

The genus *Ehretia* (Boraginaceae: Ehretioideae) in southern Africa

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ABSTRACT

The genus *Ehretia* P.Browne in southern Africa is revised. Six species and five subspecies of *Ehretia* are currently recognized in southern Africa, of which *E. alba* Retief & A.E.van Wyk, *E. namibiensis* Retief & A.E.van Wyk subsp. **namibiensis**, *E. namibiensis* subsp. **kaokoensis** Retief & A.E.van Wyk, *E. rigida* subsp. **silvatica** Retief & A.E.van Wyk and *E. rigida* subsp. **nervifolia** Retief & A.E.van Wyk are newly described. The genus is widely distributed in the region and occurs in a variety of habitats, ranging from the forests of the Eastern Cape to the hot, arid, semidesert parts of Namibia. Members of *Ehretia* in southern Africa are predominantly multistemmed shrubs or small trees. Characters of the leaf, the trichome complement, inflorescence and corolla are used to distinguish between the different species. A key to the species, distribution maps and illustrations of various micro- and macromorphological as well as palynological features are provided.

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INTRODUCTION

The genus *Ehretia* was described by Browne (1756). In 1759 Linnaeus validated the generic name with the binominal *E. tinifolia*. *Ehretia*, with about 33 species in the tropics of both the Old and New World, is found particularly in Africa and Asia, with a few species in tropical America and the West Indies. Lebrun & Stork (1997) recognized 12 species in tropical Africa, three of which extend to southern Africa (Herman 1993). The genus is widely distributed in southern Africa, occurring in a variety of habitats ranging from lush forests of the Eastern Cape to hot, arid parts of Namibia. Members of *Ehretia*

in southern Africa are predominantly multistemmed shrubs or small trees, with rigid, arching or drooping, often entangled branches. The inflorescences are cymose, the individual cymules usually scorpioid, terminal on young shoots and/or lateral at apices of abbreviated branchlets. The style is terminal and bifid, whereas the fleshy fruit is subglobose with four 1-locular pyrenes. The genus belongs to the family Boraginaceae *s.l.* of mainly herbs, characterized by inflorescences of scorpioid or helicoid cymes, terminal or gynobasic styles and fruit usually consisting of four nutlets.

Boraginaceae is sometimes treated as two separate families, Boraginaceae *s. str.* and Ehretiaceae (Hutchinson 1969). Ehretiaceae is taken to include predominantly woody taxa such as *Cordia* and *Ehretia* but also includes the herbaceous, monotypic genus *Coldenia* L. (*C. procumbens* L.). However, various characters, including woodiness, pollen morphology and also the structure of the inflorescence, show that the two families are closely related and that the recognition of two separate families is not justified (Retief & Van Wyk 1999). Since Martius (1827) proposed the family Ehretiaceae, a view followed by Lindley (1830), the circumscription of the Boraginaceae has been a matter of controversy. Many authors regarded the two families as a natural entity, and treated Boraginaceae in a wide sense, e.g. Gürke (1897), Chanda & Mukherjee (1978), Sahay (1978), Cronquist (1981), Verdcourt (1991), Brummitt (1992), Thorne (1992), Takhtajan (1997) and the Angiosperm Phylogeny Group (1998). On the other hand, fewer workers favoured two separate families, e.g. Hutchinson (1969), Dahlgren (1989) and Chant (1993). In the present paper we recognise Boraginaceae *s.l.* with five subfamilies (following Riedl 1997): Wellstedioideae, Ehretioideae, Cordioideae, Heliotropioideae and Boraginoideae.

The purpose of this paper is to present a taxonomic revision of the genus *Ehretia* in southern Africa. Diagnostic characters, an identification key, full descriptions of existing and new taxa, illustrations and distribution maps are provided. The generic description of *Ehretia* and also species descriptions are based on occurrence in southern Africa and adjacent *Flora zambesiaca*

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regions. This paper forms a part of a revision of the Boraginaceae for the *Flora of southern Africa* which is currently in progress.

MATERIALS AND METHODS

Herbarium specimens of *Ehretia* in BLFU, BM, BOL, COI, E, GRA, J, K, KNP, NBG, NH, NMB, NU, PRE, PRU, SAM, UNIN and WIND were used to gather data on morphological characters, flowering time and distribution. Extensive fieldwork was done to study live plants in their natural habitat. Both untreated and acetolysed pollen grains were studied. Pollen was acetolysed according to the standard method of Erdtman (1960). For scanning electron microscopy studies samples were coated with gold and studied with an ISI-SX-25 SEM. Although acetolysis is the basic technique used by virtually all palynologists, untreated pollen grains were also studied because certain characters are destroyed by this treatment.

HISTORICAL OUTLINE

After Browne established the genus *Ehretia* in 1756, De Candolle (1845) enlarged the concept of the genus significantly by publishing about 58 species within the genus. Many of these species are now treated as segregate genera, for example *Bourreria*, *Carmona*, *Rocheportia* and *Rotula* (Thulin 1987; Miller 1989). In De Candolle's revision only *Ehretia hottentotica*, a species described by Burchell (1824), is mentioned for South Africa. De Candolle recognized four sections within *Ehretia* and placed *E. hottentotica* in the section *Bourreria*, a taxon characterized by four pyrenes. Thunberg, the 'father of Cape botany' (Gunn & Codd 1981), collected a specimen in the Cape which he named *Capraria rigida* in his *Prodromus plantae capensis* of 1800. To him this specimen showed similarity to two species of *Capraria*, a genus now placed under *Freylinia* (Scrophulariaceae). Certain specimens collected by Drège (1843) were regarded as belonging to *Grumilea*, a genus subsequently sunk under *Psychotria* (Rubiaceae). Drège (1847) applied the name *Ehretia zeyheriana*, a *nomen nudum* of Buek (1796–1878), to specimens collected by Ecklon, Zeyher and himself. In 1859 Harvey also used this name when describing a new species differing from '*E. hottentotica*' in having larger, less obovate and thinner leaves. He stated that differences 'may be owing to a freer growth in better soil, and eventually the two varieties will perhaps be united'. Harvey mentioned that the taxon *E. eckloniana* (another manuscript name of Buek) is also closely related to *E. hottentotica*.

Wright (1904) published a revision of *Ehretia* in South Africa in which he used the name *E. hottentotica* of Burchell, although he gave Thunberg's *Capraria rigida* as a synonym. Druce (1917) had to arrange and examine a large number of African and Australian plants and consulted rather critically the Floras of these regions. He published the name *E. rigida* (Thunb.) Druce for this taxon. The method of nomenclature of the Hookerian school differed from the continental plan in not insisting upon the permanence of the specific epithet (trivial name) when transferred to a different genus. Wright (1904) thus did not use Thunberg's epithet, but followed

the so-called Kew Rule. He also published another species for the region, *E. amoena* Klotzsch, with *Galpin 1242* as the only cited specimen.

In a revision of the Boraginaceae of South West Africa (the present Namibia), Friedrich-Holzhammer (1967) recognized three microfamilies, namely Heliotropiaceae, Boraginaceae and Wellstediaceae. *Ehretia*, represented by *E. amoena* and *E. rigida*, was placed in Heliotropiaceae together with *Heliotropium* and *Cordia*. Martins (1990, 1993) revised Boraginaceae for *Flora zambesiaca* (FZ) and *Flora de Moçambique*. He recorded *E. amoena*, *E. obtusifolia* Hochst. ex DC. and *E. rigida* for the FZ region. These three species names were also listed by Herman (1993). The present revision, the first since Wright (1904) published his account of *Ehretia* for the *Flora of southern Africa* (FSA) region, provides descriptions of two new species and the reinstatement of *E. coerulea* Gürke. Six species and five subspecies are accepted, namely *E. alba* Retief & A.E.van Wyk, *E. amoena* Klotzsch, *E. coerulea* Gürke, *E. namibiensis* Retief & A.E.van Wyk subsp. *namibiensis*, *E. namibiensis* subsp. *kaokoensis* Retief & A.E.van Wyk, *E. obtusifolia* Hochst. ex DC., *E. rigida* (Thunb.) Druce subsp. *rigida*, *E. rigida* subsp. *silvatica* Retief & A.E.van Wyk and *E. rigida* subsp. *nervifolia* Retief & A.E.van Wyk.

MORPHOLOGICAL CHARACTERS OF TAXONOMIC SIGNIFICANCE

Habit

Species of *Ehretia* are predominantly shrubs, occasionally small or straggling trees. However, suffrutices no taller than up to 0.4 m are known to occur in *E. obtusifolia* and *E. rigida*. We support the observation by Burt Davy (1922) that the gap between trees and herbs is bridged by forms of every gradation in size, from those that may be classed as either trees or shrubs to those sometimes defined as woody herbs, suffrutices or 'obscurely shrubby' plants. The 'suffrutex type' of habit, occurring in the species mentioned, can be regarded as transitional to the many herbaceous growth forms in the family. However, shrubs occur in *Lobostemon*, a genus more or less endemic to the fynbos of South Africa and also a member of the mainly herbaceous subfamily Boraginoideae. The occurrence of suffrutices supports the view that there is no clear division of Boraginaceae into two families, Ehretiaceae and Boraginaceae, on the basis of habit. Various other growth forms (ecotypes) are found in *E. rigida*. Plants of subsp. *rigida* are usually stunted in habit, whereas those of subsp. *silvatica* and subsp. *nervifolia* are more lush, with branches often straggling, entangled and arching at the top. *E. rigida* subsp. *nervifolia*, a large, deciduous or evergreen, multi-stemmed shrub, is sometimes characterized by long, drooping, precocious branches with pale mauve flowers appearing early in spring together with the new leaves.

Leaf

Various leaf characters are important in distinguishing between taxa. Leaves of southern African species of

