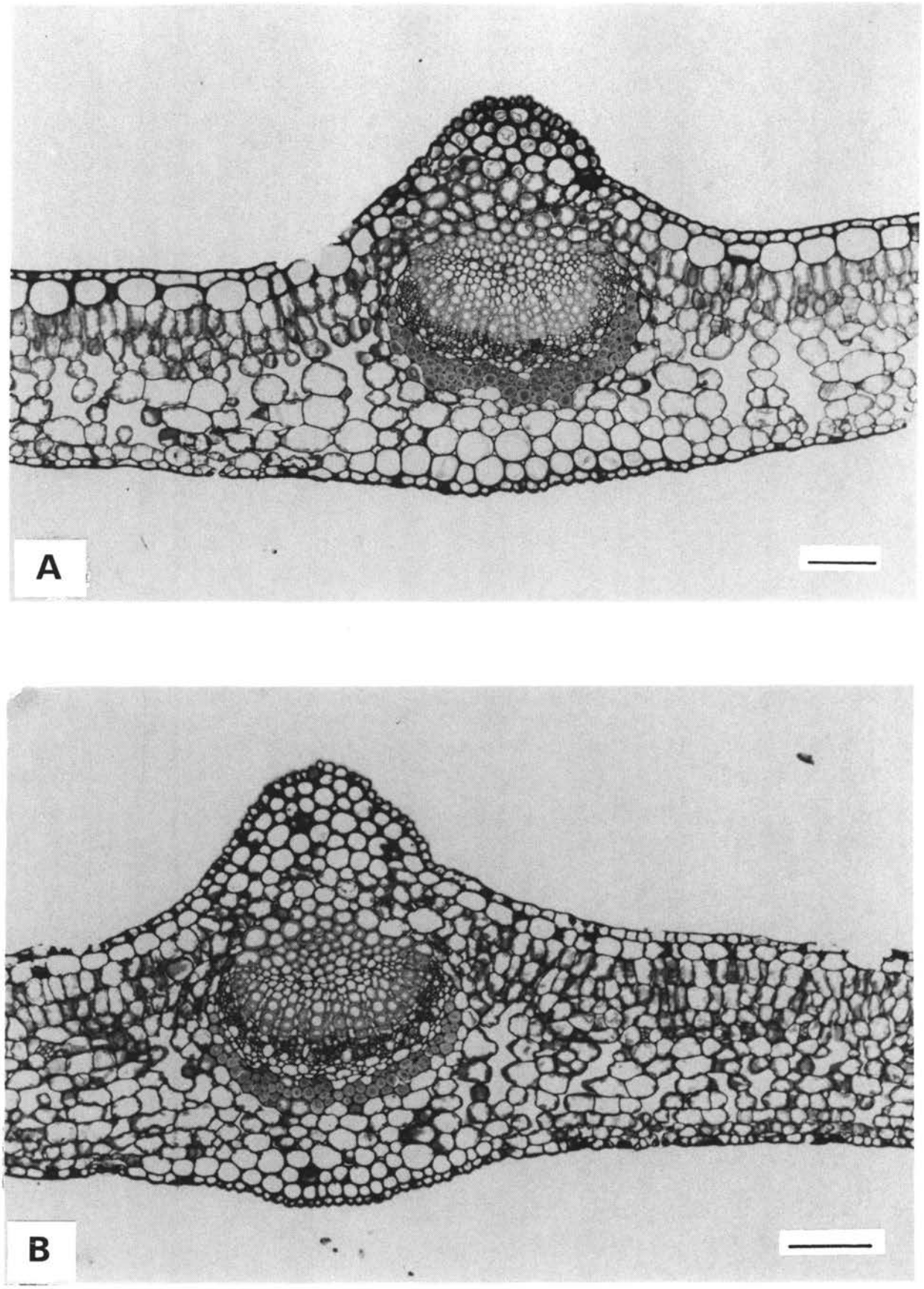


FIGURE 40.—Transverse sections of lamina. **A**, *Gymnosporia grandifolia* (*A1057 PU*); **B**, *Gymnosporia devenishii* (*Devenish 1579*). Scale bar: 10 μm.

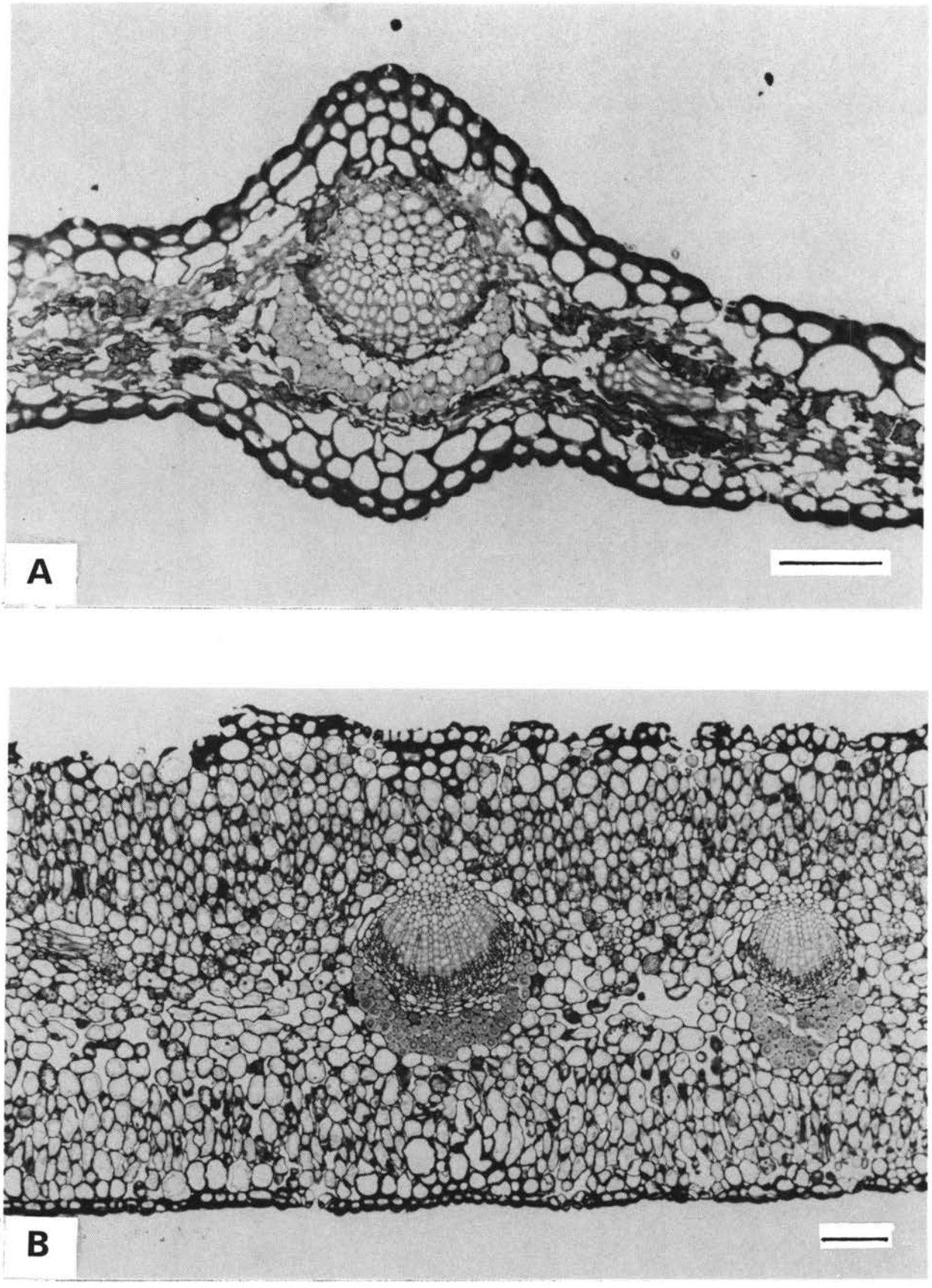


FIGURE 41.—Transverse sections of lamina. **A**, *Gymnosporia glaucophylla* (*Moll 2098*); **B**, *Gymnosporia karooica* (*Glen Kollege Herbarium 55*). Scale bar: 10 μm.

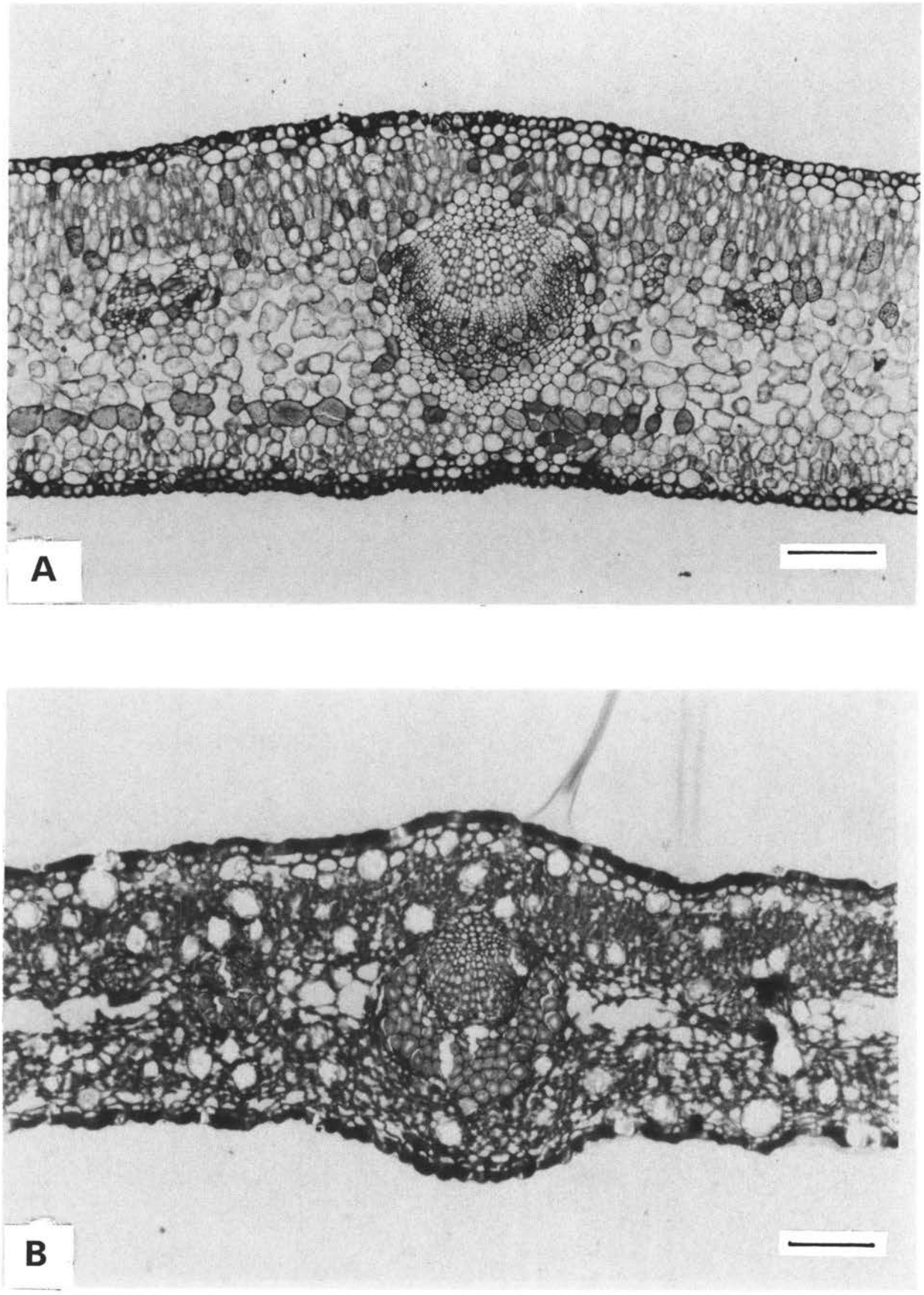


FIGURE 42.—Transverse sections of lamina. **A**, *Gymnosporia szyszylowczii* subsp. *szyszylowiczii* (*Jordaan 2273*); **B**, *G. szyszylowiczii* subsp. *namibiensis* (*Beuk 1074*). Scale bar: 10 μm.

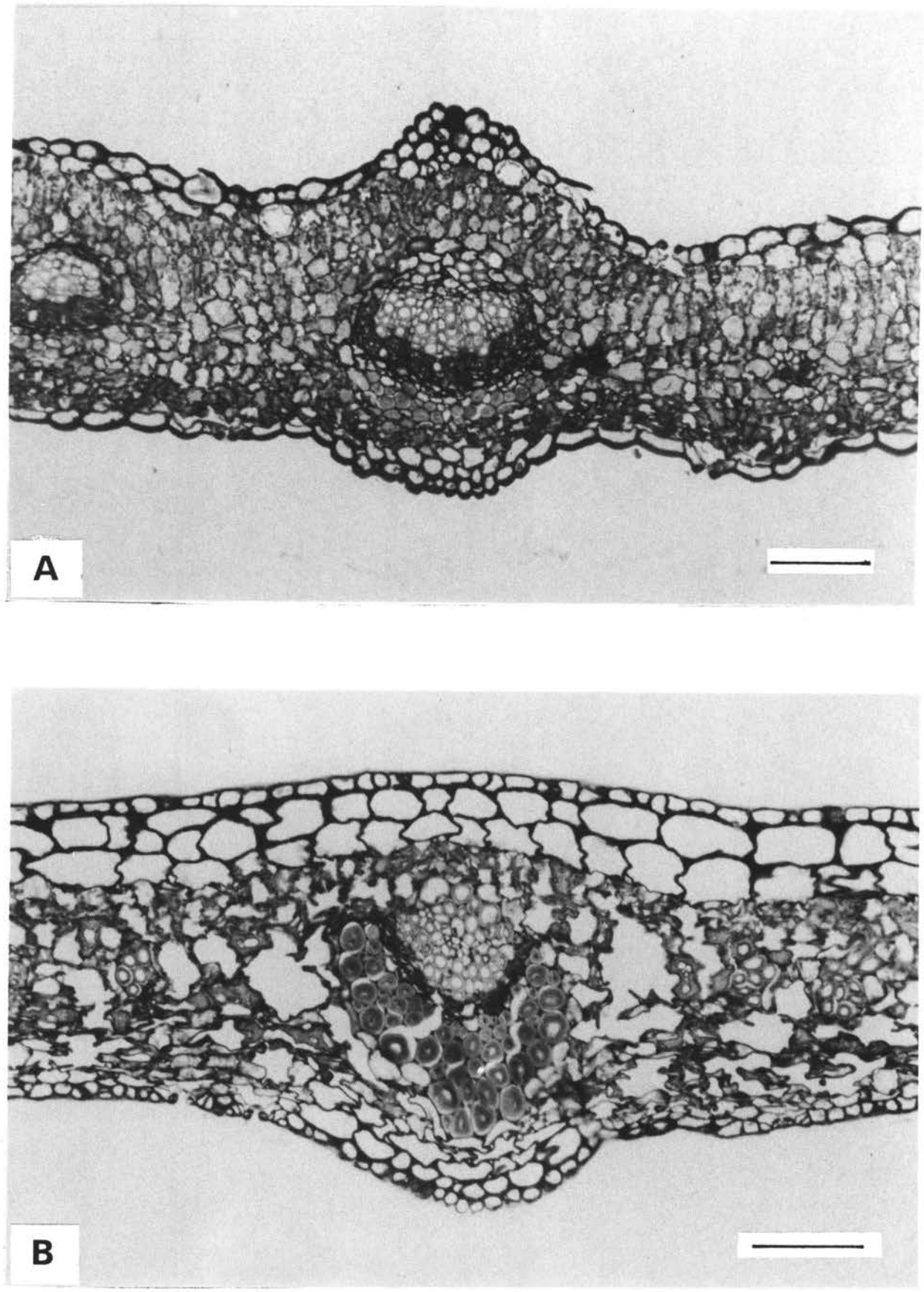


FIGURE 43.—Transverse sections of lamina. **A**, *Gymnosporia hemipterocarpa* (*Moll 5258*); **B**, *Gymnosporia arenicola* (*Kerfoot 7381*). Scale bar: 10 μm.

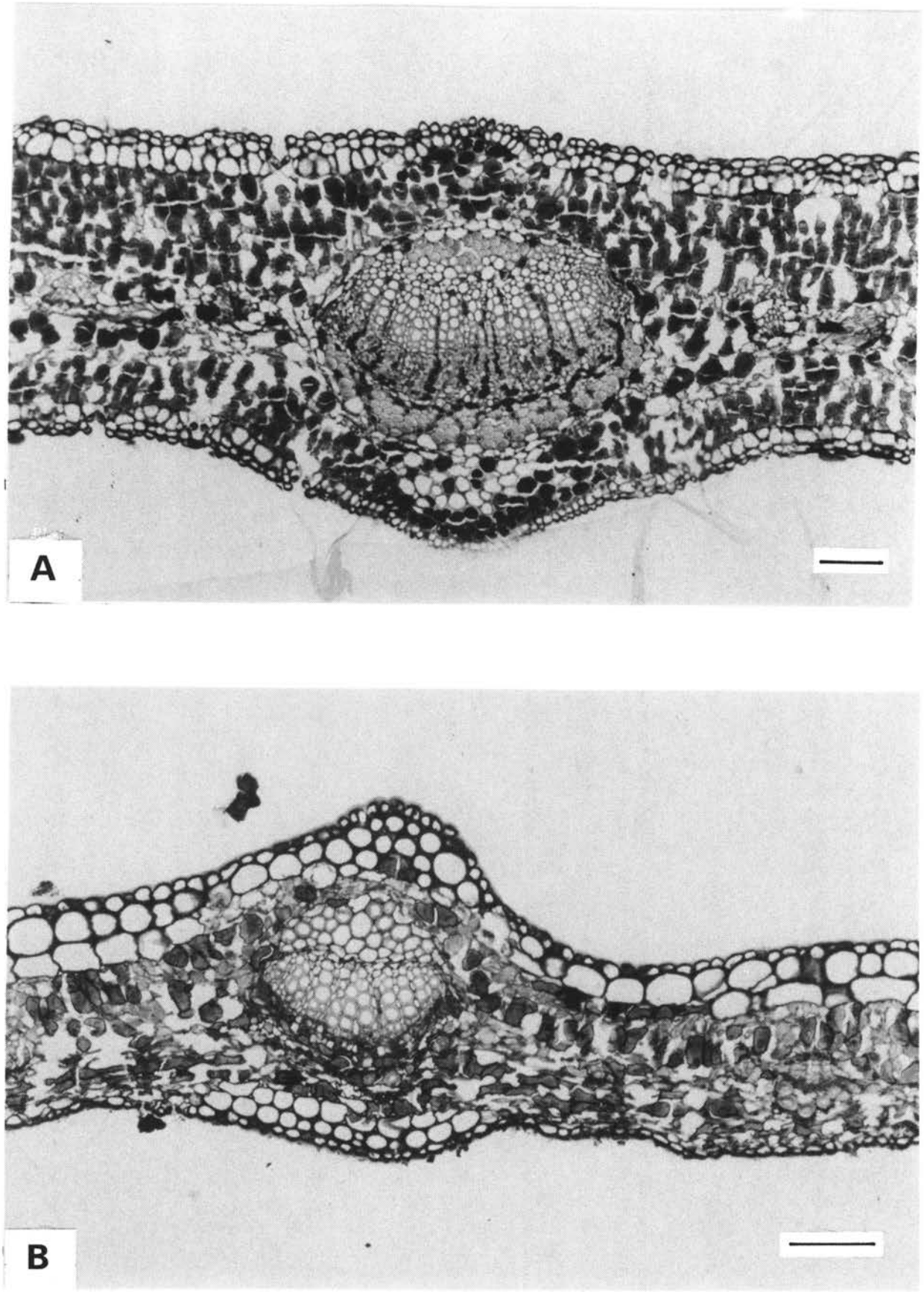


FIGURE 44.—Transverse sections of lamina. **A**, *Gymnosporia senegalensis* (*Buitendag 73*); **B**, *Gymnosporia markwardii* (*Feely & Ward 22*). Scale bar: 10 μm.

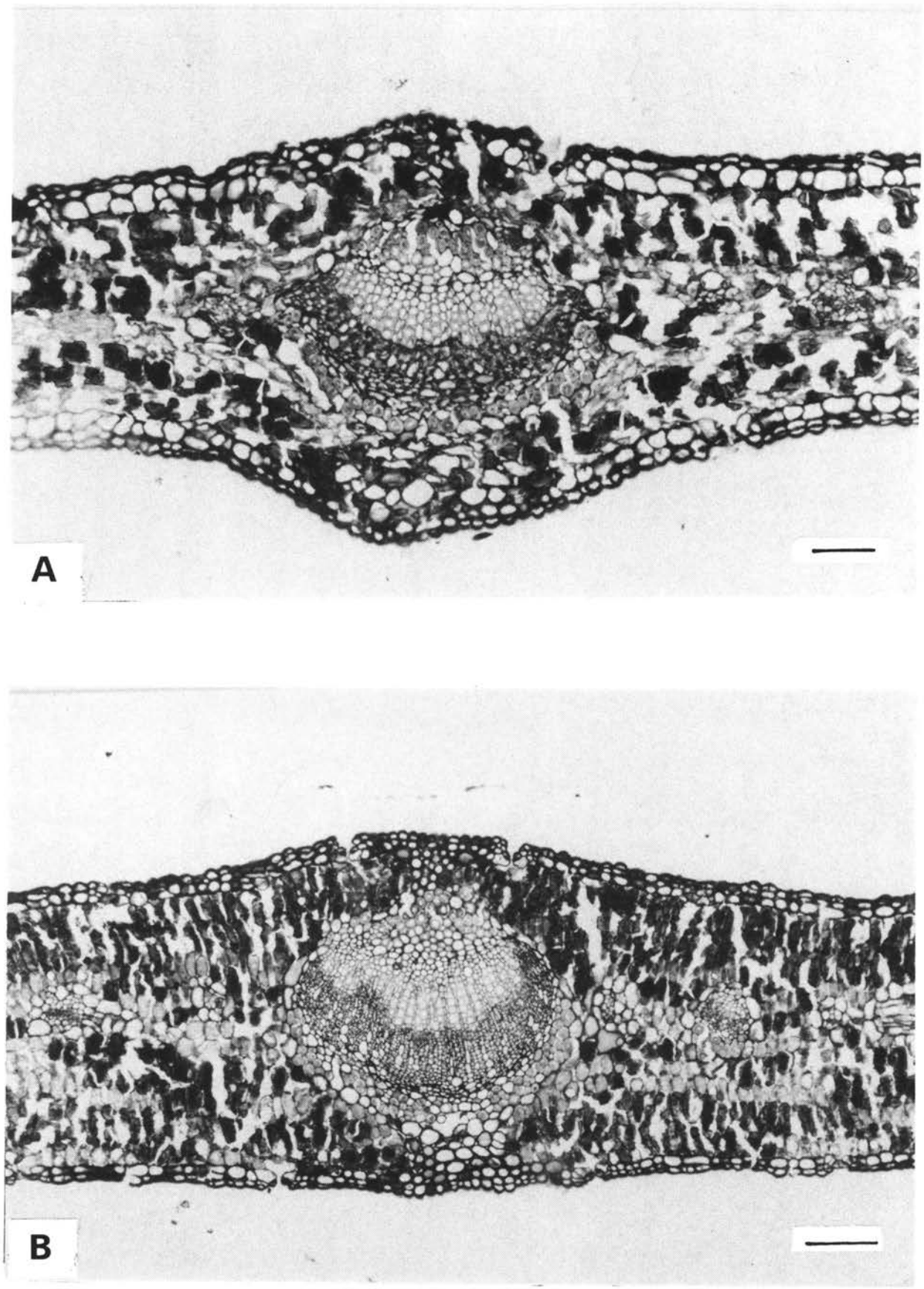


FIGURE 45.—Transverse sections of lamina. **A**, *Gymnosporia linearis* subsp. *linearis* (*Grobbelaar 2917*); **B**, *G. linearis* subsp. *lanceolata* (*Giess 32463*). Scale bar: 10 μm.

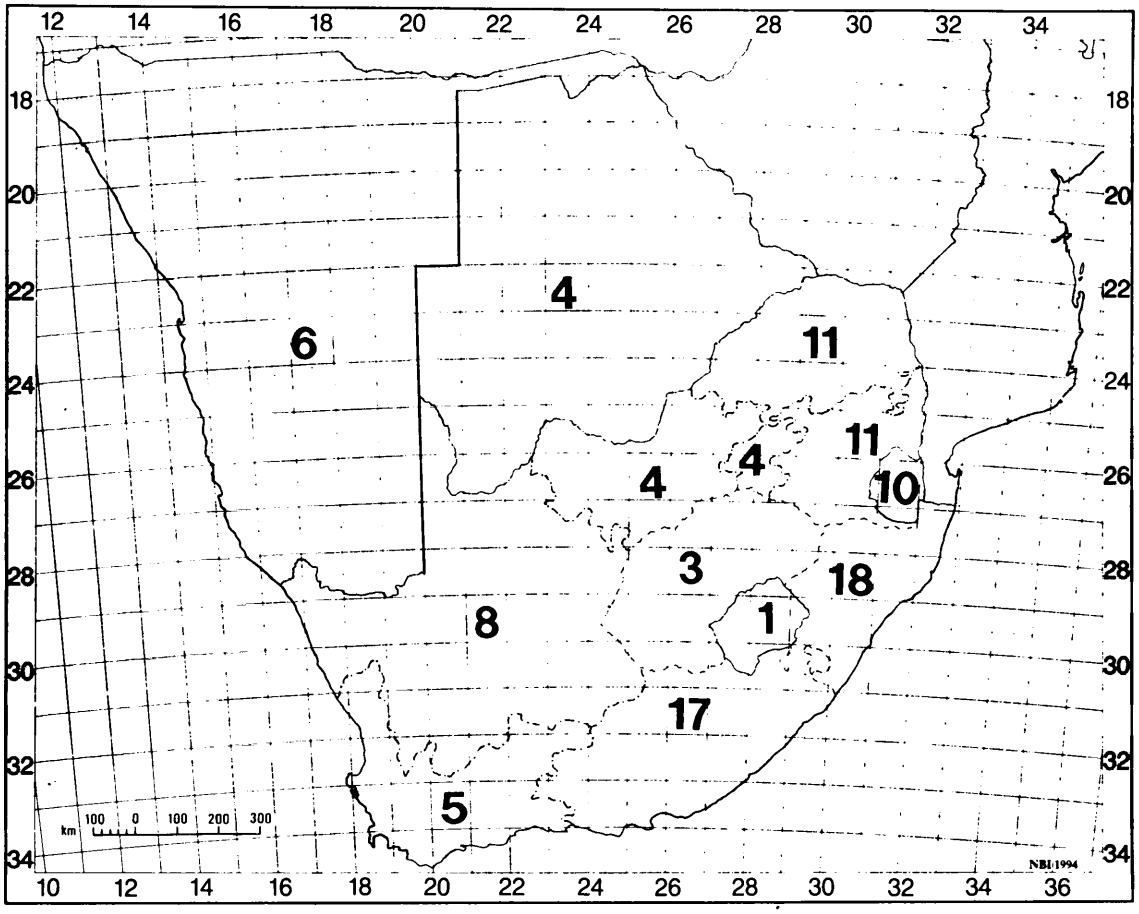


FIGURE 46.—Number of species occurring per province or country.

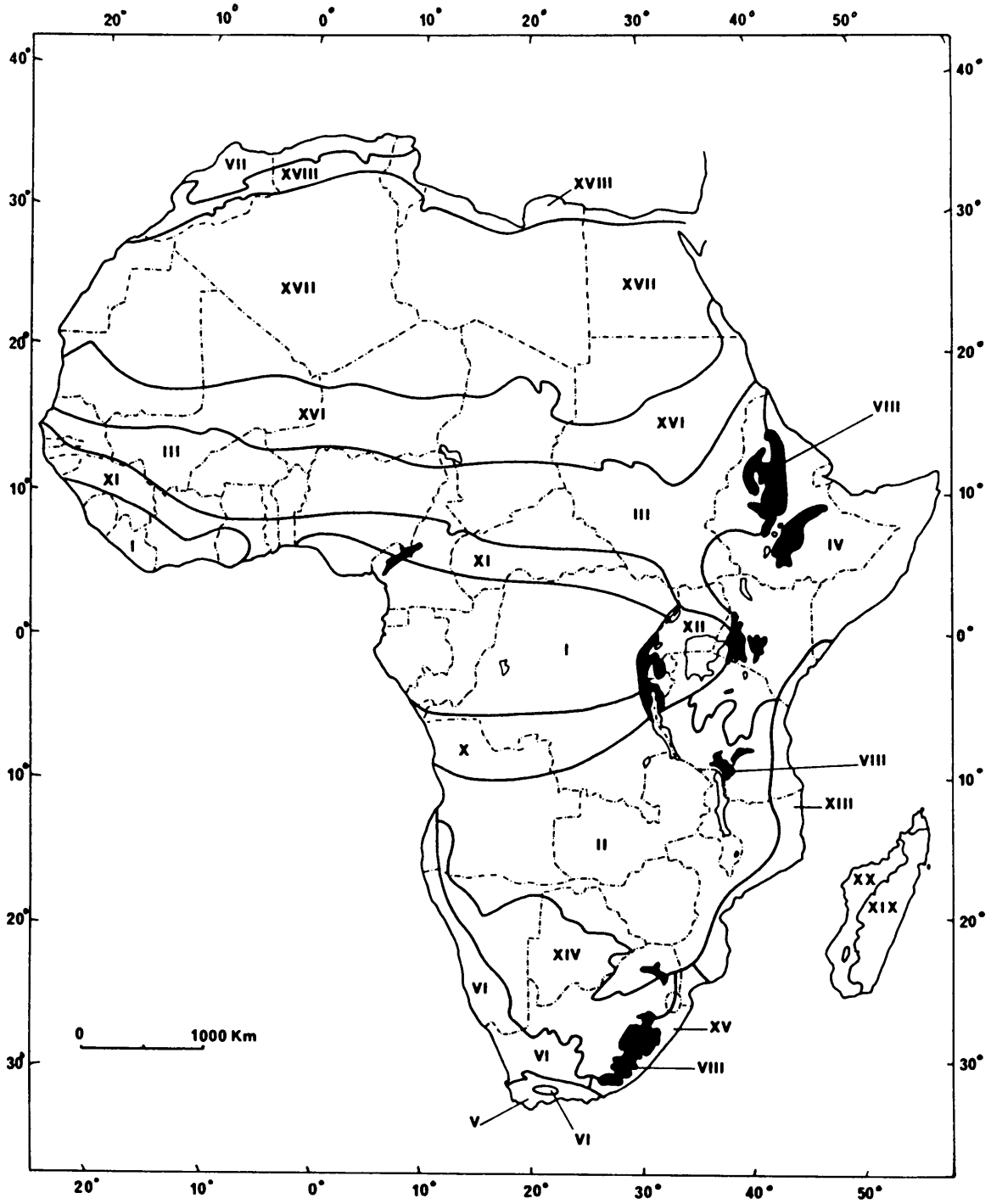


FIGURE 47.—Main phytochoria in southern Africa (according to White 1983)

II. Zambezian regional centre of edemism.
V. Cape regional centre of endemism.
VI. Karoo-Namib regional centre of edemism.
VIII. Afromontane archipelago-like regional centre of edemism.
XIV. Kalahari-Highveld regional transition zone.
XV. Tongaland-Pondoland regional mosaic.

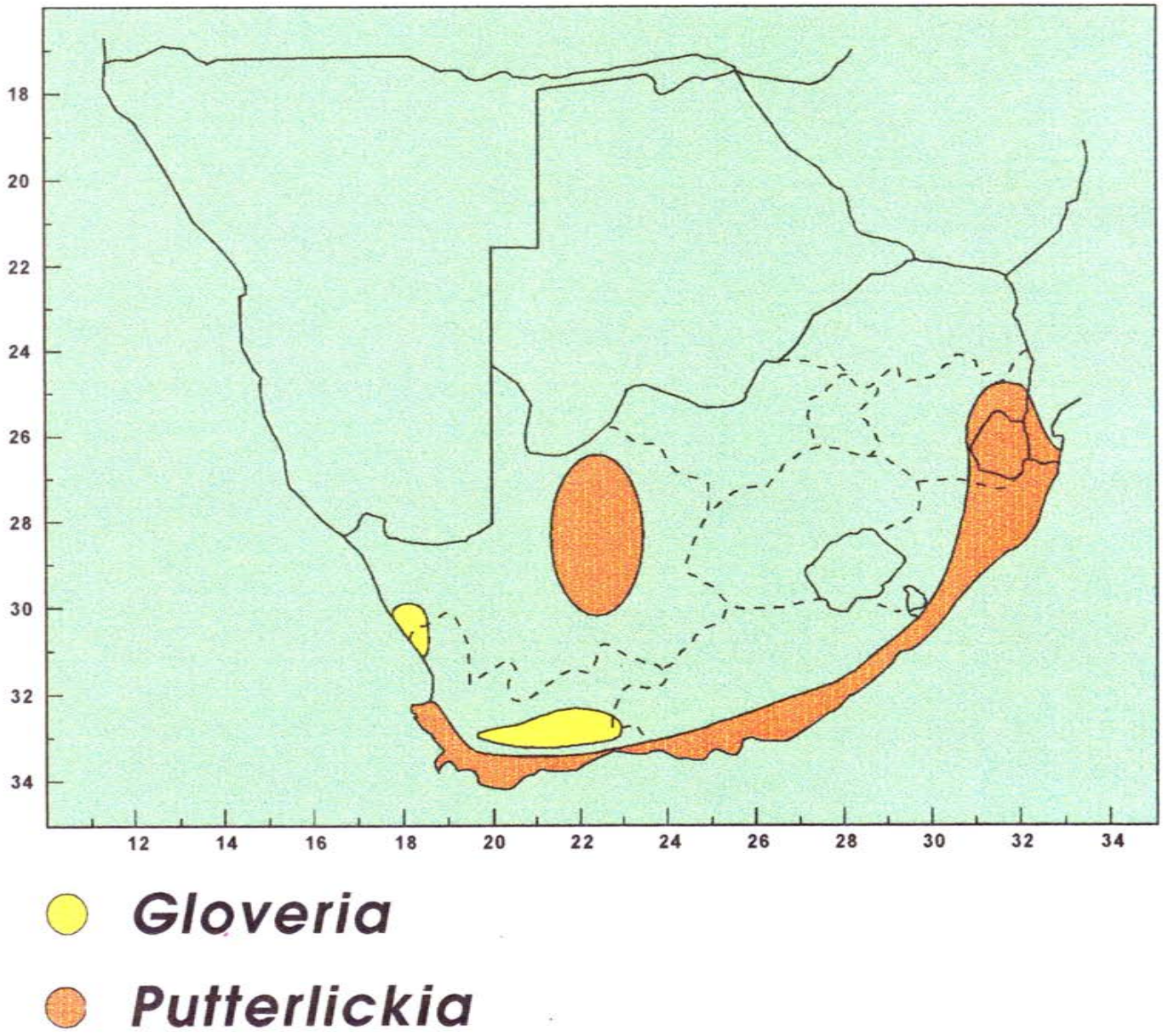


FIGURE 48.—Disjunct distribution patterns of *Gloveria* and *Putterlickia*.

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ie length 17 ci 76 ri 81 trees 1
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        ╚═17╣   ╔═5nem
            ╚═16╣   ╔═7pol
                ╚═15╬═9cap
                    ║   ╔═8bux
                    ╚═14╣   ╔═6pub
                        ╚═13╬═10ten
                            ║   ╔═2glo
                            ╚═12╩═11sen

*>
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FIGURE 49.—Cladistic computation using the ie* option based on the data matrix in Table 22 with *Putterlickia* as the outgroup.

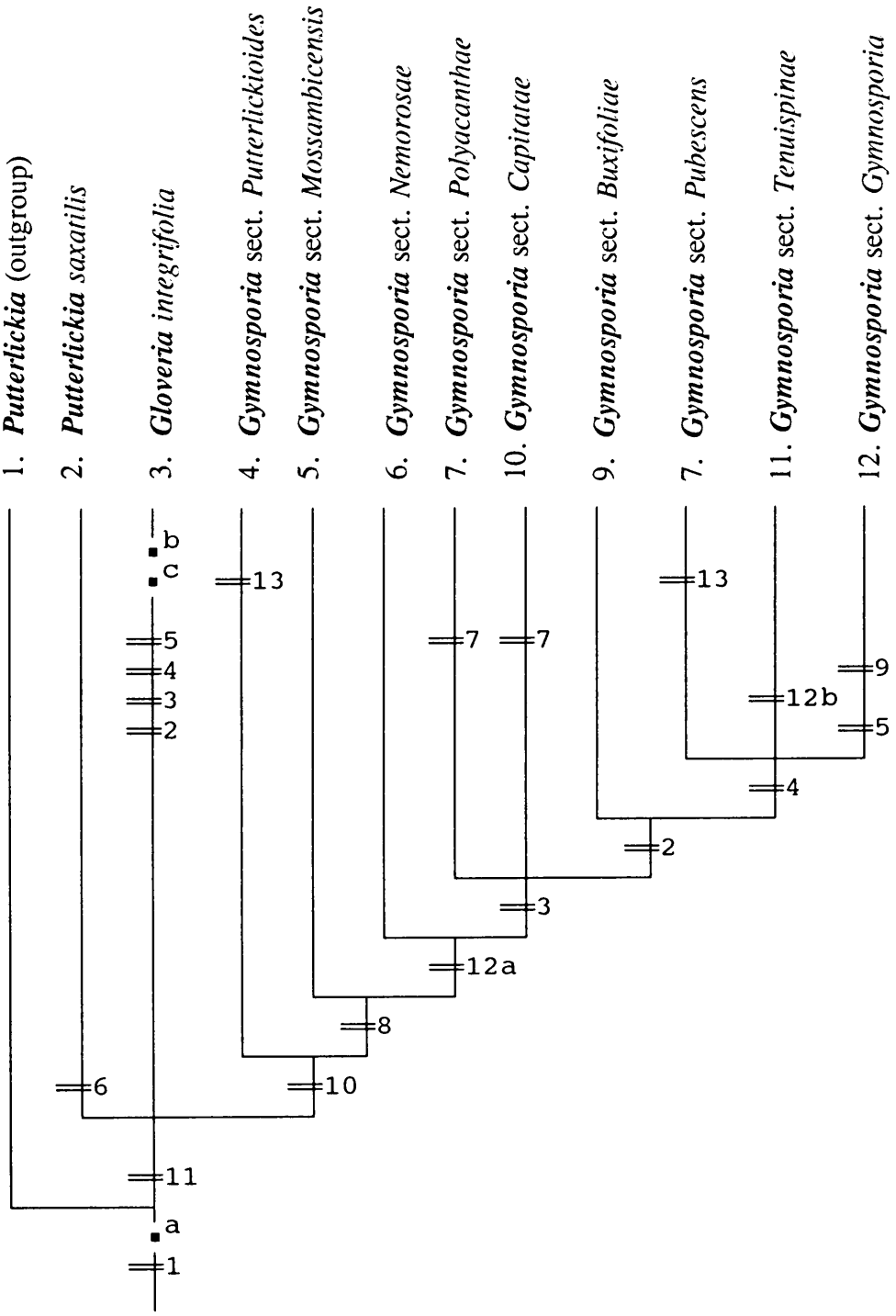

FIGURE 50.--Modified consensus tree of the species groups of the spiny members of the southern African Celastroideae. Characters are listed in Table 21.

