Flowering Plants of Africa

Volume 67

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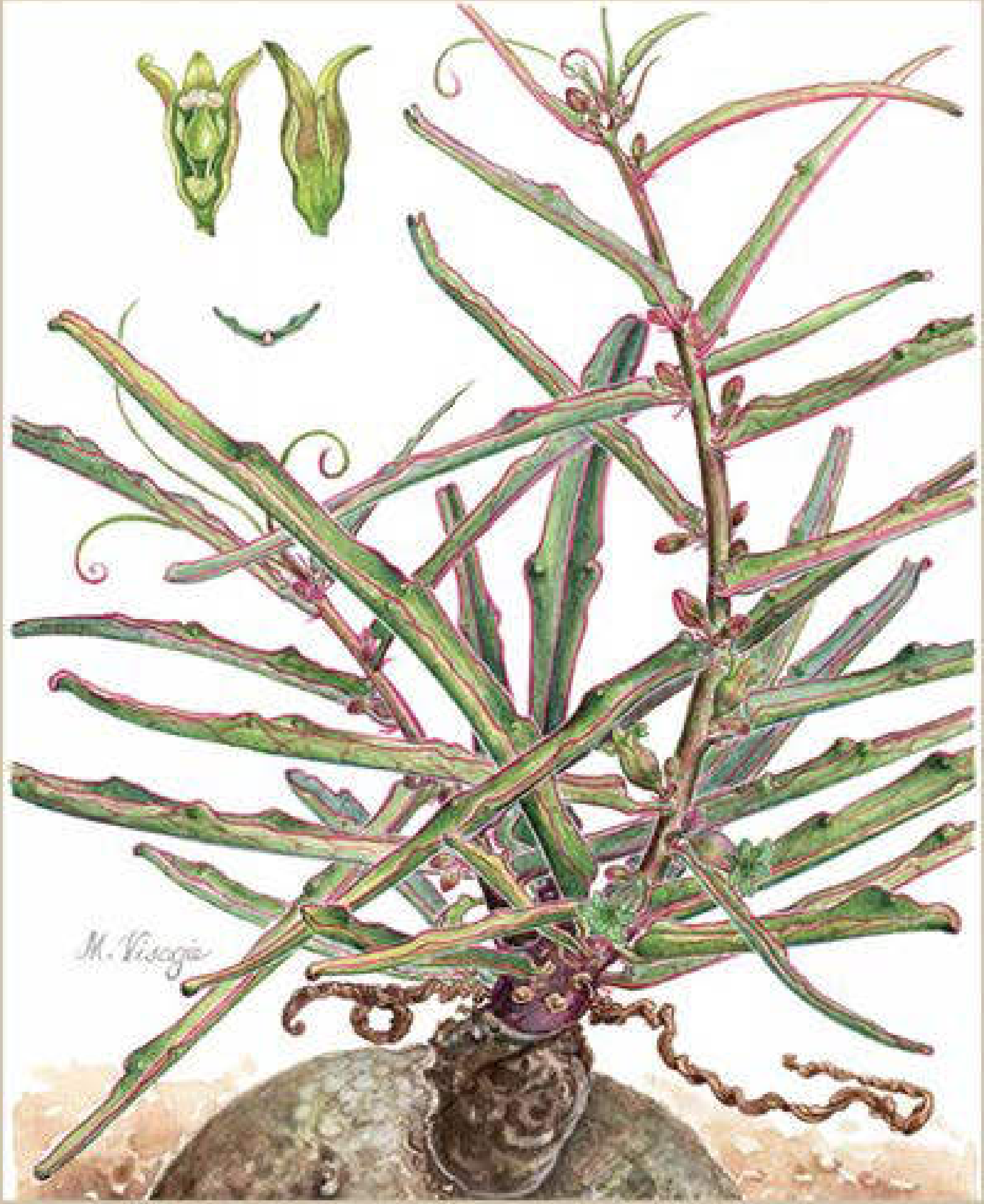

Celebrating 100 years: 1921–2021

Flowering Plants of Africa

Since its inception in 1921, this serial, modelled on the former *Curtis's Botanical Magazine*, has published well over 2 000 colour plates of African plants prepared by some 80 artists.

The object of the journal is to convey to the reader the beauty and variety of form of the African flora, to stimulate an interest in the study, conservation and cultivation of African plants, and to advance the science of botany, as well as botanical art.

The illustrations are mostly prepared by artists on the staff of the South African National Biodiversity Institute (SANBI), but we welcome other contributions of suitable artistic and scientific merit. Please see *Guide for authors and artists* on page 214.