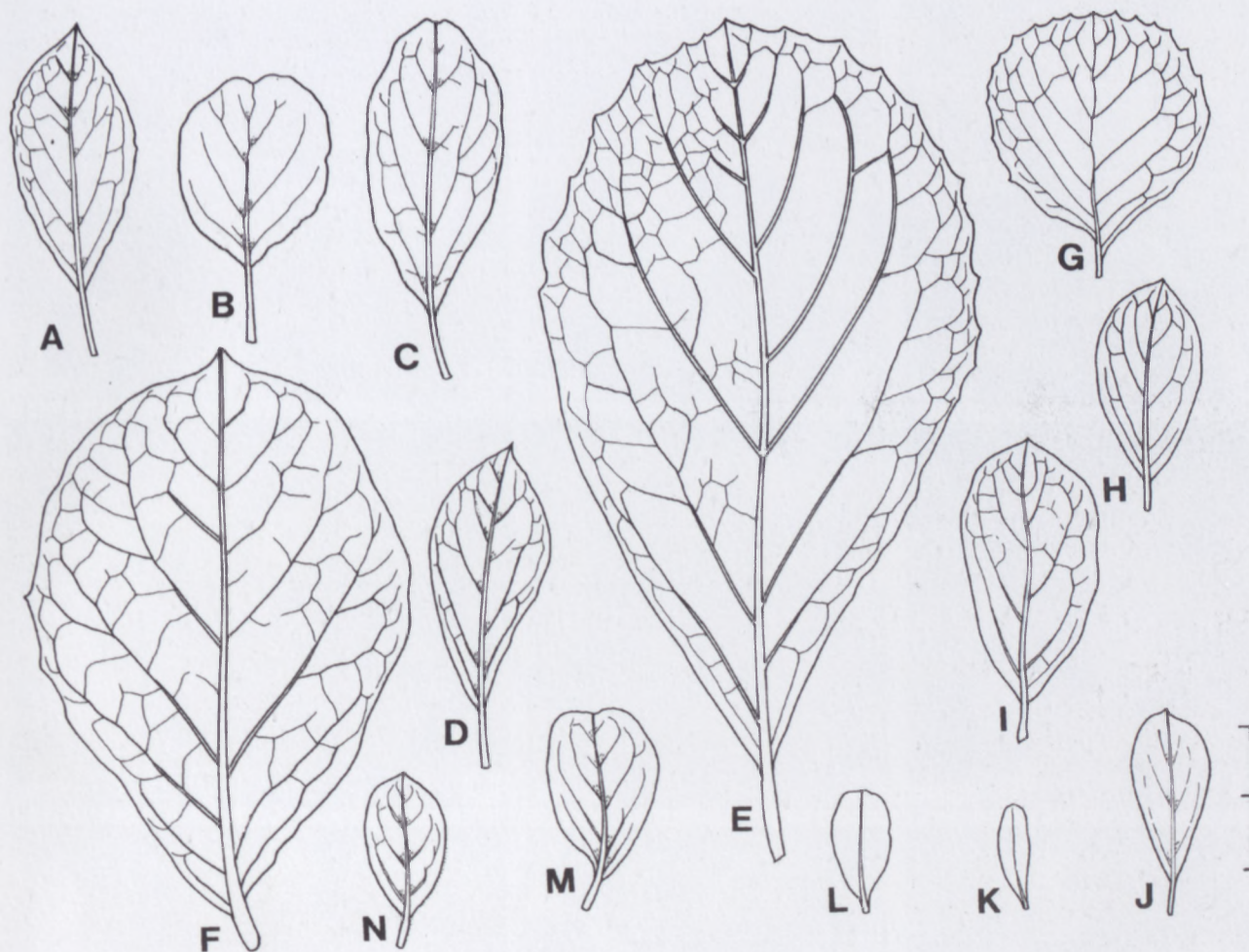


FIGURE 1.—Outline of leaf blade of *Ehretia* spp.: A, *E. rigida* subsp. *rigida*, Olivier 1208; B, *E. rigida* subsp. *silvatica*, Flanagan 605; C, *E. rigida* subsp. *nervifolia*, Jacobsen 4862; D, *E. rigida* subsp. *nervifolia*, Compton 29914; E, *E. amoena*, Codd & Dyer 4497; F, *E. amoena*, Ward 2980; G, *E. coerulea*, Miller B1136; H & I, *E. obtusifolia*, Barnard 200; J, *E. rigida* subsp. *nervifolia*, Balsinhas 3595; K, *E. alba*, Smith 2140; L, Seydel 1233; M, *E. namibiensis* subsp. *namibiensis*, Müller 997; N, *E. obtusifolia*, Lang TRV32211. Scale bar: 20 mm. Illustrations by Gillian Condy.

Ehretia are usually obovate to broadly obovate or elliptic, displaying quite some variety in size and venation (Figure 1). The size of the blade varies from 6–95 × 3–56 mm, the largest ones found in *E. amoena* (Figure 1E, F) in the relatively moist eastern regions of the Northern Province, Mpumalanga and Swaziland, to the smallest in *E. alba* (Figure 1K), a species of the drier central regions in southern Africa. Reduction in leaf size is regarded as an adaptation for reducing transpiration under stress conditions. The venation in all species is brochidodromous and is usually prominent on the lower surface (especially on dried specimens) in most species, but in *E. alba* and *E. rigida* subsp. *nervifolia*, occurring under more arid climatic conditions, the tertiary veins are obscured on the lower surface.

Three trichome types are found on leaves and other parts of *Ehretia*: (a) 2- or 3-celled short hairs, (b) setae with a 1-layered, multicellular base, and (c) simple, multicellular, capitate glandular trichomes (Figure 2A–C). The indumentum varies from sparse to dense (Figure 2D–F). The blade is sometimes glabrous except for setae occurring along the margin, a condition characteristic of various boraginaceous species (Figure 2D). These setae are often bent and usually appressed. Leaves of *E. amo-*

na, for example, are often described as rough (like sand paper) owing to short, stiff setae orientated at an angle to the upper surface. *E. alba* which occurs under relatively arid climatic conditions, has numerous stomata sunken in a prominently ribbed epidermal surface (Figure 2G), in contrast to the smoother surface of *E. rigida* from a moist habitat (Figure 2H). Domatia are sometimes present in the axils of principal lateral veins on the lower surface (Figure 2I), but may be present or absent on leaves of the same plant. Domatia are not specific for *Ehretia* in Boraginaceae; they also occur in *Cordia*, for example. The pit domatia (which are usually hairy) are believed to provide shelter to beneficial mites.

Inflorescence

Inflorescences of the Boraginaceae are characteristically scorpioid or helicoid cymes, often coiled at the apex, uncoiling and elongating at maturity. Southern African species of *Ehretia* have inflorescences with scorpioid cymes, borne apically on young shoots and/or at the apex of abbreviated branchlets (brachyblasts) (Figure 3A, D). On the basis of the composition of the inflorescence, local members of *Ehretia* can be divided into different

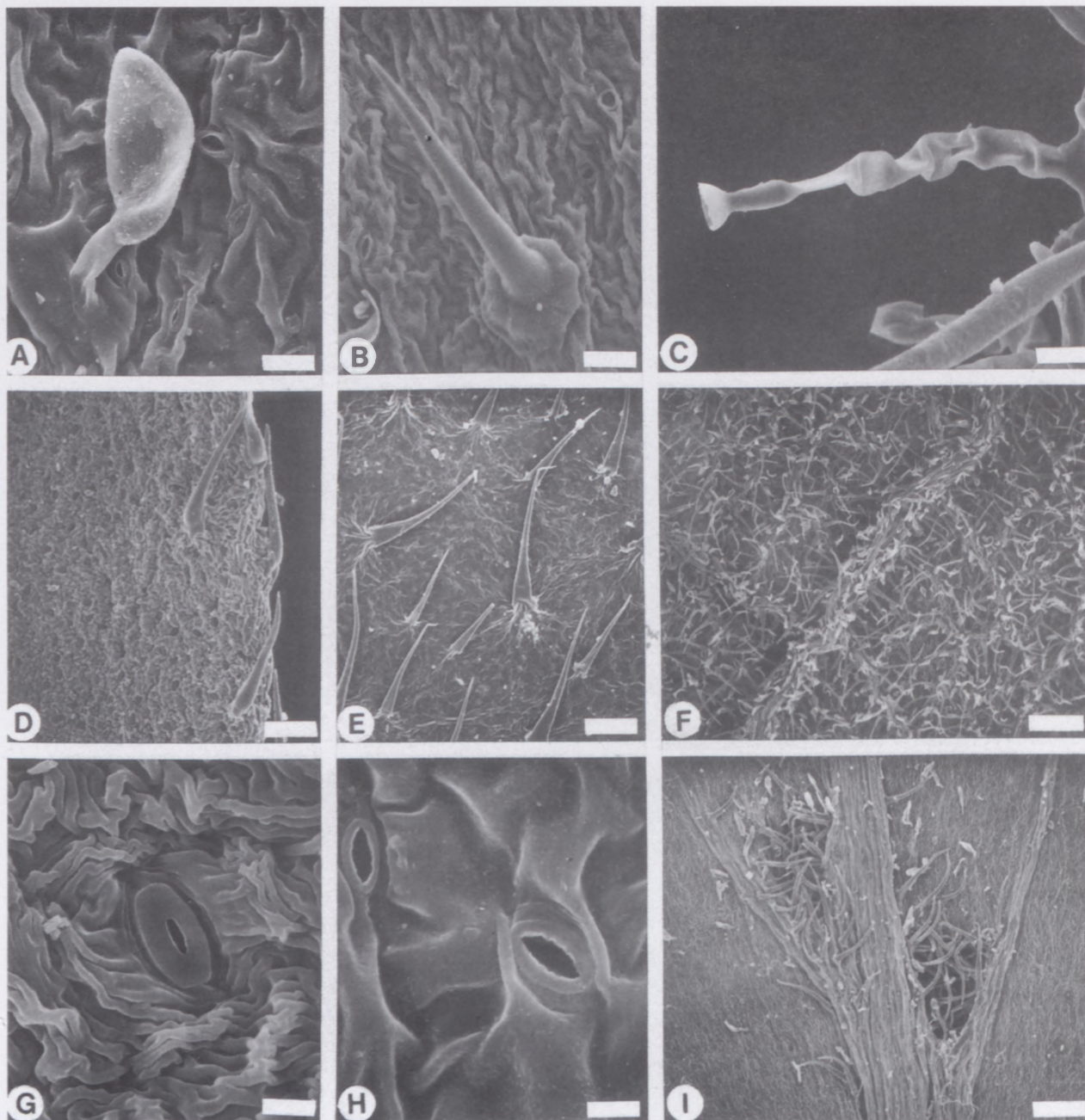


FIGURE 2.—*Ehretia* leaf surface. A, *E. rigida* subsp. *rigida*, Geldenhuys 1226, multicellular hair; B, *E. namibiensis* subsp. *kaokoensis*, De Winter & Leistner 5435, seta; C, *E. rigida* subsp. *nervifolia*, Compton 26649, glandular trichome; D, *E. alba*, Venter, Hahn & Archer 1108, blade glabrous, setae along margin; E, *E. rigida* subsp. *silvatica*, Cooper 77, setae spaced; F, *E. amoena*, Chase 4160, blade densely hairy; G, *E. alba*, Venter, Hahn & Archer 1108, epidermis wrinkled; H, *E. rigida* subsp. *rigida*, Geldenhuys 1226, epidermis not strongly wrinkled; I, *E. alba*, Venter, Hahn & Archer 1108, domatia. Scale bars: A, 20 μ m; B, 48 μ m; C, 259 μ m; D, 141 μ m; E, F, 300 μ m; G, H, 9.2 μ m; I, 233 μ m.

groups. *E. amoena* and *E. coerulea* have much-branched cymose panicles, whereas the other species are characterized by cymose inflorescences with less branching (Figures 3A, B; 4A, B). Inflorescences of *Ehretia rigida* subsp. *rigida*, however, are borne mainly apically on young shoots where several occur together in a cluster (or if only one inflorescence is present, the peduncle is rather thick, up to 1.5 mm diam.), forming a corymb-like structure (Figures 3C, D; 4C, D). The peduncle of the inflorescence is sometimes very short, with flowers clustered at the end of an abbreviated branchlet, a condition found in *E. obtusifolia*. An inflorescence often develops at the end of a new branch, whereupon new growth of the branch continues sympodially.

Trichome complements of the inflorescences (and calyces) differ and can be used to distinguish between

species. *E. amoena*, *E. rigida* and *E. alba* usually do not have simple, multicellular, capitate glandular trichomes, whereas *E. coerulea*, *E. obtusifolia* and *E. namibiensis* are characterized by this type of trichome, especially on the inflorescence, calyx and midrib of the leaf. Hybridization between species is suspected; the presence of unexpected glandular trichomes may signify this phenomenon.

Pollen

Pollen grains of southern African *Ehretia* species (Figure 5A–F), are tricolporate, isopolar, oblate-spheroidal with $P = 20\text{--}31\ \mu\text{m}$, $E = 17\text{--}29\ \mu\text{m}$ (immature pollen grains are prolate, $P = 13\text{--}22\ \mu\text{m}$, $E = 17\text{--}29\ \mu\text{m}$). The grains are \pm circular in polar view and hexagonal,