═══ represents apomorphies
■ = additional distinct characters
a = inflorescence a dichasium or monochasium
b = oil droplets present in mesophyll
c = more than one node per spine

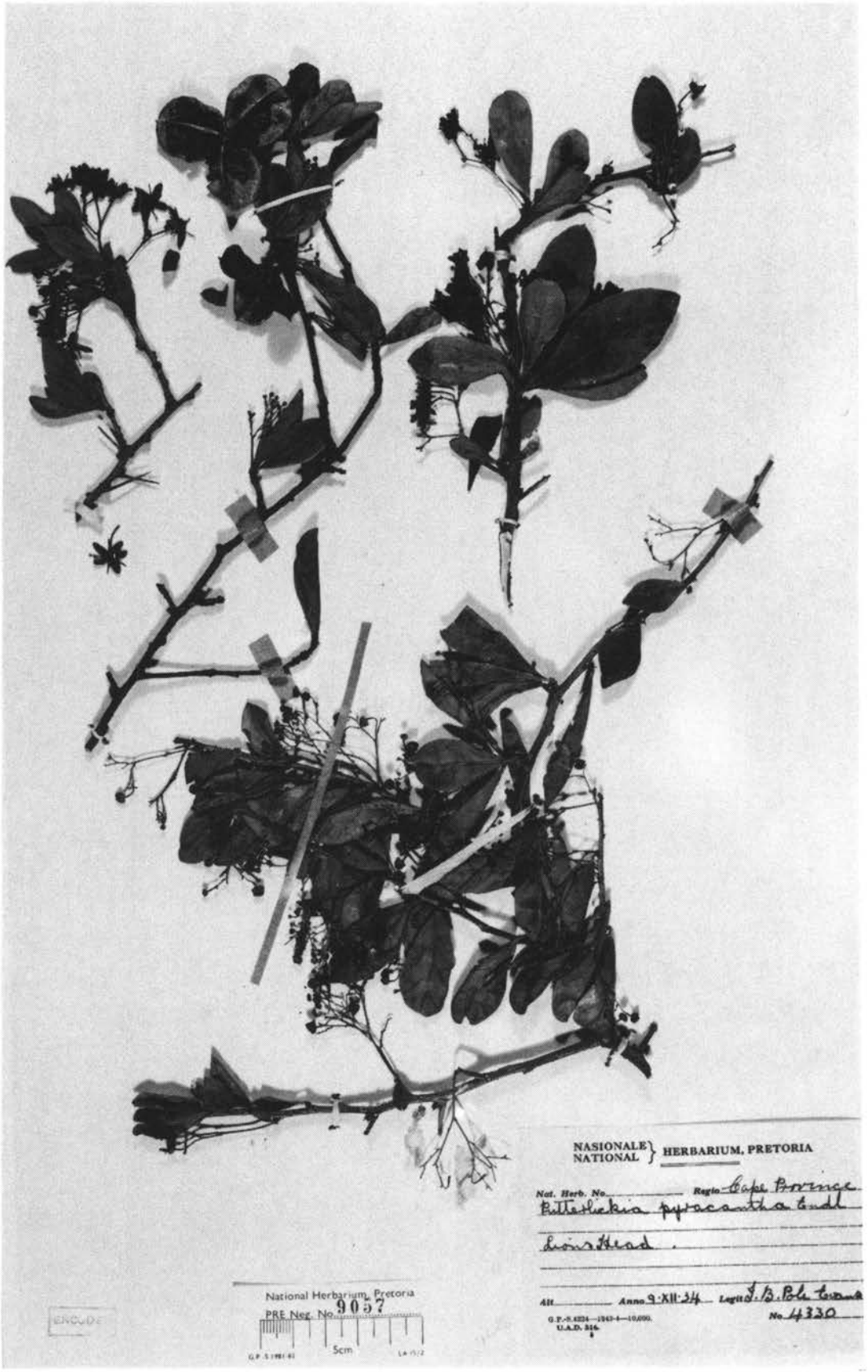

FIGURE 51.—*Putterlickia pyracantha*. Flowering branch [*Pole Evans 54330* (PRE)]. Magnification: x0.5.

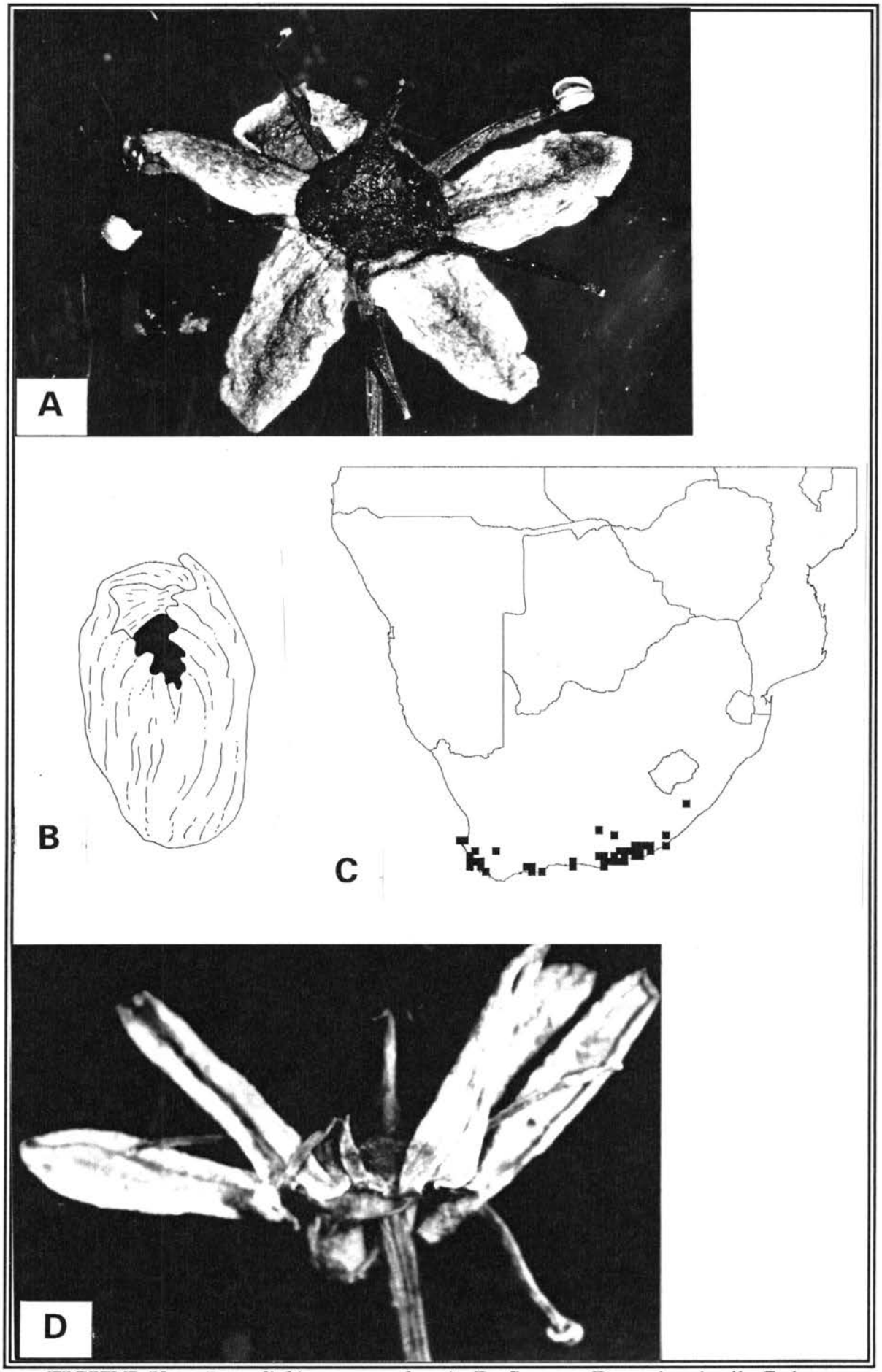

FIGURE 52.—*Putterlickia pyracantha*. **A**, **D**, flowers; **B**, seed and aril; **C**, known distribution. Magnification A, = x7; B = x4; D = x8.

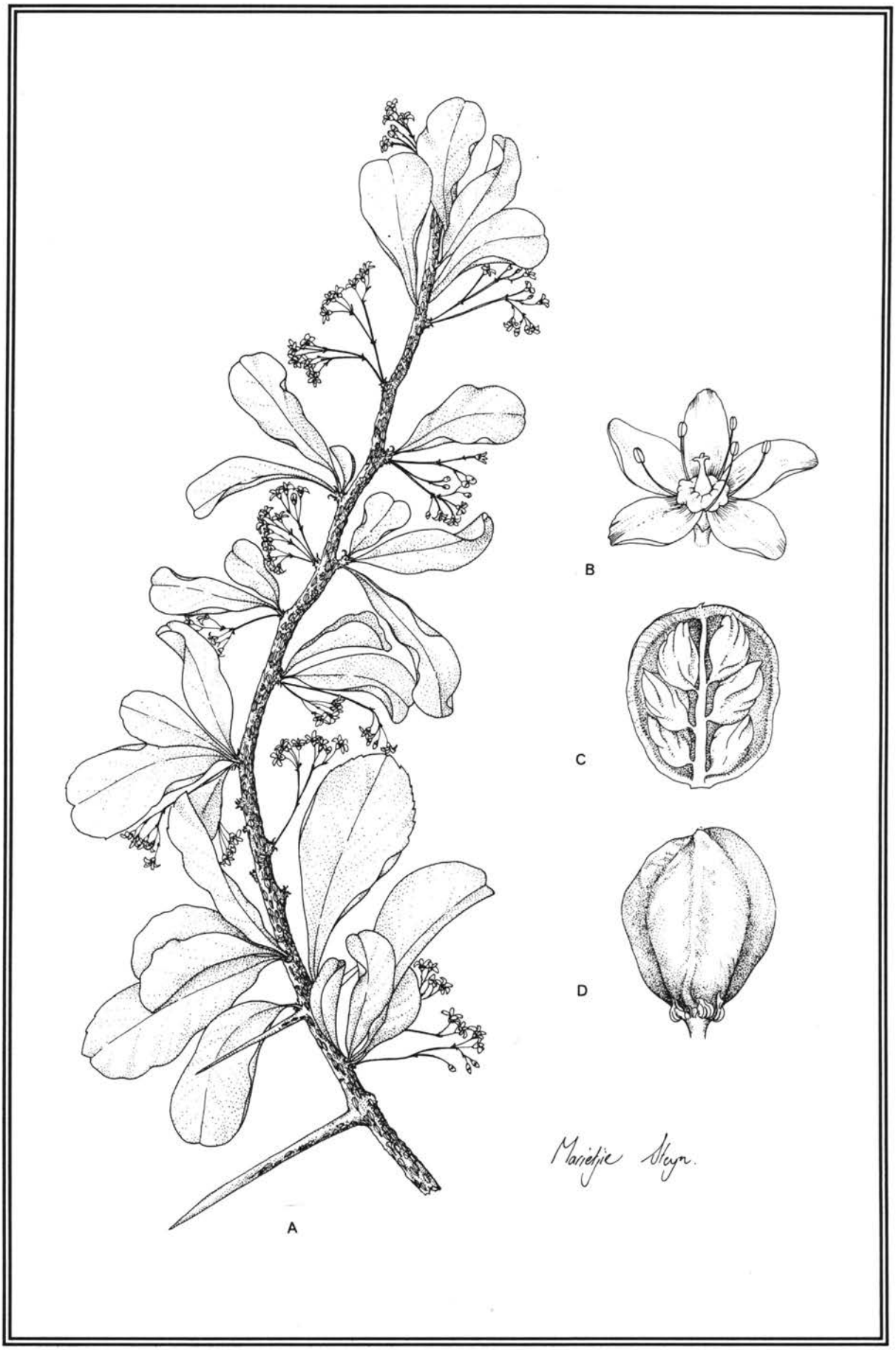

FIGURE 53.—*Putterlickia verrucosa*. **A**, flowering branch, drawn from plant growing in NBI-garden, Pretoria; **B**, flower; **C**, seed and aril; **D**, fruit. Magnification A = x0.81; B = x6; C, D = x3.

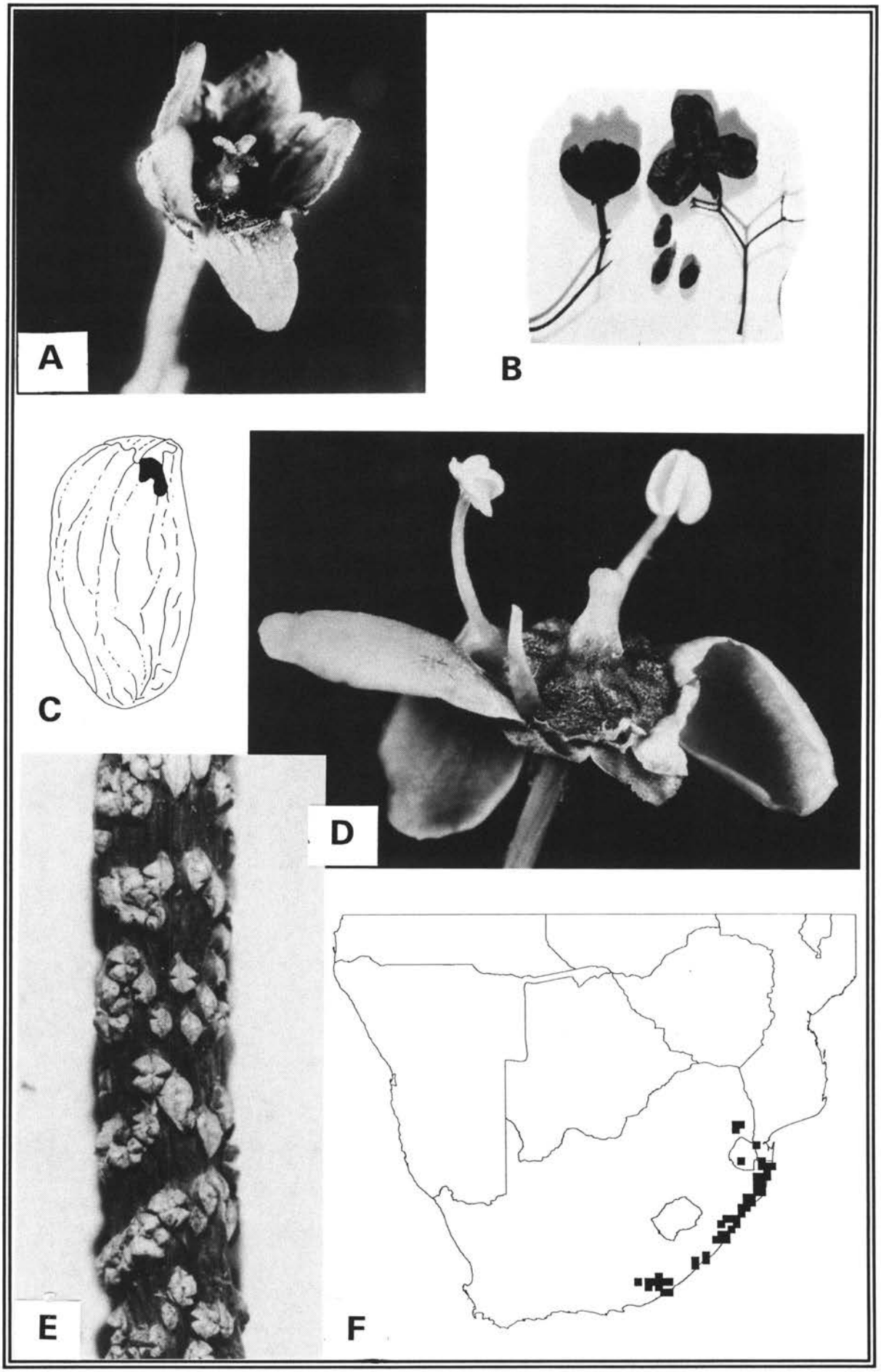

FIGURE 54.—*Putterlickia verrucosa*. **A**, **D**, flowers; **B**, fruit; **C**, seed and aril; **E**, bark of branch; **F**, known distribution. Magnification A = x10, B = 0.5x; C = x4; D = x10; E = x6.3.

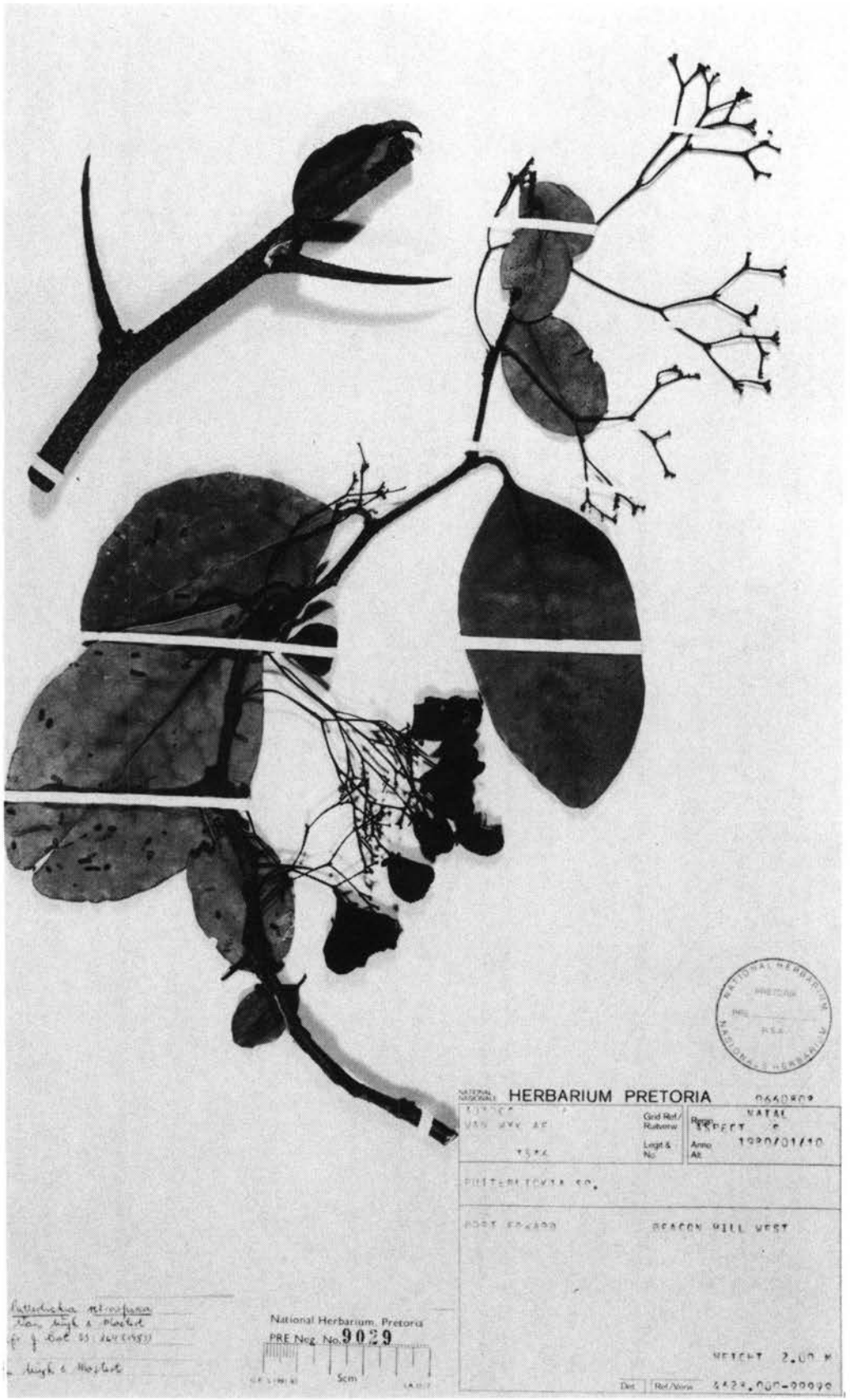

FIGURE 55.—*Putterlickia retrospinosa*. Fruiting branch [*A.E. van Wyk 3336* (PRE)]. Magnification x0.5.

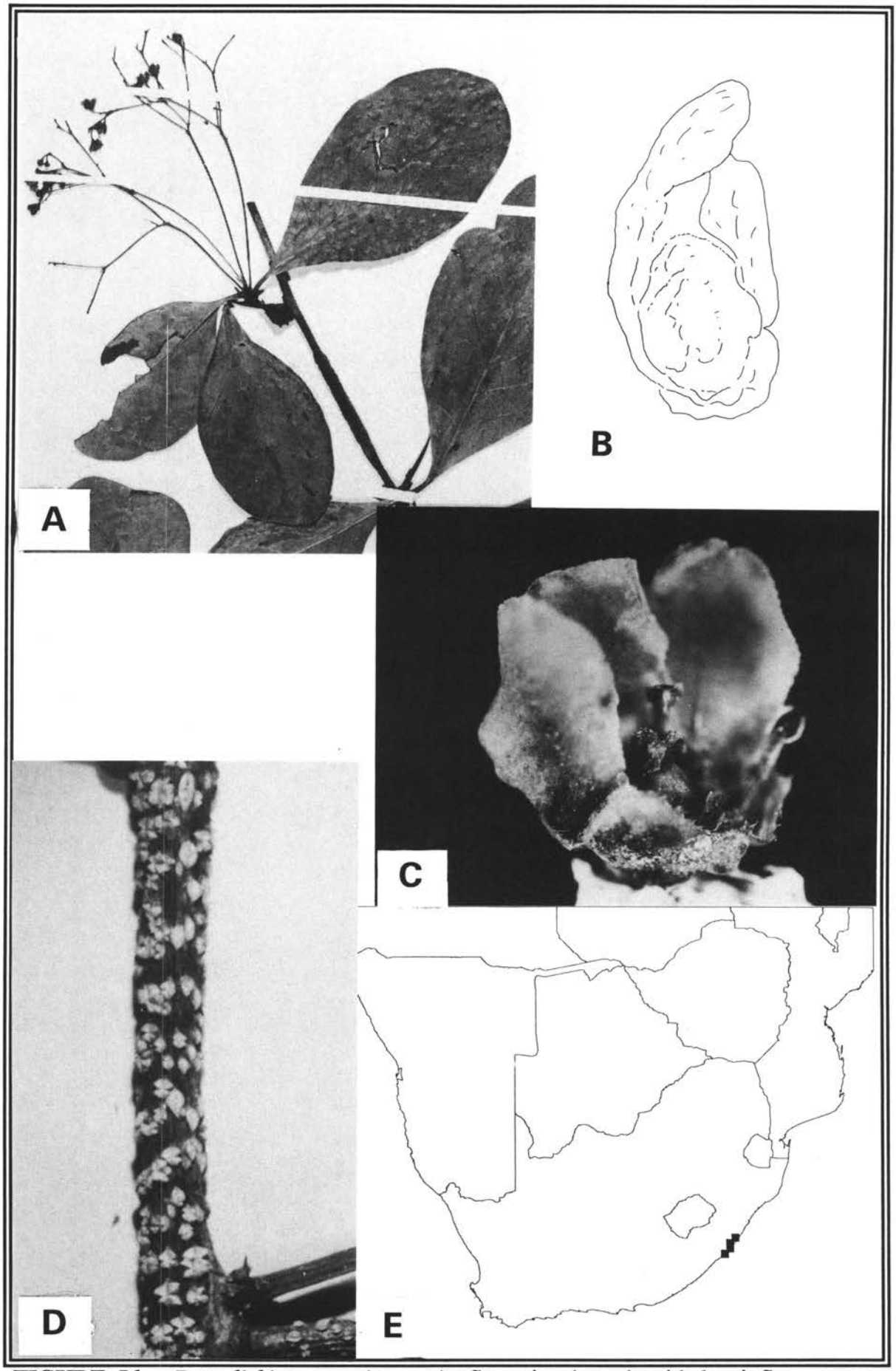

FIGURE 56.—*Putterlickia retrospinosa*. **A**, flowering branch with lax inflorescences [*Jordaan 1061* (NH)]; **B**, seed and aril; **C**, flower; **D**, bark of branch; **E**, known distribution. Magnification A = x0.5; B = x4; C = x12.5; E = x20.

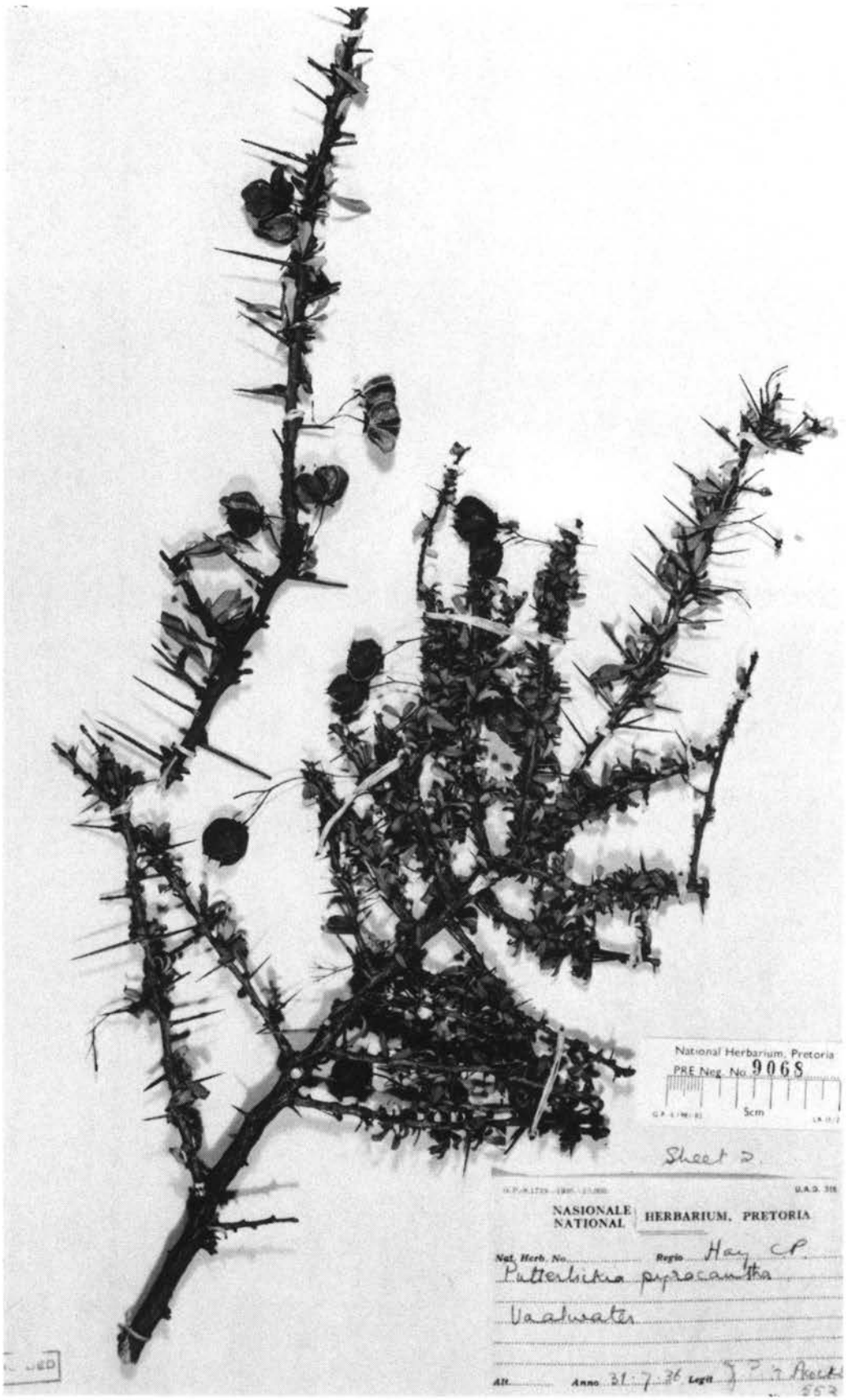

FIGURE 57.—*Putterlickia saxatilis*. Fruiting branch [*Acocks 553* (PRE)]. Magnification x0.5.

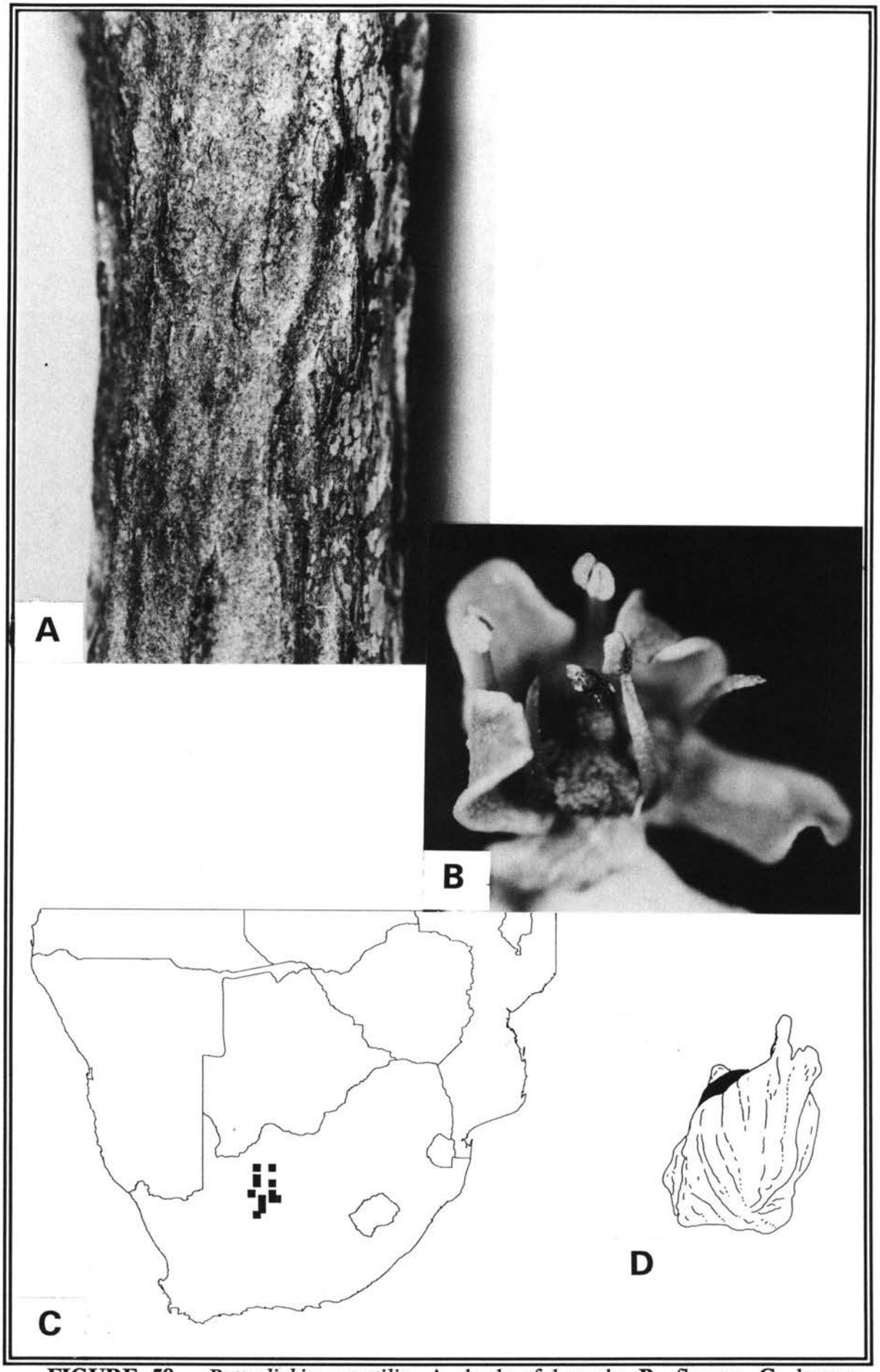

FIGURE 58.—*Putterlickia saxatilis*. **A**, bark of branch; **B**, flower; **C**, known distribution; **D**, seed and aril. Magnification A, B = x12.5; D = x4.

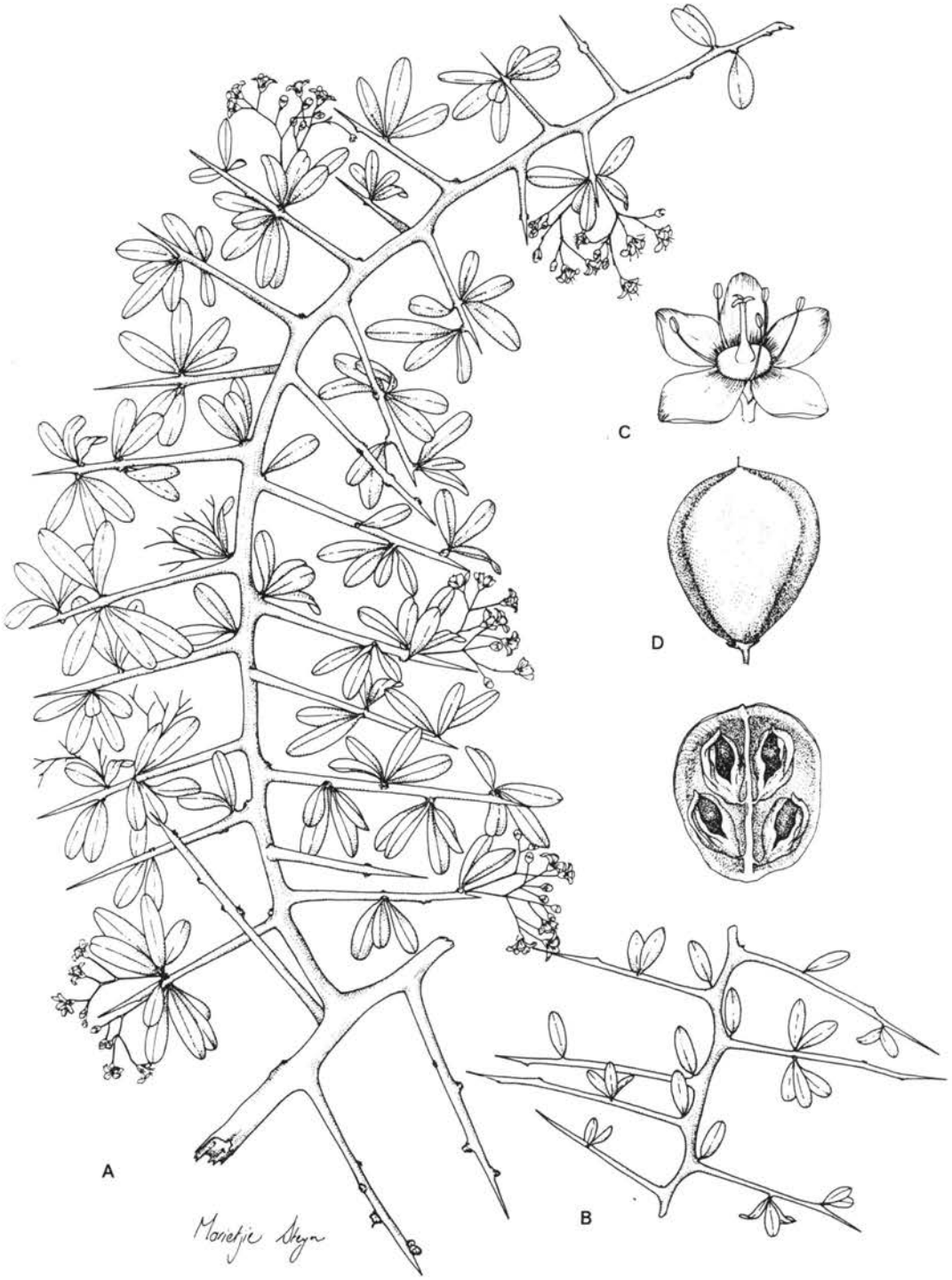

FIGURE 59.—*Gloveria integrifolia*. **A**, flowering branch [*Dahlstrand 1320* (J)]; **B**, young branchlet; **C**, flower; **D**, fruit; **E**, seed and aril. Magnification A, B = x0.7; C = x3; D, E, = x2.

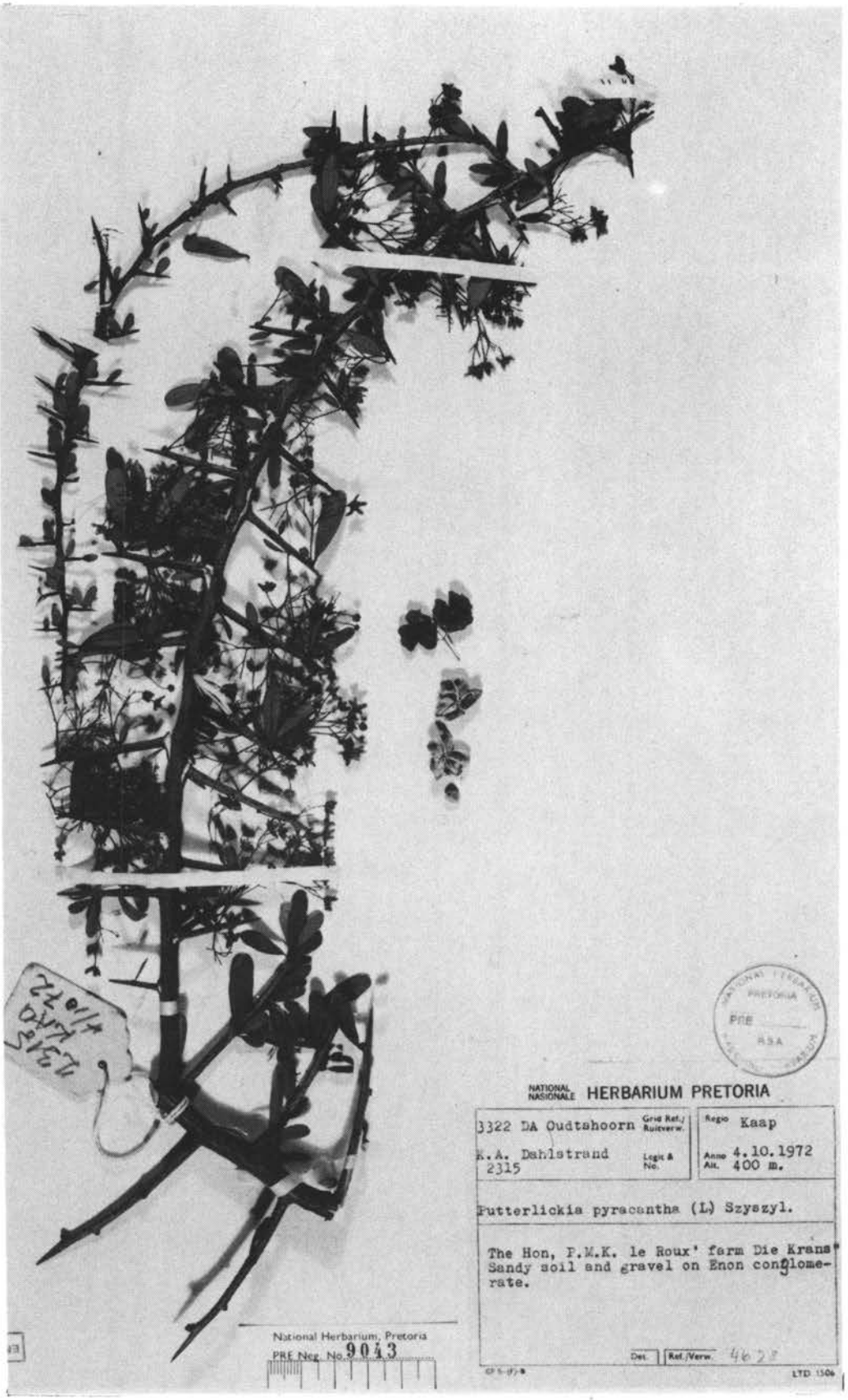

FIGURE 60.—*Gloveria integrifolia*. Flowering branch [*Dahlstrand 2315* (PRE)]. Magnification x0.5.