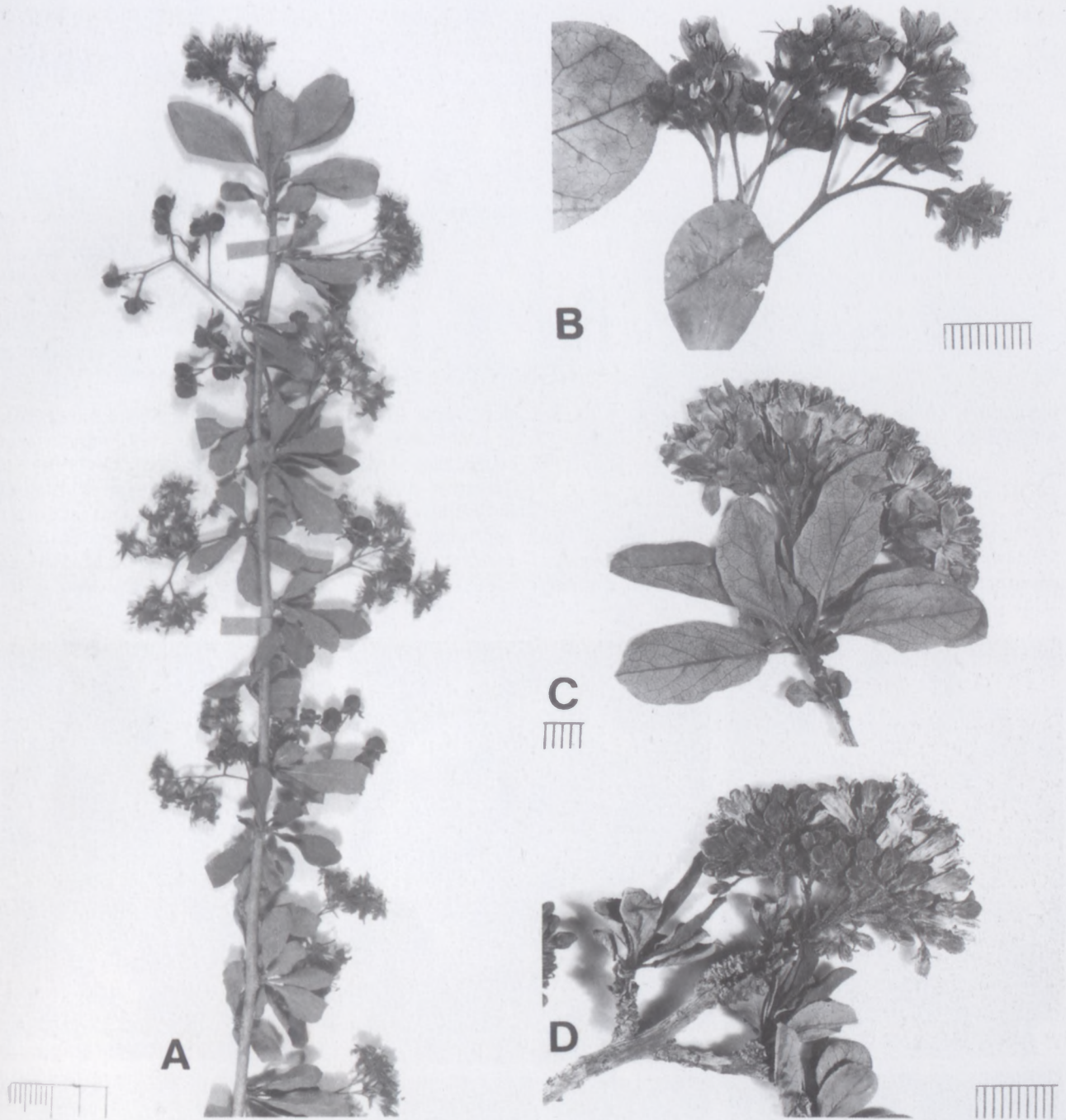


FIGURE 3.—*Ehretia* inflorescences and abbreviated branchlets. A, *E. rigida* subsp. *nervifolia*, Verdoorn 603, terminal and lateral; B, *E. rigida* subsp. *silvatica*, Thode STEU6495, inflorescence less compact; C, *E. rigida* subsp. *rigida*, Germishuizen 1490, inflorescence terminal, corymb-like; D, *E. rigida* subsp. *rigida*, Germishuizen 1490, abbreviated branchlets. Scale bars: A, 18 mm; B, 10 mm; C, 4 mm; D, 9 mm.

elliptic or rectangular in equatorial view. Apertures are long, broad or rather narrow in diameter and mesocolpium centres ('pseudocolpi') are present. The tectum is reticulate to rugulose. Orbicules are present, covering the surface of the thecae. A grain of *E. obtusifolia* was found to have four apertures instead of the normal three (Figure 5C). Two pollen types are often recognized in *Ehretia*. Pollen of *Ehretia* is usually hexagonal with relatively broad apertures and mesocolpium centres (Figure 5A). Similar pollen grains are known in *Wellstedtia* (Wellstedioideae) which is sometimes placed in its own family, Wellstediaceae and in members of the closely related family Hydrophyllaceae. Palynological and also morpho-

logical similarities between members of *Ehretia*, *Wellstedtia* and Hydrophyllaceae may point to a common ancestor or even to their placement in an entity of their own. However, elliptic or rectangular pollen grains with narrow apertures and 'furrow-like' mesocolpium centres also occur (Figure 5D). This 'pollen type' shows some similarity to that of members of *Heliotropium* (Heliotropioideae) regarded as part of Boraginaceae *s. str.* if two families are recognized, but it is actually only a stage in the development of the pollen grain to maturity. The reticulate or rugose tectum ornamentation of *Ehretia* (Ehretioideae) which bears resemblance to some pollen grains of *Cordia* (Cordioideae) may be cited in support of the

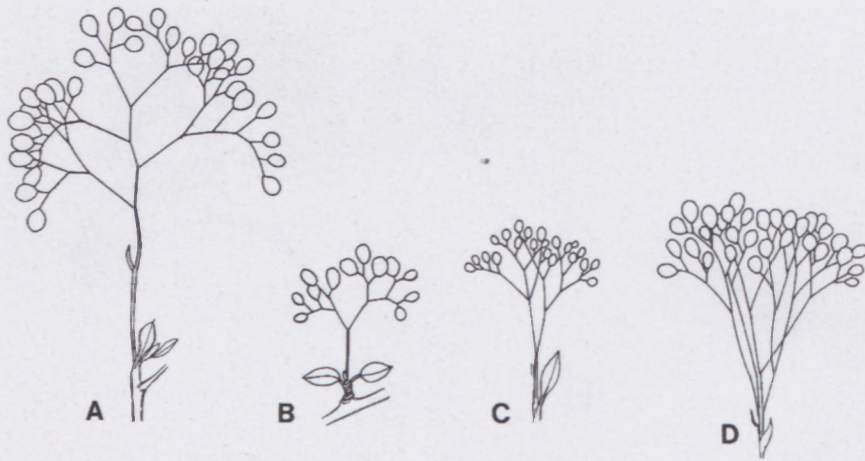


FIGURE 4.—*Ehretia* inflorescences. A, *E. amoena*, Chase 4160; B, *E. rigida* subsp. *nervifolia*, Pole Evans 1480; C, *E. rigida* subsp. *nervifolia*, Wearne 50; D, *E. rigida* subsp. *rigida*, Germishuizen 1522. Scale bar: 20 mm. Illustrations by Gillian Condy.

recognition of the separate family Ehretiaceae with the subfamilies Ehretioideae and Cordioideae.

Fruit

The family Boraginaceae is characterized not only by scorpioid or helicoid cymes, but its fruit also displays characters of importance for identification. Most mem-

bers of the Boraginaceae in southern Africa have a fruit of four nutlets. Outer nutlet surfaces vary in texture and sculpturing, a useful feature distinguishing between taxa. The fruit of *Ehretia*, however, is drupaceous with a thin to leathery exocarp, fleshy to mucilaginous mesocarp and bony endocarp. The colourful, bright red or orange fruits attract birds, which are responsible for seed dispersal. The genus can be divided into two groups on the

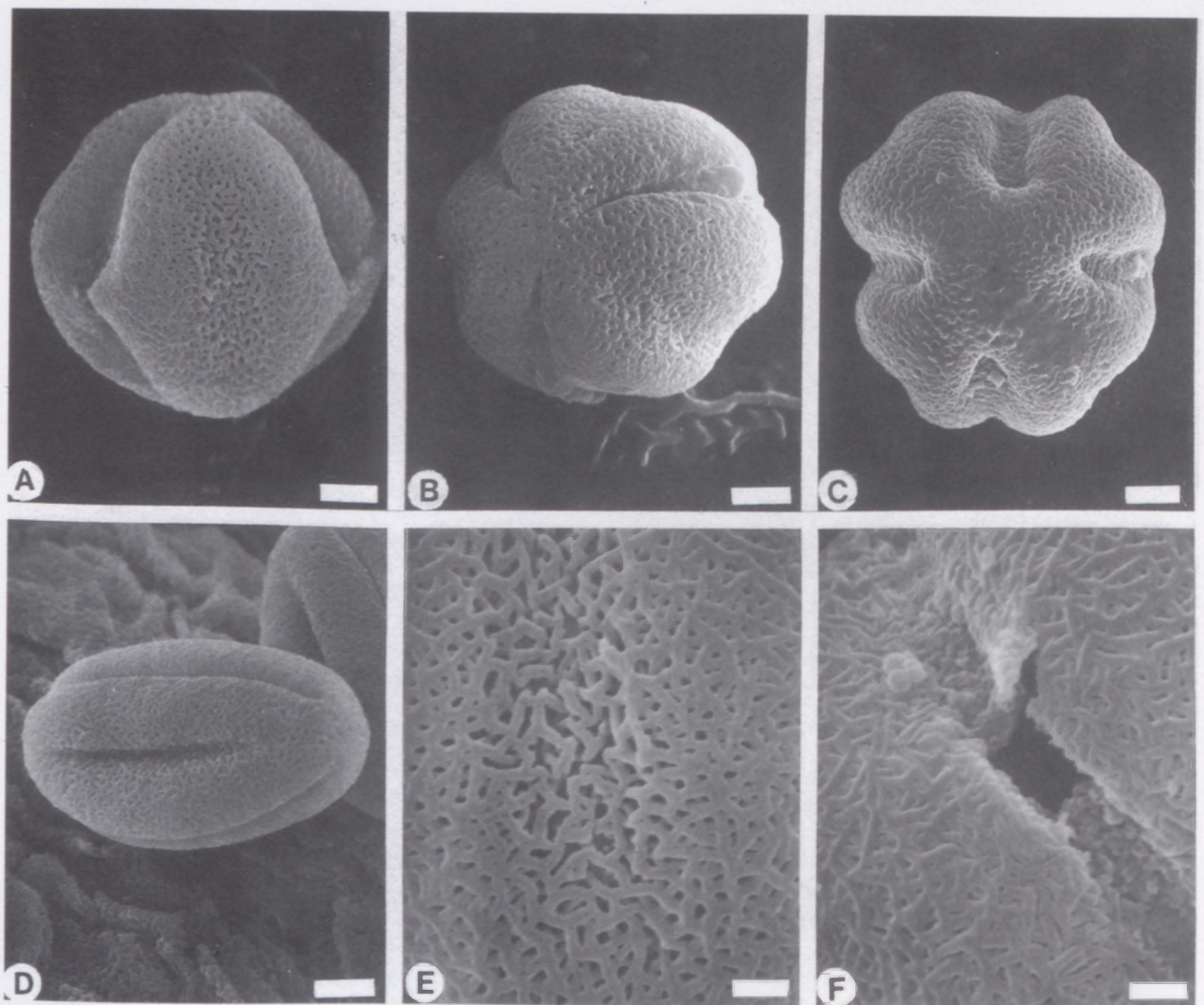


FIGURE 5.—*Ehretia* pollen. A–D, pollen grain: A, *E. rigida* subsp. *rigida*, Germishuizen 3366, equatorial view; B, *E. rigida* subsp. *nervifolia*, Ward 7223, polar view; C, *E. obtusifolia*, Verdoorn 2355, with four apertures; D, *E. rigida* subsp. *nervifolia*, Hanekom 1859, immature; E, *E. rigida* subsp. *rigida*, Germishuizen 3366, tectum; F, *E. rigida* subsp. *rigida*, Germishuizen 3366, granular ecto-aperture with lolongate endo-aperture area. Scale bars: A, 4.2 μ m; B, 3.4 μ m; C, D, 5 μ m; E, 1.6 μ m; F, 1.8 μ m.

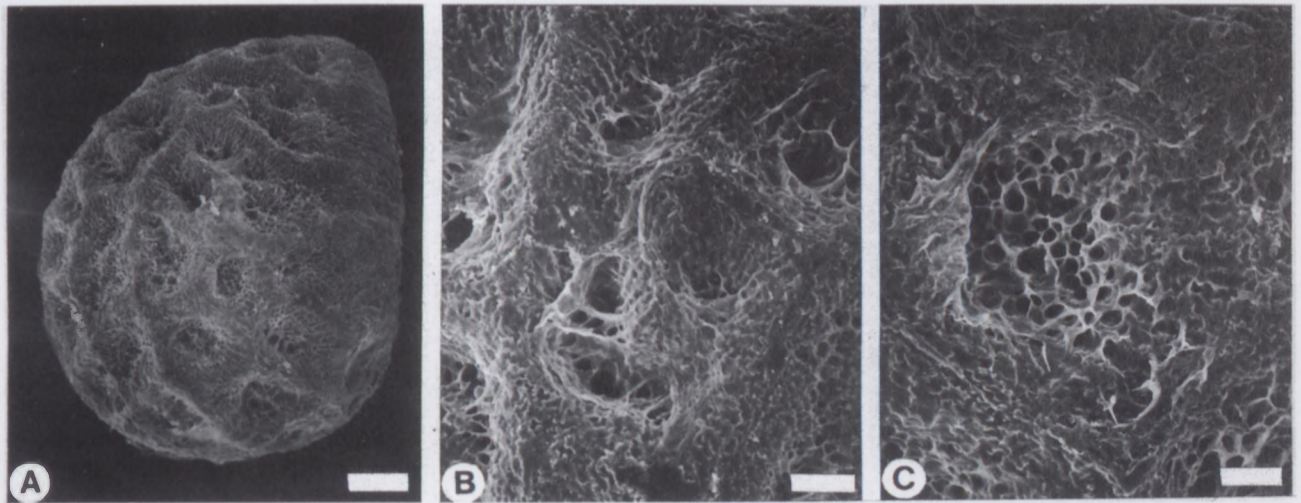


FIGURE 6.—*Ehretia* fruit, *E. amoena*, Brenan 14180. A, pyrene; B, C, surface. Scale bar: A, 459 μ m; B, 125 μ m; C, 99 μ m.

basis of fruit structure: species of the Old World including the southern African taxa have a drupe of four pyrenes with areolate surfaces and with some depressed areas (Figure 6), whereas species of the New World and Asia have one or two pyrenes per drupe with a verrucose surface. The local species show no significant differences in outer surface pattern of the pyrenes. The difference in fruit structure between members of Ehretioideae and Boraginoideae, i.e. drupe versus nutlet, is often used to support the recognition of a separate family, Ehretiaceae. However, this is not entirely true, as *Coldenia* and *Tiquilia* Pers. (Ehretioideae) have nutlets and *Tournefortia* L. (Heliotropioideae) has drupaceous fruits.

TAXONOMIC TREATMENT

***Ehretia* P.Browne**, The civil and natural history of Jamaica: 168 (1756); L.: 936 (1759); A.DC.: 502 (1845); Benth.: 840 (1876); Boiss.: 125 (1879); Gürke: 87 (1897); C.H.Wright: 4 (1904); Sim: 279 (1907); E.Phillips: 627 (1951); Riedl: 7 (1967); Kazmi: 145 (1970); Taton: 19 (1971); R.A.Dyer: 509 (1975); E.S.Martins: 75 (1990); J.S.Mill.: 20 (1991); Verdc.: 33 (1991); E.S.Martins: 34 (1993); Riedl: 91 (1997); Retief: 181 (2000). Type: *E. tinifolia* L.

Suffrutices, shrubs or small trees, usually multi-stemmed and deciduous. *Trichome complement* consisting of simple, 2- or 3-celled, short hairs, setae with 1-layered multicellular bases and simple, multicellular, capitate, glandular trichomes; young stems, inflorescence axes and calyx with the same trichome complement. *Branches* rigid, arching or drooping, often entangled. *Bark* greyish white. *Leaves* simple, alternate on young shoots or young branches or clustered at apex of an abbreviated branchlet, petiolate; leaf blade somewhat discoloured, obovate to elliptic, apex retuse, truncate, obtuse, cuspidate or acute, base asymmetric or cuneate, margin usually entire, ciliate, upper and lower surface variously hairy or, if glabrous, then still with setae usually densely arranged along margin; petiole short in proportion to length of midrib. *Inflorescence* a cymose pan-

icle or a dichotomously branched cyme with cymules mostly scorpioid, usually ebracteate. *Flowers* bisexual, regular, sessile or pedicellate, usually precocious, short-lived, sometimes fragrant. *Calyx* deeply divided, usually hairy outside but glabrous inside; tube shallow; lobes 5, ovate or triangular, apex obtuse to acute, ciliate. *Corolla* white, cream-coloured, pale mauve, blue, lilac or purple, usually 5-lobed, imbricate; tube funnel-shaped or cylindrical; lobes oblong, reflexed, shorter than, as long as or longer than tube. *Stamens* as many as corolla lobes; filaments linear, arising from throat of corolla tube, exerted; anthers oblong, lobed at base. *Ovary* 4-locular, with a single ovule at or above the middle of each locule; style terminal, flattened, bifid, stigmas capitate. *Fruit* subglobose, drupaceous, breaking up at maturity into four 1-locular pyrenes, usually glabrous. *Seed* elliptic, convex on back, with a deep cavity on face.

Species \pm 33, in the tropics of both Old and New World, particularly in Africa and Asia, a few in tropical America and West Indies; six in southern Africa, widespread (Figure 7).

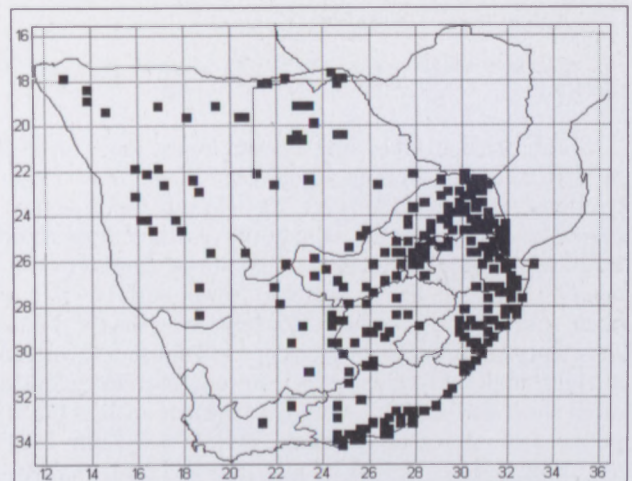


FIGURE 7.—Distribution of *Ehretia* in southern Africa.

Key to species

- 1a Corolla tube widely funnel-shaped, \pm as long as calyx; corolla lobes and tube white; lower surface of leaf blade prominently veined, densely to sparsely hairy, setae appressed, setae on veins conspicuously orientated at right angles to veins 1. *E. amoena*
- 1b Corolla tube \pm cylindrical, gradually widening into a throat, longer than calyx; lobes white, mauve, blue, lilac or purple, tube white or coloured; leaf blade with venation prominent or obscure on lower surface, glabrous, except for setae along margin or differently hairy:
- 2a Inflorescence axes and calyces densely covered with glandular trichomes, often intermixed with slender setae:
- 3a Inflorescence a much-branched cymose panicle; corolla blue or purplish blue, occasionally white; lower surface of leaf blade prominently veined, densely to sparsely hairy, setae appressed, setae on veins conspicuously orientated at right angles to veins 2. *E. coerulea*
- 3b Inflorescence a simple cymose panicle; corolla purple to mauve, tube can be white; lower leaf surface not with setae appressed and conspicuously orientated at right angles to veins, densely glandular pubescent or pilose:
- 4a Leaf blade densely hairy throughout with glandular trichomes and long, slender setae or only densely setulose, with glandular trichomes only present on midrib and veins; suffrutex, shrub or small tree of shade or full sun, rocky ridges, thornveld, woodland or open flats 3. *E. obtusifolia*
- 4b Leaf blade pilose, only midrib with scattered glandular trichomes; shrub of dry river beds, riverine woodland, calcrete and rocky outcrops 4. *E. namibiensis*
- 2b Inflorescence axes with setae and/or multicellular hairs, axes can appear to be glabrous because multicellular hairs are short and appressed:
- 5a Corolla tube and lobes white, young buds mauve; leaf blade glabrous except for setae along margin or scattered multicellular hairs, venation of lower surface obscure or only midrib and lateral veins prominent when leaves are young; leaf surface wrinkled with numerous sunken stomata when blade thickens under relatively arid climatic conditions; shrub of open and riverine woodland, dry river beds, rocky hillsides, red sand 5. *E. alba*
- 5b Corolla tube usually white, lobes pale mauve, lilac or purple; venation of lower surface prominent, under more arid conditions tertiary venation sometimes obscured; leaf surface not wrinkled to somewhat so; shrub or shrubby tree of valley bushveld, forest, riverine vegetation, kloofs, hillsides, grassland, often part of a bush clump 6. *E. rigida*

1. *Ehretia amoena* Klotzsch in Peters, Naturwissenschaftliche Reise nach Mossambique: 248 (1861); Gürke: 335 (1895); C.H.Wright: 5 (1904); Baker & C.H.Wright: 24 (1905); Codd: 161 (1951); J.H.Ross: 297 (1972); Coates Palgrave: 802 (1977); P.van Wyk: 239 (1984); E.S.Martins: 76 (1990); Verdc.: 34 (1991); E.S.Martins: 36 (1993); Beentje: 576 (1994); Retief & Herman: 351 (1997); Van Wyk & Van Wyk: 162 (1997). Type: Mozambique, surroundings of Sena, Peters (B, holo.; K!).

E. mossambicensis Klotzsch: 249 (1861). Type: Mozambique, Tete, Rios de Sena, Peters (B, holo.†).

E. stuhlmannii Gürke: 336 (1895). Types: Tanzania, Uzaramo Dist., Dar es Salaam, Stuhlmann 57 (B, syn. †); Nyika, Mtindi Market to Kwa Mkenbe, Volkens 35 (B, syn.†).

E. goetzei Gürke: 311 (1900). Type: Tanzania, Morogoro Dist., Ukutu, Megeta River, near Kisaki, Goetze 128 (B, holo.†; K!).

E. corymbosa sensu Fosberg: 260 (1974).

E. obtusifolia sensu Pooley: 438 (1993); sensu P.van Wyk: 239 (1984).

Shrub or small tree, single or multistemmed, up to 5 m high, branches arching at top. *Leaf blade* occasionally elliptic, 45–95(–114) \times 23–56(–75) mm, apex obtuse, cuspidate, margin entire, sometimes with one or more teeth, widely spaced, on either side of apex, veins prominently raised on lower surface, lower surface of leaf blade prominently veined, densely to sparsely hairy, setae appressed, setae on veins conspicuously orientated at right angles to veins, upper surface less hairy, setae often short and stiff at an angle to surface of leaf blade, giving a rough texture to blade; petiole 4–10 mm long, length of petiole : length of midrib = \pm 1 : 14. *Inflorescence* a branched cymose panicle, terminal on a young shoot or terminal on a short young shoot at apex of an

abbreviated branchlet; axes and calyx clothed with setae and multicellular hairs. *Calyx lobes* narrowly triangular, 2–3 \times 1 mm, apex acute. *Corolla* white; tube widely funnel-shaped, as long as calyx; lobes reflexed, usually as long as calyx or longer, apex obtuse, margin not ciliate. *Fruit* glabrous; pyrenes 3–4 mm long. *Flowering time*: October to December.

Distinguishing characters: corolla white, tube funnel-shaped; inflorescence a corymbose panicle, setae and multicellular hairs on axes. *Distribution*: eastern part of southern Africa, extending northwards into Zimbabwe and further eastwards into Mozambique (Figure 8); also in Malawi, Zambia, Kenya and Tanzania (Verdcourt 1991). *Habitat*: margin of coastal forest, bushveld, woodland, mopane veld, along watercourses, sandy soil. *Common names*: sandpaper bush; *skurweblaarbos* (Afrikaans);

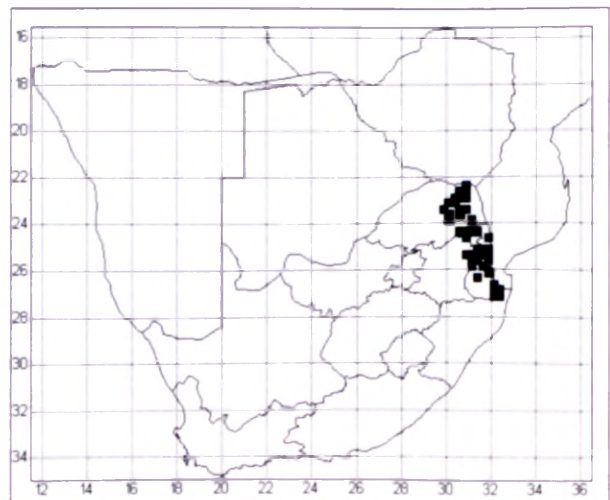


FIGURE 8.—Distribution of *Ehretia amoena* in southern Africa.