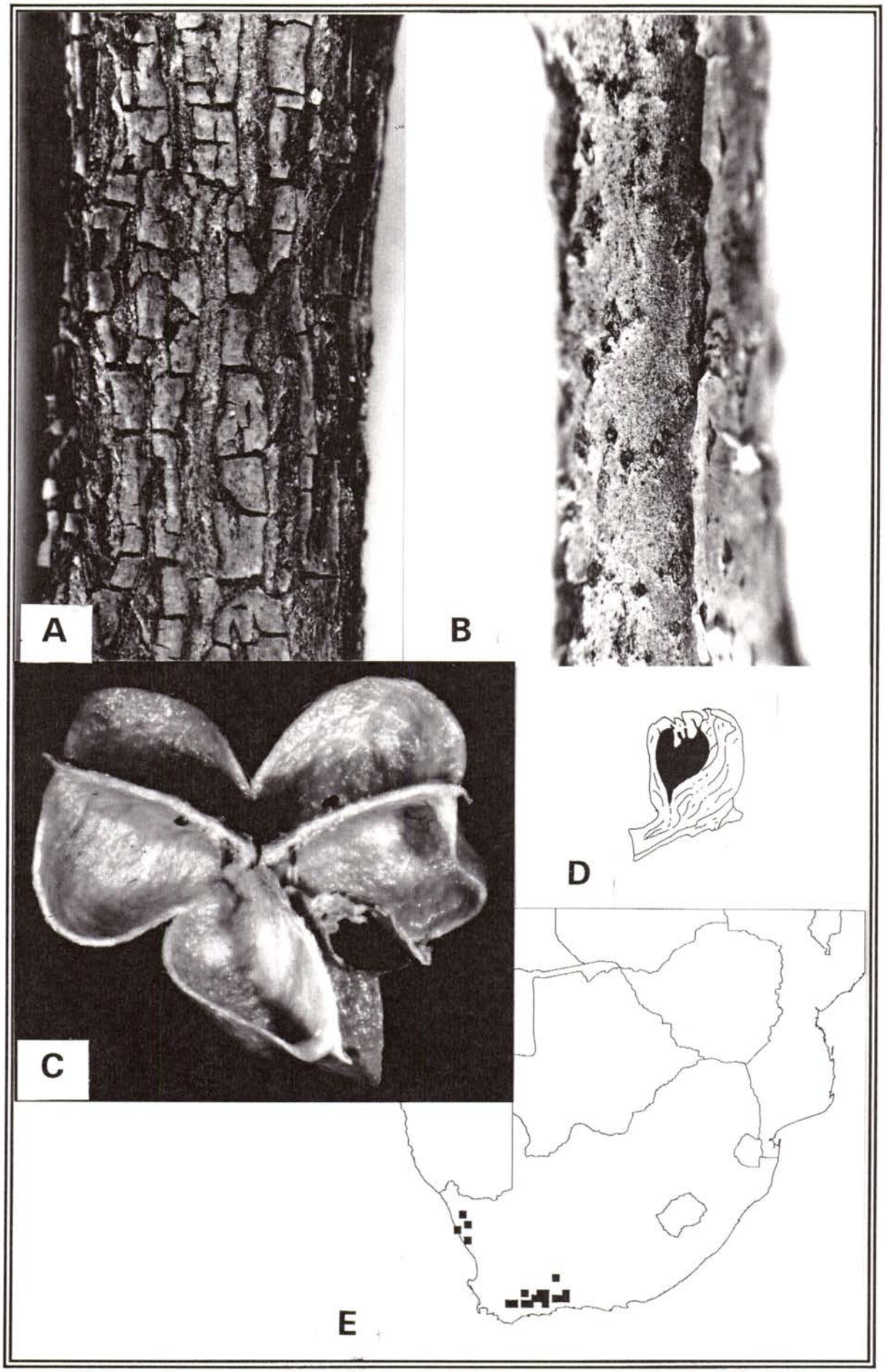

FIGURE 61.—*Gloveria integrifolia*. **A**, old bark of branch; **B**, younger bark of branch; **C**, fruit; **D**, seed and aril; **E**, known distribution. Magnification A = x10; B = x2.5; C = x5; D =x4.

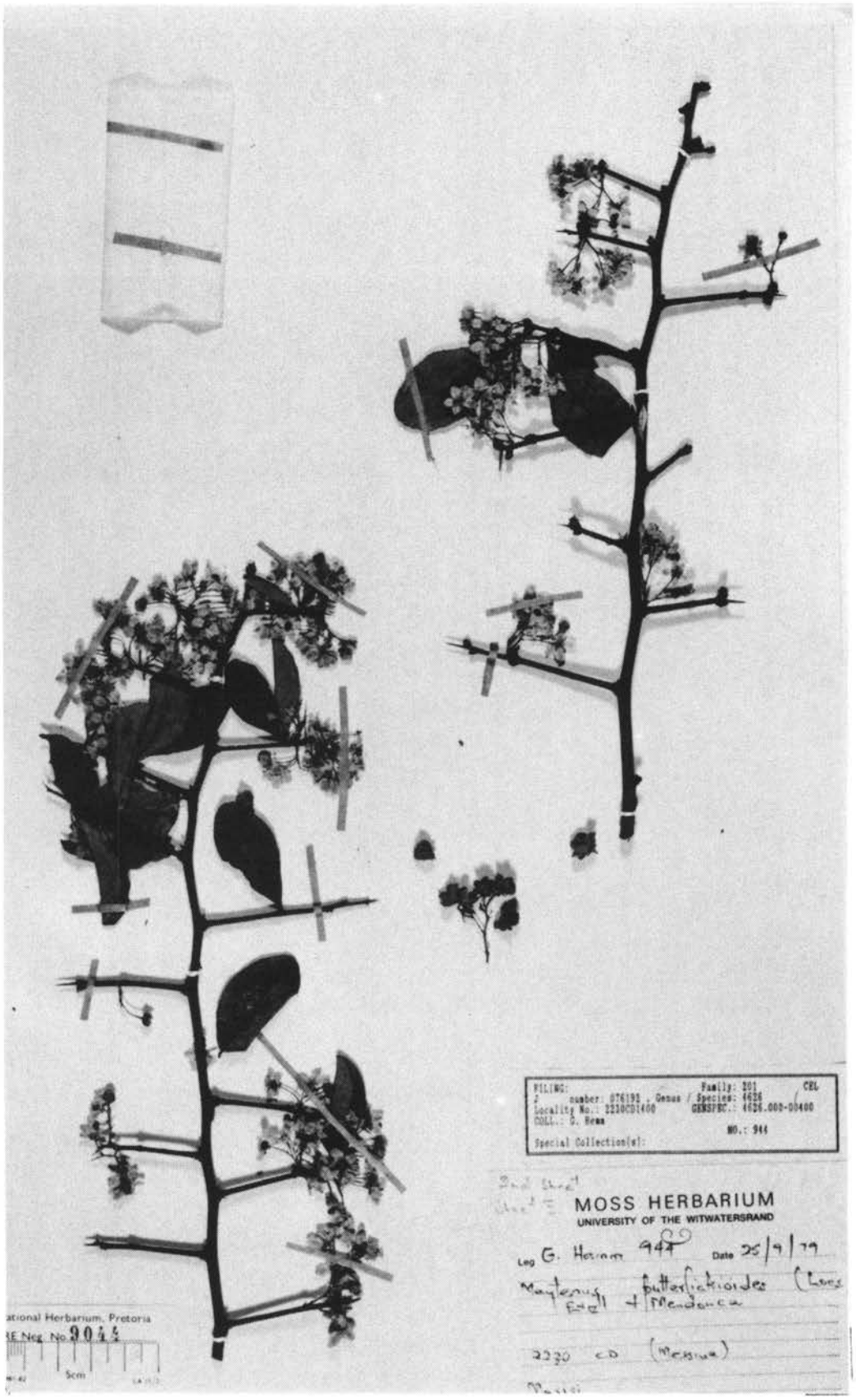

FIGURE 62.—*Gymnosporia putterlickioides*. Flowering branch [*Hemm 944* (J)]. Magnification x0.5.

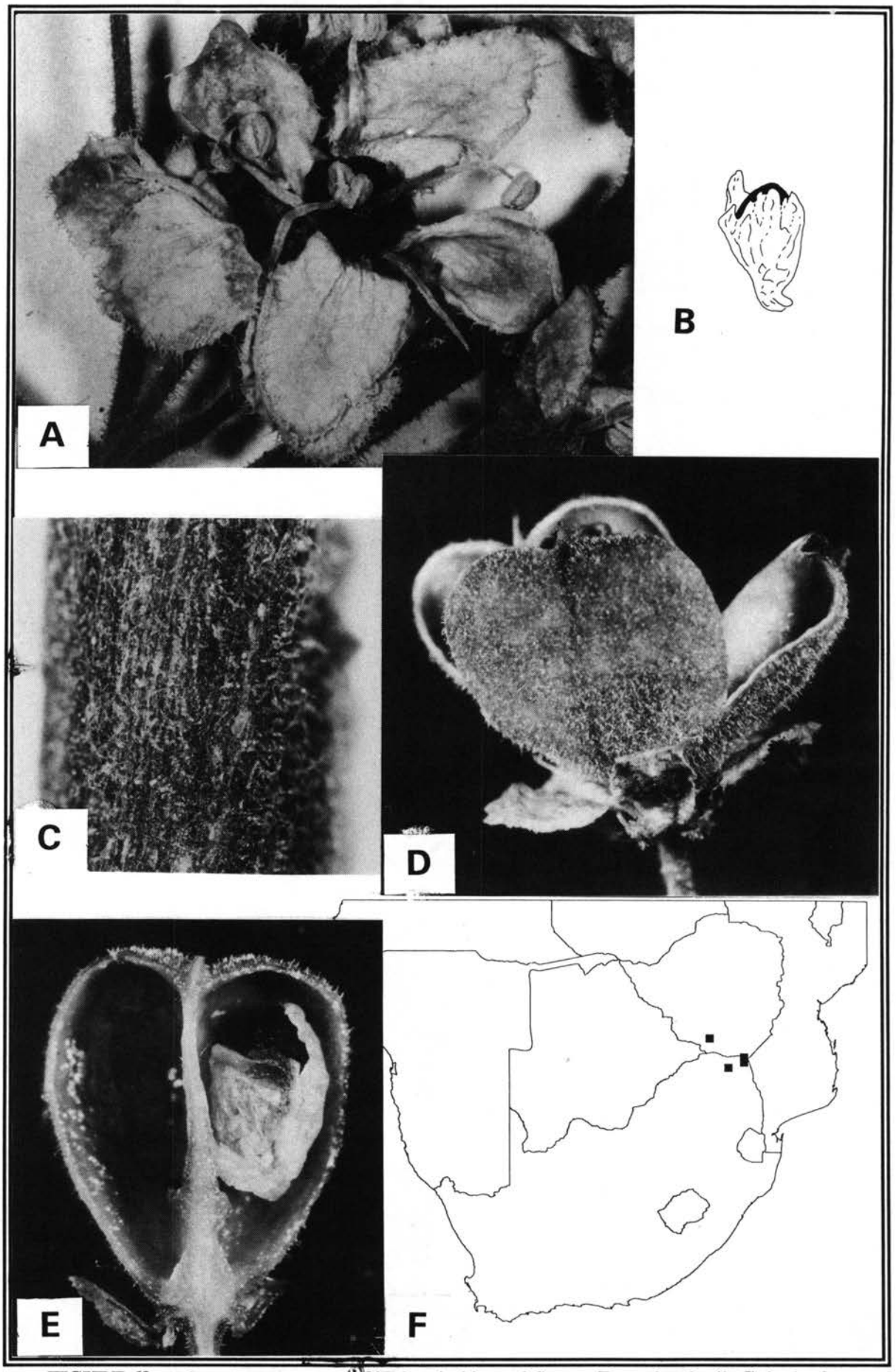

FIGURE 63.—*Gymnosporia putterlickioides*. **A**, bisexual flower; **B**, seed and aril; **C**, bark of branch; **D**, fruit; **E**, seed and aril in capsule; **F**, known distribution. Magnification A, D, E = x8; B = x4; C = x20.

FIGURE 64.—*Gymnosporia mossambicensis*. Flowering branch [*De Winter 9385* (PRE) (neotype)]. Magnification x0.5.

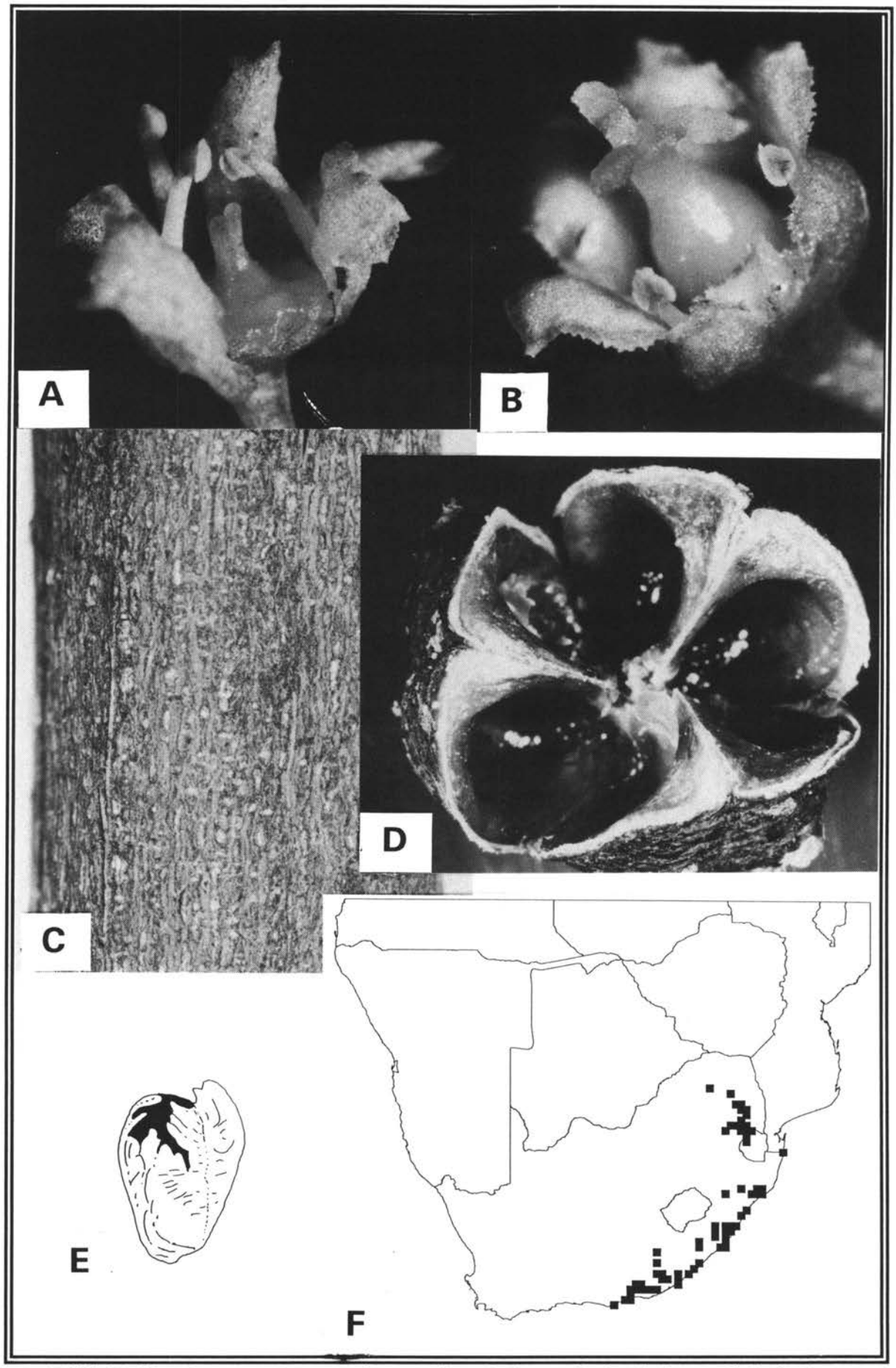

FIGURE 65.—*Gymnosporia mossambicensis*. **A**, male flower; **B**, female flower; **C**, bark of branch; **D**, fruit; **E**, seed and aril; **F**, known distribution. Magnification A, B = x20; C = x6.3; D = x8; E = x4.

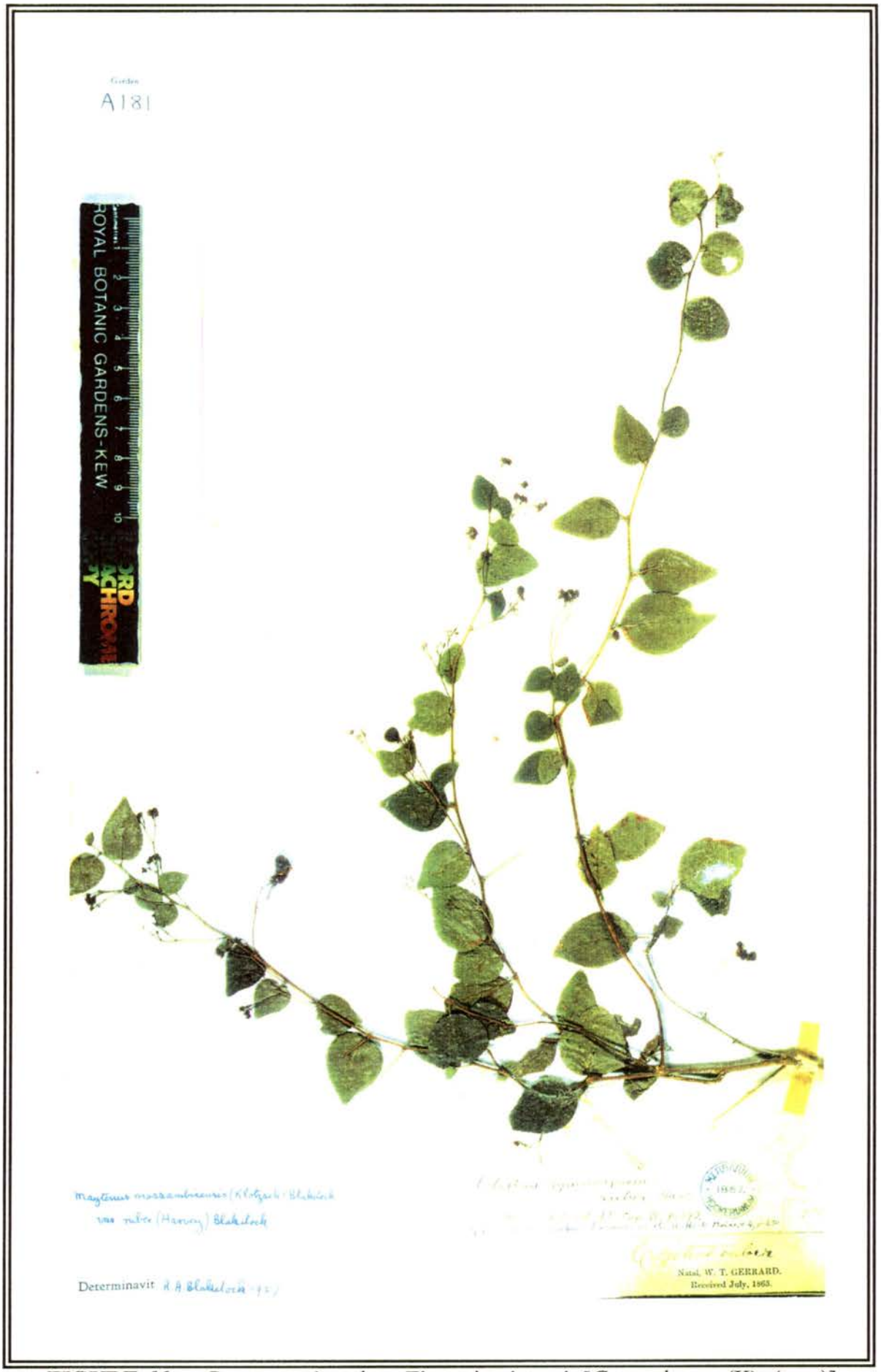

FIGURE 66.—*Gymnosporia rubra*. Flowering branch [*Gerrard s.n.* (K) (type)]. Magnification x ±0.5.

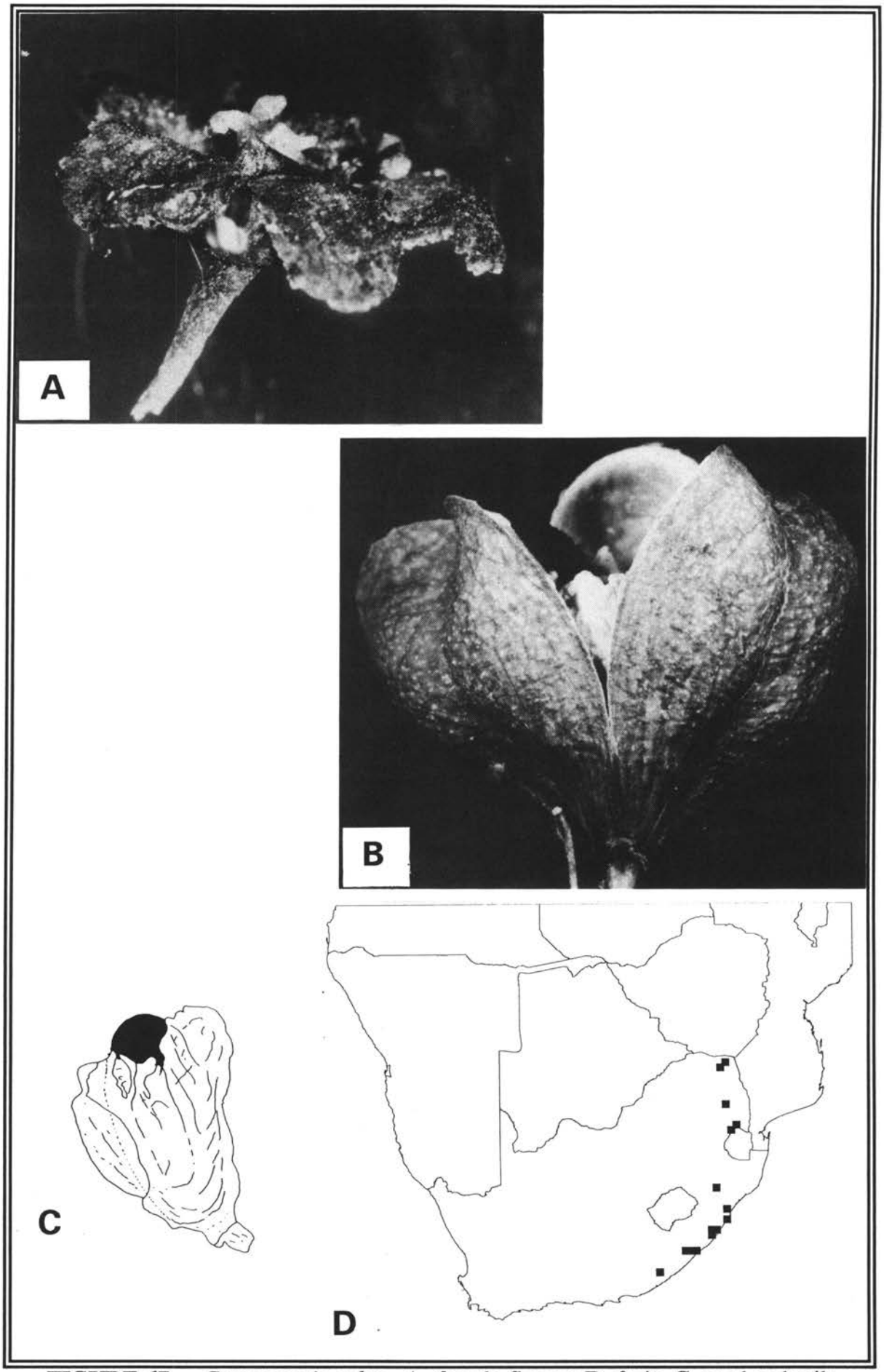

FIGURE 67.—*Gymnosporia rubra*. **A**, female flower; **B**, fruit; **C**, seed and aril; **D**, known distribution. Magnification A, C = x6.3; B = x25; D = x4.

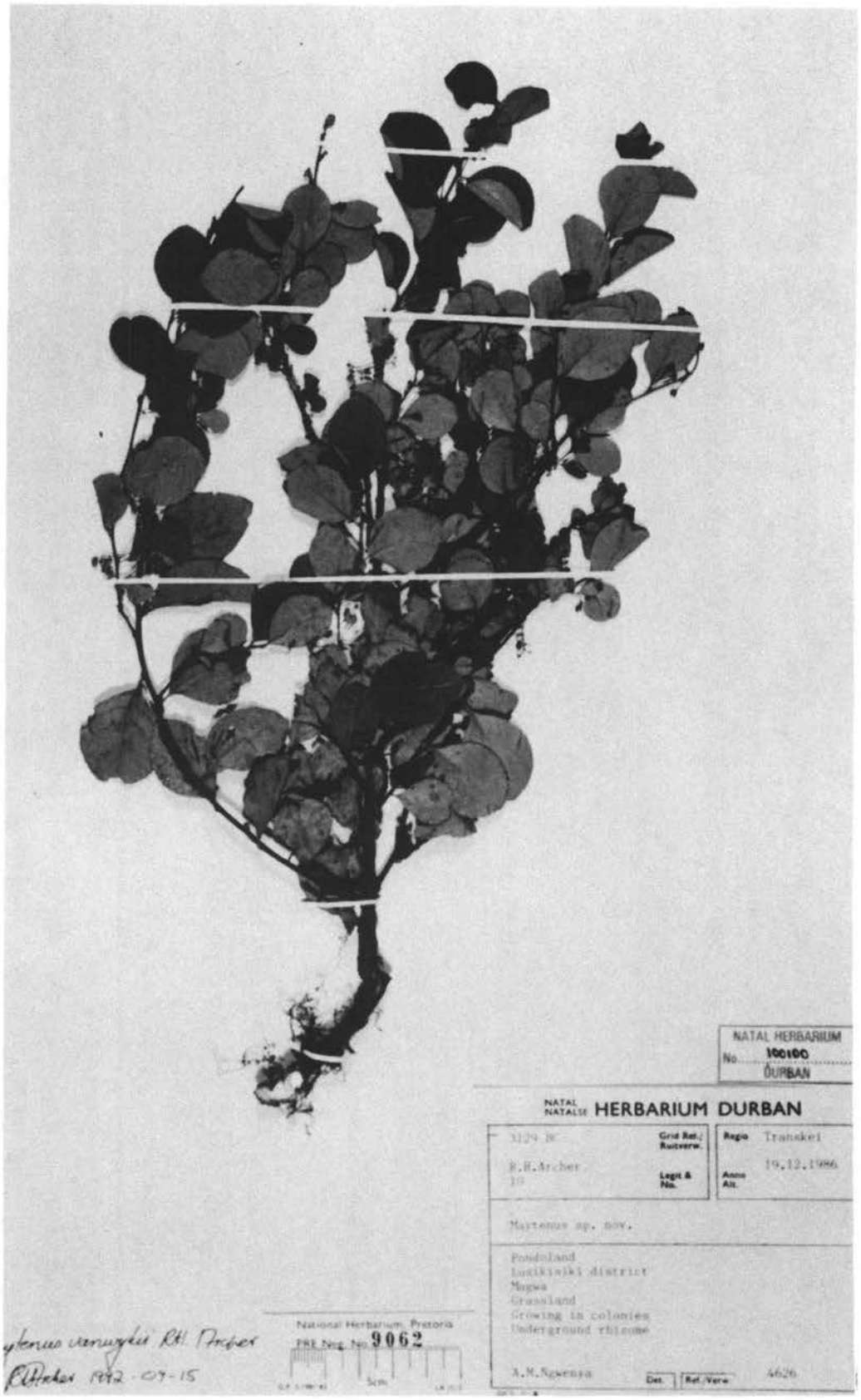

FIGURE 68.—*Gymnosporia vanwykii*. Flowering branch [*Archer 10* (NH)]. Magnification x0.5.

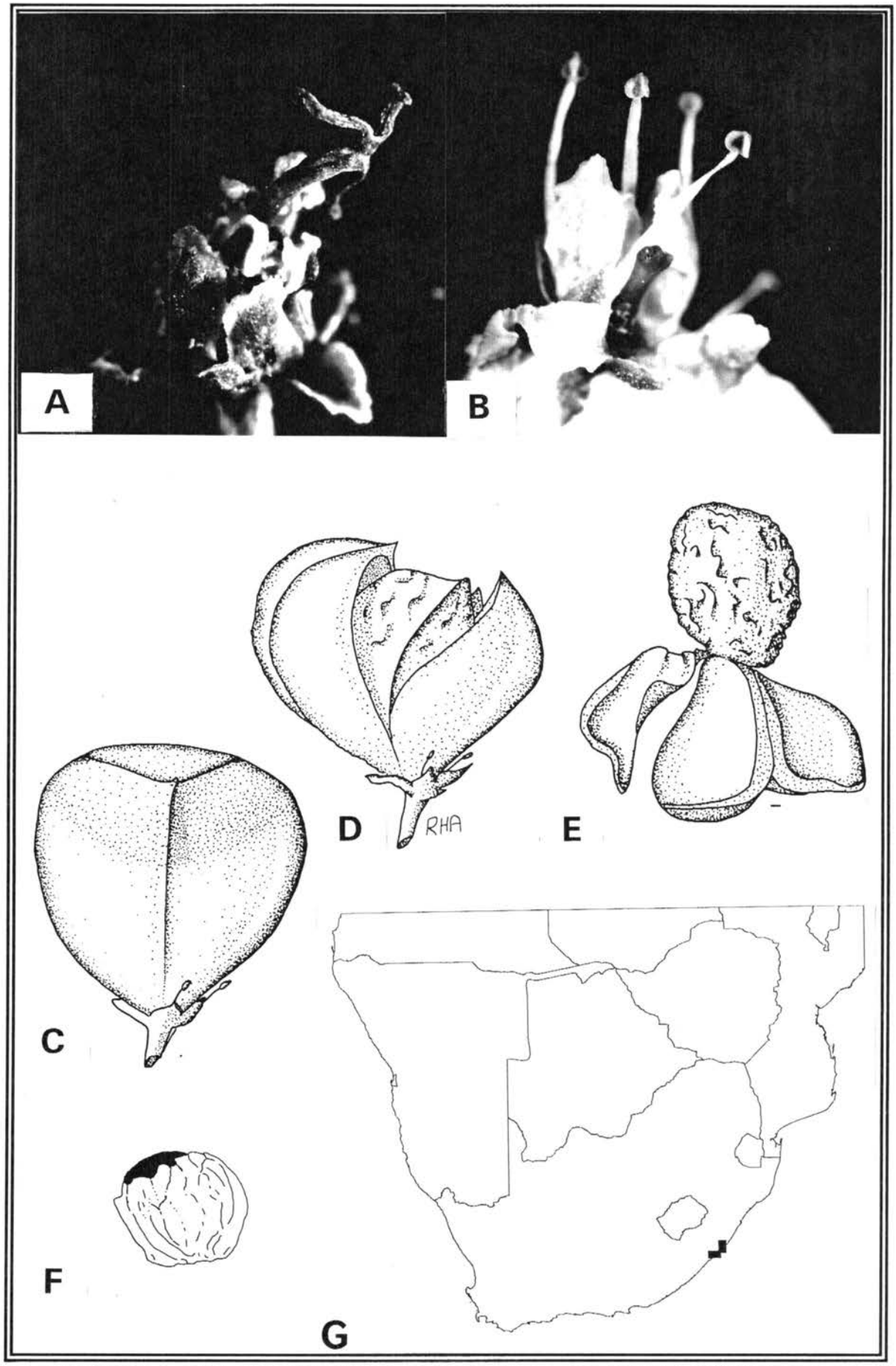

FIGURE 69.—*Gymnosporia vanwykii*. **A**, female flower; **B**, male flower; **C**, fruit; **D**, fruit, partly dehiscent; **E**, fruit completely dehiscent; **F**, seed and aril; **G**, known distribution. Magnification A = x20; B = x12.5; C = x6; D, E = x5.5; F = x4.

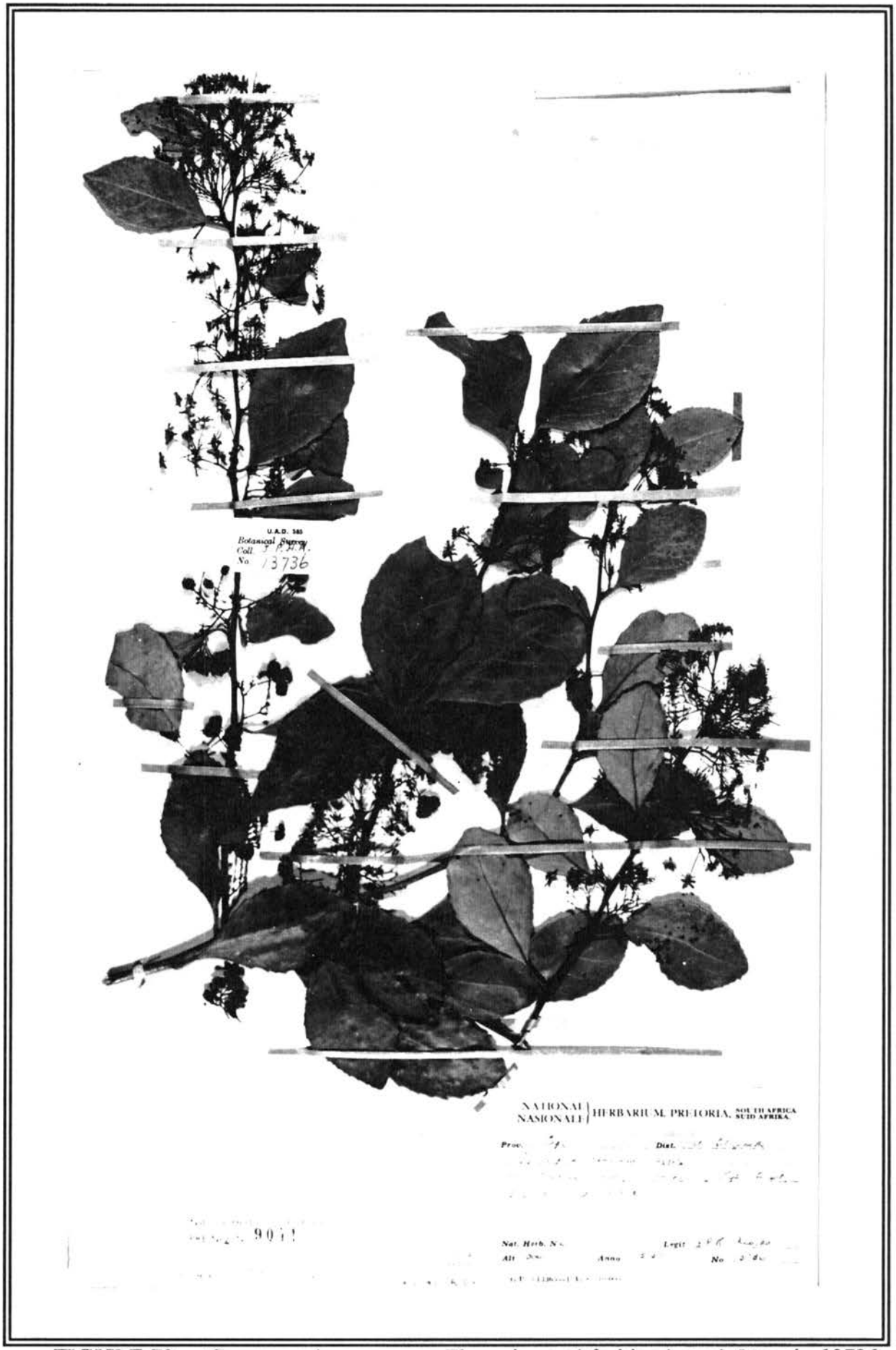

FIGURE 70.—*Gymnosporia nemorosa*. Flowering and fruiting branch [*Acocks 13786* (PRE)]. Magnification x0.5.

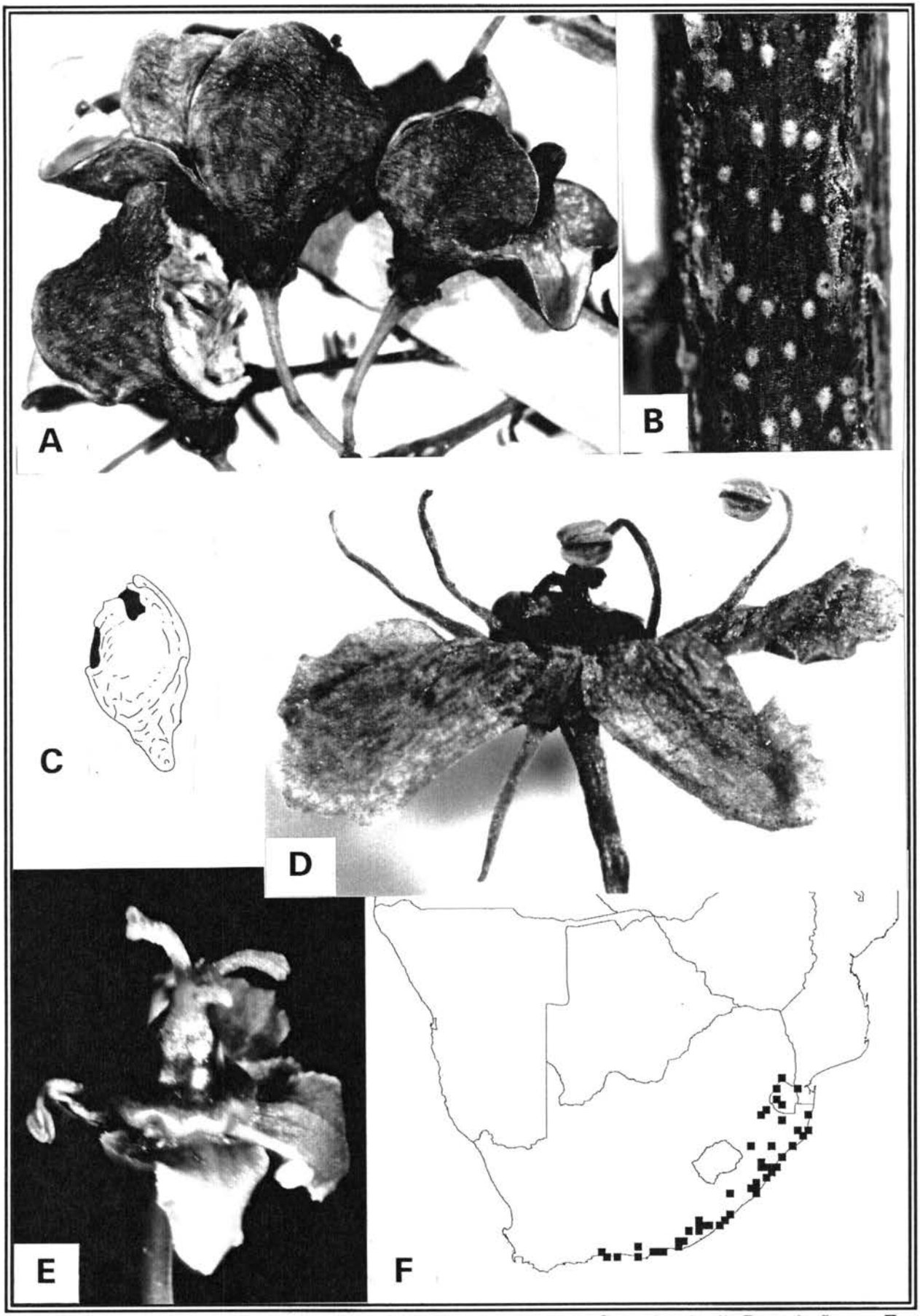

FIGURE 71.—*Gymnosporia nemorosa*. **A**, fruit; **B**, bark of branch; **C**, seed and aril; **D**, male flower; **E**, female flower; **F**, known distribution. Magnification A = x6.3; B = x10; C = x4; D, E = x16.