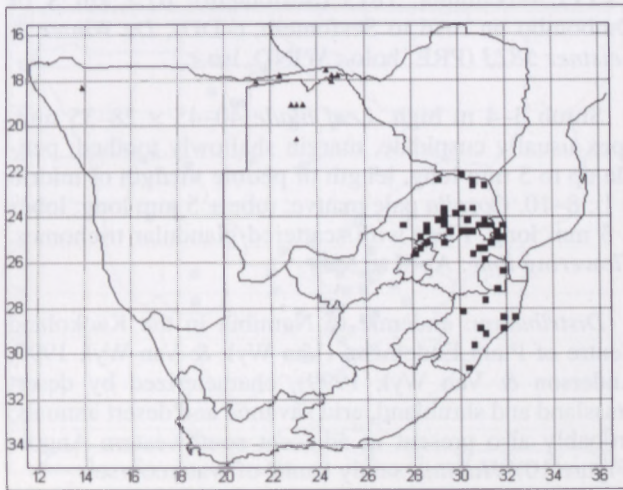


FIGURE 9.—Distribution of *E. coerulea*, ▲; and *E. obtusifolia*, ■, in southern Africa.

mutupe (Sotho); *umklele-omkhulu* (Zulu). *Utilization*: fruit edible, not very tasty; browsed by game; wood strong, used for fence posts and stampers; grows quickly from seed (Pooley 1993). *Illustrations*: Codd: 161 (1951); Palmer & Pitman: 1946 (1972); Pooley: 438 (1993); Van Wyk & Van Wyk: 163 (1997).

2. *Ehretia coerulea* Gürke in *Botanische Jahrbücher* Heft 3: 312 (1900); Baker & C.H.Wright: 24 (1905) pro parte; White: 364 (1962). Type: Tanzania, Iringa Dist., Lukose River, *Goetze 484* (B, holo.; K!).

E. coerulea Gürke var. *glandulosa* Suss. in Suss. & Merxm.: 116 (1951). Type: Marandellas, bush by the river through compound, *Dehn 697* (M, holo.).

Tall shrub or small tree, up to 4(–8) m high. *Leaf blade* occasionally asymmetric, 40–80 × 20–60 mm, apex obtuse to truncate, cuspidate, margin entire or dentate in upper half of blade, veins raised on lower surface, setae perpendicular to veins, appressed, glandular trichomes present, upper surface with setae only or glandular pubescent; petiole 4–10 mm, length of petiole : length of midrib = 1 : 5–6. *Inflorescence* a cymose panicle, axes and calyx with setae and glandular trichomes. *Calyx lobes* narrowly triangular, ± 3–4 mm long, apex acute. *Corolla* blue to purplish blue, occasionally white; tube cylindrical, occasionally funnel-shaped, ± 4–5 mm long; lobes shorter than or as long as tube, 3–4 mm long. *Fruit* glandular hairy; pyrenes ± 4 mm long. *Flowering time*: November to December.

Distinguishing characters: corolla blue to purplish blue; tube ± cylindrical, occasionally funnel-shaped; inflorescence a cymose panicle with setae and glandular trichomes. *Distribution*: Namibia and Botswana (Figure 9); also in Zambia, Zimbabwe, Malawi and Tanzania. *Habitat*: savanna, woodland, mopane veld, veld adjacent to riverine vegetation, termitaria, sandstone outcrops.

3. *Ehretia obtusifolia* Hochst. ex DC., *Prodrumus* 9: 507 (1845); A.Rich.: 83 (1850); C.B.Clarke: 142 (1883); Hiern: 716 (1898); Riedl: 48 (1967); Kazmi: 146 (1970); E.S.Martins: 78 (1990); Verdc.: 35 (1991). Type:

Ethiopia, Tigre, Medschara, near Gapdia, *Schimper 652* (G, holo.; K!).

E. fischeri Gürke: 336 (1895). Types: Tanzania, Mwanza Dist., Kagehi, *Fischer 323* (B, syn. †) & Biharamulo/Mwanza Dist., Usinga near French Mission at Usambiro, *Stuhlmann 850* (B, syn. †).

Suffrutex, shrub or small tree, up to 3 m high. *Leaf blade* 17–25 × 10–12 mm, apex usually obtuse, margin entire, venation prominent on lower surface, upper surface with setae and scattered glandular trichomes, lower surface densely covered with setae and glandular trichomes; petiole up to 2–4 mm long, length of petiole : length of midrib = 1 : 6. *Inflorescence* a branched cyme, one or two at apex of a short abbreviated branchlet, densely covered with setae and glandular trichomes. *Calyx lobes* narrowly ovate to triangular, 2.5–3.0 mm long, apex obtuse to acute. *Corolla* tube cylindrical, white, 5 mm long; lobes mauve or blue, ± 4 mm long; margin at apex ciliate. *Fruit* glabrous, pyrenes 3.0–3.5 mm long. *Flowering time*: September to December.

Ehretia obtusifolia is closely related to *E. amoena* and *E. rigida* subsp. *nervifolia*. Usually they are readily distinguished, but in areas where the species are sympatric, specimens with intermediate features occur (Martins 1990).

Distinguishing characters: corolla cylindrical, tube white, lobes mauve or blue; inflorescence axes and calyx glandular hairy. *Distribution*: Northern Province, Mpumalanga, Gauteng, Swaziland and KwaZulu-Natal (Figure 9); also northwards into Africa, up to Ethiopia; also found in Iran, Afganistan, Pakistan and India (Riedl 1967). *Habitat*: bushveld, woodland, grassveld, hill slopes, bushclumps, stony soil, sandy loam.

4. *Ehretia namibiensis* Retief & A.E.van Wyk, sp. nov., *E. obtusifoliae* affinis sed lamina folii pilosa, sparse pubescenti cum trichomatibus glandulosis sparsis solum in costa, setis paginae superioris brevioribus quam illis in pagina inferiori differt (costa laminae folii non dense glanduloso-pubescenti); distributione geographica etiam differt.

TYPE.—Namibia, 2416 (Maltahöhe): Farm Bullsport, (–AB), *Liebenberg 5087* (WIND, holo.; K, PRE, iso.).

E. amoena sensu Friedr.-Holzh.: 3 (1967) pro parte.

Shrub, up to 3.5 m high. *Stems* with scattered setae and glandular trichomes. *Bark* light grey. *Leaves* alternate or clustered on older branches, pilose, petiolate; leaf blade broadly obovate or broadly elliptic, 20–50 × 10–35 mm, apex mostly retuse, occasionally acute, obtuse or emarginate, margin entire or shallowly toothed, sparsely hairy with setae on upper surface shorter than on lower surface, scattered glandular trichomes present on midrib of lower surface, dull yellowish green; petiole 3–5 mm long, length of petiole : length of midrib = 1 : 5–10. *Inflorescence* lateral, single at apex of very abbreviated branchlet or terminal, one or two together at apex of branchlet; axes densely hairy with scattered setae and glandular trichomes. *Calyx lobes* narrowly triangular, 3 mm long, apex obtuse to acute, margin ciliate. *Corolla* lavender-blue or pale mauve, 8–9 mm long; lobes slight-

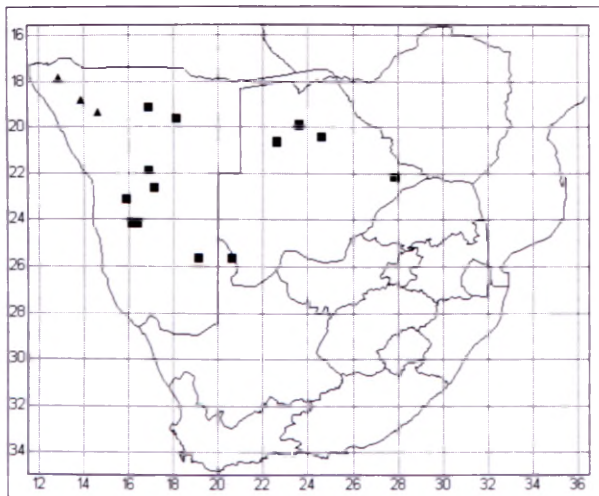


FIGURE 10.—Distribution of *Ehretia namibiensis* subsp. *namibiensis*, ■; and *E. namibiensis* subsp. *kaokoensis*, ▲, in southern Africa.

ly shorter than tube. *Fruit* subglobose, 5–6 × 4–5 mm long, glabrous or with glandular trichomes.

Distinguishing characters: corolla lavender-blue or pale mauve, tube cylindrical; leaf blade sparsely hairy with setae and scattered glandular trichomes on midrib only. *Distribution:* occurs over a large area of Namibia and Botswana (Figure 10); according to Giess (1971) it is known from mopane, thornbush and highland savanna in Namibia.

Key to subspecies

- Apex of leaf blade mainly retuse; leaf blade 20–25 × 10–20 mm; fruit glabrous 4a. subsp. *namibiensis*
 Apex of leaf blade mainly cuspidate; leaf blade 40–45 × 28–35 mm; fruit glandular hairy 4b. subsp. *kaokoensis*

4a. subsp. *namibiensis*

Shrub, 2–3 m high. *Leaf blade* 20–25 × 10–20 mm, apex mainly retuse, margin entire, indumentum pilose with setae and multicellular hairs present; petiole up to 4 mm long, length of petiole : length of midrib = 1 : 5 or 6. *Corolla* lavender-blue to mauve or purple; tube ± 5 mm long; lobes ± 4 mm long. *Fruit* glabrous. *Flowering time:* October to May.

Distribution: Namibia and Botswana (Figure 10). *Habitat:* dry river beds, riverine woodland on shallow soil, calcrete and rocky outcrops. *Utilization:* extract of roots drunk by man in hope of enhancing conception by wife (Woollard & Bethea 2168). *Common name:* 'mogorometsa' (Woollard & Bethea 2168).

4b. subsp. *kaokoensis* Retief & A.E.van Wyk, subsp. nov., subsp. *namibiensis* affinis sed magnitudine laminae folii (40–45 × 28–25 mm non 20–25 × 10–20 mm), apice plerumque cuspidato (non plerumque retuso), margine interdum dentibus vadosis, fructu cum trichomatibus glandulosis sparsis, non glabro, differt.

TYPE.—Namibia, 1813 (Sesfontein): 67.2 km S of Ombombo on road to Sesfontein, (–DD), *De Winter & Leistner 5823* (PRE, holo.; WIND, iso.).

Shrub 3–4 m high. *Leaf blade* 40–45 × 28–35 mm, apex usually cuspidate, margin shallowly toothed; petiole up to 5 mm long, length of petiole : length of midrib = 1 : 8–10. *Corolla* pale mauve; tube ± 5 mm long; lobes ± 3 mm long. *Fruit* with scattered glandular trichomes. *Flowering time:* April to May.

Distribution: endemic to Namibia in the Kaokoland Centre of Plant Endemism (Van Wyk & Van Wyk 1997, Anderson & Van Wyk 1999), characterized by desert grassland and shrubland, arid savanna and desert annuals; probably also present in adjacent southwestern Angola (Figure 10). *Habitat:* sandy banks of watercourses.

5. *Ehretia alba* Retief & A.E.van Wyk, sp. nov., *E. rigidae* (Thunb.) Druce affinis sed sic differt: lobi corollae albi (non malvini indici vel purpurei); carina et venae laterales in pagina inferiora foliorum juvenicum prominentes (venae tertiariae praeterea prominentes); lobi calycis anguste triangulares (non triangulares et ovati).

TYPE.—Namibia, 2218 (Gobabis): Breitenberg, Gobabis Dist., (–DC), *Merxmüller 1071* (WIND, holo.; PRE, iso.).

Shrub up to 4 m high. *Branches* rigid. *Leaf blade* 6–25 × 3–13 mm, apex acute or obtuse; glabrous except for appressed setae along margin, thin or thick in texture, drying reddish brown when pressed or blade with lateral veins obscure, drying the same colour as midrib; midrib and secondary veins on lower surface prominent; petiole up to 3 mm long, length of petiole : length of midrib = 1 : 10–15. *Inflorescence* usually single at apex of abbreviated branchlet; axes and calyces with multicellular hairs and scattered setae; peduncle short. *Flowers* sometimes fragrant. *Calyx lobes* narrowly triangular, up to 3 mm long; apex acute to acuminate. *Corolla* white, fading to cream-coloured; tube 3 mm long; lobes ± 3 mm long, as long as tube or slightly shorter. *Style* white, sometimes tinged purple or lilac. *Flowering time:* August to October.