FIGURE 72.—*Gymnosporia pubescens*. **A**, fruiting branch [*P. van Wyk BSA3120* (PRU)]; **B**, flower; **C**, seed and aril; **D**, fruit. Magnification A = x1; B = x5 ; C = x2; D = x6.

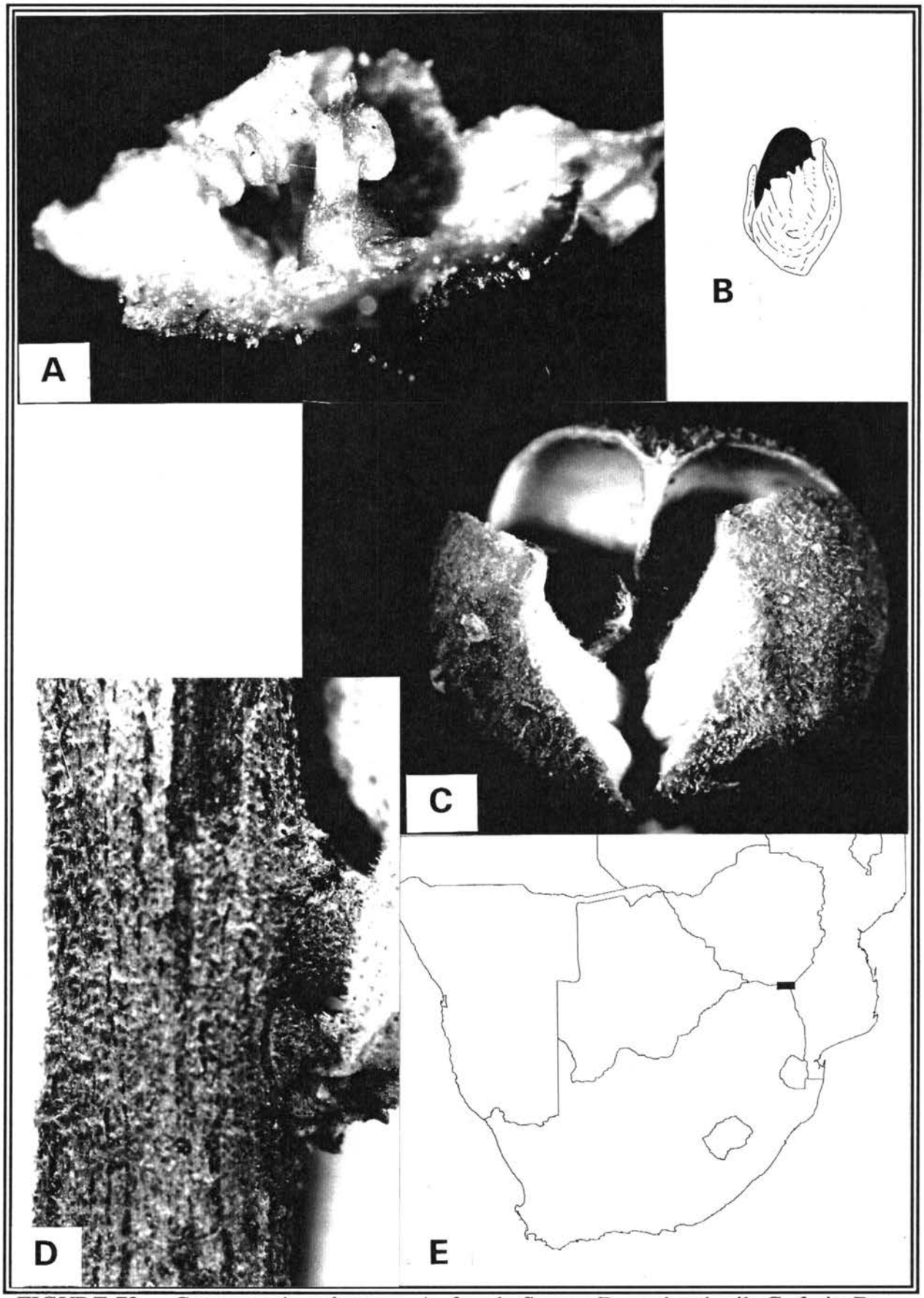

FIGURE 73.—*Gymnosporia pubescens*. **A**, female flower; **B**, seed and aril; **C**, fruit; **D**, bark of branch; **E**, known distribution. Magnification A = x25; B = x4; C = x8; D = x12.5.

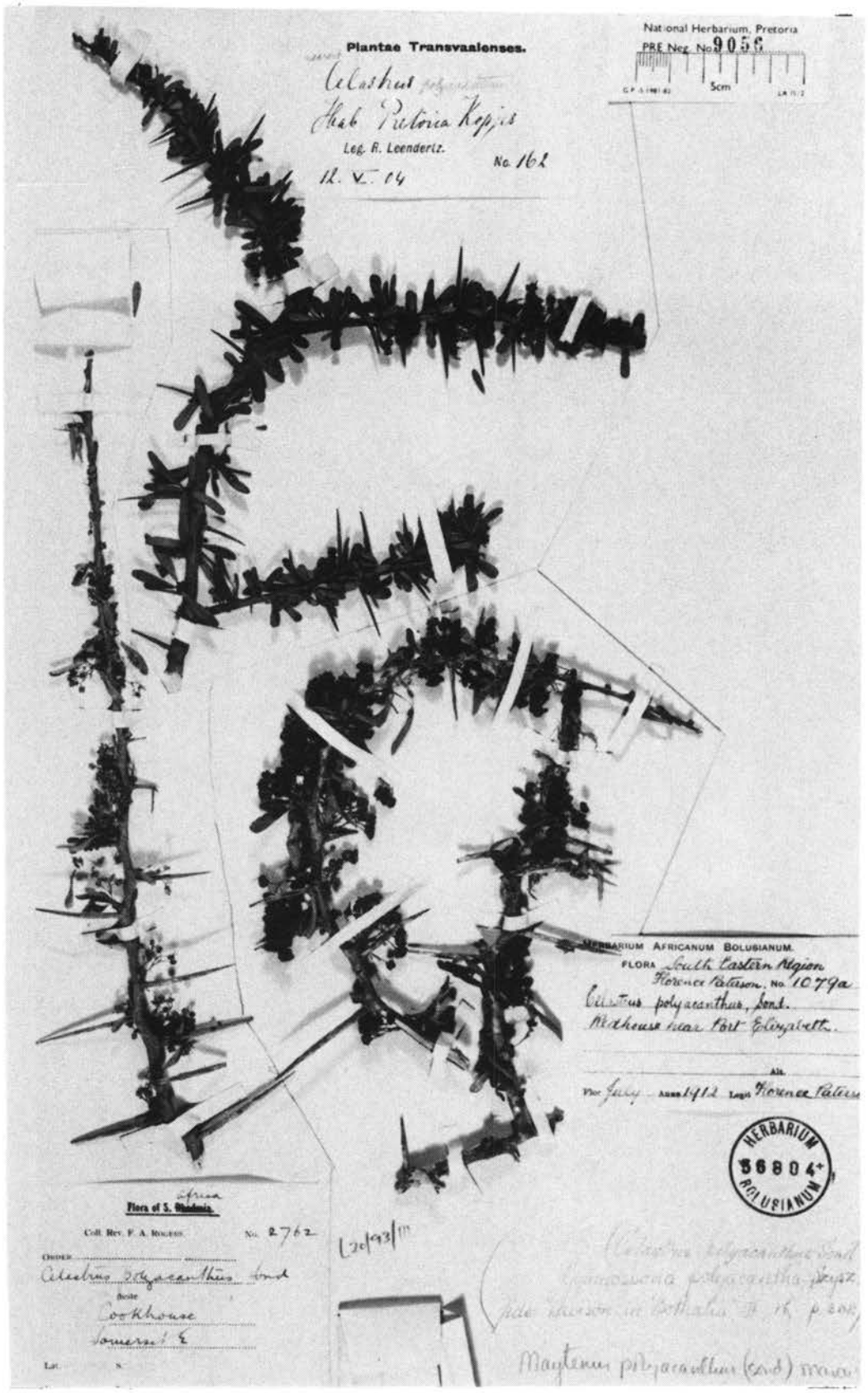

FIGURE 74.—*Gymnosporia polyacantha* subsp. *polyacantha*. Fruiting branch [*Patterson 1079a* (BOL)]. Magnification x0.5.

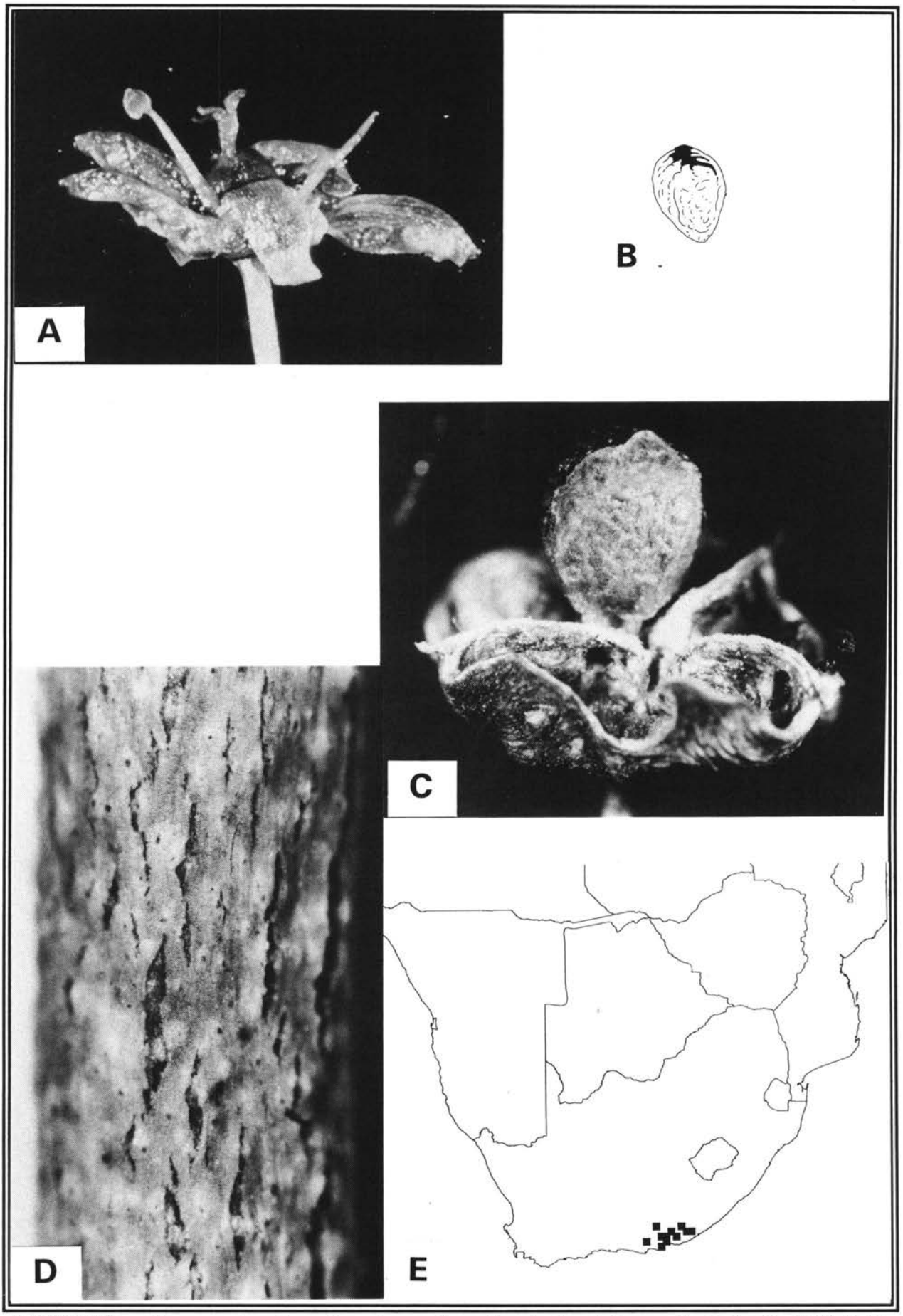

FIGURE 75.—*Gymnosporia polyacantha* subsp. *polyacantha*. **A**, female flower; **B**, seed and aril; **C**, fruit; **D**, bark of branch; **E**, known distribution. Magnification A = x10; B = x4; C = x12.5; D = x20.

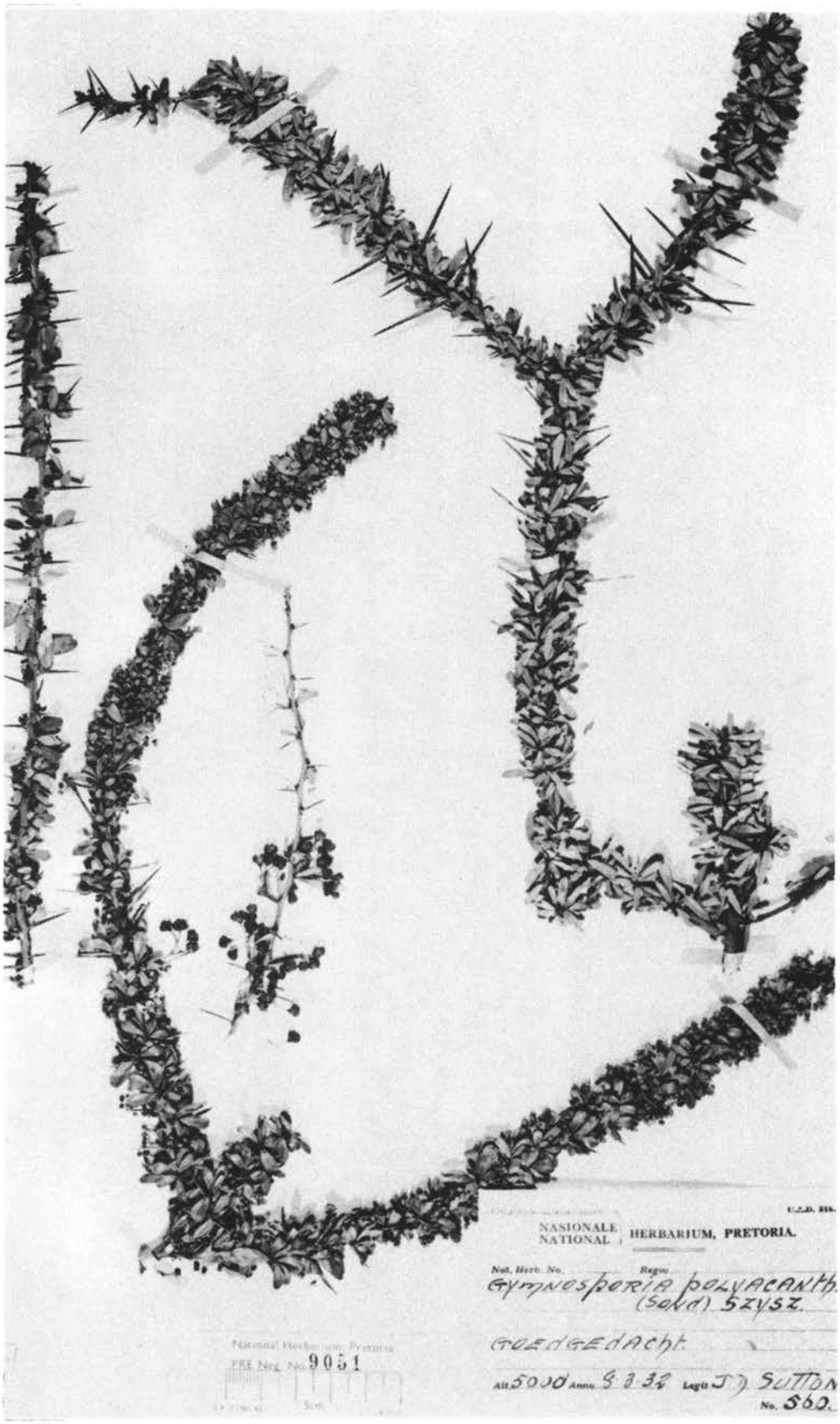

FIGURE 76.—*Gymnosporia polyacantha* subsp. *vaccinifolia*. Fruiting branch [*Sutton 560* (PRE)]. Magnification x0.5.

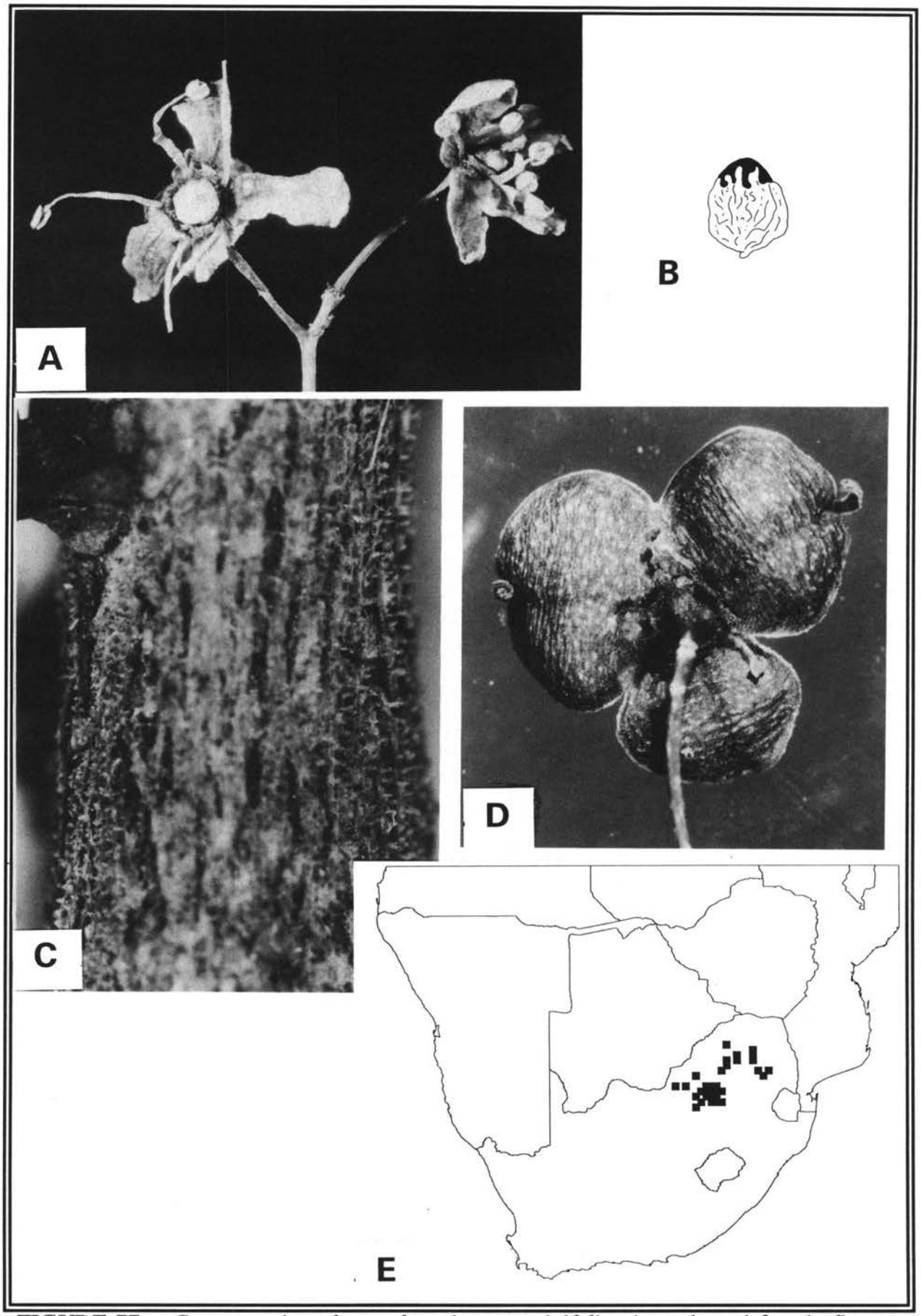

FIGURE 77.—*Gymnosporia polyacantha* subsp. *vaccinifolia*. **A**, male and female flowers on same inflorescence; **B**, seed and aril; **C**, bark of branch; **D**, fruit; **E**, known distribution. Magnification A, D = x10; B = x4; C = x25.

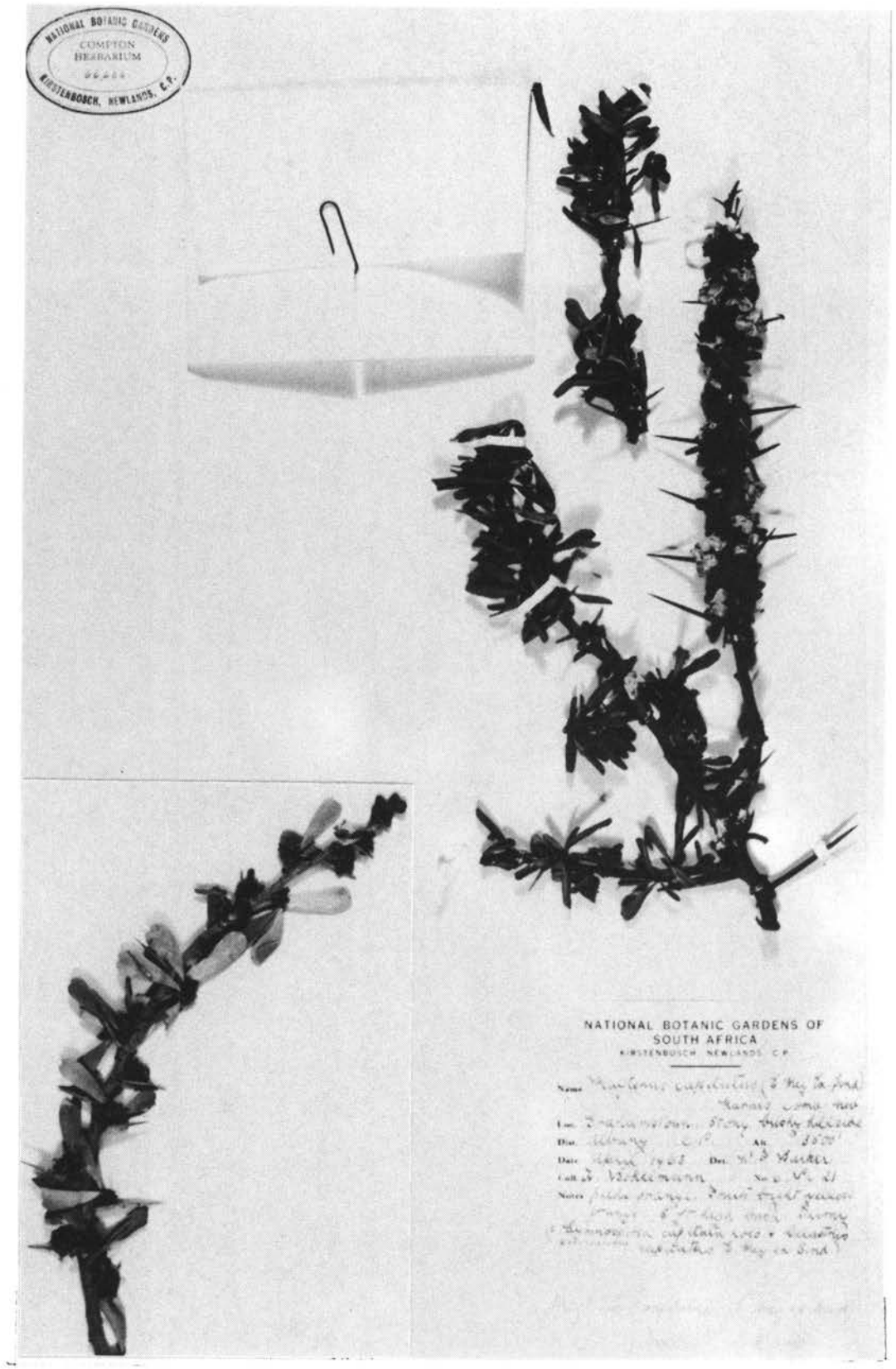

FIGURE 78.—*Gymnosporia capitata*. Fruiting branch [*Bokelmann 6* (NBG)]. Inlet, branch with leaves [*Flanagan 2585* (SAM)]. Magnification x0.5.

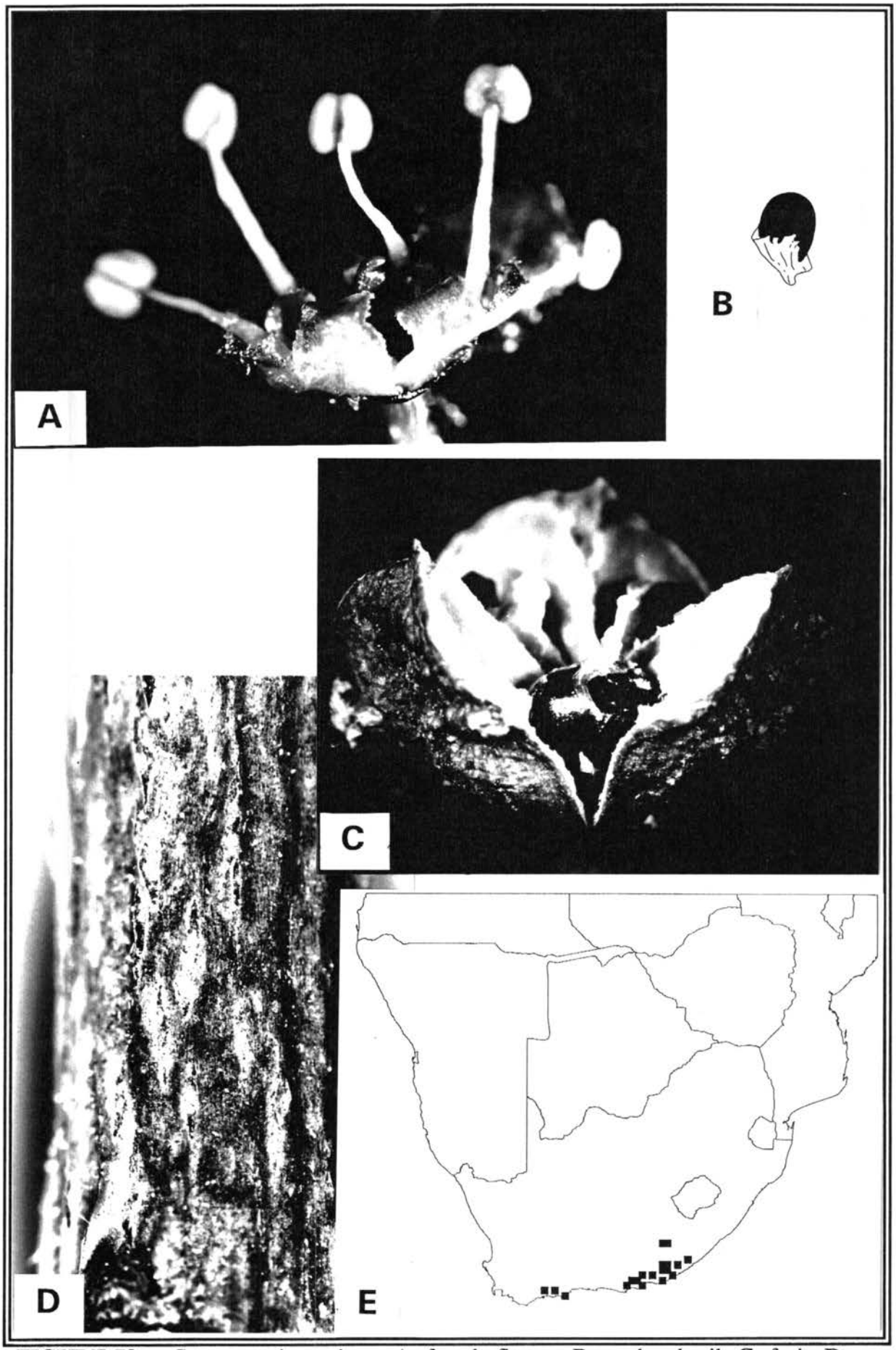

FIGURE 79.—*Gymnosporia capitata*. **A**, female flower; **B**, seed and aril; **C**, fruit; **D**, bark of branch; **E**, known distribution. Magnification A, D = x16; B = x4; C = x12.5.

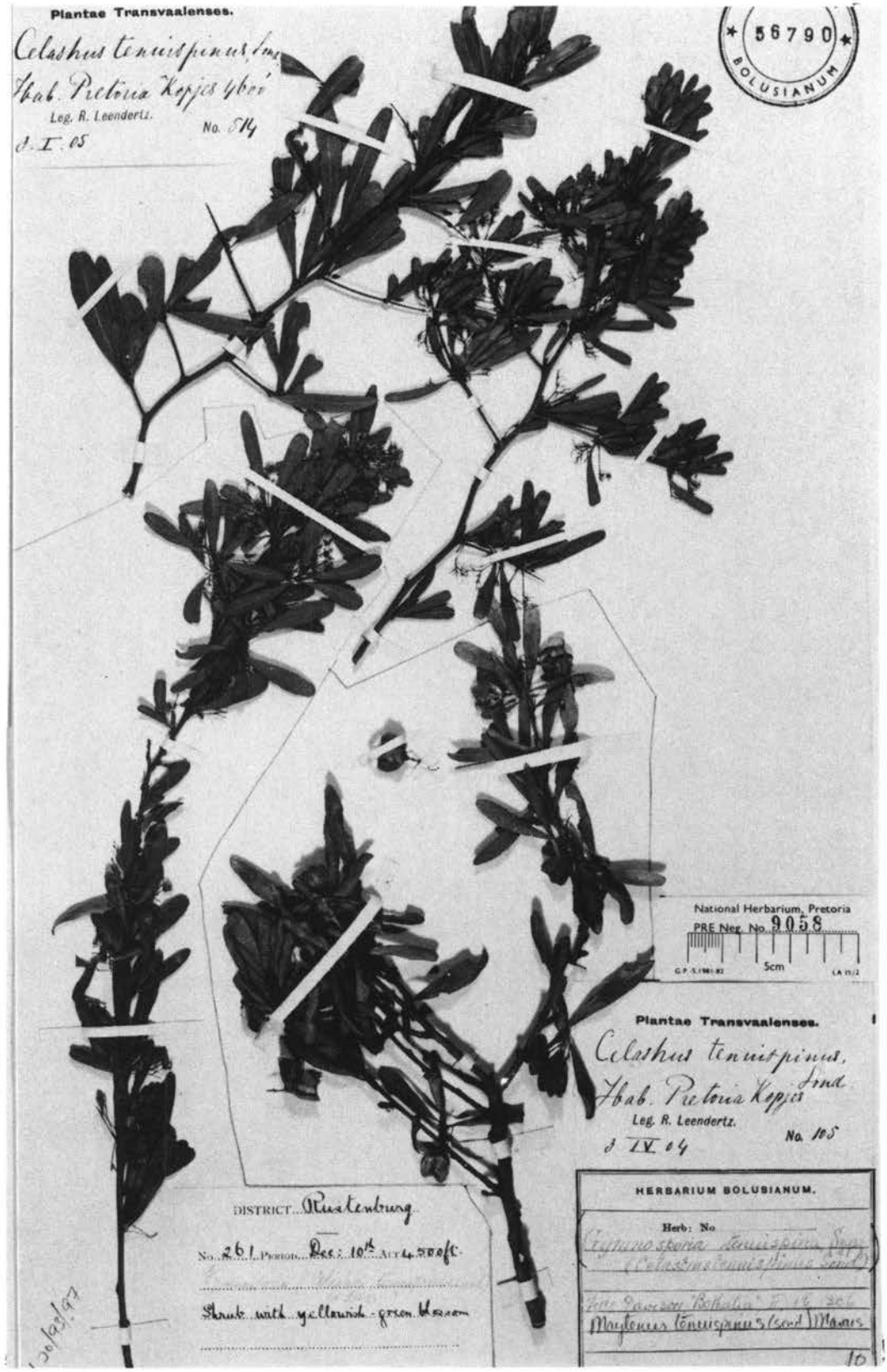

FIGURE 80.—*Gymnosporia tenuispina*. Fruiting branch [*Leendertz 105* (BOL)]. Magnification x0.5.

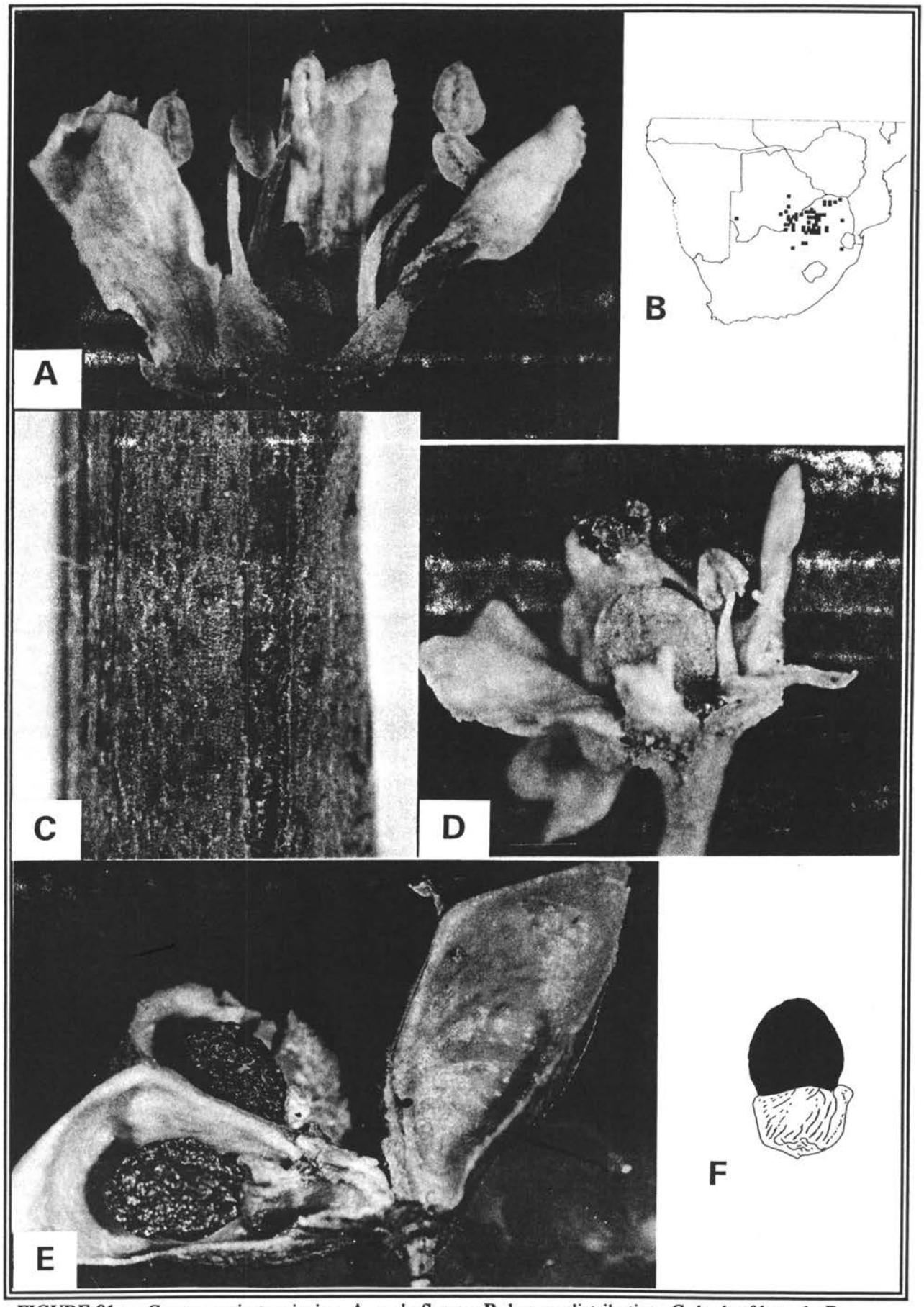

FIGURE 81.—*Gymnosporia tenuispina*. **A**, male flower; **B**, known distribution; **C**, bark of branch; **D**, female flower; **E**, fruit; **F**, seed and aril. Magnification A = x10; C, D = x25; E = x6.3; F = x4.

FIGURE 82.—*Gymnosporia gariepensis*. **A**, fruiting branch [*Jurgens* 28856 (PRE)]; B, flowering branch [Ortendahl s.n. (P)]; **C**, bark of branch. Magnification A = x1; B = 0.5; C = x16.

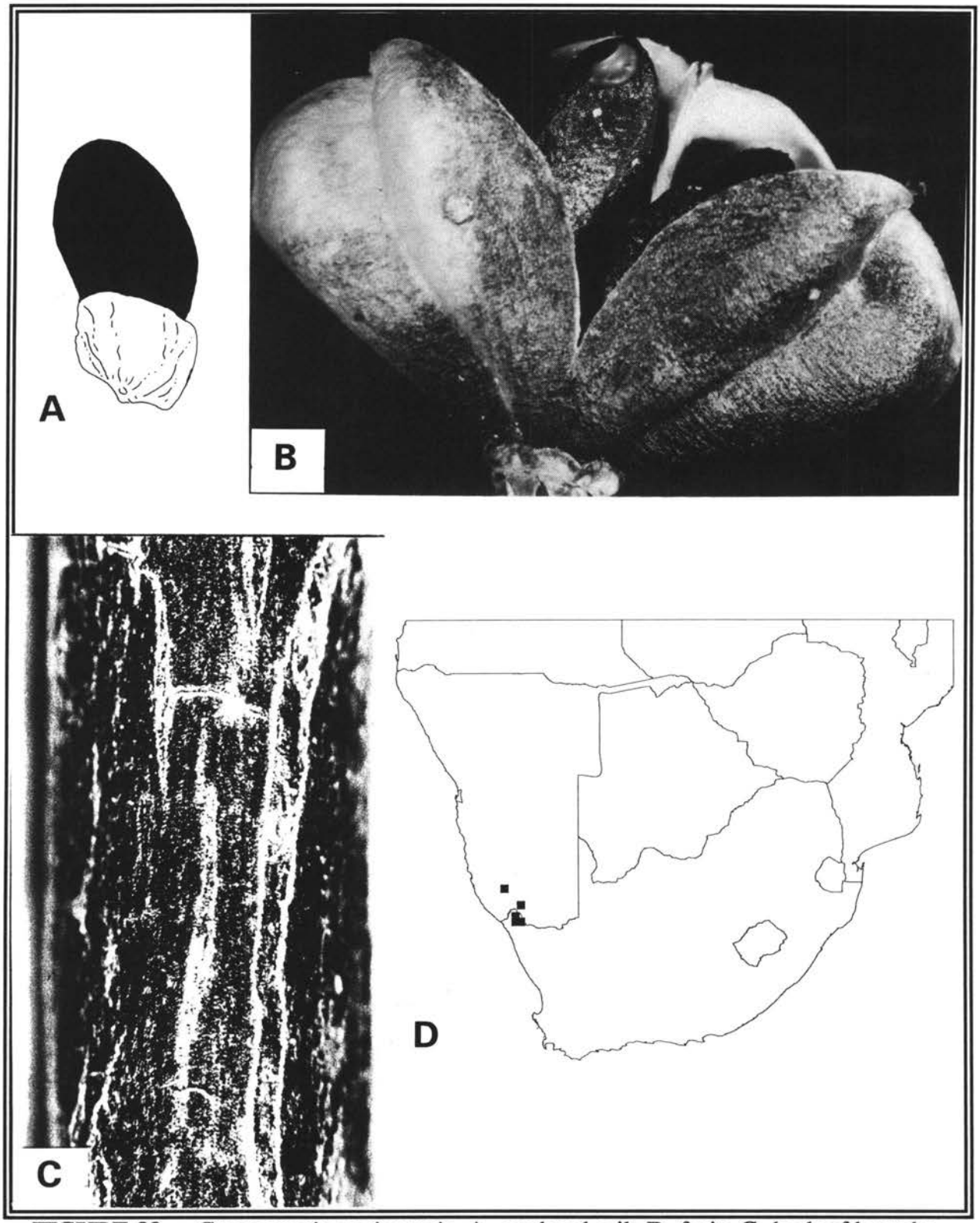

FIGURE 83.—*Gymnosporia gariepensis*. **A**, seed and aril; **B**, fruit; **C**, bark of branch; **D**, known distribution. Magnification A = x4 B = x6.3; C = x16.

FIGURE 84.—*Gymnosporia oxycarpa*. **A**, fruiting branch [*P. van Wyk BSA2030* (PRE)]; **B**, female flower; **C**, seed and aril; **D**, fruit. Magnification A = x0.8; B = x2; C, D = x1.

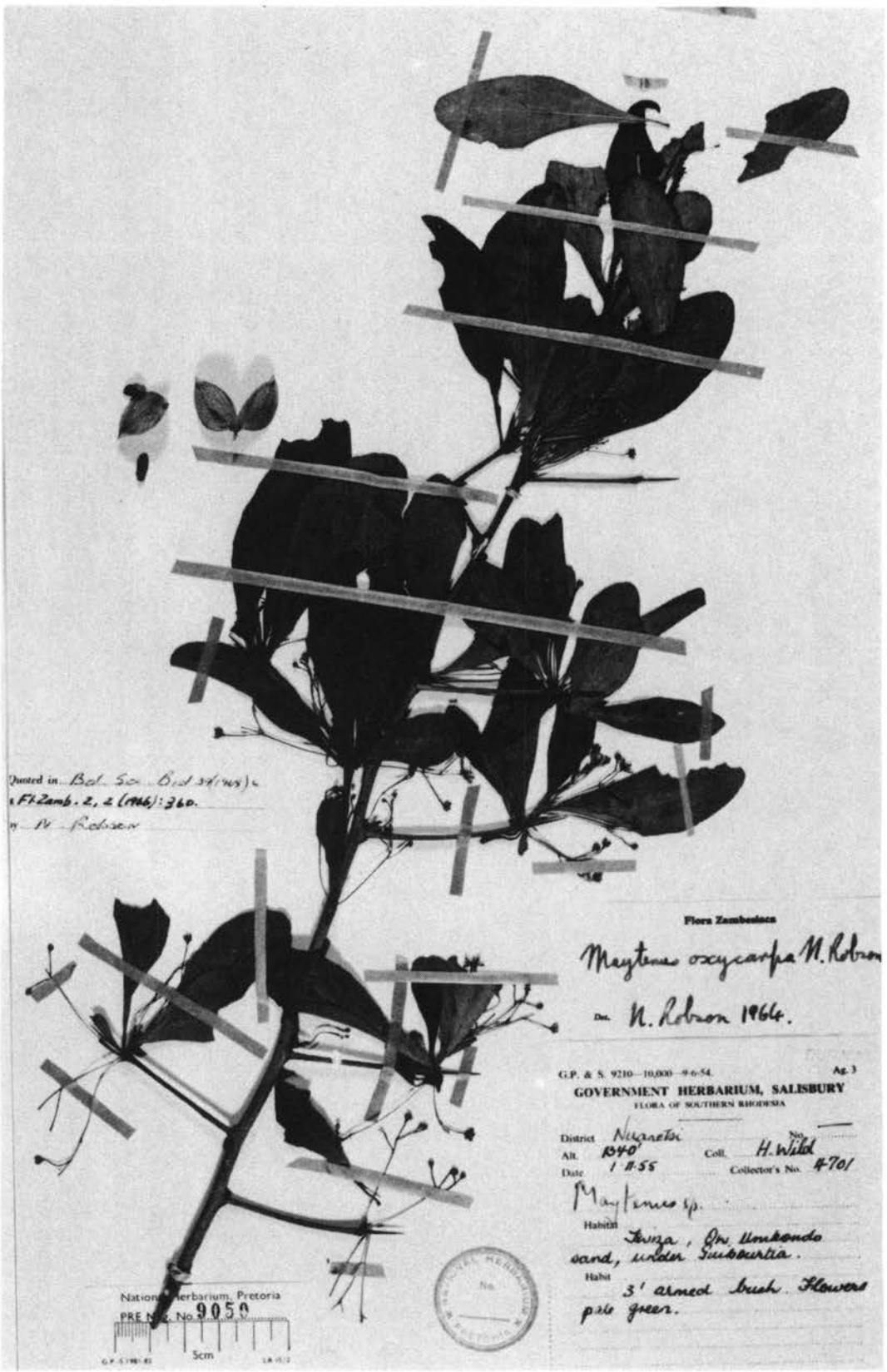

FIGURE 85.—*Gymnosporia oxycarpa*. Fruiting branch [*Wild 4701* (PRE)]. Magnification = x0.5.

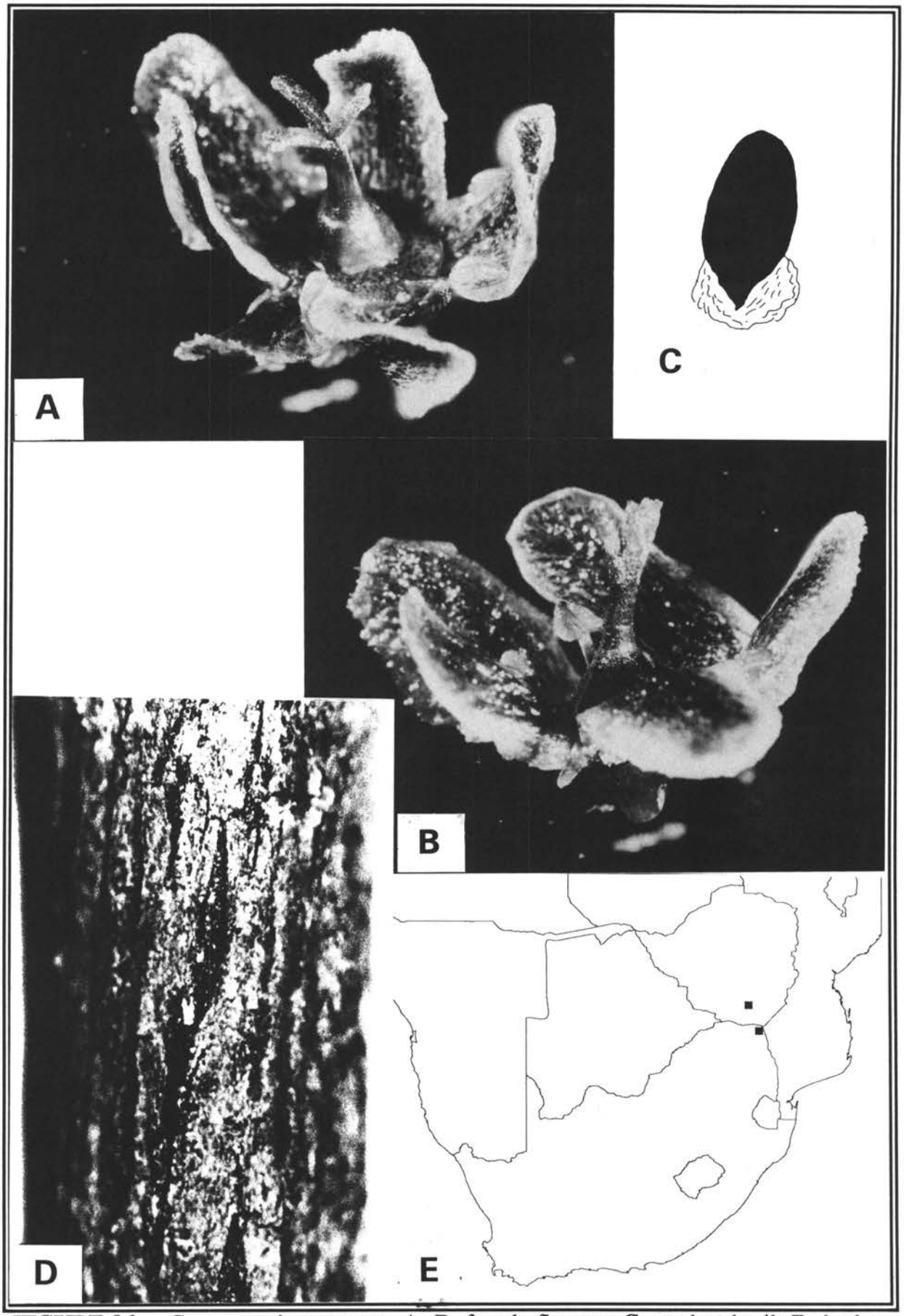

FIGURE 86.—*Gymnosporia oxycarpa*. **A**, **B**, female flowers; **C**, seed and aril; **D**, bark of branch; **E**, known distribution. Magnification A, B = x10; C = x4; D = x16.

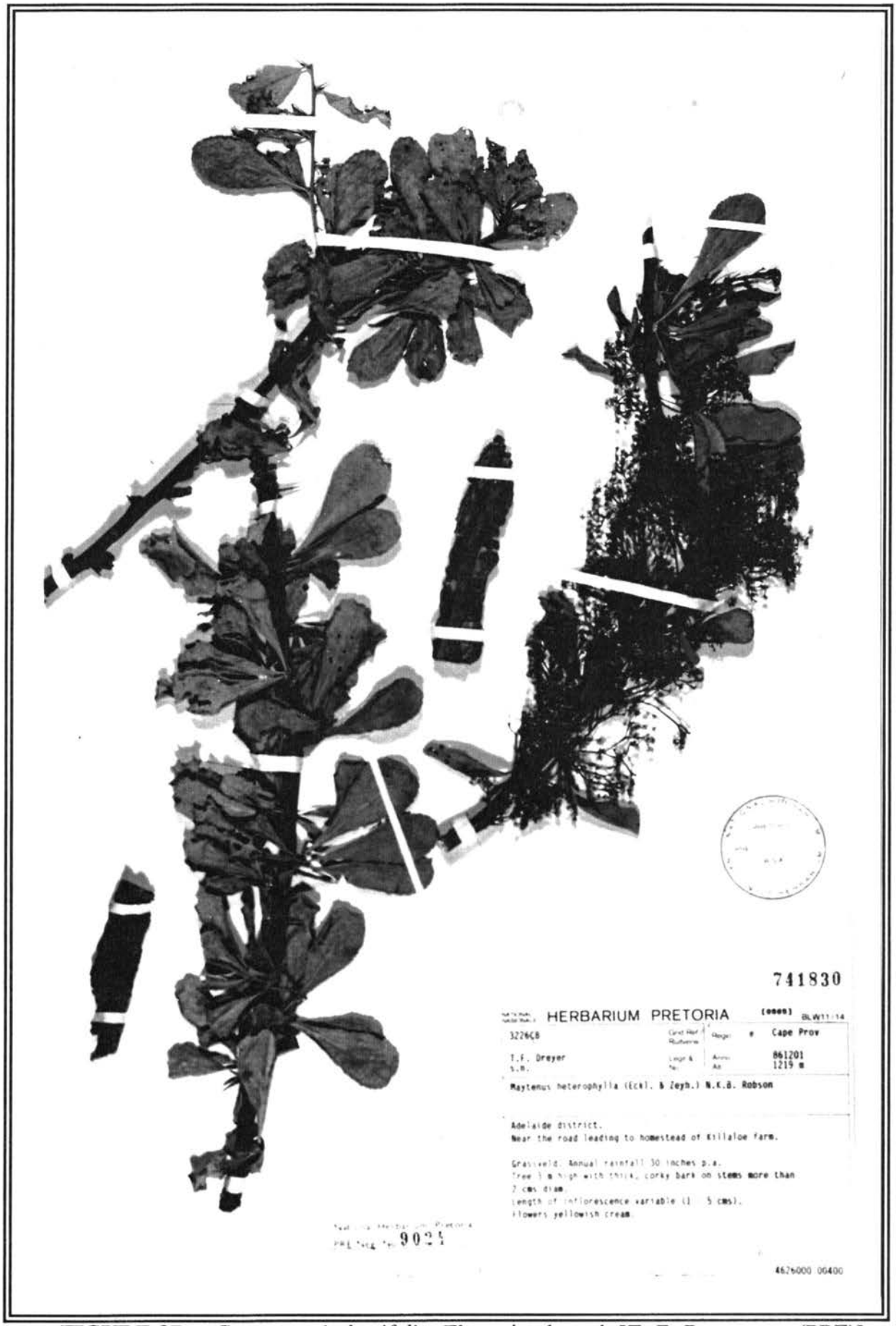

FIGURE 87.—*Gymnosporia buxifolia*. Flowering branch [*T. F. Dreyer s.n.* (PRE)]. Magnification x 0.5.

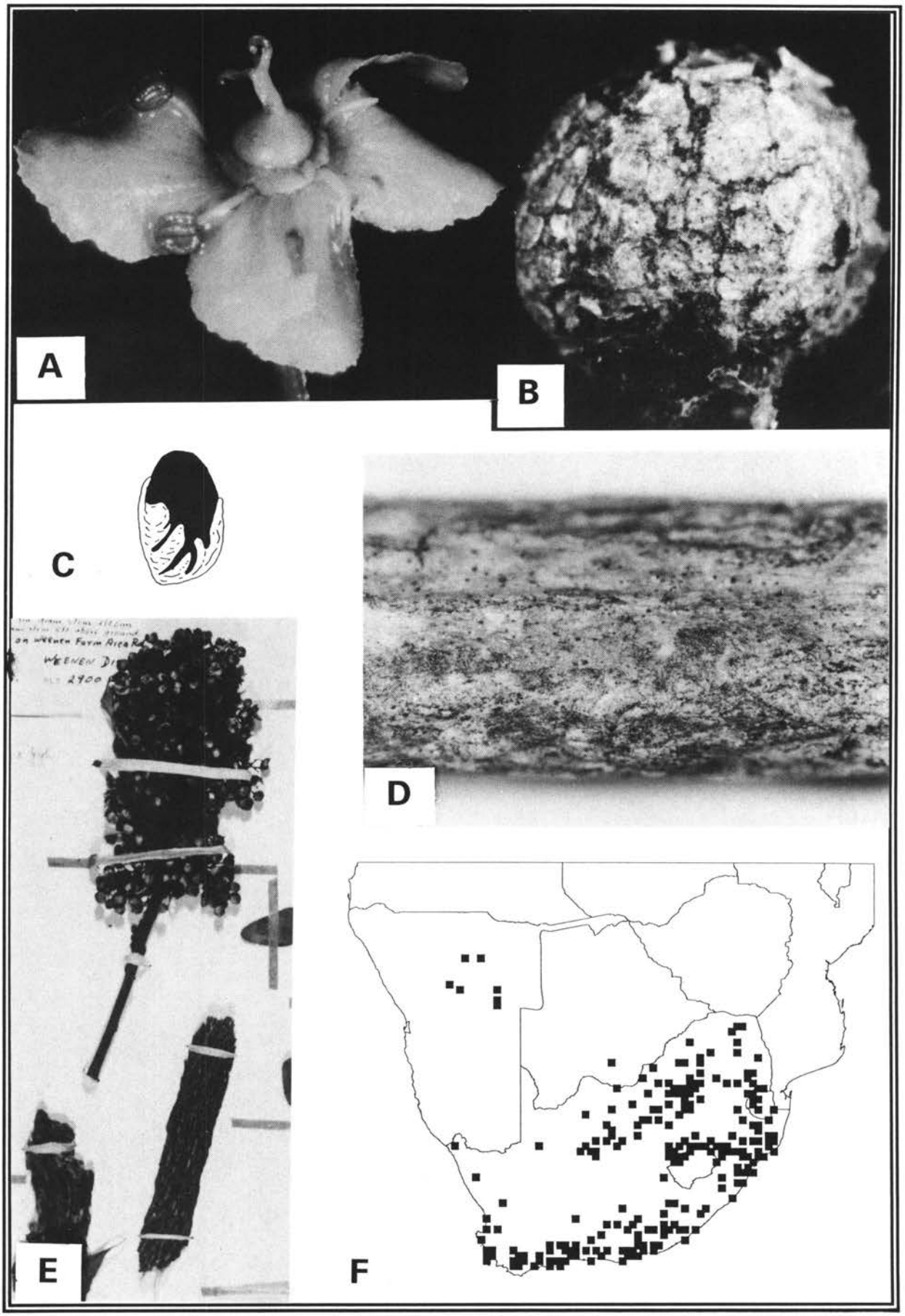

FIGURE 88.—*Gymnosporia buxifolia*. **A**, female flower; **B**, fruit; **C**, seed ans aril; **D**, bark of branch; **E**, fruiting branch; **F**, known distribution. Magnification A = x12.5; B, D = x16; E = x0.5; C = x4.

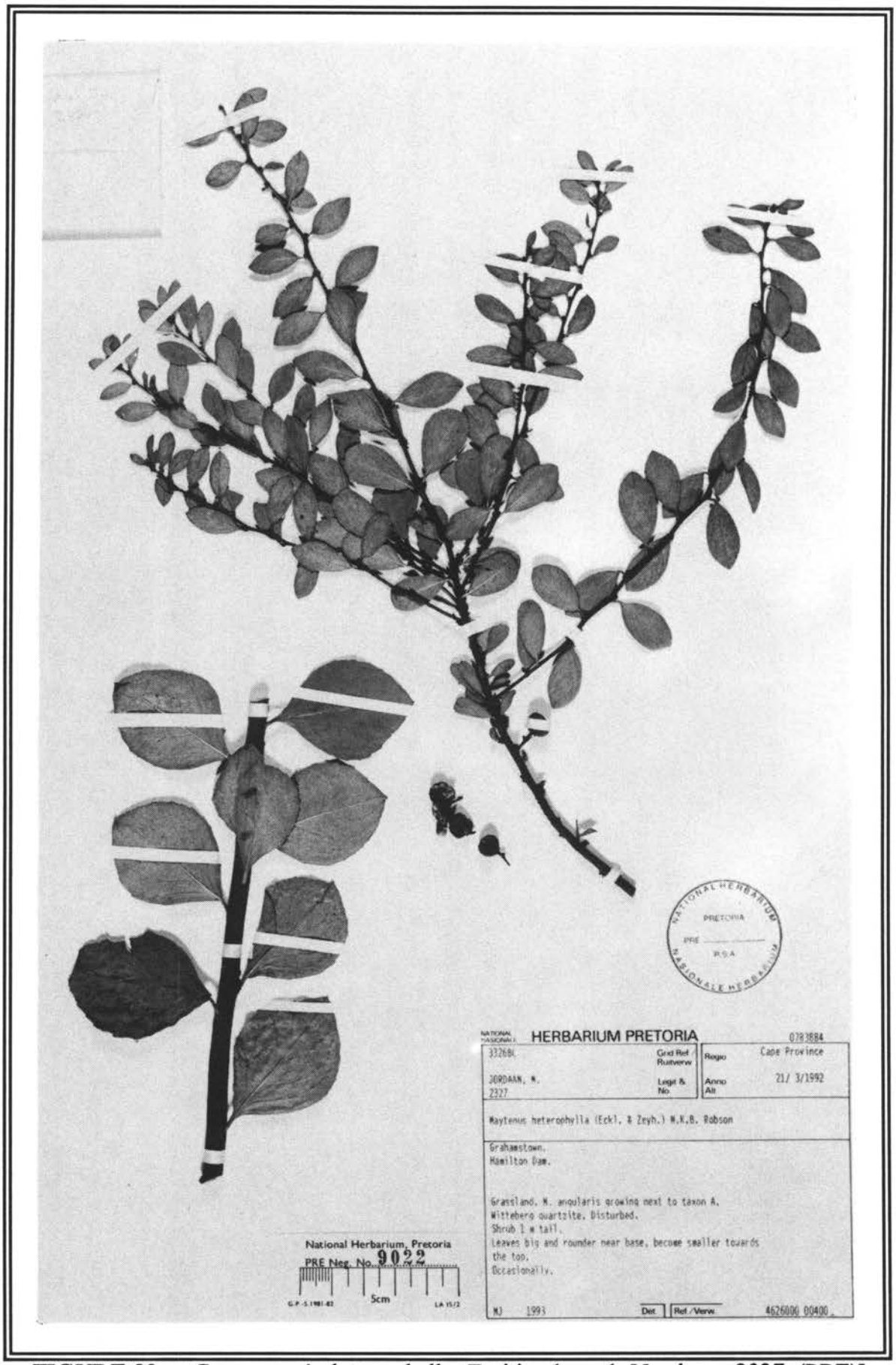

FIGURE 89.—*Gymnosporia heterophylla*. Fruiting branch [*Jordaan 2327* (PRE)]. Magnification x0.5.

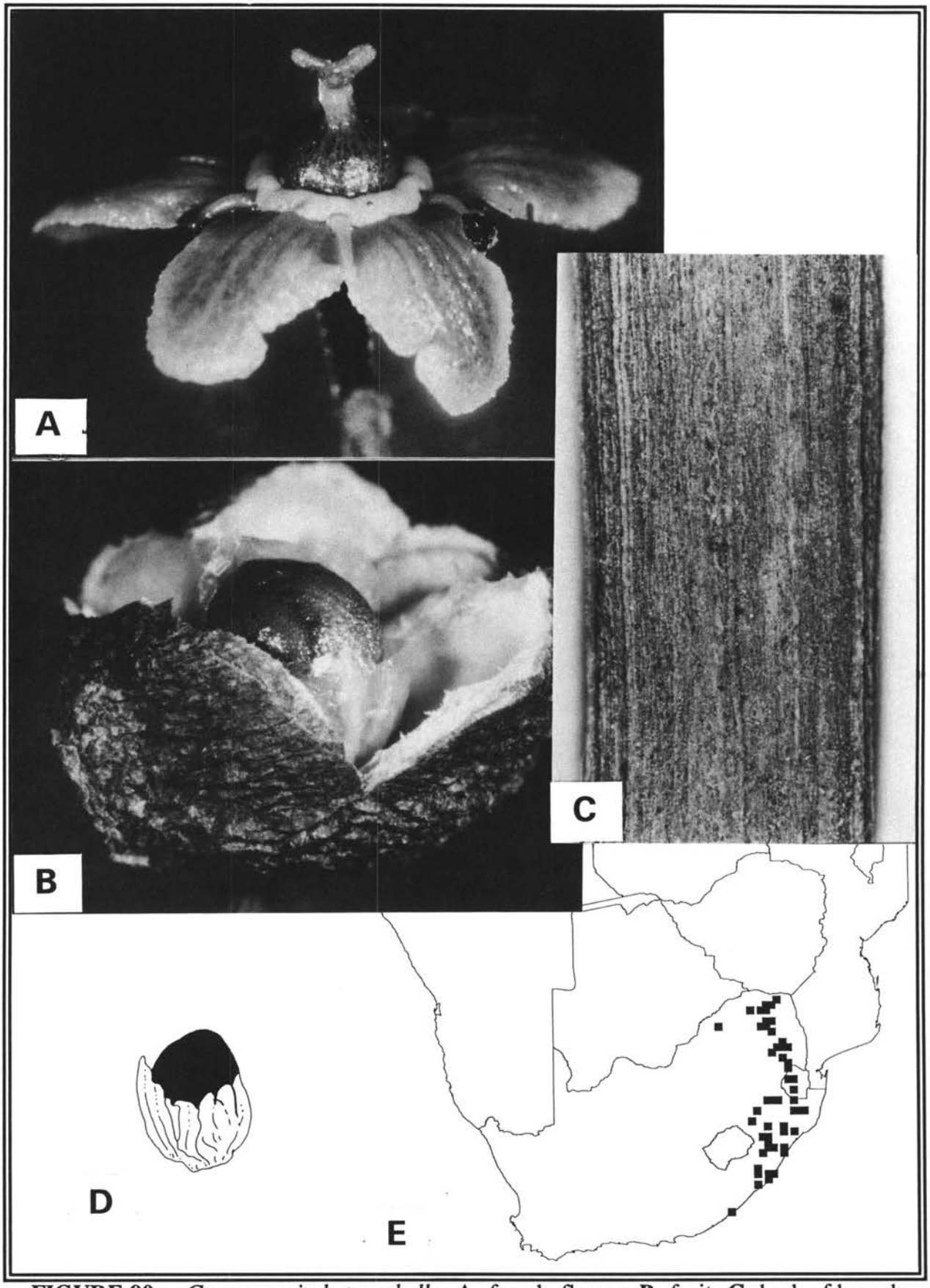

FIGURE 90.—*Gymnosporia heterophylla*. **A**, female flower; **B**, fruit; **C**, bark of branch; **D**, seed and aril; **E**, known distribution. Magnification A = x16; B = x10; C = x8; D = x4.

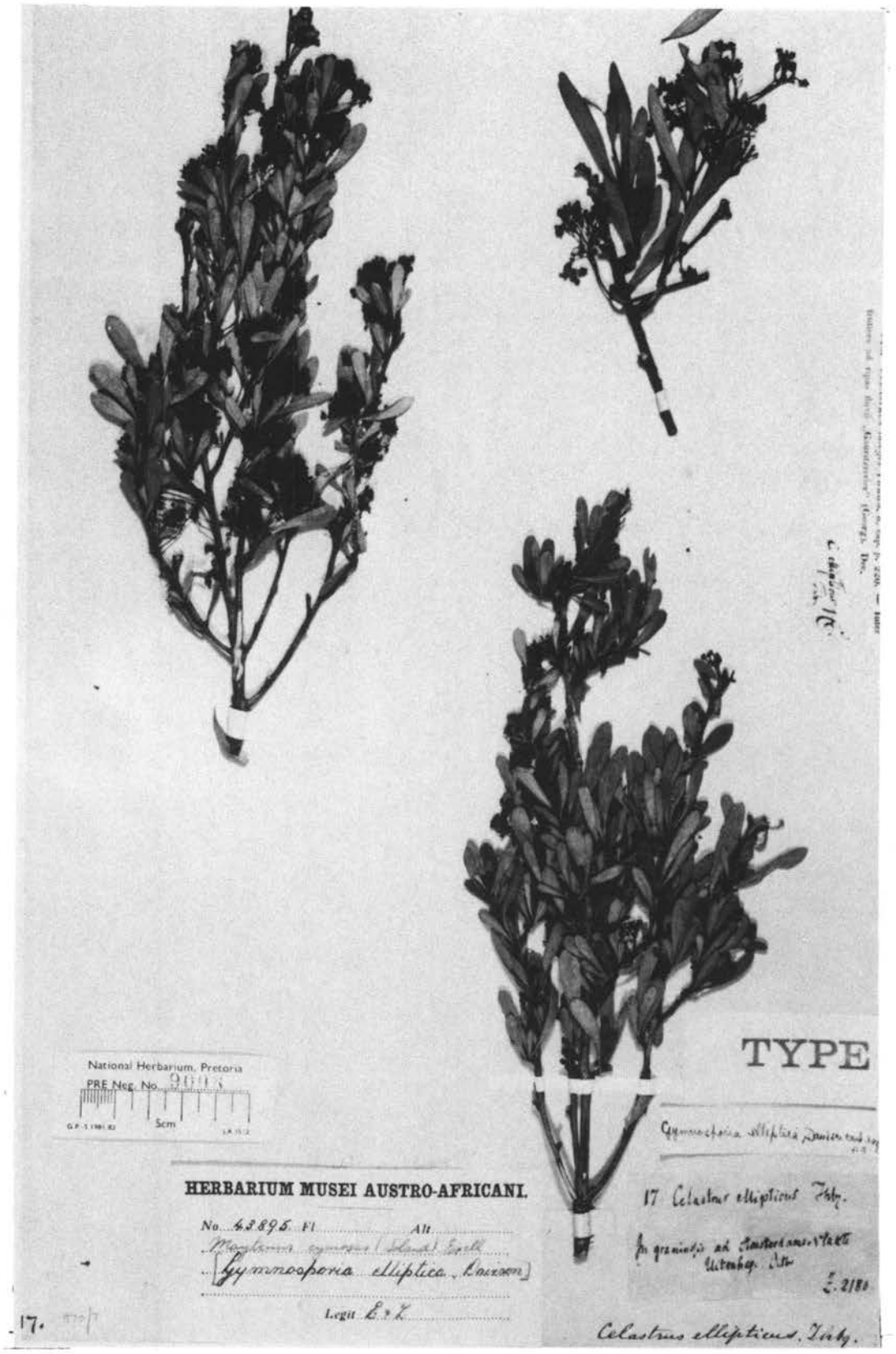

FIGURE 91.—*Gymnosporia elliptica*. Flowering branch [*Zeyher 2180* (SAM)]. Magnification x0.5.

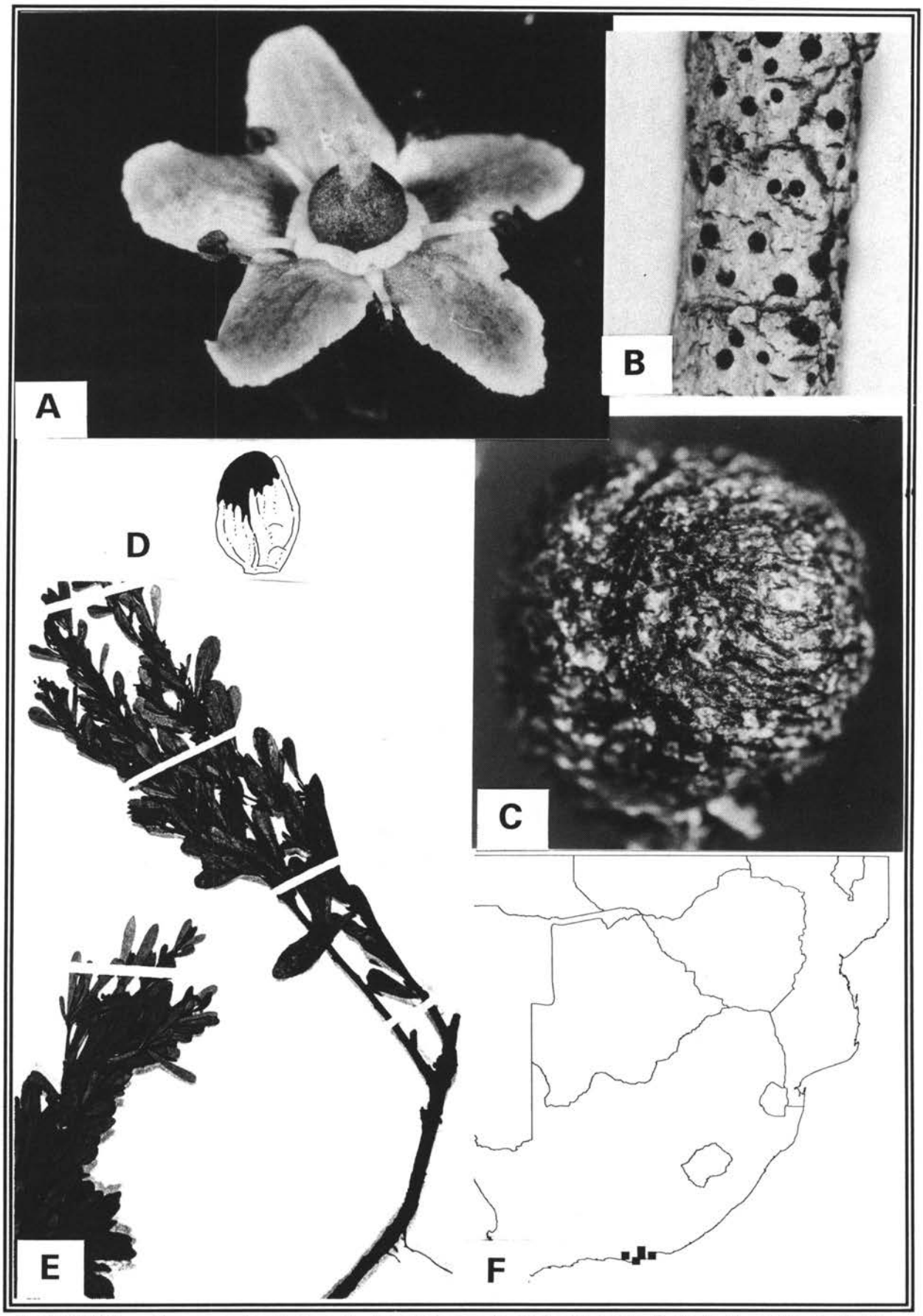

FIGURE 92.—*Gymnosporia elliptica*. **A**, female flower; **B**, bark of branch; **C**, fruit; **D**, seed and aril; **E**, branch with rhizome [*Jordaan 2294* (PRE)]; **F**, known distribution. Magnification A, C = x12.5; B = x10; D = x4; E = x0.5.

FIGURE 93.—*Gymnosporia uniflora*. Fruiting branch [*Hildyard 65* (PRE)]. Magnification x0.5.

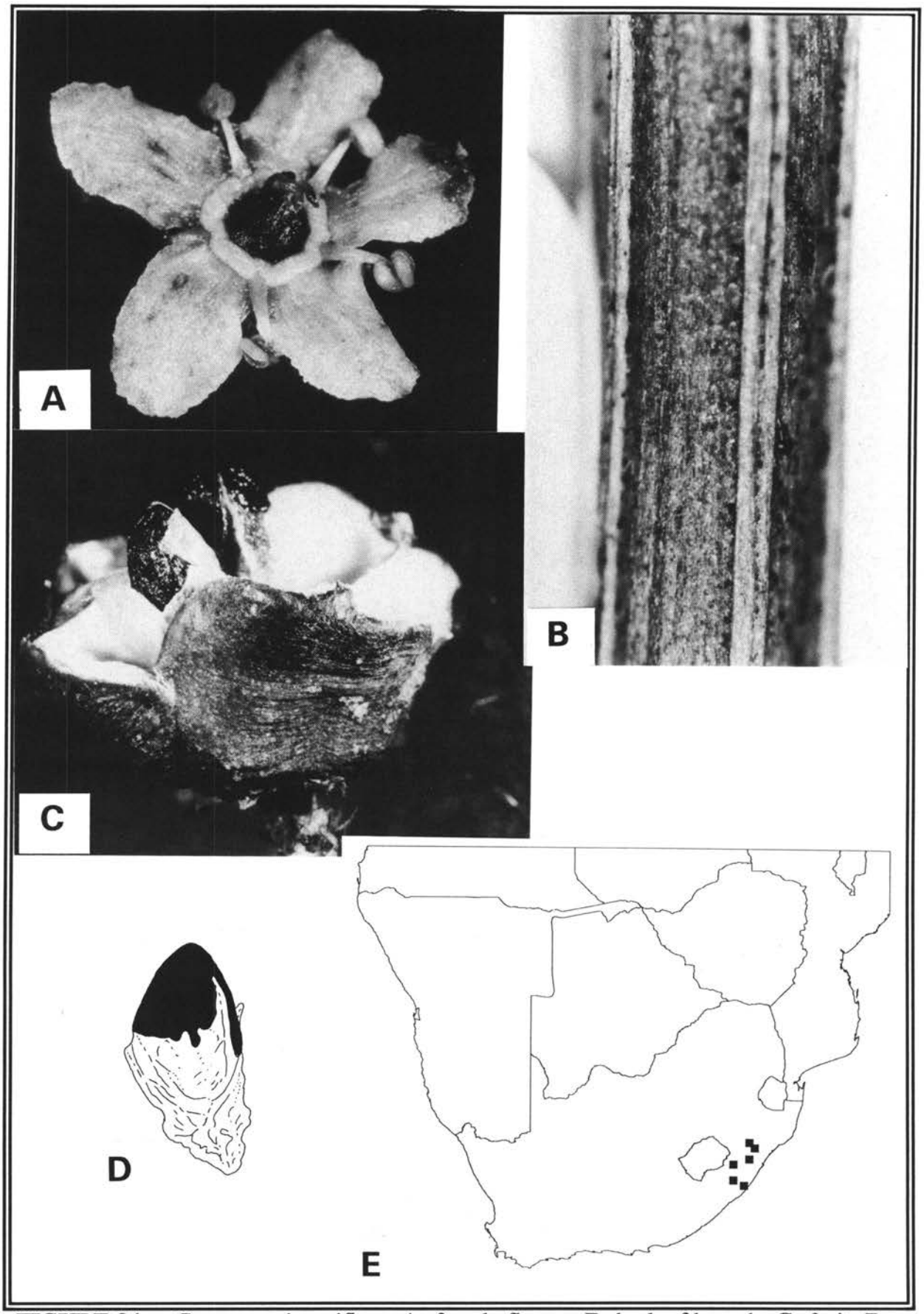

FIGURE 94.—*Gymnosporia uniflora*. **A**, female flower; **B**, bark of branch; **C**, fruit; **D**, seed and aril; **E**, known distribution. Magnification A = x10; B = x20; C = x6.3; D = x4.

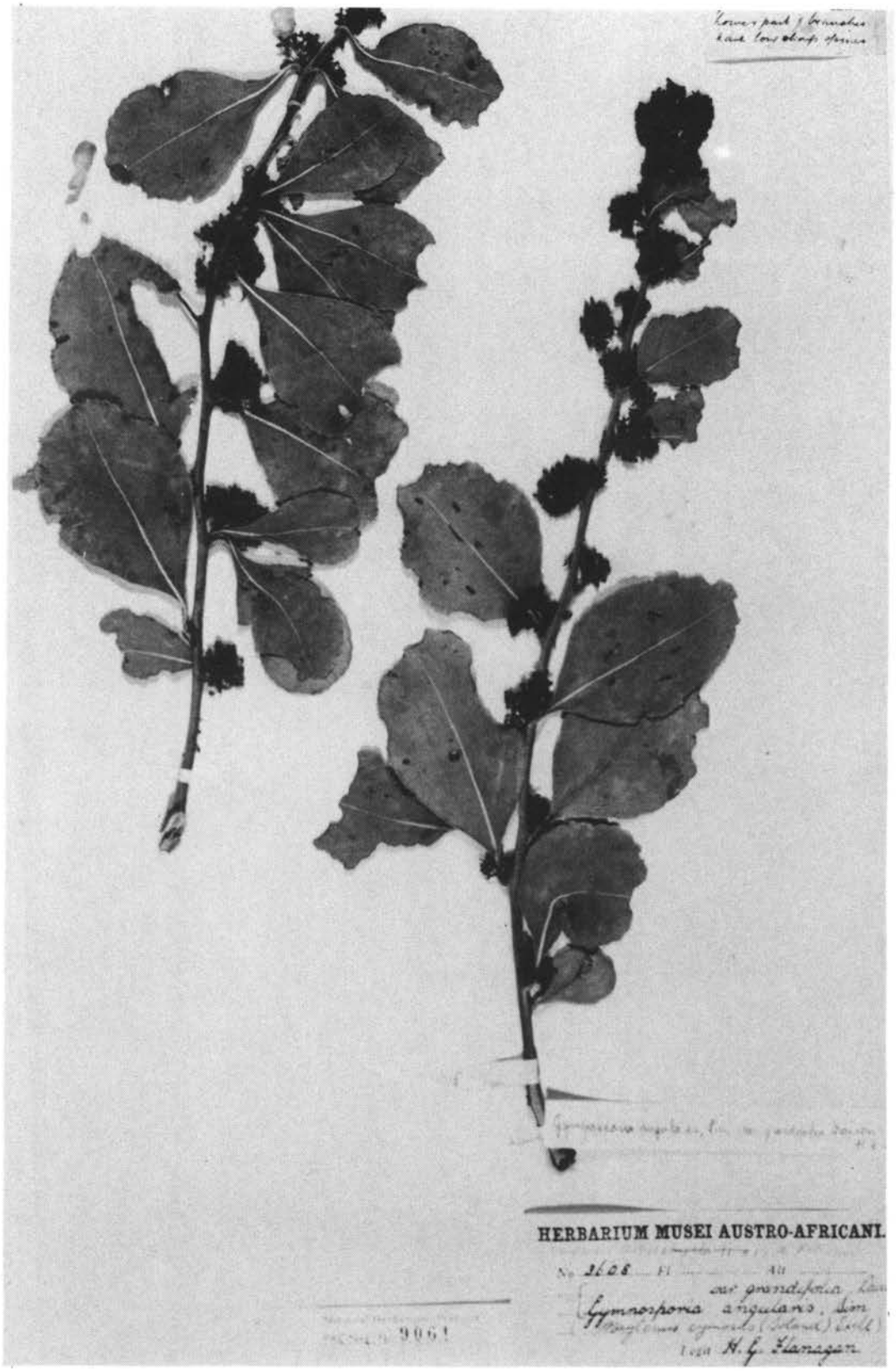

FIGURE 95.—*Gymnosporia grandifolia*. Flowering branch [*Flanagan s.n.* (SAM)]. Magnification x0.5.