Distinguishing characters: corolla tube and lobes white, young buds pale mauve; leaves thickening when older and also under unfavourable climatic conditions, glabrous except for setae along margin and scattered multicellular hairs, leaf surface wrinkled, with numerous sunken stomata. *Distribution:* Namibia, Botswana, Free State, North-West, Northern Cape (Figure 11); it is found in different biomes (Rutherford & Westfall 1994), namely Grassland, Nama-Karoo, Succulent Karoo and Savanna; according to Acocks (1988), *E. alba* occurs in Kalahari Thornveld, Vryburg Shrub Bushveld and Typical Orange River Broken Veld in South Africa. *Habitat:* riverine woodland, open woodland, thornveld and dry river beds, stony places and red sand. *Utilization:* grazed. *Common name:* *bergwitboom(bos)* (Afrikaans)—according to Smith (1966) the flowers produced in great abundance before the leaves unfold, give the plants a whitish (Afrikaans: wit) appearance when seen from a distance; stems and branches also of a pallid greyish colour.

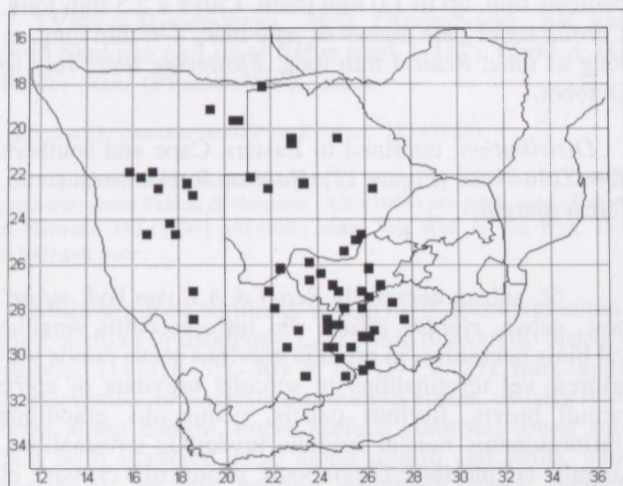


FIGURE 11.—Distribution of *Ehretia alba* in southern Africa.

6. *Ehretia rigida* (Thunb.) Druce in Report of the Botanical Society and Exchange Club, British Isles 1916: 620 (1917); Palmer & Pitman: 1943 (1972); Coates Palgrave: 803 (1977); Venter & Venter: 172 (1996); Van Wyk & Van Wyk: 163 (1997). Type: South Africa, Cape of Good Hope, *Thunberg UPS14330* (UPS, holo.; PRE, microfiche!).

Capraria rigida Thunb.: 103 (1800). Type: as above.

Much-branched shrub or multistemmed tree, up to 12 m high. *Leaf blade* 20–60 × 9–45 mm, apex slightly retuse, obtuse to acute, occasionally cuspidate, venation on lower surface distinct, lower surface glabrous or hairy with setae and multicellular hairs along veins, upper surface glabrous or hairy with setae or multicellular hairs scattered along veins, coriaceous or thin; petiole 2–10 mm long, length of petiole : length of midrib = 1 : 3–11. *Inflorescence* single or more than one terminal on a prominent new shoot and/or terminal on an abbreviated branchlet, densely clothed with multicellular hairs and scattered setae; peduncle varies in thickness. *Calyx lobes* ovate to triangular, 2.0–2.5 mm long, apex obtuse to acute. *Corolla* tube cylindric, 7–10 mm long, usually white; lobes pale mauve, lilac or purple, shorter or as long as tube. *Fruit* glabrous; pyrenes ± 3 mm long.

Distinguishing characters: venation of lower surface prominent; inflorescence and calyx clothed with setae and/or multicellular hairs; calyx ovate; corolla tube cylindric, white; lobes pale mauve, lilac or purple. *Distribution:* eastern parts of southern Africa; northwards into Zimbabwe and eastwards into Mozambique (Figure 12). *Habitat:* valley bush, hillsides, forest, bush clumps, thornveld, woodland or open flats.

Key to subspecies

- 1a Inflorescences terminal, one or several in a 'head' on young shoots, much-branched; peduncles and pedicels usually thick, up to 1.5 mm diam.; leaf blade usually somewhat coriaceous; usually a stunted shrub with branches rigid and entangled; more or less confined to Albany Centre of Endemism 6a. *E. rigida* subsp. *rigida*
- 1b Inflorescences terminal on very short young shoots or occasionally terminal on short young shoots at apices of

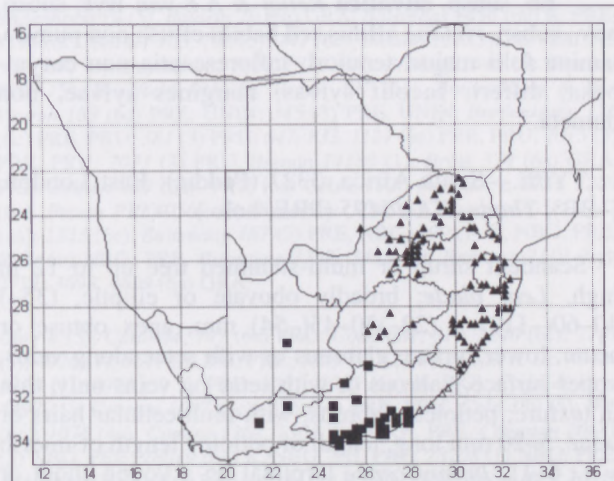


FIGURE 12.—Distribution of *Ehretia rigida* subsp. *rigida*, ■; *E. rigida* subsp. *silvatica*, Δ and *E. rigida* subsp. *nervifolia*, ▲, in southern Africa.

abbreviated branchlets, once- or twice-branched; peduncles and pedicels usually thinner, up to 1.0 mm diam.; leaf blade thin in texture; known from Bathurst eastwards to KwaZulu-Natal, further north into Free State, North-West, Gauteng, Mpumalanga and Northern Province:

- 2a Tree or scandent shrub of forest in Eastern Cape and southern KwaZulu-Natal 6b. *E. rigida* subsp. *silvatica*
- 2b Shrub of savanna in KwaZulu-Natal, Free State, North-West, Gauteng, Mpumalanga and Northern Province 6c. *E. rigida* subsp. *nervifolia*

6a. subsp. *rigida*

Ehretia hottentotica Burch.: 147 (1824); C.H.Wright: 5 (1904) pro parte. Type: Graaff-Reinet, *Burchell 2117*.

E. zeyheriana H.Buek ex Harv.: 5 (1859). Syntypes: Eastern Cape, near Uitenhage, *Zeyher 161* (PRE, iso.), *Prior PRE40572* (PRE, iso.); Albany, *T. Williamson s.n.* (TCD).

Shrub or tree, often stunted, up to 4 m high. *Leaf blade* 20–35 × 12–23 mm, apex acute or rounded, glabrous or main veins with setae and others with scattered setae, coriaceous or thin; petioles 3–8 mm, length of petiole : length of midrib = 1 : 4–7. *Inflorescence* terminal, one or several in a 'head' on young shoots, many-flowered, peduncles and pedicels thick, up to 1.5 mm diam., multicellular hairs or long, thin setae present. *Calyx lobes* triangular, ± 2.0–2.5 mm long, apex obtuse to acute. *Corolla* cylindric, 8–10 mm long; tube usually white; lobes lilac, blue, bluish purple or purple, shorter than tube. *Fruit* ± 3 mm long. *Flowering time:* October to March.

Distribution: Eastern and Western Cape, more or less confined to the Albany Centre of Plant Endemism (Van Wyk & Van Wyk 1997; Anderson & Van Wyk 1999) (Figure 12). *Habitat:* scrub, bushclumps, *Euphorbia* thick- et, valley bushveld, dune bush. *Common names:* Cape lilac—plants bear masses of lilac to lilac-blue flowers and in general appearance are suggestive of the European lilac (Smith 1966). *Illustrations:* Batten & Bokelmann: t. 99, 3 (1966); Palmer & Pitman: 1944 (1972); Shearing & Van Heerden: 123 (1994).

6b. subsp. *silvatica* Retief & A.E.van Wyk, subsp. nov., subsp. *rigidae* affinis sed habitu effuso non pumilo, lamina folii maiori tenuiori, inflorescentia non corymbosa, differt. Incolit sylvas, margines sylvae, non dumeta.

TYPE.—South Africa, 3327 (Peddie): East London, (-BB), Thode STEU6495 (PRE, holo.).

Scandent shrub or multi-stemmed tree up to 12 m high. *Leaf blade*: broadly obovate or elliptic, (35-) 40-60(-110) × (22-)30-45(-54) mm, apex obtuse or acute; lower surface glabrous or with setae along veins, upper surface glabrous or with setae on veins only, thin in texture; petioles glabrous, with multicellular hairs or setae, 5-20 mm long, length of petiole : length of midrib = 1 : 6-11. *Inflorescence* terminal on a young shoot or occasionally terminal on short young shoot at apex of abbreviated branchlet, few-flowered, peduncles and

pedicels thin, up to 1.0 mm diam. *Calyx* ± 2.5 mm long. *Corolla* lobes pale mauve or pale lilac, 4-6 mm long, as long as tube. *Fruit* 4 mm long. *Flowering time*: July to October.

Distribution: confined to Eastern Cape and southern KwaZulu-Natal (Figure 12). *Habitat*: forest, forest scrub, forest margin.

6c. subsp. *nervifolia* Retief & A.E.van Wyk, subsp. nov., subsp. *rigidae* affinis sed inflorescentiis singulis vel binis lateralibus in ramulis brevibus secus ramos anteriores, vel terminalibus in surculis brevibus in apice ramuli brevis, floribus paucis, pedunculis gracilibus (inflorescentiis non in surculis juvenibus terminalibus, singulis vel pluribus, corymbosis, pedunculis crassis), et distributione differt. Incolit graminosos, nemores vel savannam maritimam, non dumeta.