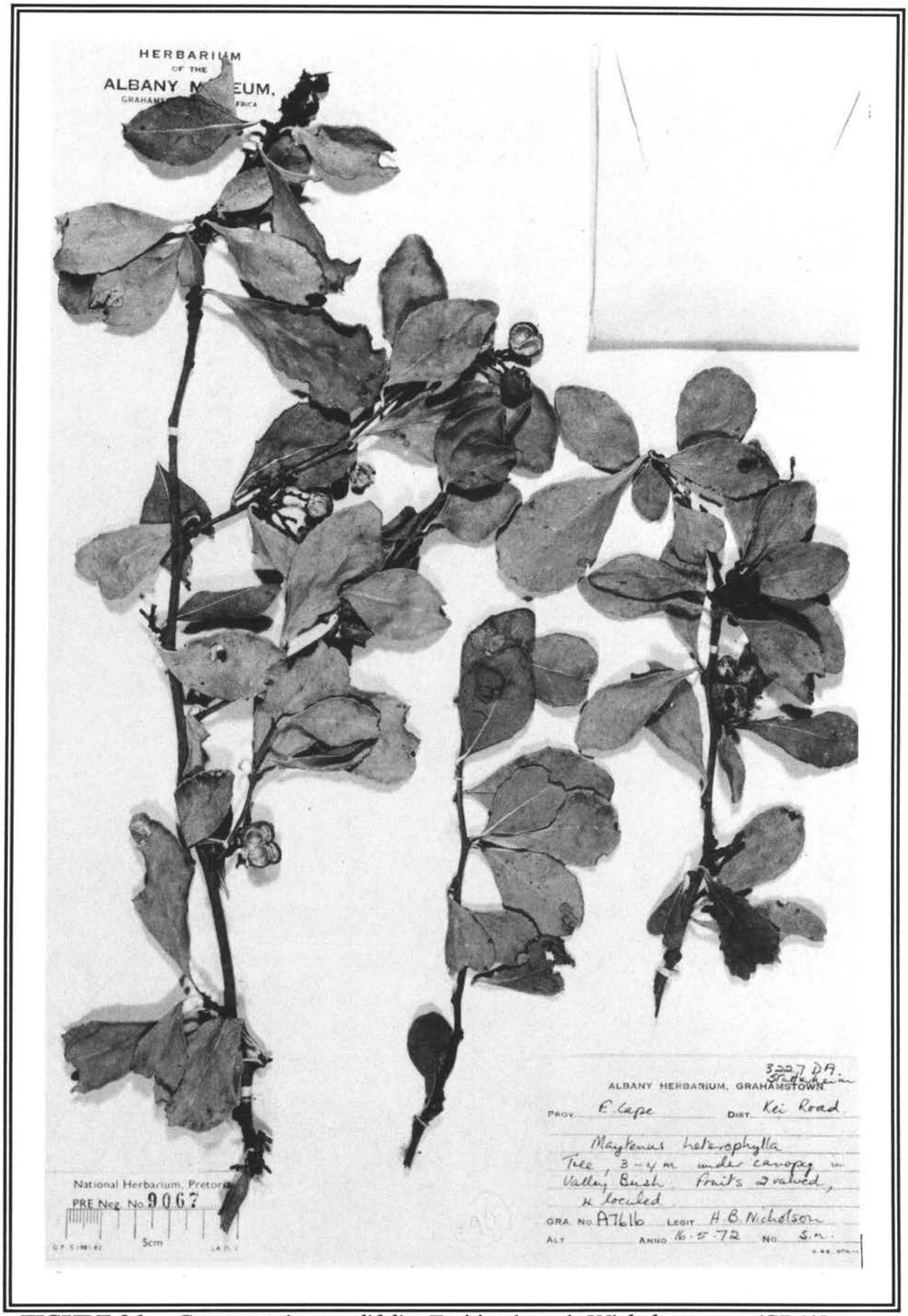

FIGURE 96.—*Gymnosporia grandifolia*. Fruiting branch [*Nicholson s.n.* (GRA)]. Magnification x0.5.

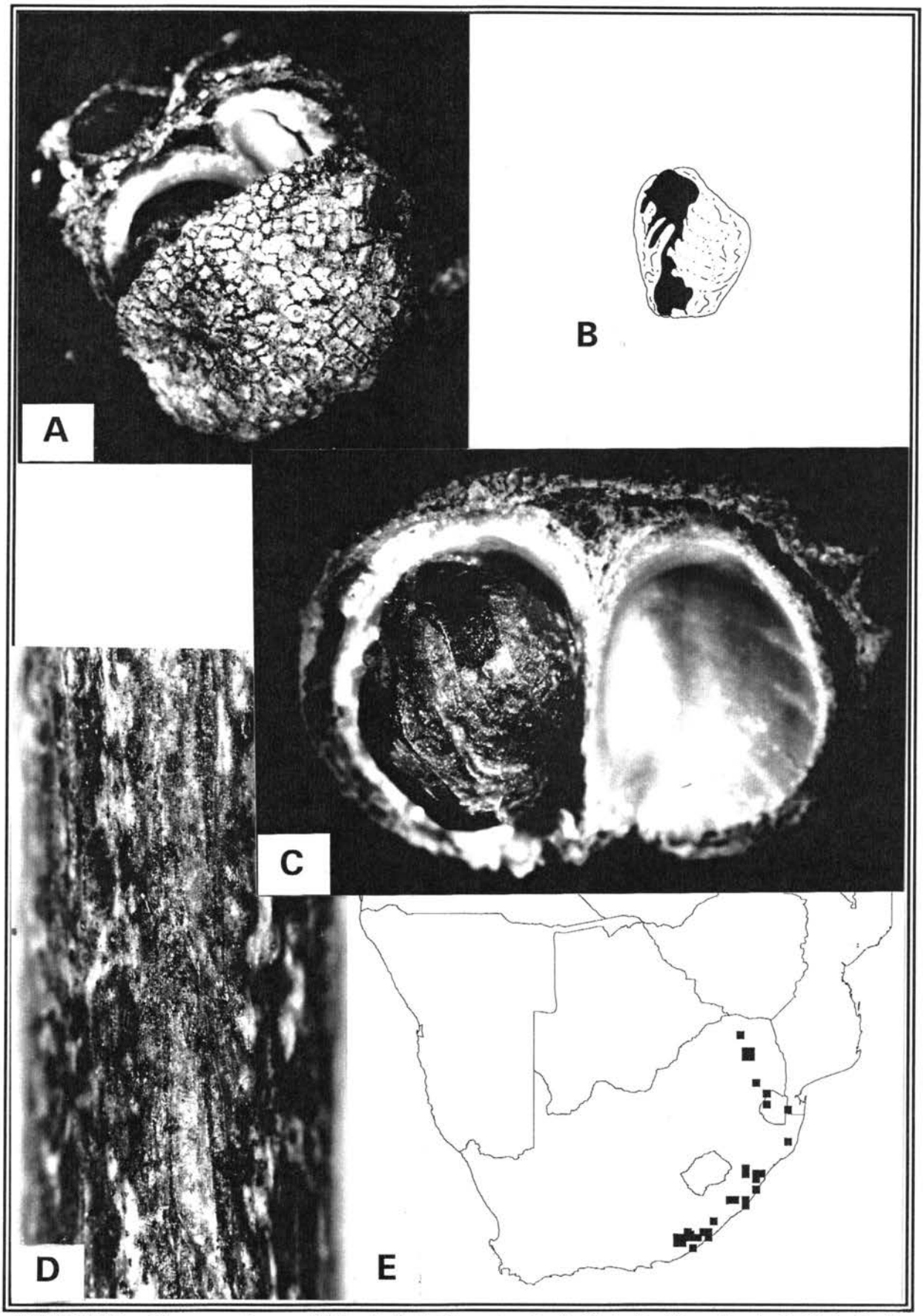

FIGURE 97.—*Gymnosporia grandifolia*. **A**, fruit; **B**, seed and aril; **C**, fruit with seed and aril; **D**, bark of branch; **E**, known distribution. Magnification A = x16; B = x4; C = x20; D =x16.

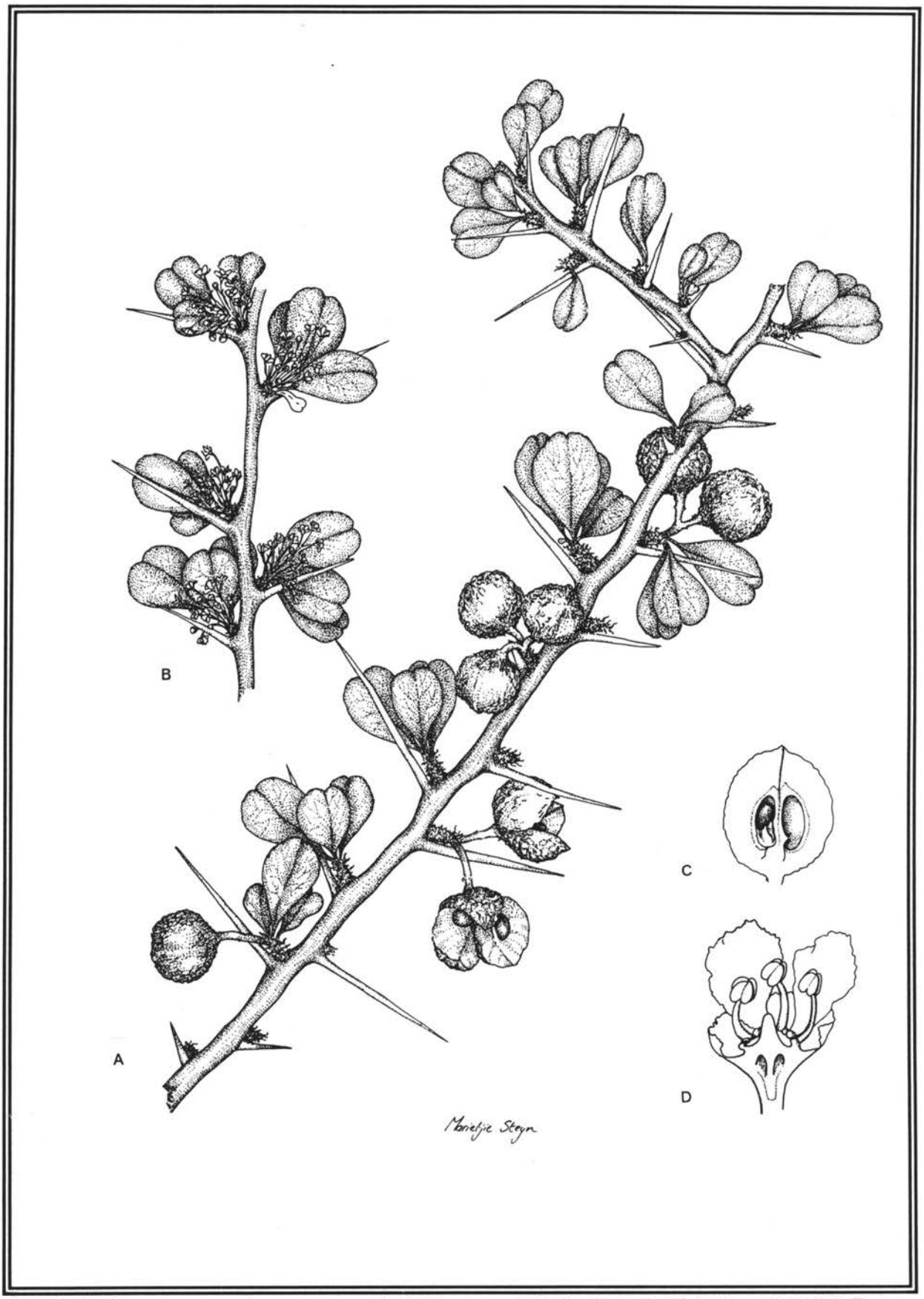

FIGURE 98.—*Gymnosporia macrocarpa*. **A**, fruiting branch [*Balkwill, Balkwill & Green 5356* (J)]; **B**, flowering branch [*Balkwill & Balkwill 5087* (J)]; **C**, fruit with seed and aril; **D**, male flower, crossection. Magnification A, B = x0.81; C = x2; D = x6.

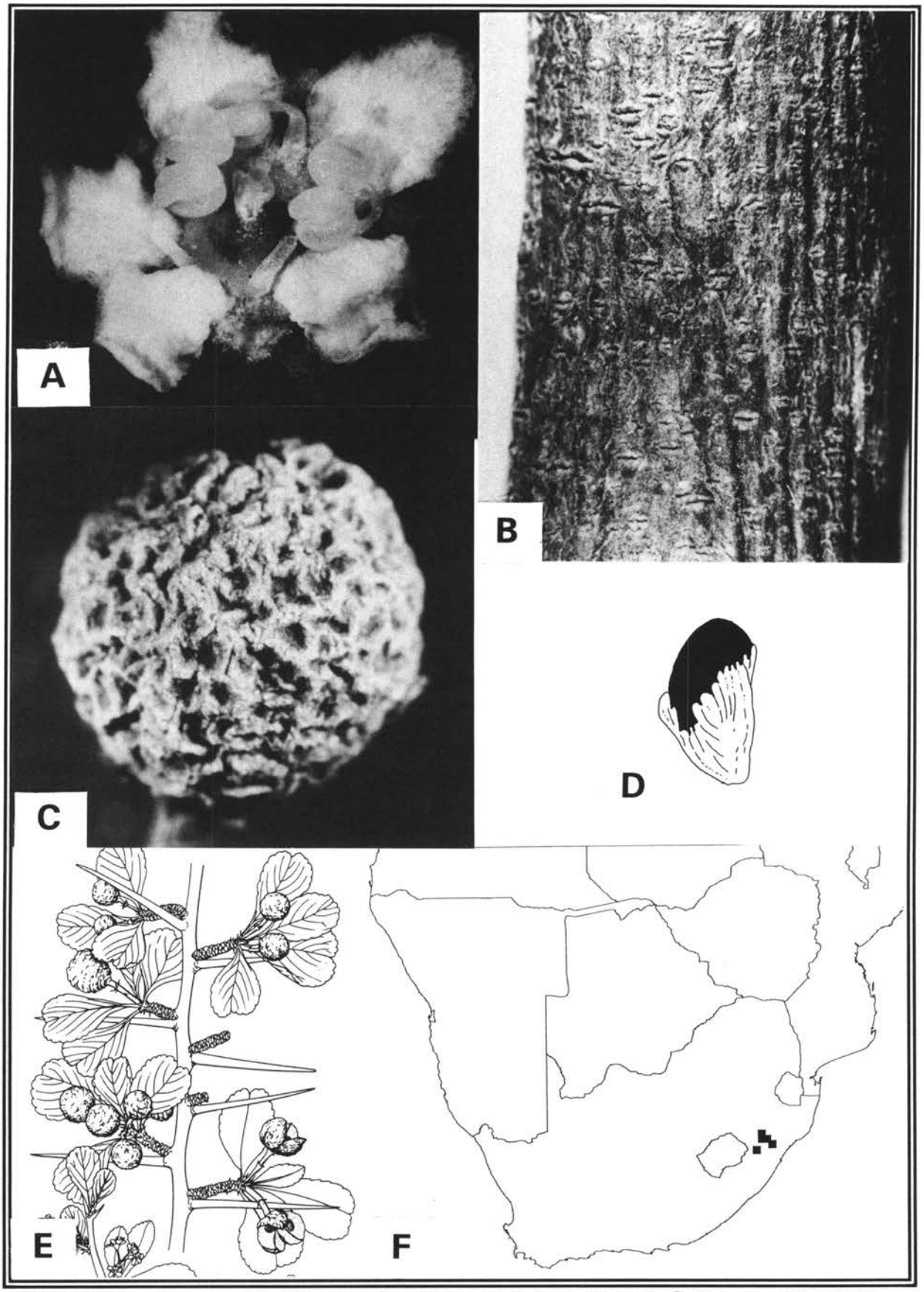

FIGURE 99.—*Gymnosporia macrocarpa*. **A**, male flower; **B**, bark of branch; **C**, fruit; **D**, seed and aril; **E**, branch with well developed brachyblasts; **F**, known distribution. A = x12.5; B = x6.3; C = x8; D = x4; E = x0.35.

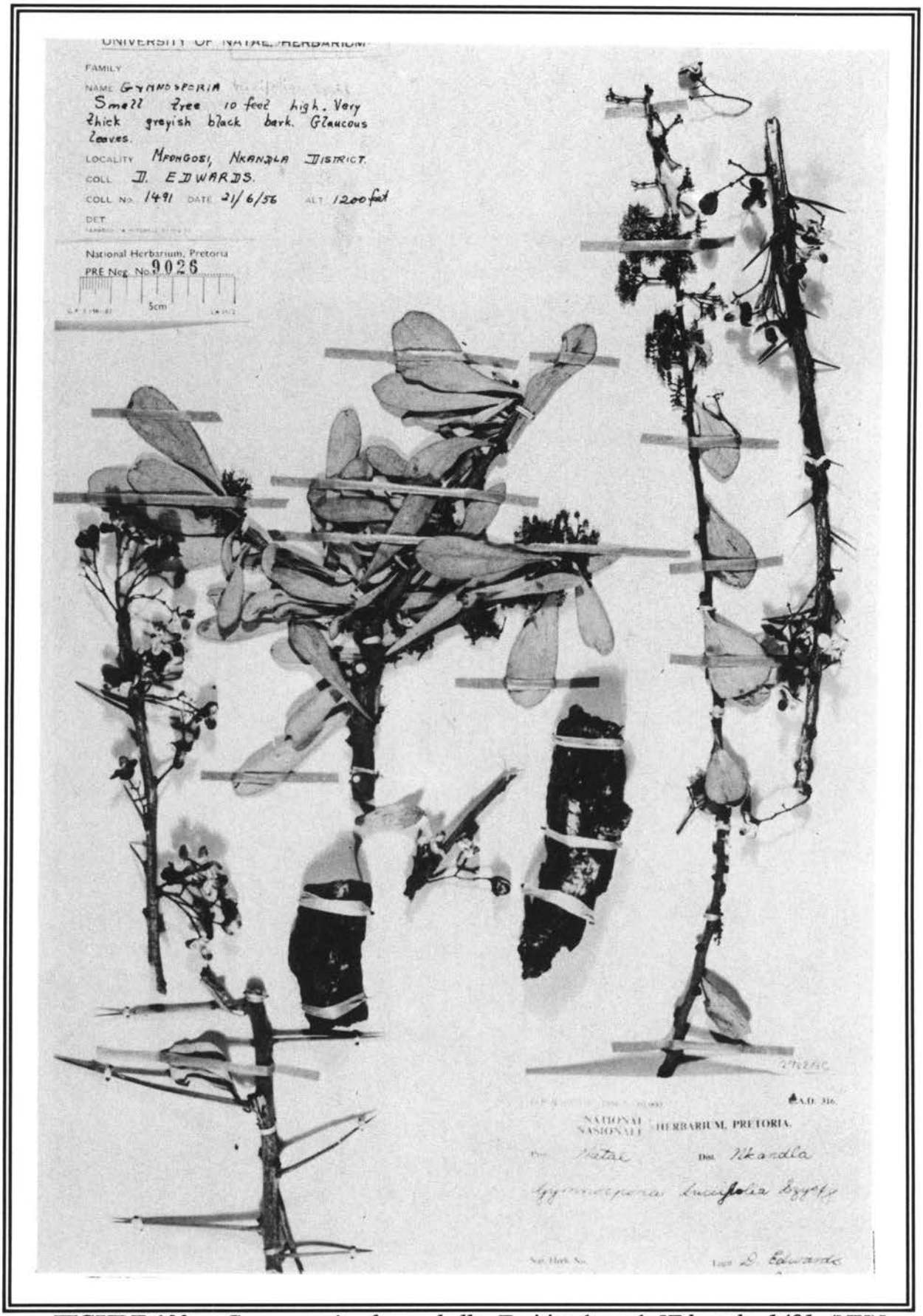

FIGURE 100.—*Gymnosporia glaucophylla*. Fruiting branch [*Edwards 1491* (NU)]. Magnification x0.5.

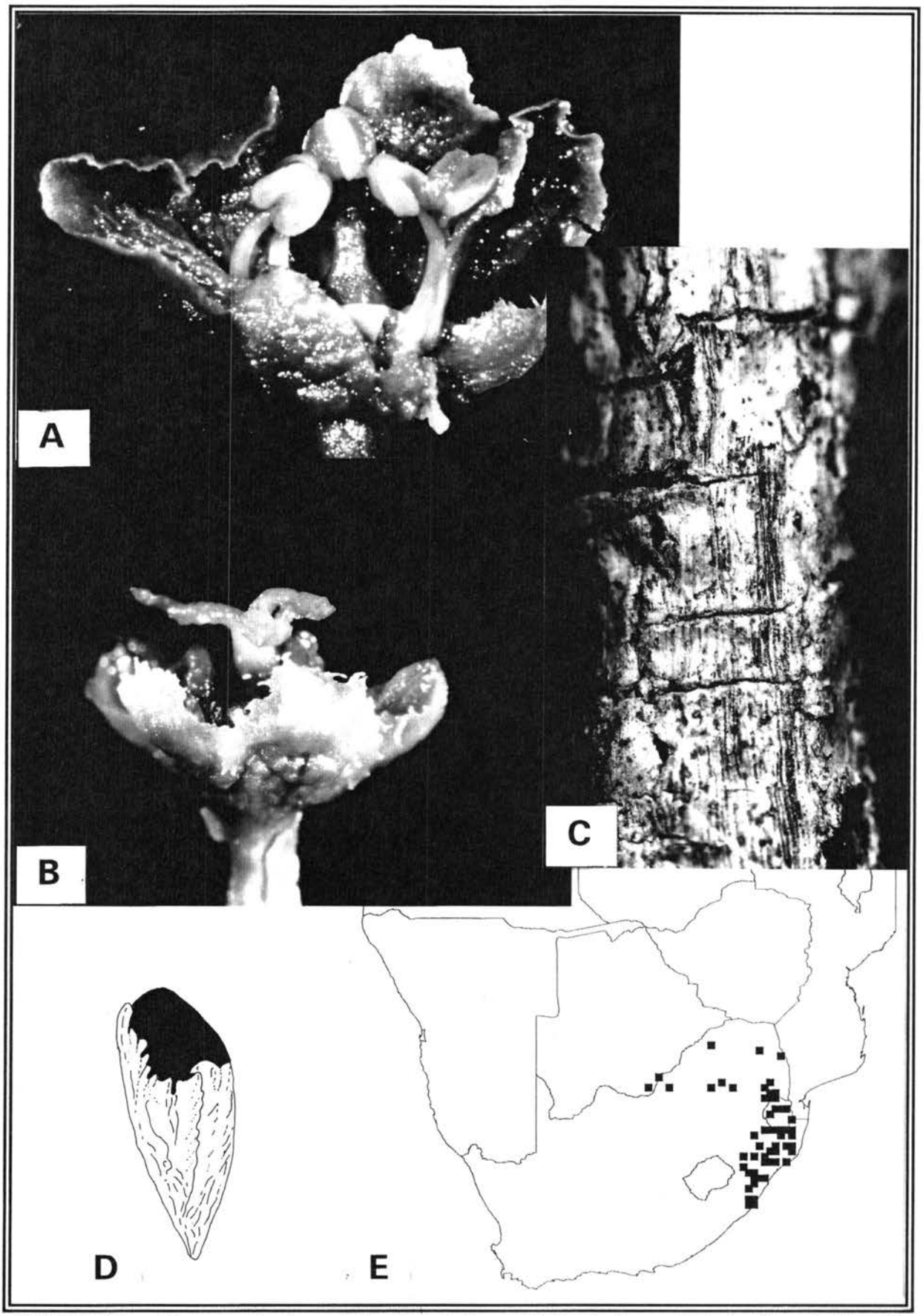

FIGURE 101.—*Gymnosporia glaucophylla*. **A**, male flower; **B**, female flower; **C**, bark of branch; **D**, seed and aril; **E**, known distribution. Magnification A =x16; B =x20; C = x10; D = x4.

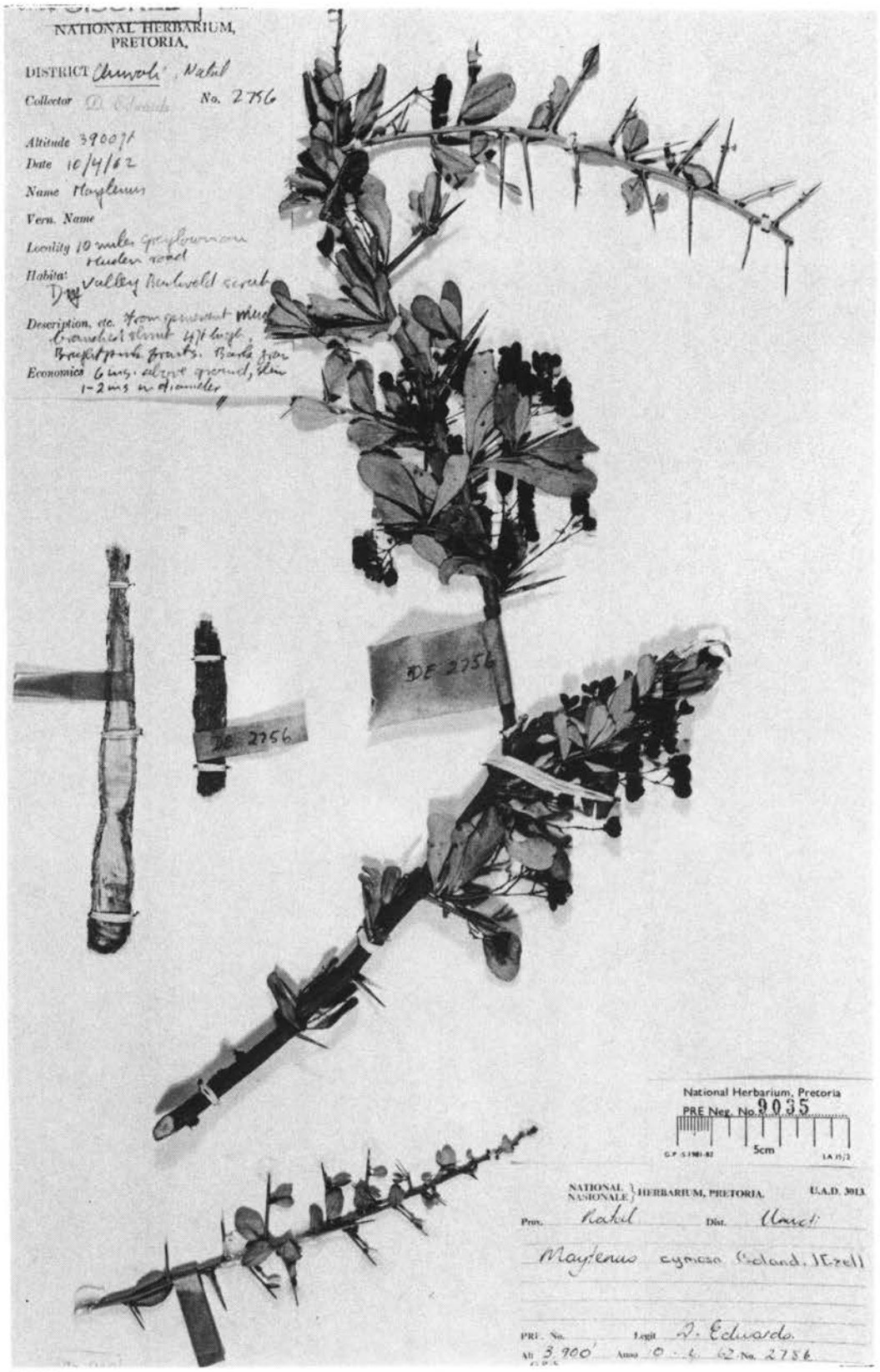

FIGURE 102.—*Gymnosporia tenuifolia*. Fruiting branch [*Edwards 2756* (PRE)]. Magnification x0.5.

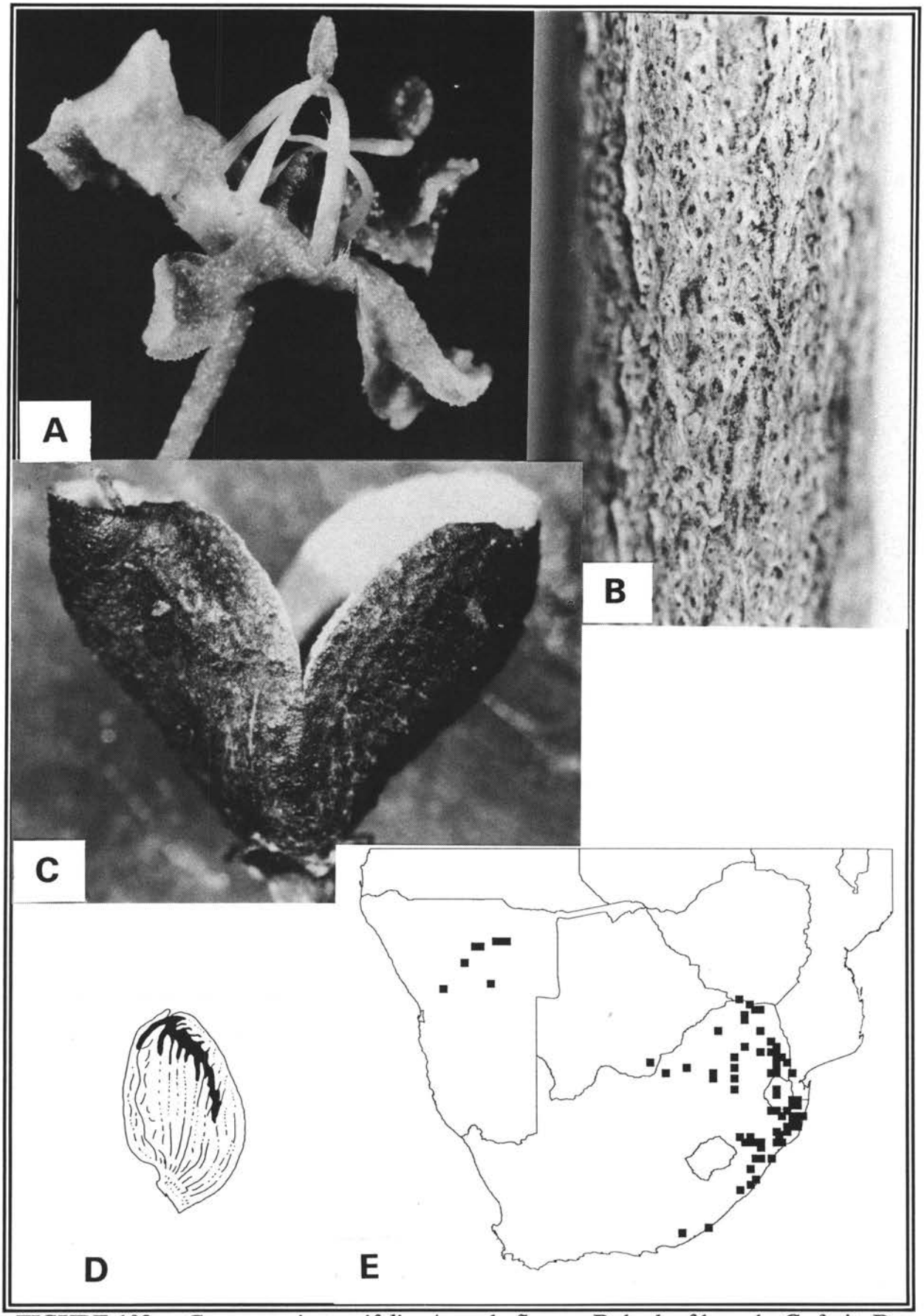

FIGURE 103.—*Gymnosporia tenuifolia*. **A**, male flower; **B**, bark of branch; **C**, fruit; **D**, seed and aril; **E**, known distribution. Magnification A, B = x16; C = x20; D = x4.

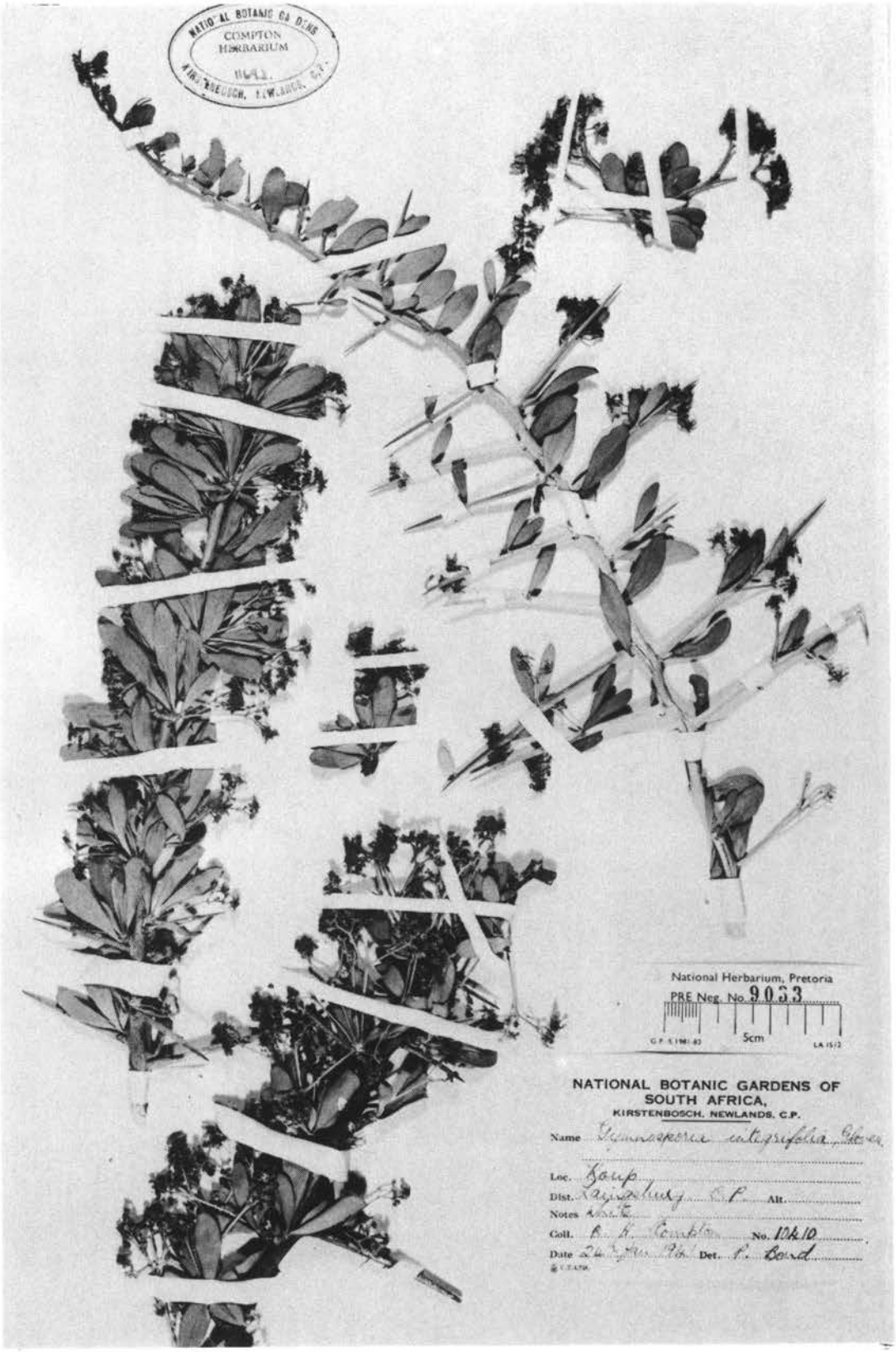

FIGURE 104.—*Gymnosporia szyszylowiczii* subsp. *szyszylowiczii*. Fruiting branch [*Compton 10410* (NBG)]. Magnification x0.5.

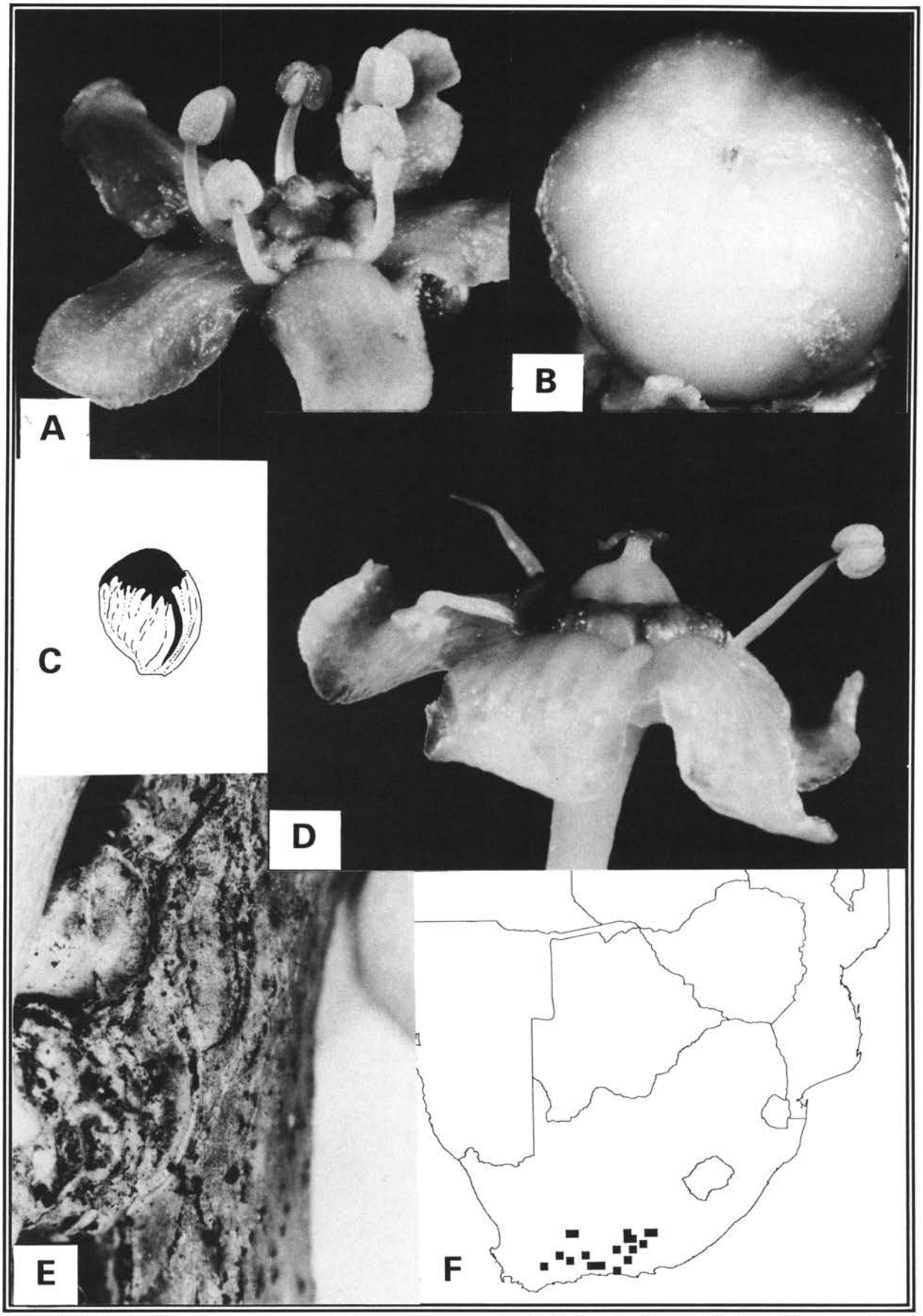

FIGURE 105.—*Gymnosporia szyszylowiczii* subsp. *szyszylowiczii*. **A**, male flower; **B**, fruit; **C**, seed and aril; **D**, female flower; **E**, bark of branch; **F**, known distribution. Magnification A, D, E = x12.5; B = x10; C = x4.

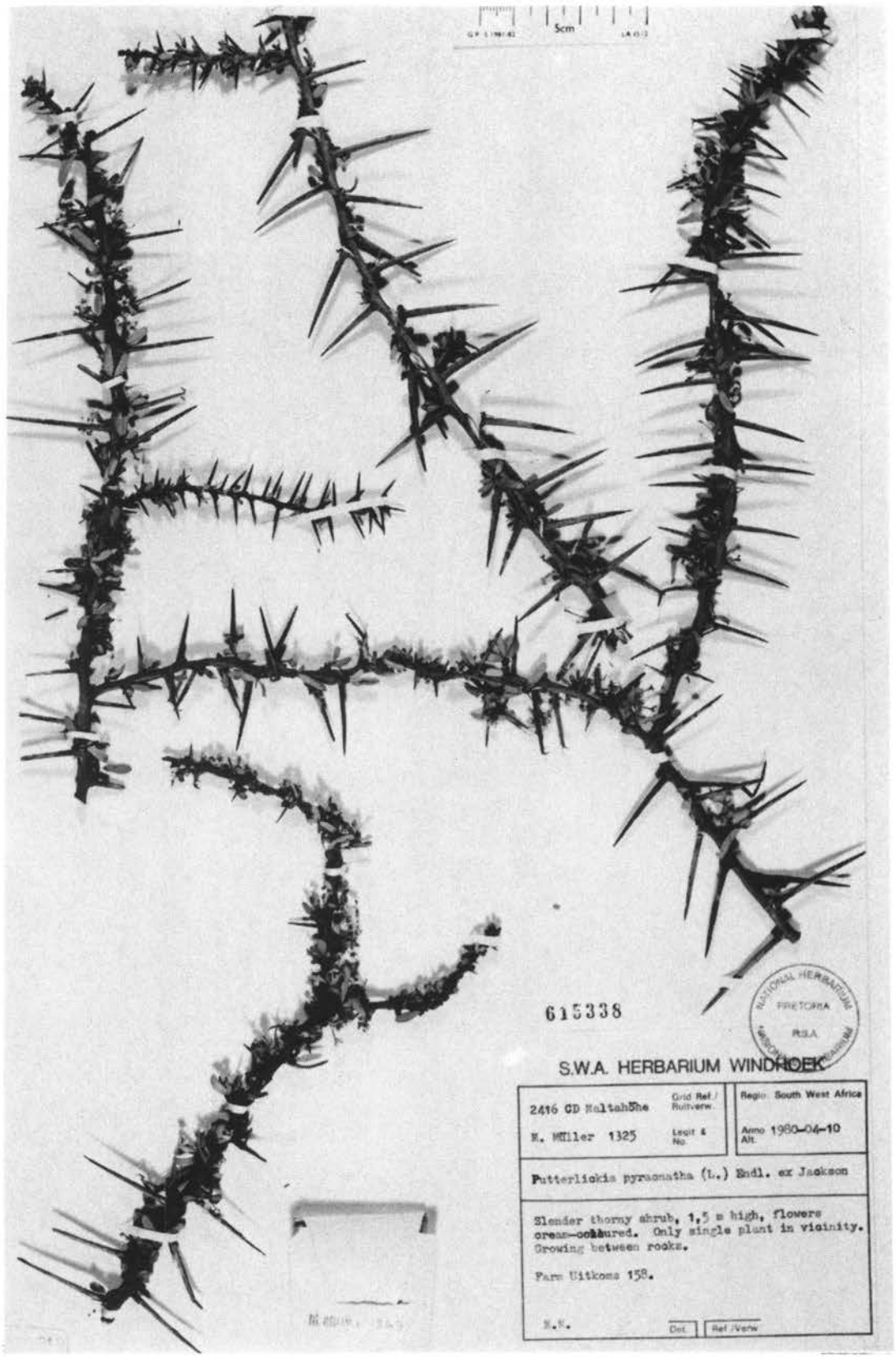

FIGURE 106.—*Gymnosporia szyszylowiczii* subsp. *namibiensis*. Flowering branch [*Muller 1325* (WIND)]. Magnification x0.5.

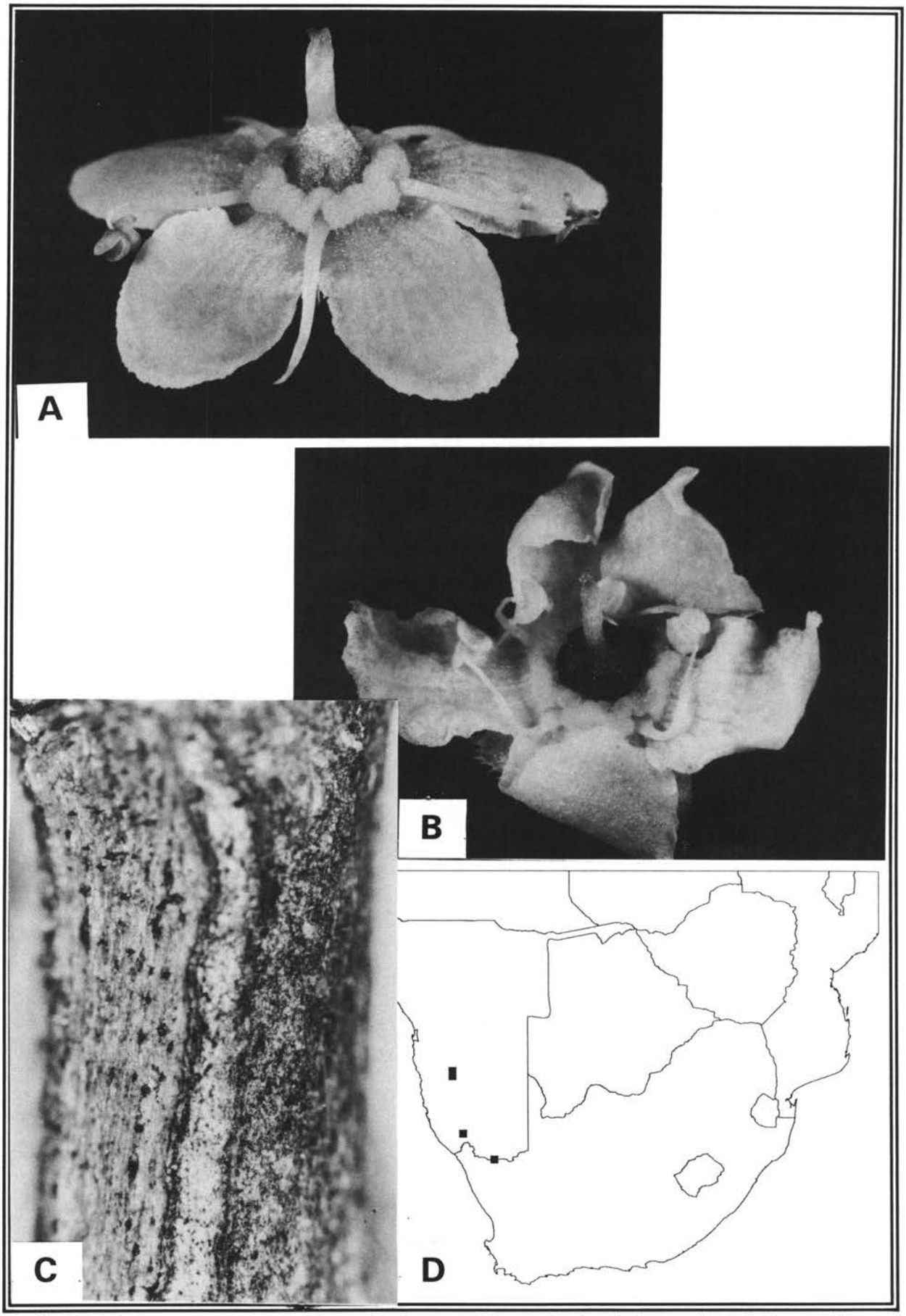

FIGURE 107.—*Gymnosporia szyszylowiczii* subsp. *namibiensis*. **A**, female flower; **B**, male flower; **C**, bark of branch; **D**, known distribution. Magnification A = x12.5; B = x16; C = x20.

FIGURE 108.—*Gymnosporia karooica*. Flowering and fruiting branches [*Grey Kollege Herbarium 55* (BOL) (type)]. Magnification x0.5.

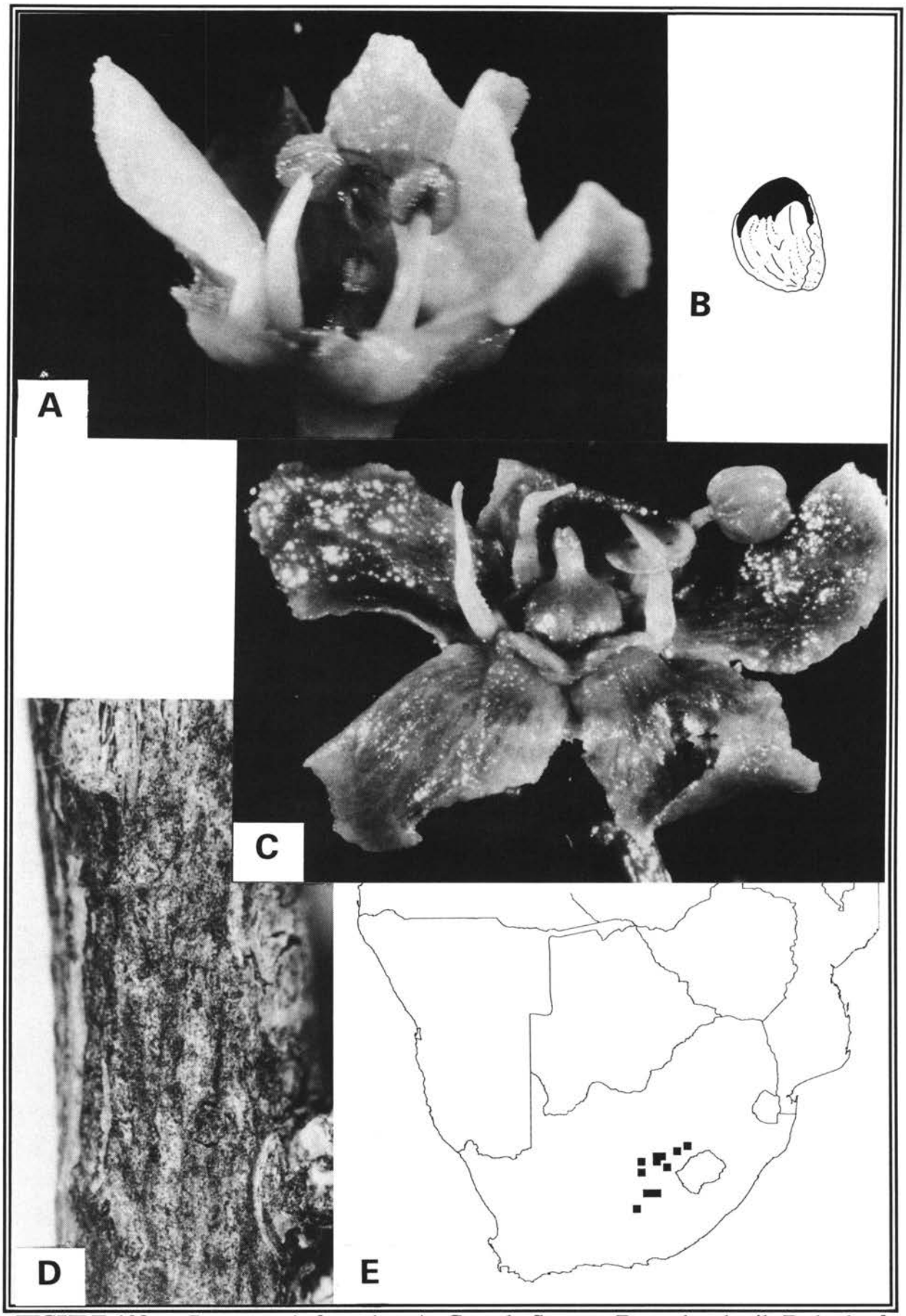

FIGURE 109.—*Gymnosporia karooica*. **A**, **C**, male flowers; **B**, seed and aril; **D**, bark of branch; **E**, known distribution. Magnification A, C = x16; B = x4; D = x.12.5.

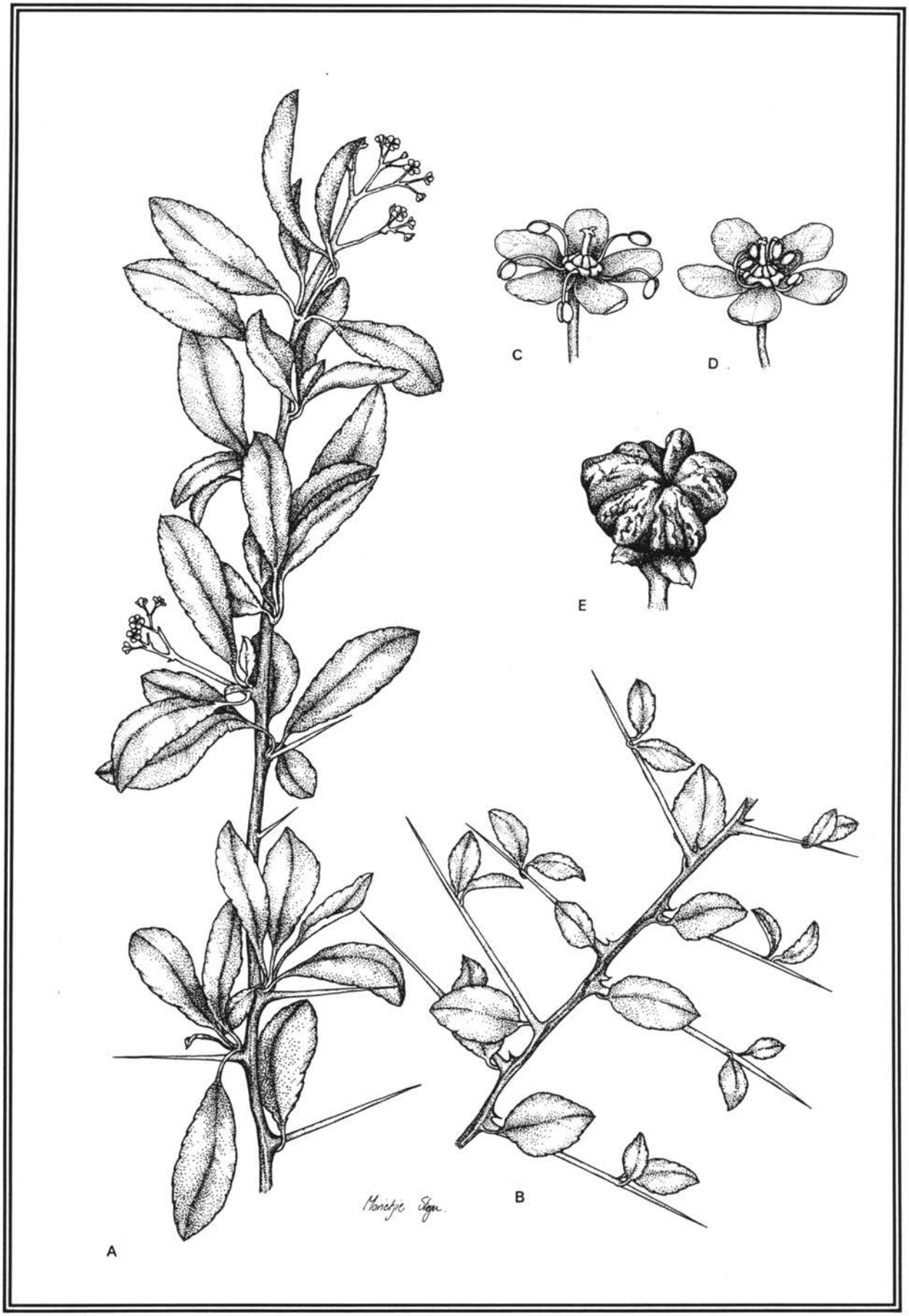

FIGURE 110.—*Gymnosporia devenishii*. **A**, flowering branch [*Jordaan* 2777 (PRE)]; **B**, young branchlet; **C**, female flower; **D**, male flower; **E**, fruit. Magnification A, B = x0.81; C—E = x4.

FIGURE 111.—*Gymnosporia devenishii*. Fruiting branch [*Cooper 154* (NH)]. Magnification x0.5.

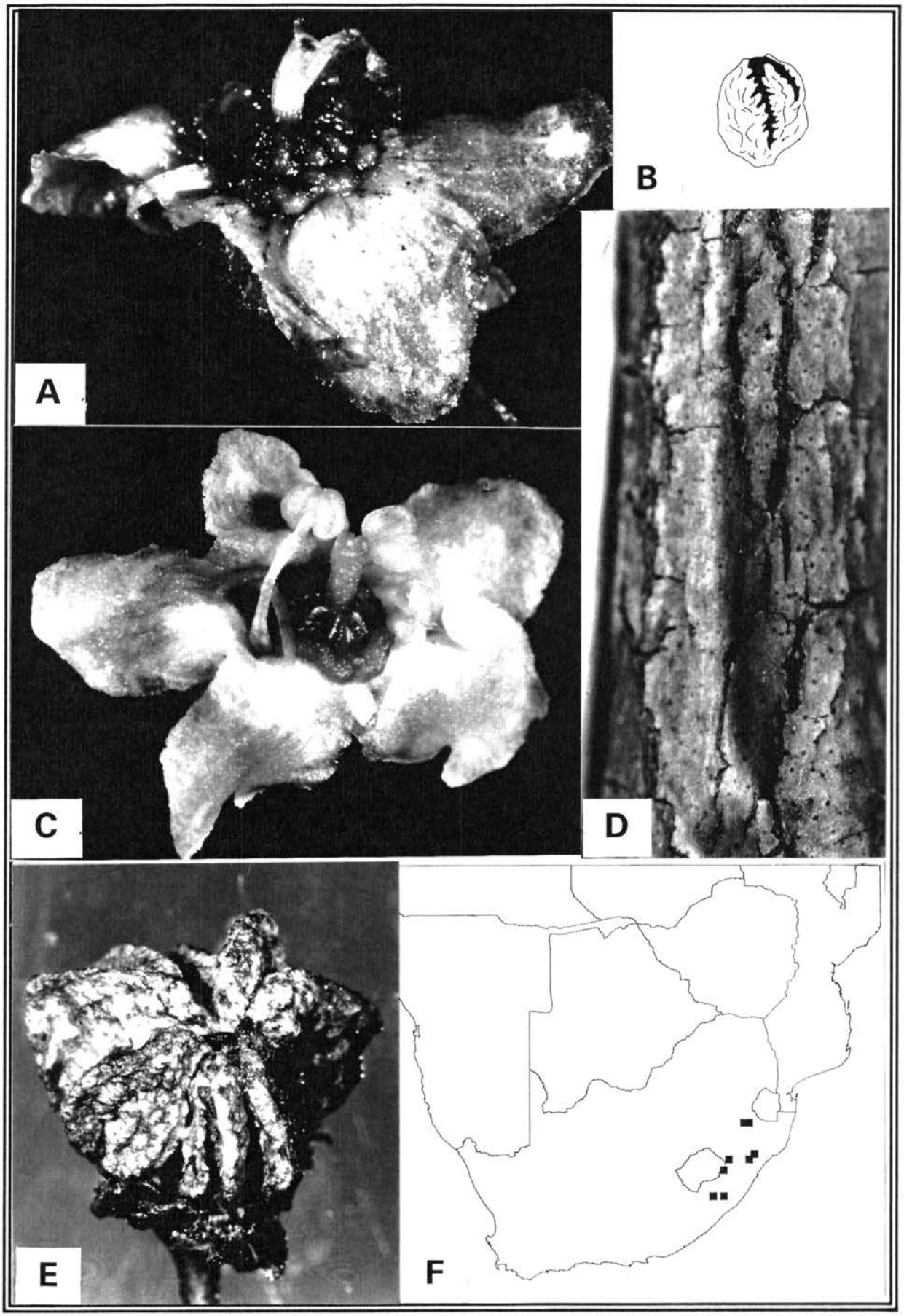

FIGURE 112.—*Gymnosporia devenishii*. **A**, female flower; **B**, seed and aril; **C**, male flower; **D**, bark of branch; **E**, fruit; **F**, known distribution. Magnification A = x20; B = x4; C = x16; D = x25; E = x8.

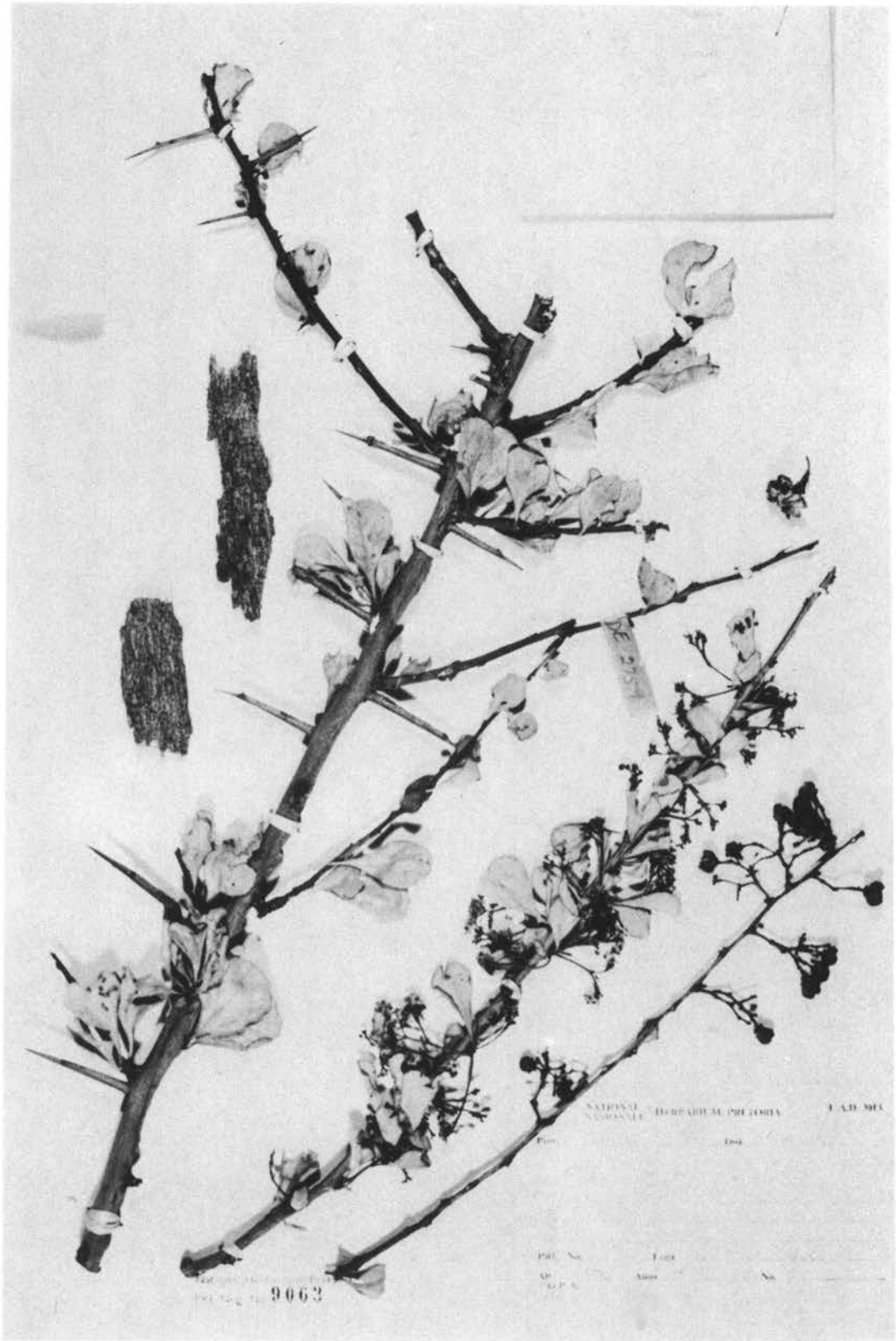

FIGURE 113.—*Gymnosporia hemipterocarpa*. Fruiting branch [*Edwards 2759* (PRE)]. Magnification x0.5.

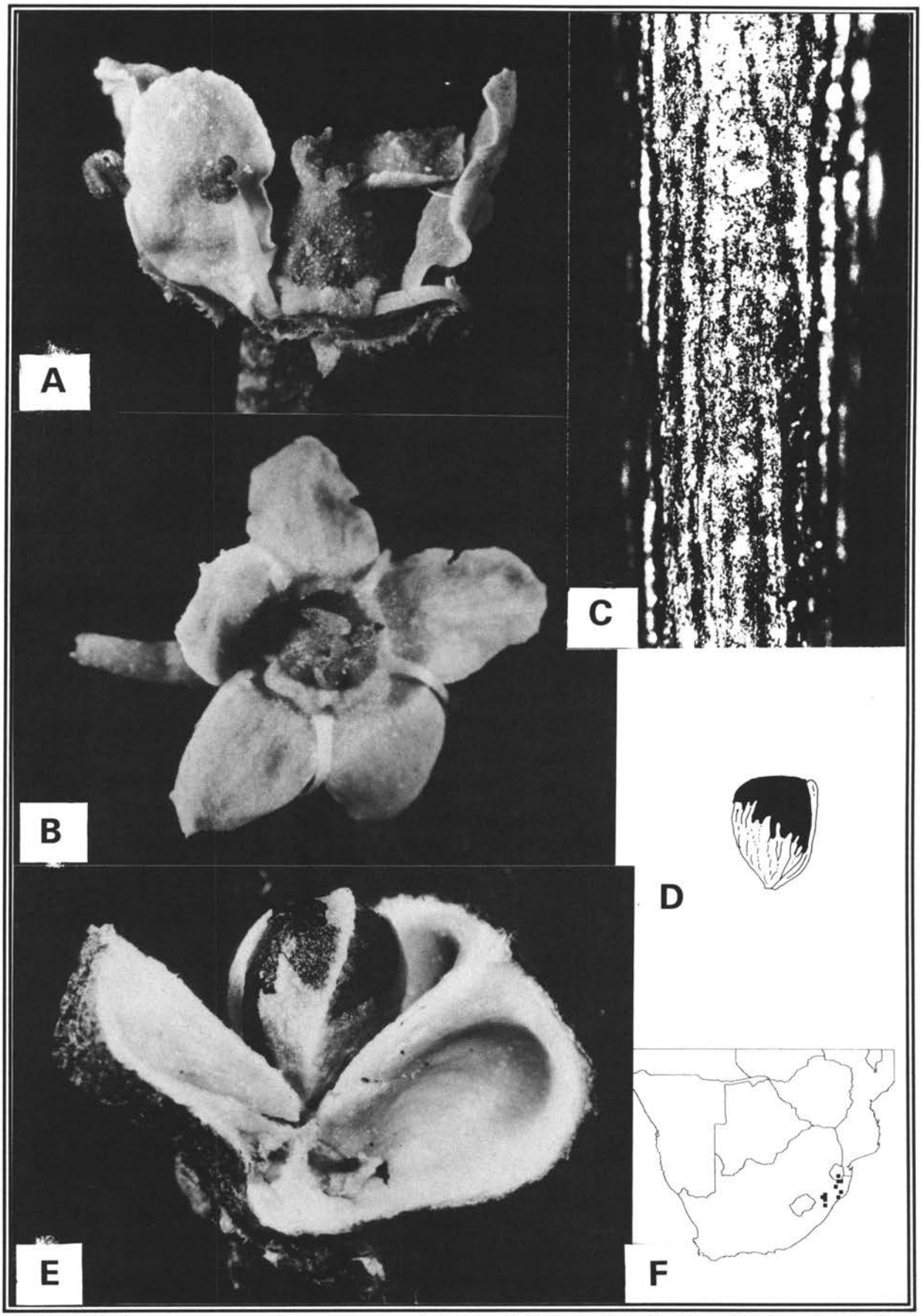

FIGURE 114.—*Gymnosporia hemipterocarpa*. **A**, **B**, female flowers; **C**, bark of branch; **D**, seed and aril; **E**, fruit with seed and aril; **F**, known distribution. Magnification A = x20; B = x12.5 C = x16; D = x4; E = x10.

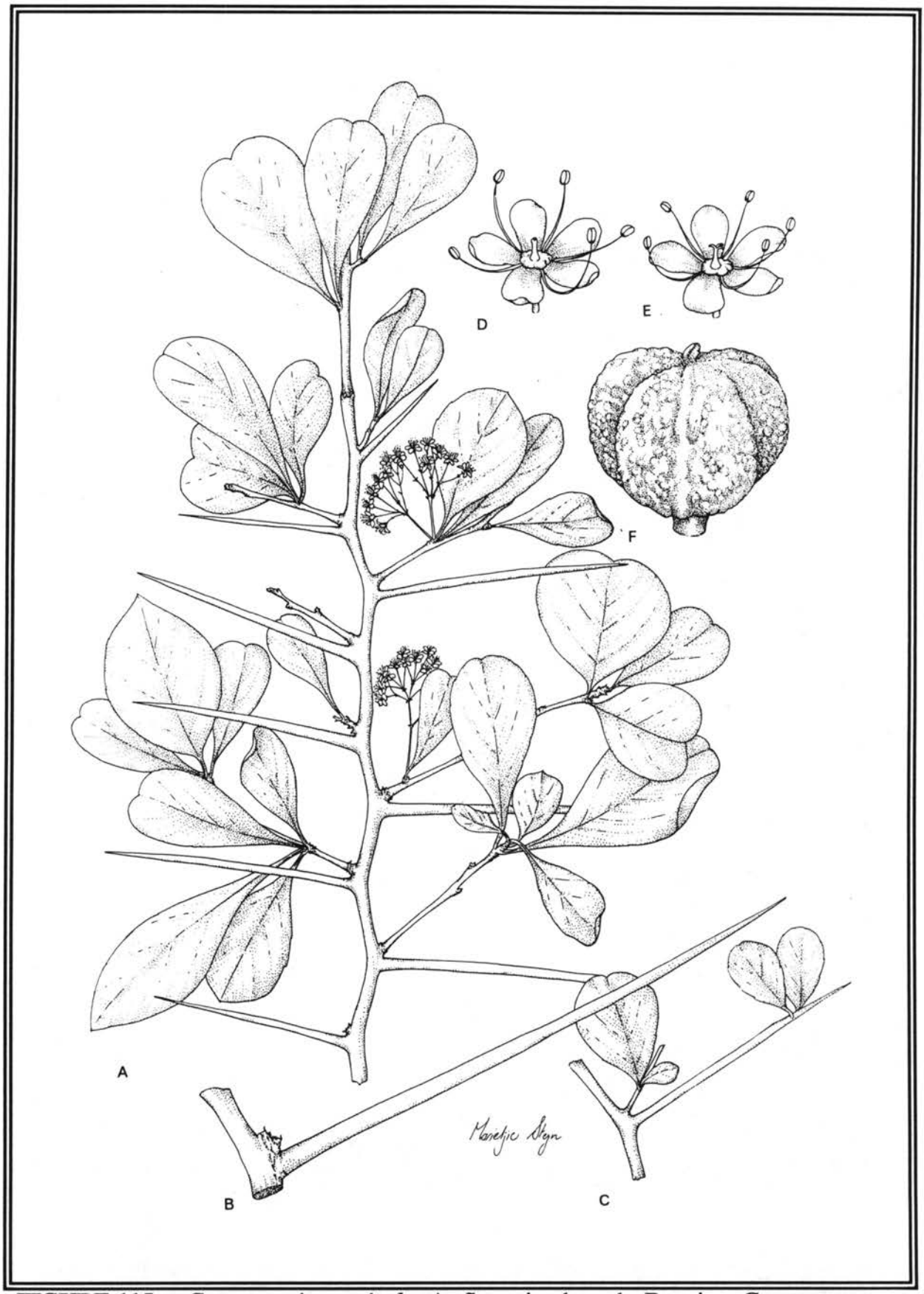

FIGURE 115.—*Gymnosporia arenicola*. **A**, flowering branch; **B**, spine; **C**, young branchlet with leaves on spine; **D**, male flower; **E**, female flower; **F**, friut. Magnification A—C = x0.7; D, E = x3; F = x8.

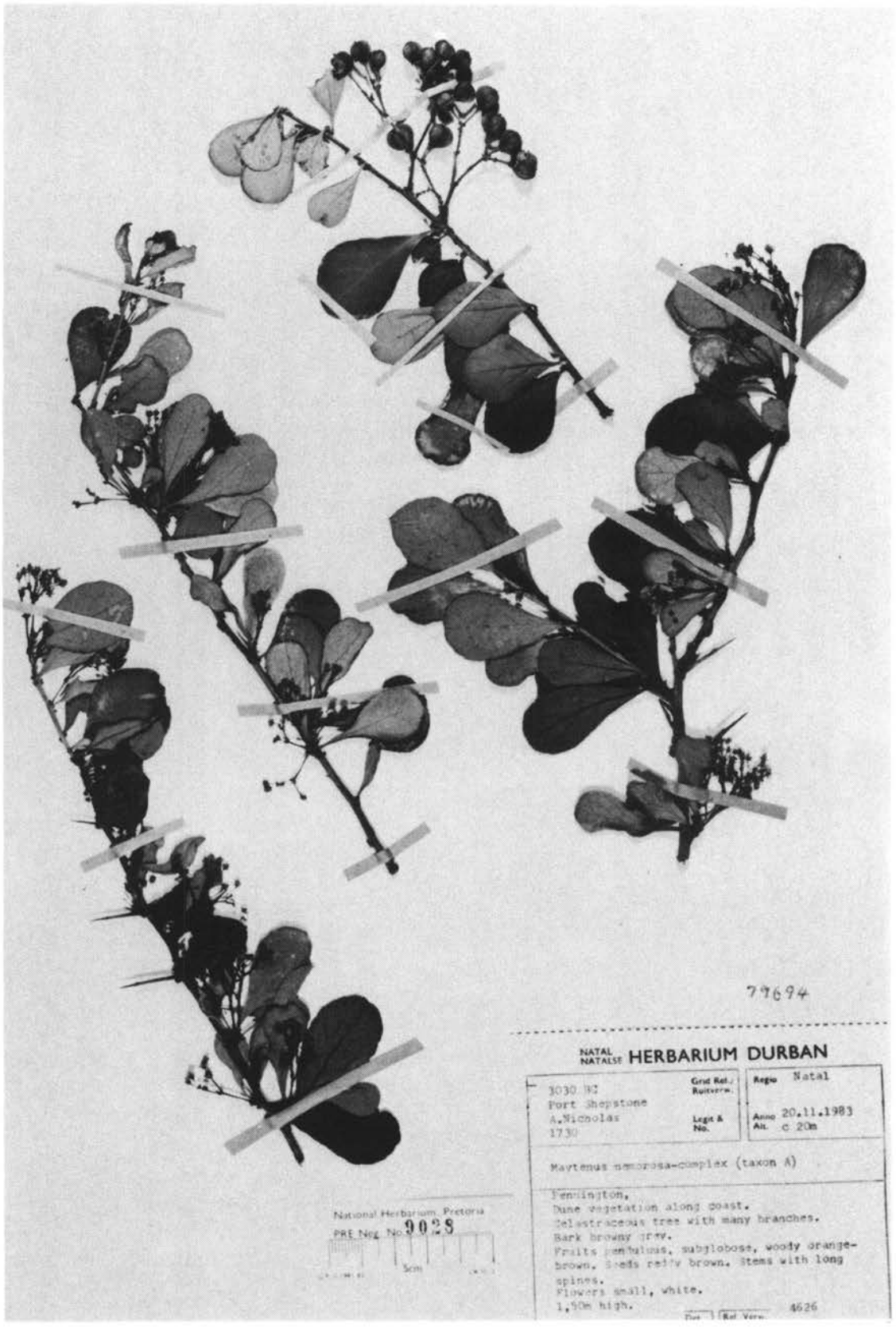

FIGURE 116.—*Gymnosporia arenicola*. Flowering and fruiting branch [*Nicholas 1730* (NH)]. Magnification x0.5.

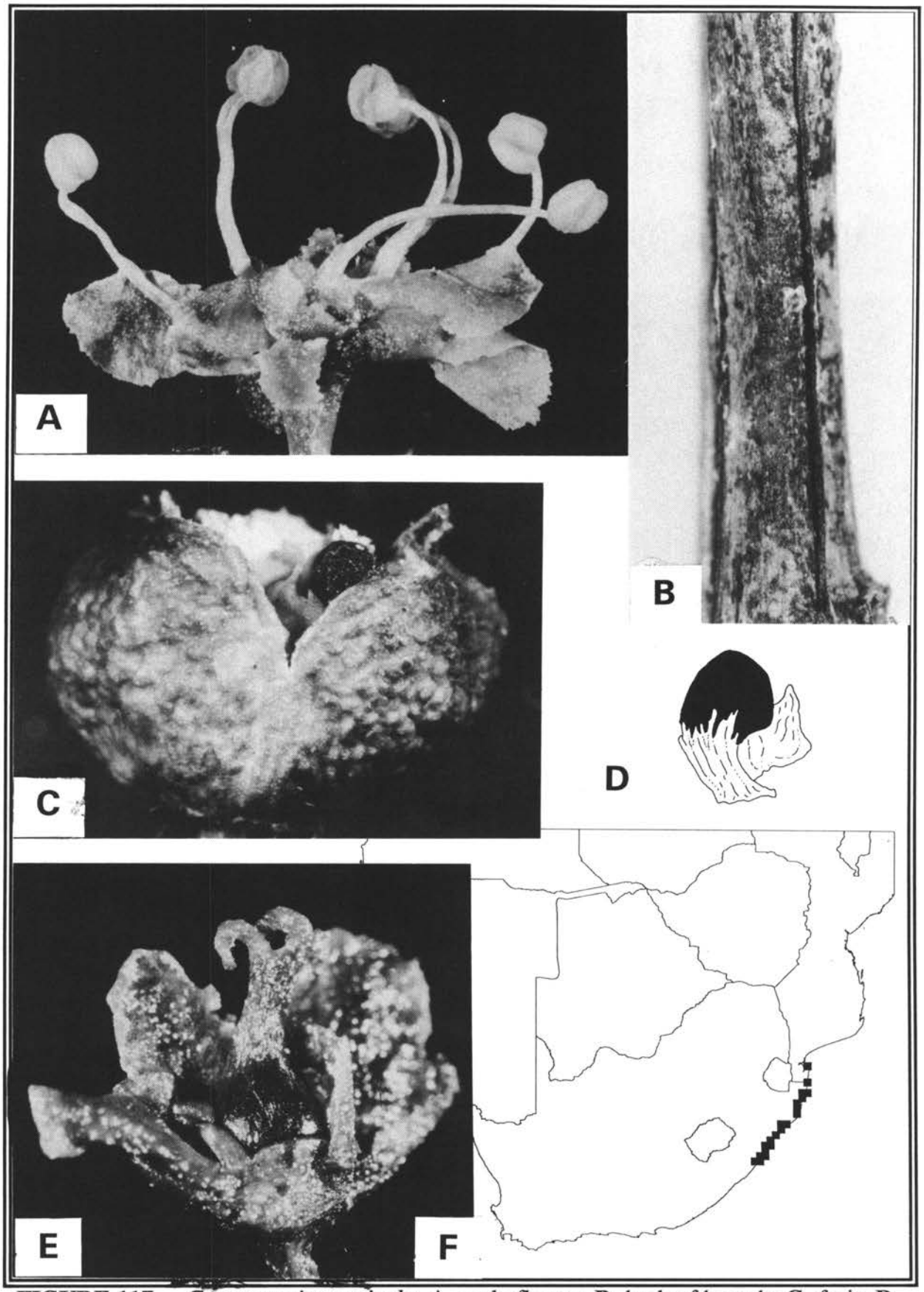

FIGURE 117.—*Gymnosporia arenicola*. **A**, male flower; **B**, bark of branch; **C**, fruit; **D**, seed and aril; **E**, female flower; **F**, known distribution. Magnification A = x12.5; B =x10; C = x8; D = x4; E = x20; F = x10.