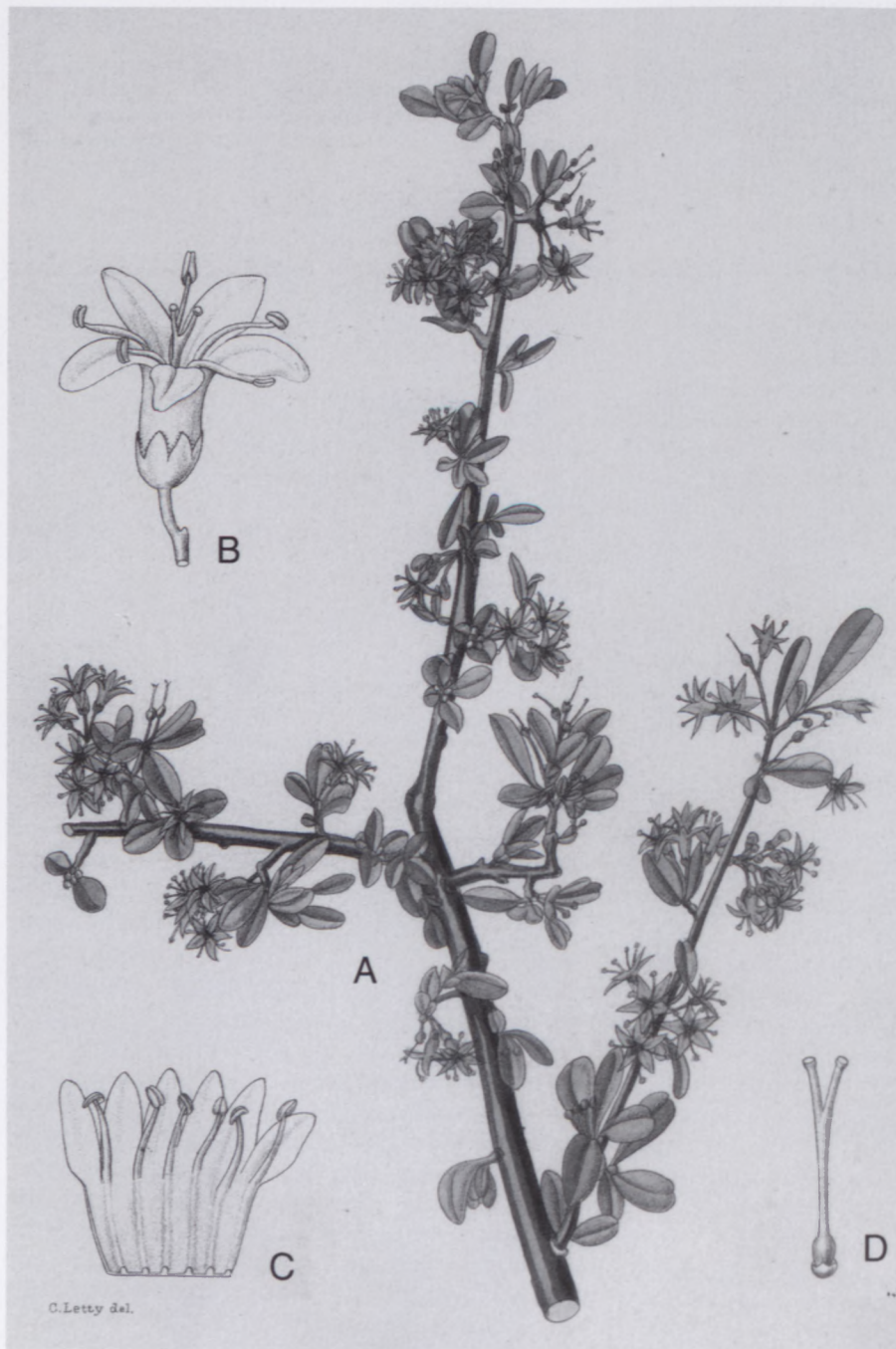


FIGURE 13.—*Ehretia rigida* (Thunb.) Druce subsp. *nervifolia*, published as *E. hottentotica*, Pole Evans 1929. A, flowering branch, × 0.8; B, single flower, × 3.2; C, corolla from 6-merous (unusual) flower laid open, × 2.5; D, pistil, × 4.9. Illustrations by Cythna Letty.

TYPE.—Mpumalanga, 2431 (Acornhoek), 8.8 km from Skukuza on Lower Sabie road, (–DC), *Codd & De Winter 5031* (PRE, holo.; K, iso.).

Ehretia hottentotica sensu Pole Evans: t. 353 (1929).

E. rigida sensu J.H.Ross: 297 (1972); Venter & Venter: 172 (1996) pro parte; sensu Fabian & Germish.: 338 (1997) pro parte; sensu Retief & Herman: 352 (1997) pro parte; sensu Van Wyk & Van Wyk: 163 (1997) pro parte.

Multistemmed shrub, up to 5 m high. *Branches* entangled, arching or drooping. *Leaf blade* obovate to broadly elliptic, (11–)16–35(–50) × (4–)7–15(–25) mm, apex acute, obtuse or emarginate, margin entire, usually with setae along margin, upper surface glabrous, lower surface with scattered setae along midrib and veins, with coriaceous or thin texture; yellowish green, greyish green to dark green; petiole 1.5–5.0 mm long, length of petiole : length of midrib = 1 : 3–7. *Inflorescences* one or two lateral on apices of abbreviated branchlets along older branches or terminal on very short young shoot or terminal on a short young shoot at apex of abbreviated branchlet, few-flowered; axes and calyx with multicellular hairs and/or setae; peduncles thin, only slightly elongating in fruit. *Calyx* 5-merous, sometimes 6-merous; lobes 1.5–2.0 mm long. *Corolla* 5-merous, sometimes 6-merous; tube white, 5–8 mm long; lobes mauve, 2–6 mm long. *Fruit* ± 4 mm long. *Flowering time*: September to December. Figure 13.

Distinguishing characters: corolla lobes pale mauve; branches arching prominently or conspicuously drooping when plants are growing in a more arid environment; leaf blade usually glabrous except for appressed setae along margin or pubescent with setae along midrib and veins; multicellular hairs present on inflorescence and calyx; tertiary veining not prominent on lower surface but secondary veins so, usually three on either side of midrib, raised. *Distribution*: North-West, Northern Province, Mpumalanga, Swaziland and KwaZulu-Natal (Figure 12); extends into Mozambique and Zimbabwe; sympatric with *E. amoena* and *E. obtusifolia*. *Habitat*: shrub of savanna, dry thornbush, coastal scrub. *Common names*: puzzle bush; *morôbê* (Tswana); *deurmekaarbos* (Afrikaans)—according to Smith (1966) this name was given to *Ehretia* known from Griqualand West to the Waterberg. *Utilization*: tea made from dried leaves, stalks and berries (*Sutton* 785); fruit edible. *Illustrations*: Pole Evans: t. 353 (1929); Van Wyk & Malan: 253 (1997); Fabian & Germishuizen: 339 (1997).

SPECIMENS EXAMINED
(southern Africa only)

Specimens held at PRE, unless otherwise indicated. The numbers in brackets signify the identity of the specimens: (1) *E. amoena*; (2) *E. coerulea*; (3) *E. obtusifolia*; (4a) *E. namibiensis* subsp. *namibiensis*; (4b) *E. namibiensis* subsp. *kaokoensis*; (5) *E. alba*; (6a) *E. rigida* subsp. *rigida*; (6b) *E. rigida* subsp. *silvatica*; (6c) *E. rigida* subsp. *nervifolia*.

Abner 5 (2). *Acocks* 93 (5) K, PRE; 724 (5) BOL, PRE; 2211 (5) BOL, K, PRE; 2471 (5) BOL, PRE; 11856 (6a). *Adams* 163 (5) NBG. *Anderson* L2, L4, L7 (5); L14 (6c); 227 (5). *Apuuli* 27 (6a) GRA. *Archibald* 3717 (6b) GRA, PRE; 5868 (6b).

Badenhorst 79 (5). *Balarin* 29 (6a) GRA. *Balsinhas* 3456 (6c) K, PRE; 3595 (6c). *Barker* 103, 108 (5); 741 (6c). *Basson* 127 (5). *Barnard* 145 (4a); 200 (3). *Bayliss* 482 (6b); 1326 (4b). *Boshoff* 1646 (5). *Bouwer* 2188 (5). *Bradfield* 103 (5). *Braun* 197 (6c). *Bredenkamp & Van Vuuren* 183 (6c) PRE, UNIN; 345 (3) PRE, UNIN. *Bredenkamp* 126 (6c) PRE, PRU; 381 (3) PRU; 647, 833, 1121 (6c) PRE, PRU; 2015 (3) PRE, PRU; 2073 (3) PRU. *Brenan* 14180 (1). *Brink* 374 (6a) GRA, PRE. *Britten* 439 (6a); 1852 (6a) GRA; 1926 (6a) GRA, PRE; 2269 (6a). *Brown* PRE40569 (5). *Brueckner* 936 (5). *Buerger* 1058, 1142 (4a); 1313 (6c). *Buitendag* 187 (3) PRE, NBG; 799 (1) K, NBG, PRE; 863 (6c) NBG, PRE. *Burgoyne* 3332, 3483 (5). *Burrows* 2119 (6a); 2771, 3698, 4609 (6a) GRA.

Carr 4 (5). *Catto* 44, 147 (6c) PRU. *Codd* 661, 810, 2240 (6c); 2741 (3); 4976 (1); 5617 (3) BM, PRE; 5659 (1) K, PRE. *Codd & De Winter* 3126 (1); 4976 (1) K, PRE; 5001, 5031 (6c) K, PRE. *Codd & Dyer* 4497 (1); *Coetzee* 1097 (6c); 256 (6c) PRE, PRU. *Cole* 339 (5); 990 (6c); 1075 (4a). *Comins* 1261, 1303 (6a) GRA, PRE. *Compton* 26649 (3) NBG, PRE; 28019 (6c) K, NBG, NH, PRE; 28208 (1) NBG, PRE; 28422 (6c) NH, NBG, PRE; 29354 (1) K, NH, PRE; 29914 (6c); 30316 (6c) NBG, NH, PRE; 30398 (6c) K, NBG, NH, PRE; 31022 (6c); 31136 (1) K, NBG, NH, PRE. *Cooper* 77, 84 (6b) NH, PRE. *Crawley* PRE40559 (3). *Crous* 36 (6c) GRA. *Culverwell* 279 (3); 498 (6c); 1089 (6c); 1355 (1). *Curson* 265, 381 (6c). *Curtis* 203 (6a) GRA.

Dahlstrand 811 (6a) GRA. *Dale* 2143 (1). *Daly* 790 (6a) GRA. *De Winter* 369, 404, 5918A, 5966 (6c). *De Winter & Leistner* 5435, 5823 (4b). *De Winter & Wiss* 4291 (2) K, PRE, WIND. *Devanish* 1465 (6c) K, PRE. *Dieterlen* 867 (6c). *Dinter* 297 (4a) SAM. *Dlamini* PRE40557 (6c); PRE40583 (1). *Dold* 2394 (6a) GRA. *Dold & Johnson* 2394 (6a) GRA. *Downing* 483 (6c) PRE, NU. *Du Preez* 191 (6c) BLFU. *Du Toit* 166 (6c); 826 (6c) K, PRE; 2800 (6c) NH.

Ecklon & Zeyher PRE12110, PRE21252 (6a). *Edwards* 910, 1267 (6c) NU, PRE. *Ellery* 314 (6c). *Engelbrecht* 534, 579 (6c) NMB.

Fairall 2 (6c) NBG. *Fanshaw & Bradley* 109 (6a) GRA. *Flanagan* 605 (6b) BOL, GRA, NH; 778 (6a) PRE, SAM. *Forest Dept.* PE 135 (6a) GRA. *Fouche* PRE40548 (6c). *Fourie* 127, 2251 (6c); 2848 (3). *Fourcade* 3065, 5413 (6a) NBG. *Francis* 13 (6a) GRA. *Fries & Norlindh* 629, 836 (6a).

Galala 119 (3). *Galpin* 7 (6a); 454, 499, 500 (3); PRE10690 (6a); 1242 (1) K, PRE; 14783, 14788 (4a); 3322 (6a) GRA. *Geldenhuis* 887, 1226 (6a). *Gemmell* BLFU9030 (6b). *Genis* 95 (6c). *Germishuizen* 1490 (6a) PRE, K; 1503, 1522 (6a); 2219 (3); 3366, 5093, 7750A (6c). *Gerstner* 736, 6085 (6c). *Gibbs Russell* 3343 (6a); 3656, 3726 (6a) PRE, GRA; 3841, 3902 (6a) BOL, GRA, PRE; 3974 (6a). *Giess* 9536 (5); 9581 (2). *Giess & Wiss* 3317 (5). *Giffen* 1493 (6a). *Gillett* 504 (6c) K; 1068, 1068A (6c); 2452 (6a) NBG; 2600 (6c) NBG; 4593 (6a) GRA, PRE. *Gilliland* 789 (1); 800 (3). *Goldblatt* 4940 (6a). *Goossens* 97 (6c); 667, 991, 1296 (5). *Green* 43, G51 (6c). *Grobler* 16 (5) PRE, WIND.

Hafström H771 (5). *Hall* 45 (6a) GRA. *Hall-Martin* 1244 (1) PRU. *Haller* 17 (6a) GRA. *Hancock* 49 (6c) NH, PRE. *Hanekom* 971 (5) K, PRE; 175A (4a) PRE, WIND; 176a (5) PRU; 1637, 1859 (6c) K, PRE. *Hahn* 243 (1) PRU. *Hansen* 3177, 3243 (5); 3476 (3) K, PRE. *Hardy & Scott-Smith* 1526 (6c) K, PRE. *Hemm* 240 (6c). *Henderson* 104 (6c). *Henrici* 1834, 2555 (5). *Herman* 759 (1); 1101 (5). *Herman, Welman, Pienaar & Crosby* 683, 694 (6c). *Heydorn* 31 (6c). *Hildyard* 192 (6c). *Hillary & Robertson* 525 (5). *Hilner* 327 (6a) GRA. *Hines* 114, 133 (5) PRE, WIND. *Hitchins* 61 (6c) NH, NU, PRE. *Hobson* 968, 1145 (6a) GRA. *Hoffman* 40 (6c); 1019 (6a) GRA. *Hofmeyr* 50, 62 (6c). *Holland* 270 (6a) GRA. *Holt* 146 (3). *Holzhammer* 715 (5). *Hoole* L18 (4b) GRA. *Huntley* 1208 (3); 1390, 1909 (6c). *Hutchinson* 1534 (6a) NBG; 1939 (6c) NBG.