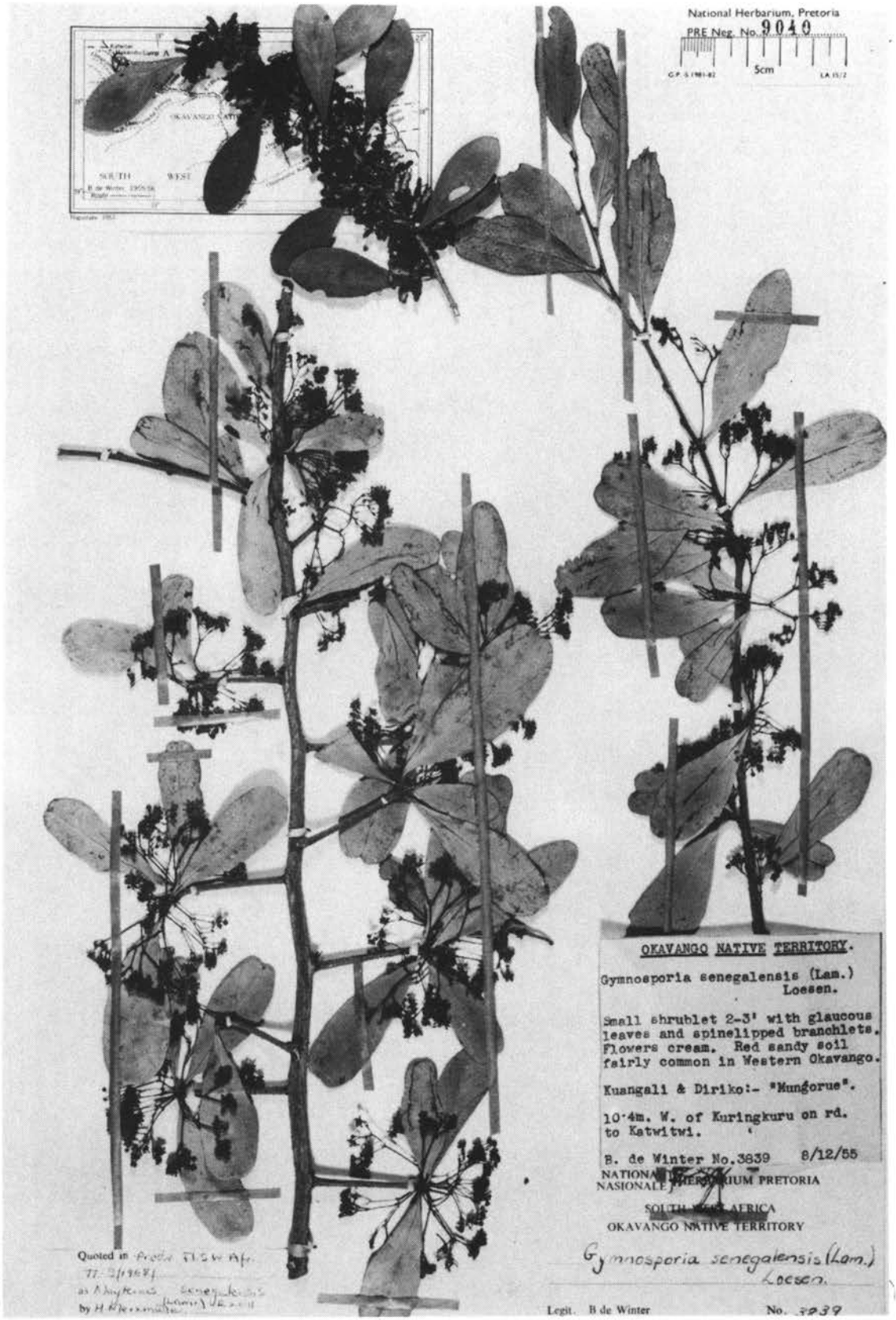

FIGURE 118.—*Gymnosporia senegalensis*. Flowering branch [*De Winter 3839* (PRE)]. Magnification x0.5.

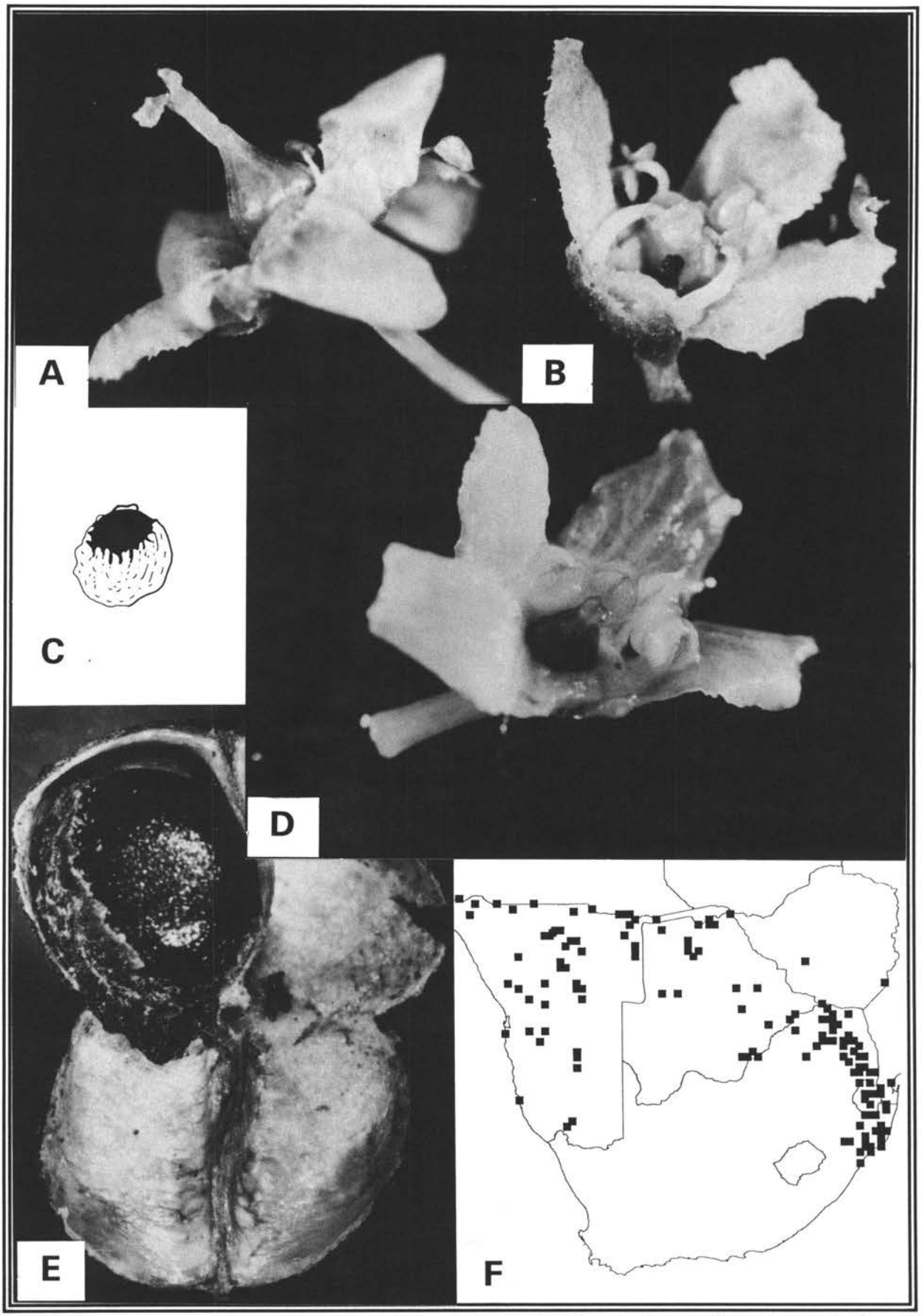

FIGURE 119.—*Gymnosporia senegalensis*. **A**, female flower; **B**, **D**, male flowers; **C**, seed and aril; **E**, fruit with seed and aril; **F**, known distribution. Magnification A = x32; B, D = x20; C = x4; E = x10.

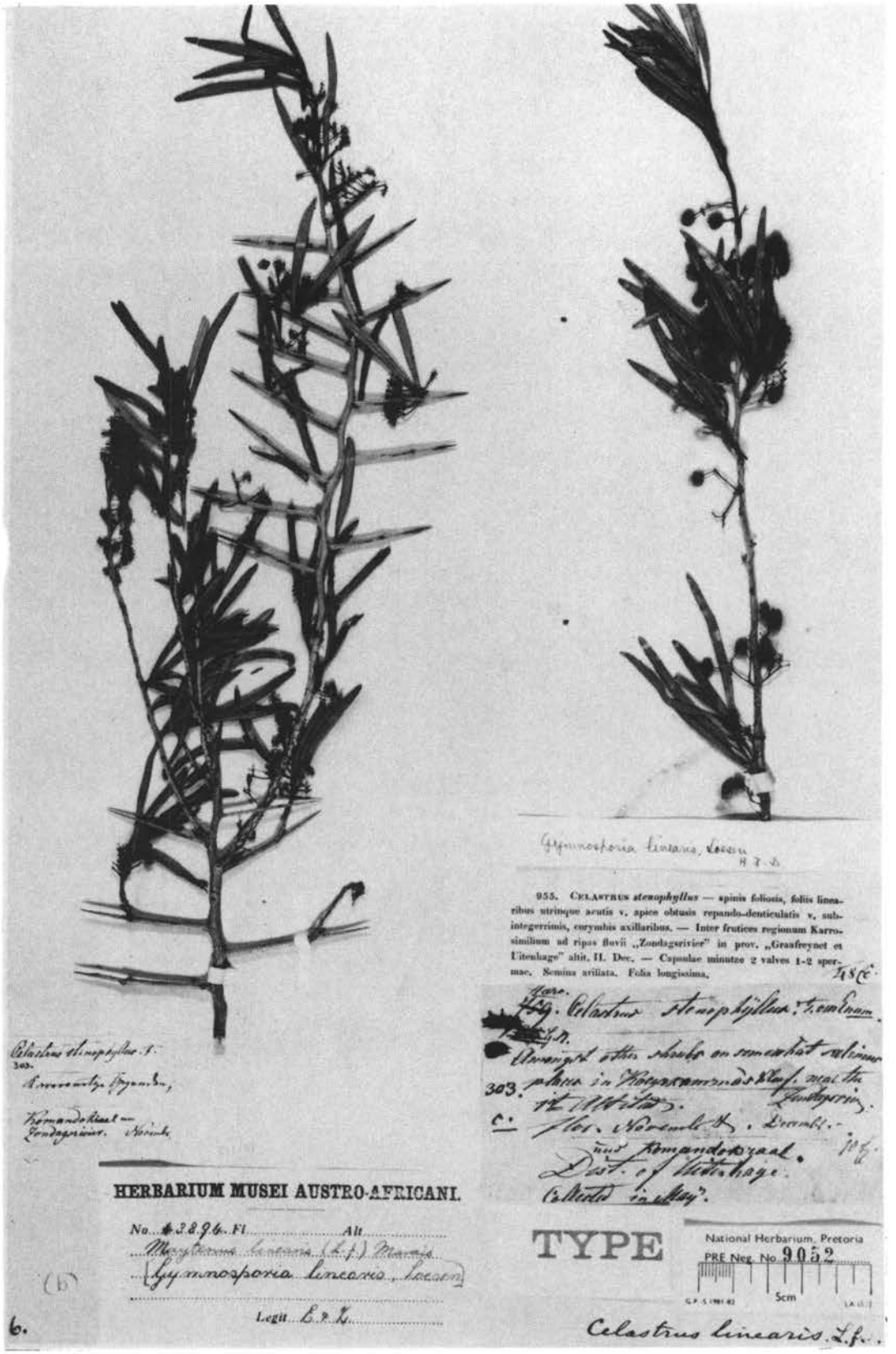

FIGURE 120.—*Gymnosporia linearis* subsp. *linearis*. Fruiting branch [*Ecklon & Zeyher 955* (SAM) (type)]. Magnification x0.5.

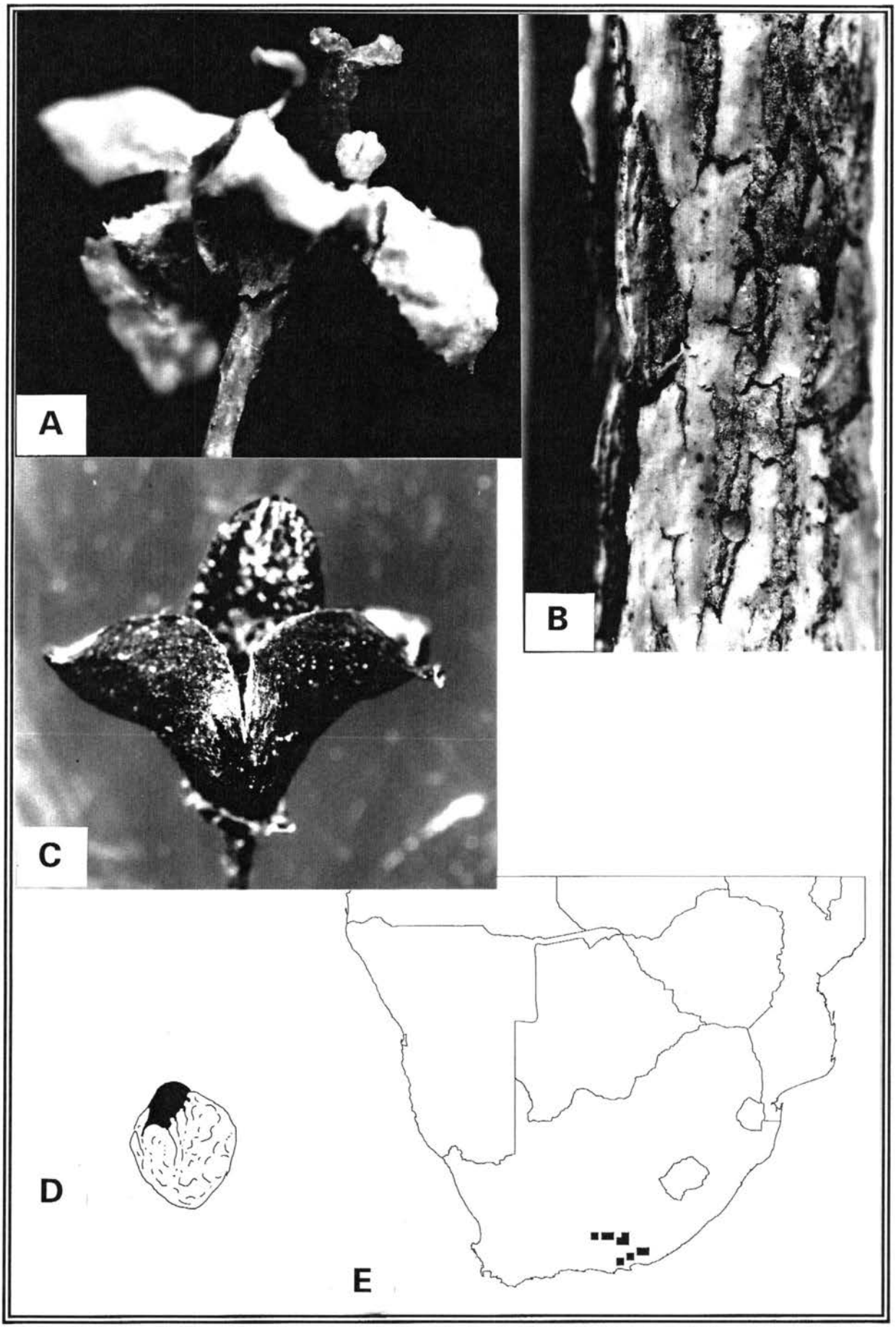

FIGURE 121.—*Gymnosporia linearis* subsp. *linearis*. **A**, female flower; **B**, bark of branch; **C**, fruit; **D**, seed and aril; **E**, known distribution. Magnification A = x32; B = x16; C = x12.5; D = x4.

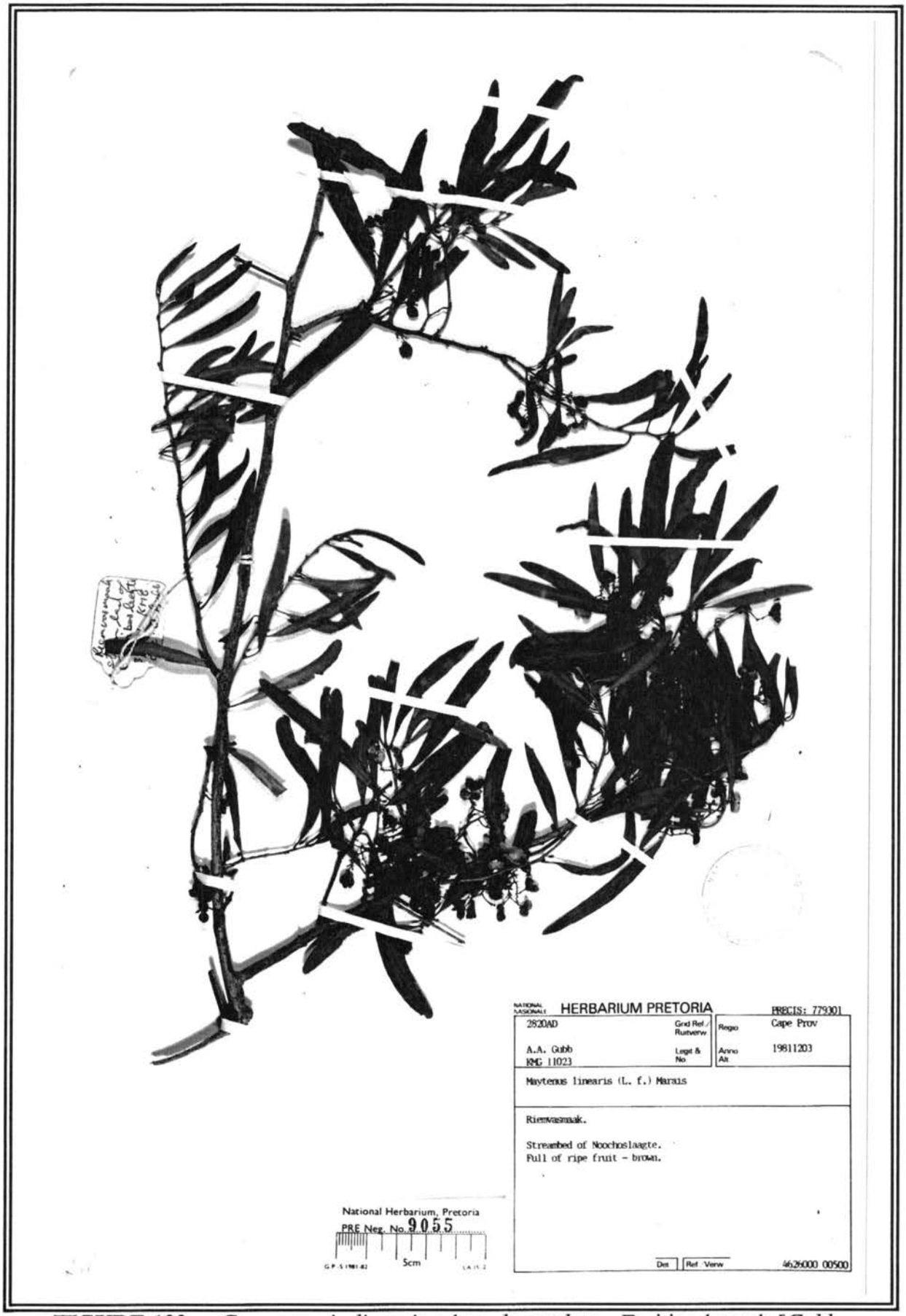

FIGURE 122.—*Gymnosporia linearis* subsp. *lanceolata*. Fruiting branch [*Gubb MG11023* (PRE)]. Magnification x0.5.

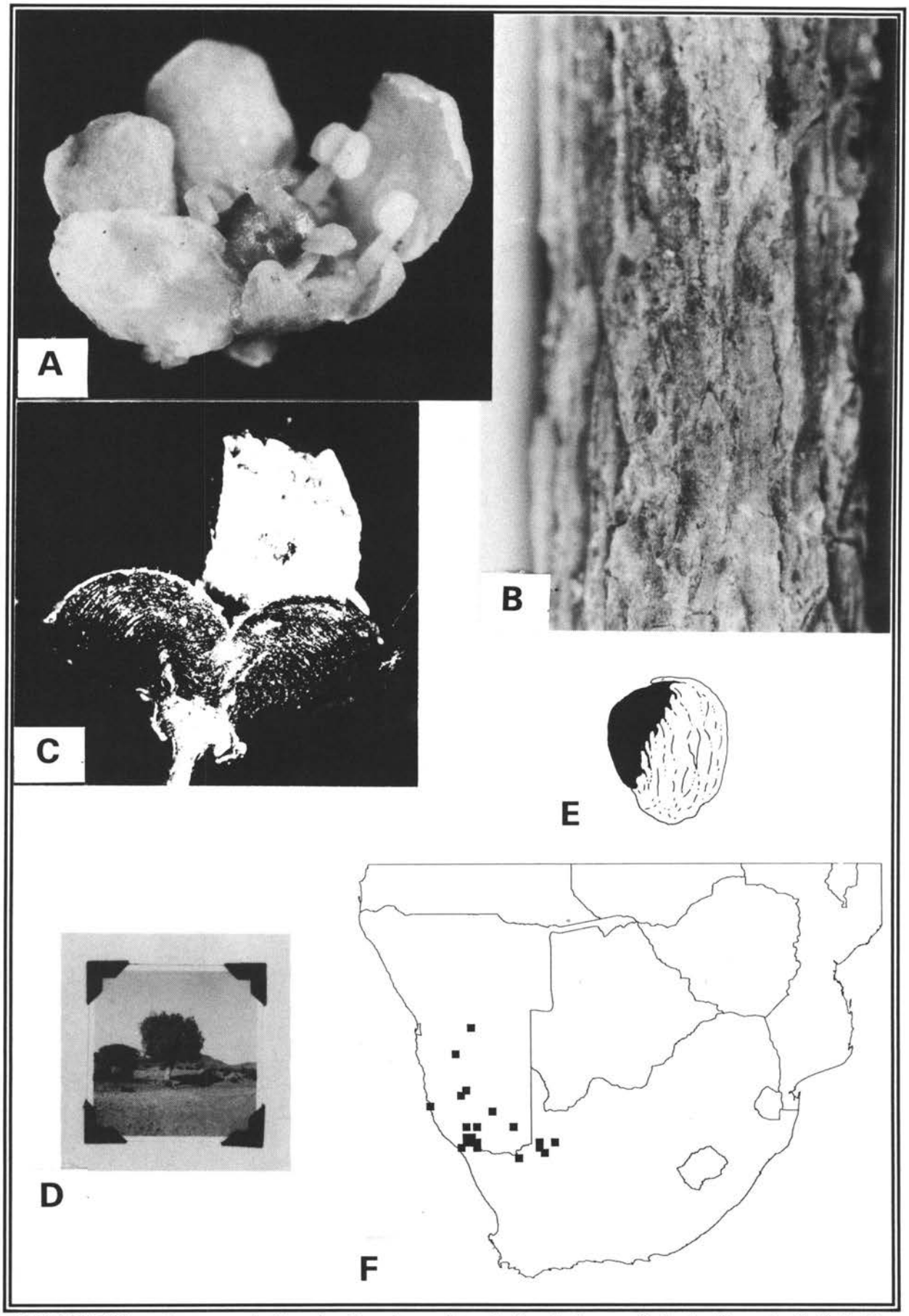

FIGURE 123.—*Gymnosporia linearis* subsp. *lanceolata*. **A**, female flower; **B**, bark of branch; **C**, fruit; **D**, habit: tree; **E**, seed and aril; **F**, known distribution. Magnification A = x25; B = x12.5; C = x10; E = x4.

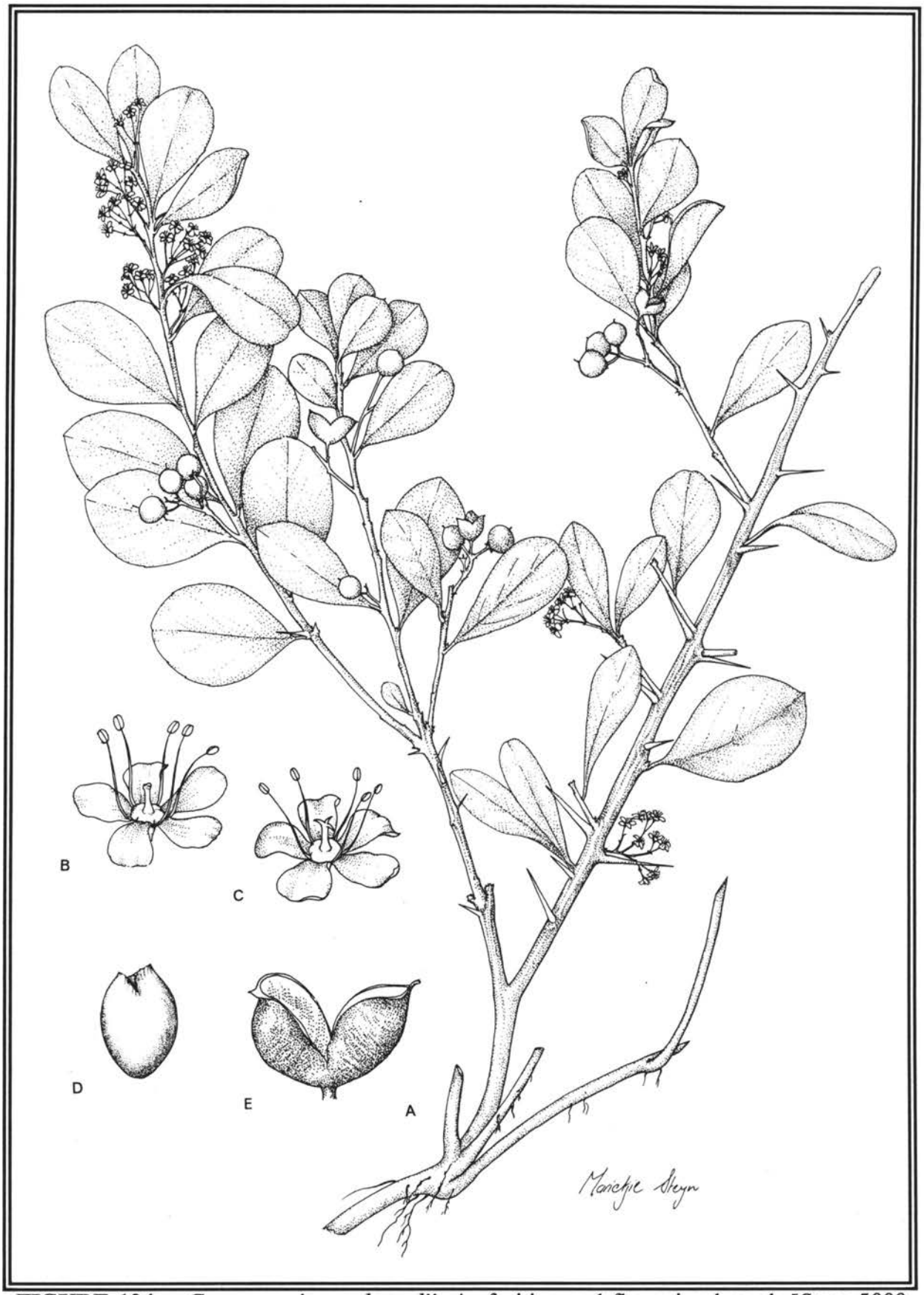

FIGURE 124.—*Gymnosporia markwardii*. **A**, fruiting and flowering branch [*Strey 5000* (NH, PRE)]; **B**, male flower; **C**, female flower; **D**, seed and aril; **E**, bilocular fruit. Magnification A = x0.81; B, C = x4; D, E = x3.

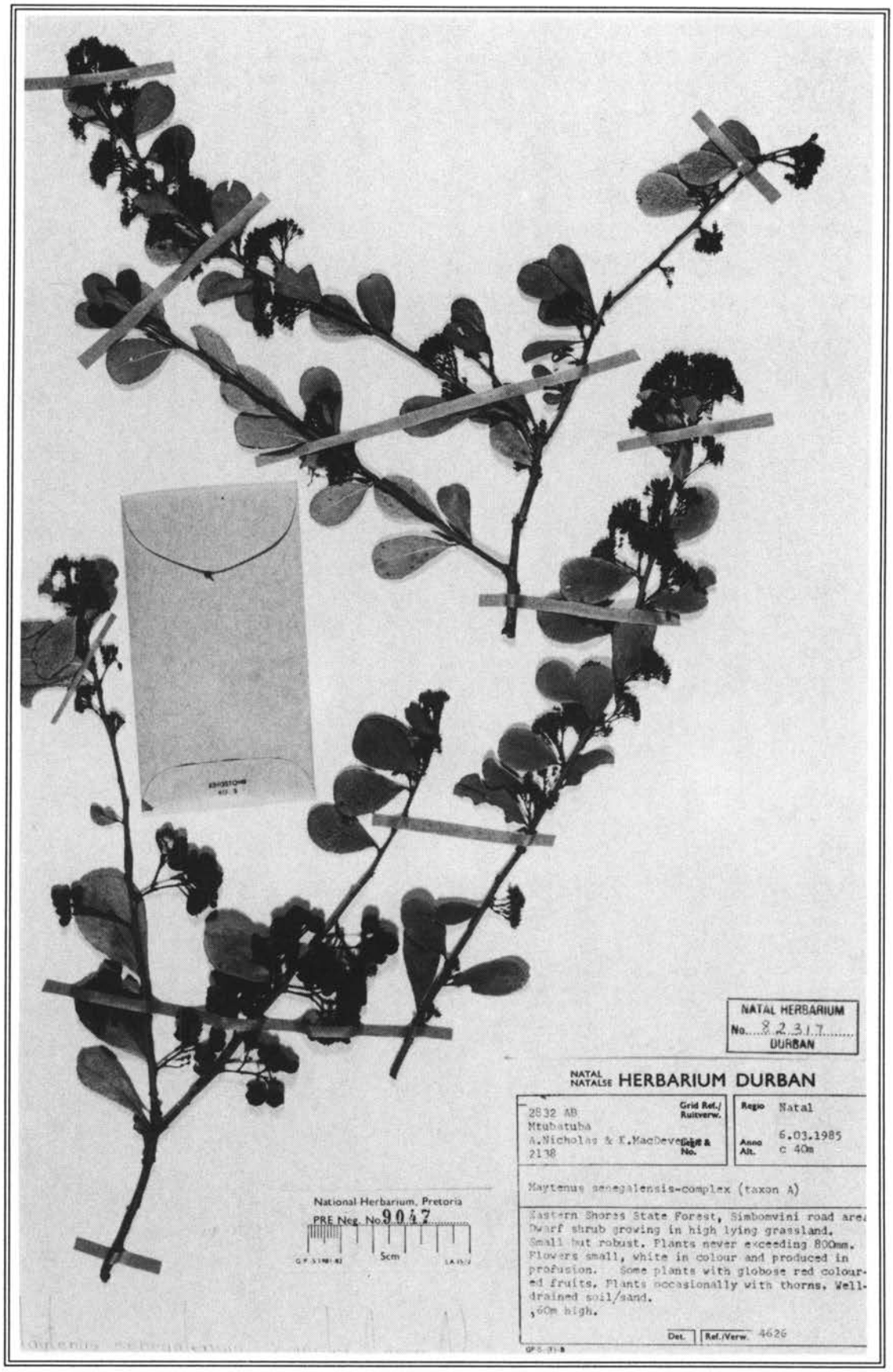

FIGURE 125.—*Gymnosporia markwardii*. Flowering and fruiting branch [*Nicholas & K. MacDevette 2138* (NH) (type)]. Magnification x0.5.

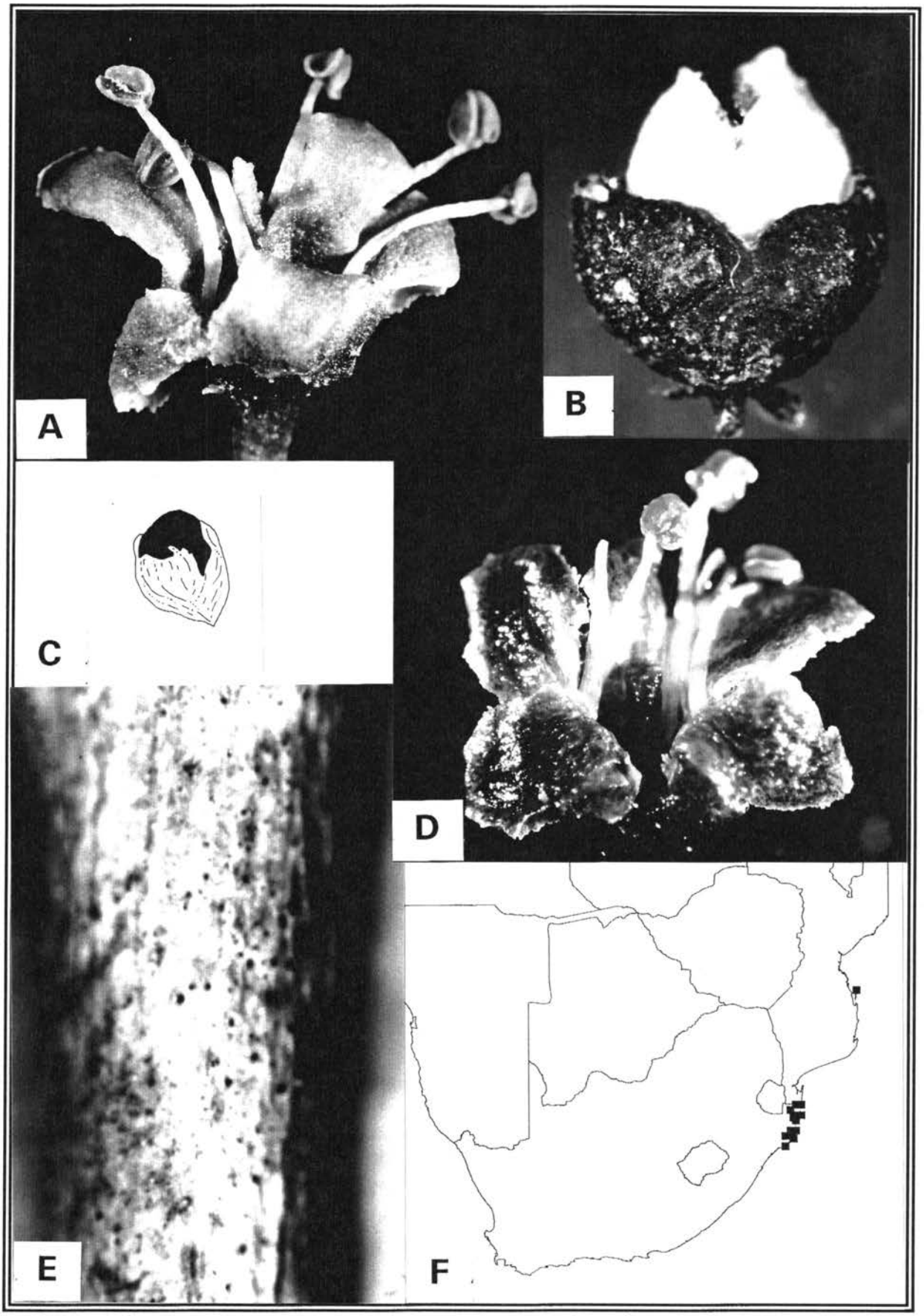

FIGURE 126.—*Gymnosporia markwardii*. **A**, female flower; **B**, fruit; **C**, seed and aril; **D**, male flower; **E**, bark of branch; **F**, known distribution. Magnification A, D = x16; B = x8; C = x4; E = x25.

APPENDIX

Gymnosporia bachmannii *Loes.* in Engl., Botanische Jahrbücher 19: 232 (1895); Davison: 308 (1927). Type: *Bachmann 847* (K, lecto., here designated).

Maytenus bachmannii (Loes.) Marais: 384 (1960); Coates Palgrave: 495 (1981); Moll: 216 (1992); Pooley: 264 (1993).

Shrub or rarely a small straggling tree, up to 4 m tall, glabrous, only occasionally with spines. *Spines* small, slender, few, up to 15 mm long, without leaves or inflorescences. *Branches* slender, brownish grey, with orange underbark in striations; branchlets angular-striate. *Leaves* mostly alternate, rarely fasciculate, glabrous, chartaceous, bright green above, paler beneath, petiolate; lamina narrowly elliptic, 15—60 × 3—13 mm, apex and base tapering to narrow point; margin closely serrulate; venation prominent below, reticulate, midrib prominently raised above; petiole pinkish, up to 5 mm long. *Stipules* very small, subulate, marcescent. *Inflorescence* a few-flowered dichasium, axillary. *Flowers* 2—7 per cyme, creamy white, small, 3 mm in diameter. *Sepals* 0.5 mm long, triangular, margin uneven. *Petals* 2 mm long, oblong, margin uneven. *Disc* narrow, undulate. *Male flowers* with stamens slightly shorter than petals; filaments 0.1 mm long. *Ovary* 3-locular; ovules 2 per locule; style very short; stigma 3-lobed. *Capsules* red, pyriform, smooth, chartaceous, 2—5 mm long. *Seeds* 2—4, reddish brown; aril orange, completely covering the seed.

Common names: willow koko tree, *wilgerkokoboom*.

Flowering time: January—March.
Fruiting time: February—July.

Diagnostic features: usually spineless;, occasionally found with a few spines; leaves alternate rather than fasciculate, very distinctively discolorous when dry, apex and base tapering to a narrow point, midrib prominently raised.

Distribution and habitat: this species is endemic to the rocky banks of Natal Group Sandstone rivers and streams in southern Kwazulu/Natal and Pondoland.

Vouchers: *Davidson 1117* (J), *Strey 9559* (NH, PRE); *Thode 4676* (STE), *Van Jaarsveld & Camphor 10199* (NBG); *Van Wyk 2605* (PRE, PRU); *Venter 1039* (PRE).

Specimens examined

Gymnosporia bachmannii

Abbott 168, 3030CC (PRU); 651, 3130AA (PRU); 3171, 3130AA (PRU); 3224, 3130AA (PRU); 3230, 3130AA (PRU); 4139, 3130AA (PRU), *Archer* 255, 3418AB (PRU), *Davidson* 1117, 3030CA (J), *Kerfoot* 6396, 3030CA (J), *Marais* 1150, 3030CD (PRE), *Nicholson* 743, 3130AA (PRE), *Strey* 7426, 3030CB (PRE); 9559, 3030CD (NH, PRE); 11060 3030CB (NH, PRE), *Thode* 4676, 3030CD (STE), *Van Jaarsveld & Camphor* 10199, 3129BD (NBG); *Van Wyk* 1618, 3129BD (PRE); 1666, 3130AA (PRE); 2605, 3030CC (PRE, PRU); 6044, 3030CB (PRE); 7202, 3030CC (PRU); 7388, 3130AA (PRU); 8575, 3129BC (PRU), *Van Wyk & Matthews* 7901, 3129BD (PRU), *Venter* 948, 3129BD (PRE); 1008, 3030CC (PRE); 1039, 3030CD (PRE).