Immelman 188 (3). *Irvine* L.19 (6c). *Ivy* 2 (3).

N. Jacobsen 102, 1539 (6c), 1934, 2623 (3). *W.J. Jacobsen* 1874, 2560, 4862, 4871 (6c), 4999 (3). *Jacot Guillarmod* 9657 (6a) GRA. *James* 256 (1) PRU. *Joffe* 316 (6c). *Johnson* 1057 (6b) GRA, PRE. *Jooste* 185 (5). *Junod* TRV24405.

Keet 1385 (6c); 1653 (5) PRE, WIND; 5988 (5). *Kerfoot* 7967 (4a) J, PRE. *Kerfoot & Falconer* 32 (4a) J, PRE. *Kings* 1357A (6c). *Klopper* 61A, 124A/12 (6c). *Kok & Pienaar* 1303 (1) PRE, PRU. *Kreulen* 537 (5).

Lang TRV30172 (1); 32107 (3); TRV32211 (3). Lawn 334 (3) NH; 600 (6c) NH. Le Roux 64 (6c) NMB; 556 (6c); 1030 (2) PRE. WIND. 1173 (4b) WIND. Leach & Bayliss 11528 (3). Leendertz 284 (6c) GRA; 506 (6c) PRU; 769, 801 (3); 905 (6c); PRE59261 (3); TRV5314 (6c); TRV5550 (3); TRV9747 (6c). Leistner 894, 2061 (5) PRE. K. Leity 22 (6c); PRE8257 (6a). Liebenberg 849 (6a); 5087 (6a) K. PRE; 8634 (6) K. PRE; 8740 (6c). Liengme 348 (1); 440 (1) K. PRE. Louw 387, 1023 (6c). Lubbe 1774 (6a) GRA. Lubbe, Everard & Avis 2735 (6b) GRA.

MacClean 974 (6c) NH. PRE. MacDonald 141 (6c) PRU; 455 (6c) E. K. NU. PRE. MacOwan 93 (6a) GRA. K. PRE; 353 (6a) BM. SAM. Maguire 575, 630 (6a) NBG; 1333 (6c) NBG; Makgakga 58 (3). Mansvelt Marloth13487 (6c). Markotter NHU17842 (6c). Marloth 815 (5); 2074 (6c); 4274 (6a). Marsh 937 (6a). Mason 2606 (5). Mathee 1092 (6c) PRU. McFerren 129 (2). McMurtry 2018 (1); 2715 (6c); 2879 (1). Merxmüller 1071 (5) PRE. K. Miller B1136 (2). Mogg 15195A, 15195B, 15864, 16593, 19843, 20072 (6c); 21143 (6c) GRA; 23571, 31006, 37156, 37230 (6c). Moll 753 (6c); 1079 (6c) NU. PRE; 1128 (6c) K. NU. PRE; 1805 (6c); 2169 (6c) NU. PRE; 2204 (3) NU. PRE; 4123 (6c); 4143 (6c) K. NH. PRE; 4244 (6c) NH. PRE; 4258 (6c) E. K. NH. PRE; 4390 (1). Moll & Morris 625 (6b) NU. PRE. Moran PRE40563 (5). Morris 800 (6b); 596 (6c) NH. PRE; 1025 (6c) K. NU. PRE; 1197 (5a). Morris & Engelbrecht 30, 1118 (5). Moss & Rogers 273 (1) NBG. Mott 356, 769 (6c). Muller 897, 1073 (6c) NMB; 1637 (5) NMB; PRE40558 (5). Müller 997 (4a). Murdoch 53 (1).

Nel 69 (1) K. NBG. PRE; 119 (6c); 238 (1) NBG. PRE; 264 (1) K. PRE. Netshungani 1624 (1). Ngwenya 36 (3) NH; 379 (6c). Nicholson 705, 724 (6b); 901, 1330 (6c); 1459, 1552 (6b); 1566 (3); 1617 (6b). Nicol 60 (6a) NBG. Noel 629 (6a) GRA. Norrgrann 241 (3).

Oates 61, 65 (3); 95 (1); 105 (3); 308 (5); 357 (1). Obermeyer 750 (6c); 828 (1) K. PRE; 1246 (1); TRV29257 (1); TRV33565 (6c). Obermeyer, Schweickerdt & Verdoorn 44, 45 (6c). O'Callaghan 1012 (6b) GRA. Olivier 1208 (6a); 2336 (6a) PRU; 2821 (6a). Onderstall 1077 (6c). Osborne 151 (6a) GRA.

Palmer 1167 (6a). Paterson 2026 (6a). Pauw 127 (6c) PRU. Pearson 4399 (5); 8260 (5) BM. PRE. Peeters, Gericke & Burelli 11 (5). Pegler 110 (6b). Pentz 324 (6c). Penzhorn 6442 (6a) GRA. Peyper 1287 (5) NMB; 2043 (6c) NMB. Pahl 3.40 (6a) GRA. Phelan 703 (6c). Phillips 42 (5). Phillipson 365 (6a) K. PRE; 3193 (6a) GRA. PRE. Pienaar 643, 673 (6c). Pole Evans 1480, PRE40545 (6c); PRE40592 (1). Pott 171 (6a) GRA. Potts 3216 (5). Prinsloo 45 (3). A. Prior PRE40566 (6a). J. Prior 397 (1).

Raal 1383 (3). Ramovha 23 (6c) PRU. Reed 8 (6a) GRA. Renny 97 (1). Repton 4 (6c). E. Retief 619 (6c). I.M. Retief 278, 547 (1). Retief & Strauss 2167 (3). Reyneke 410 (5). Roberts 1843A, 5365 (6c). Rodin 4203 (6c). Rogers TRV2603 (1) BOL. PRE; 12891 (1) K. PRE; 17134 (6a) K; 18220 (1) BM. PRE; 21832 (6c). Rose Innes 9, 189 (6c). Ross 2009, 2014 (6c) NH. PRE. Roux 94 (5). Rowland 169 (3).

SAGP/SAAB 1/ 34 (6c) PRE. PRU; 2/44 (6c); 2/49 (6c) PRU; 3/93, 4/75 (6c) PRE. PRU. Salisbury 61 (6a); 138 (6a) GRA. Scharf 1481 (6a); 1681 (6a) NBG. PRE; 1159 (6a). Scheepers 1735 (5). Schlechter 3294 (6c) BM. BOL. GRA. NH. PRE. Schrire 1169, 1504 (3) NH. Schmidt 84 (6b) GRA. Schweickerdt 1014 (6c). Seagrief 149.6 (6a) GRA. Seaman 67, 97 (6c) NMB. Seydel 239, 1233 (5); 1239 (5) COI. PRE. Shackleton 566 (1) PRU. Sidey 2393 (6c); 3134 (6a); 3723 (6c). Smit 219, 1256 (1) PRU. Smith 254, 398 (1); 693 (6c); 739, 1090, 2140 (5); 2149 (1) K. PRE; 2592 (5) 5195, 3245, 7017 (6c). Smuts & Gillett 2104, 2126, 2136, 3447 (3). Snyman & Noailles 233 (6c). Spies 11 (1). Spreeth 6 (6c) PRU. Stayner 64 (6a) GRA. PRE. Stephan 823 (6c). Stewart 88 (6c) NH. PRE. Steynberg 986 (3). Stirton 8854 (6c) K. PRE. Story 4592 (5); 4942 (5) PRE. K; 5504 (4a). Straub 122 (3). Strey 1136 (6c); 2505 (6a); 4853 (3) NH. PRE; 5874 (6c); 9021 (6c) NH. NU. PRE; 9969 (6c) NH. PRE. Strey & Moll 3734 (1) NH. PRE. Sutton 785 (6c). Swartz 33 (6a). Swierstra TRV4383 (3).

Tainton 2 (6c). Tanaka 21 (5). Taylor 946, 1286A (6a). Taylor & Edwards 8861 (6b) GRA. G.C. Theron 236, 447 (6a); 1455 (6c). J.J. Theron 2048 (3) J. PRE. Thode A598 (6a); 2713A (6b) NH. PRE; 6495 (4b). Thompson 918, 1884 (6a) NBG. PRE. Thorncroft 3018 (1). Thorne SAM35767 (4a) SAM. Tinley 332 (1) K. NU. PRE; 494 (6c) NH. NU. PRE. Tinley & Ward 30 (6c). Tölken & Hardy 716 (5). Troughton 108 (6a) GRA. PRE. Turner 20 (6c). Tyson 2201 (6a) GRA. SAM; 2662 (6a) SAM; Marloth Herb 8502 (6a).

Vahrmeijer 376A (6c); 1500 (1) K. PRE. Van Dam TRV18826 (6a). Van den Berg 3 (1). Van der Schijff 618 (3); 782 (1) KNP. PRE; 904 (6c) K. KNP. PRE; 915 (3); 1213 (1) KNP. PRE; 2273 (6c) K. PRE; 3306 (6c); 3406, 3917, 4075 (6c) K. PRE. Van der Schijff & Marais 3639 (1) KNP. PRE. Van der Spuy 36 (5). Van Graan & Hardy 494 (6c). Van Greuning 525 (1) PRE. PRU; 500, 580 (1) PRU. Van Heerden 743 (1). Van Rooyen & Bredenkamp 4, 99 (5) PRU. Van Rooyen & Schultz 4318 (6c) PRU. Van Rooyen 1012 (1) PRU; 1053, 1144A, 1266 (1) PRU; 1948, 1989 (6c) PRE. PRU; 4421(6c) PRU. Van Vuuren 549, 1583 (6c). A.E. van Wyk 392 (6a) NBG. PRE; 460 (6c); 2615 (1) PRU; 10462 (1) PRU; 3029 (6c) PRE. PRU; 3547 (6c) PRU; 4019, 5156, 5918, 5954 (1) PRE. PRU. P. van Wyk BSA352 (1) PRE. PRU; BSA1552, BSA3110 (1) PRU. Van Wyk & Theron 4719 (3) PRE. PRU. Venter 1945 (3) BLFU. PRE; 1108, 2813 (6c); 5148, 7216, 8583 (1); 12173, 13052 (1) UNIN; 13056 (6c) NU; 13598 (6c) UNIN. Venter, Hahn & Archer 41 (5); 93 (2). Verdoorn 50, 603 (6c); 1121 (5) BOL. NMB. PRE; 2110, 2353 (3); 2354 (6c) K. PRE; 2355, 2357 (3); 2358 (6c). Viljoen 88 (6c). Von Gadow 451 (6a) GRA. PRE.

Wager PRE59522 (3); TRV 22463 (1); TRV23672 (3). Walter 29 (6a) GRA. Wannorp 93 (5). Ward 3 (2); 1206 (1) NH. PRE; 2980 (1); 3751 (6b) NU. PRE; 7223 (6c) NH. PRE. Wearne 50 (6c) NU. PRE. Webber 7742A (6a) GRA. Wentzel N15 (1). Werdermann & Oberdieck 1057 (6a); 1948 (6c) K. PRE; 2286 (5). Werger 1465 (6c). West 399, 489 (6c); 1549 (6c) K. NH. PRE. Westphal TRV29118 (1). White 2 (6a) GRA. Wild 5082 (5). Williamson 81 (6c). Wilman 14 (5). Winter 2417 (3) UNIN; 2695 (6c) UNIN; 2892 (3) UNIN; 2966 (6c) UNIN; 3082 (3) UNIN. Wood 10919, 11500 (3) NH. Woollard & Bethea 2168 (4a).

Young 504A (6c); 584A (3); 2516 (6c).

Zambatis 264, 713, 722 (3); 748 (1); 1204 (3), 1224, 1233 (3). Zeyher 161 (6a) BOL. GRA. K. NBG. PRE. Zietsman 290, 981 (6c) NMB; 1341 (6c) NMB. PRE; 1373 (5) PRE. NMB; 3445 (5) NMB. Zwanziger 164 (6c).

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