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History of this series

(note Afrikaans translation and changes in title)

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The Flowering Plants of South Africa

Volume 25 (1945–1946) to Volume 26 (1947):
The Flowering Plants of Africa

Volume 27 (1948–1949) to Volume 52 (1992–1993):
The Flowering Plants of Africa
Die Blomplante van Afrika

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Flowering Plants of Africa

Cover illustration: *Adenia repanda* (Plate 2373)

Flowering Plants of Africa

A peer-reviewed journal containing colour plates with descriptions of flowering plants of Africa and neighbouring islands

Edited by

Alicia Grobler

with assistance of

Gillian Condy

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2021

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Contents

Volume 67

New taxa published in this volume

Aloiampelos tenuior var. *viridifolia* (Van Jaarsv.) Van Jaarsv., comb. nov., p. 33
Aloiampelos tenuior var. *decidua* (Reynolds) Van Jaarsv., comb. nov., p. 33
Aloiampelos tenuior var. *densiflora* (Reynolds) Van Jaarsv., comb. nov., p. 34
Aloiampelos tenuior var. *rubriflora* (Reynolds) Van Jaarsv., comb. nov., p. 34
Psychotria suber Van Jaarsv. & S.Venter sp. nov., p. 143
Carissa sebrabergensis Van Jaarsv. & Swanepoel sp. nov., p. 150

Tarchonanthus parvicapitulatus Asteraceae: Tarchonantheae

Namibia, South Africa, Zimbabwe

Tarchonanthus parvicapitulatus *P.P.J.Herman*, Bothalia 32: 26 (2002); Boon: 588 (2010); Cron et al.: 669 (2019).

Tarchonanthus L. and *Brachylaena* R.Br. are the only two genera included in the tribe Tarchonantheae of the family Asteraceae (Ortiz 2009). These are two of only a few genera in the family Asteraceae of which the members may develop into proper trees. The tribe Tarchonantheae, together with the tribes Oldenburgieae, Dicomeae and Cardueae, comprise the subfamily Carduoideae (Ortiz 2009). From the ITS trees presented for this subfamily by Ortiz (2009) and Ortiz et al. (2009), it is clear that the tribes Tarchonantheae and Oldenburgieae (containing only the South African endemic genus *Oldenburgia* Less.) are more closely related and situated far from the other tribes in the subfamily Carduoideae.

Species of *Tarchonanthus* and *Brachylaena* are dioecious, meaning that male and female florets are borne on separate plants (Figures 1–3). The female florets contain, besides the corollas, only fertile pistils (Figure 3b). The male florets contain the fertile stamens and a sterile pistil (Figure 2a, b). The sterile pistil in the male floret is, however, functional in that it serves as a pollen presenter. When the corolla of the male florets is still closed, the pollen is released from the anthers onto the young, included, distal portion of the style, which is usually unbranched or rarely has two small lobes (Figure 2a, b). The corolla lobes then open, the style starts elongating, carrying with it the numerous pollen grains. When outside the confinement of the corolla, the pollen is available to be collected by insects or blown away by the wind.

Representatives of the genus *Tarchonanthus* can be distinguished from representatives of the genus *Brachylaena* by the florets lacking a pappus and the presence of cottony woolly hairs enveloping the cypselae (indehiscent, single-seeded, dry fruit), the latter suggesting wind as an obvious mode of dispersal (Figures 1m, 3d). It has also been suggested that plant species with seed/fruit firmly embedded in cottony coverings are adapted for directed dispersal by birds as nest material (Dean et al. 1990). The woolly fruit of *Tarchonanthus* are reminiscent of those of *Eriocephalus* L. (commonly known as *kapokbosse*, Afrikaans for 'snow bushes'). The fruit of many *Eriocephalus* species are abundantly present in the nests of birds (Dean et al. 1990). We suggest that birds may, in a similar manner, contribute to fruit dispersal in *Tarchonanthus*. The hairs in the capitula of *Tarchonanthus* and *Eriocephalus* species were described by Herman (2001) as being rather similar in having transverse walls (septate hairs). Despite this similarity, *Tarchonanthus* differs from *Eriocephalus* in having the

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PLATE 2380.—1, leafy twig, × 1; 2, branchlet with male synflorescences, × 1; 3, male capitulum, × 2; 4, male floret, × 2; 5, branchlet with female synflorescences, × 1; 6, fruiting branchlet, × 1; 7, mature cypsela covered in woolly hairs and tipped by dried remains of the female floret, × 4; 8, cypsela in longitudinal section and with hairs removed, × 4; 9, habit of multi-stemmed tree, ± 4 m tall. Voucher specimens: sterile twig, *Hyde-Johnson 114*; male plant, *Hyde-Johnson 115*; female plant, *Hyde-Johnson 116*, all in H.G.W.J. Schweickerdt Herbarium, Pretoria. Artist: Jenny Hyde-Johnson.

PLATE 2380 *Tarchonanthus parvicapitulatus* cottony hairs on the cypselae interspersed with numerous glandular hairs (Figure 3c). In addition, the capitula of *Eriocephalus* are bisexual, with fertile outer female florets and central functionally male florets and with paleae on the receptacle. *Eriocephalus* also belongs to a different tribe: the tribe Anthemideae.

Tarchonanthus is confined to sub-Saharan Africa, with its centre of diversity in southern Africa. This is the second species of *Tarchonanthus* to be figured in this series, the first being *T. obovatus* DC. (Herman & Condy 2001). When not in flower, members of the genus may be readily identified by the leaves being distinctly discolorous, white-felted on lower surface, green and minutely puckered with glandular reticulation on upper surface (Figure 4c), and with a strong smell of camphor when crushed. The latter property of the leaves is the

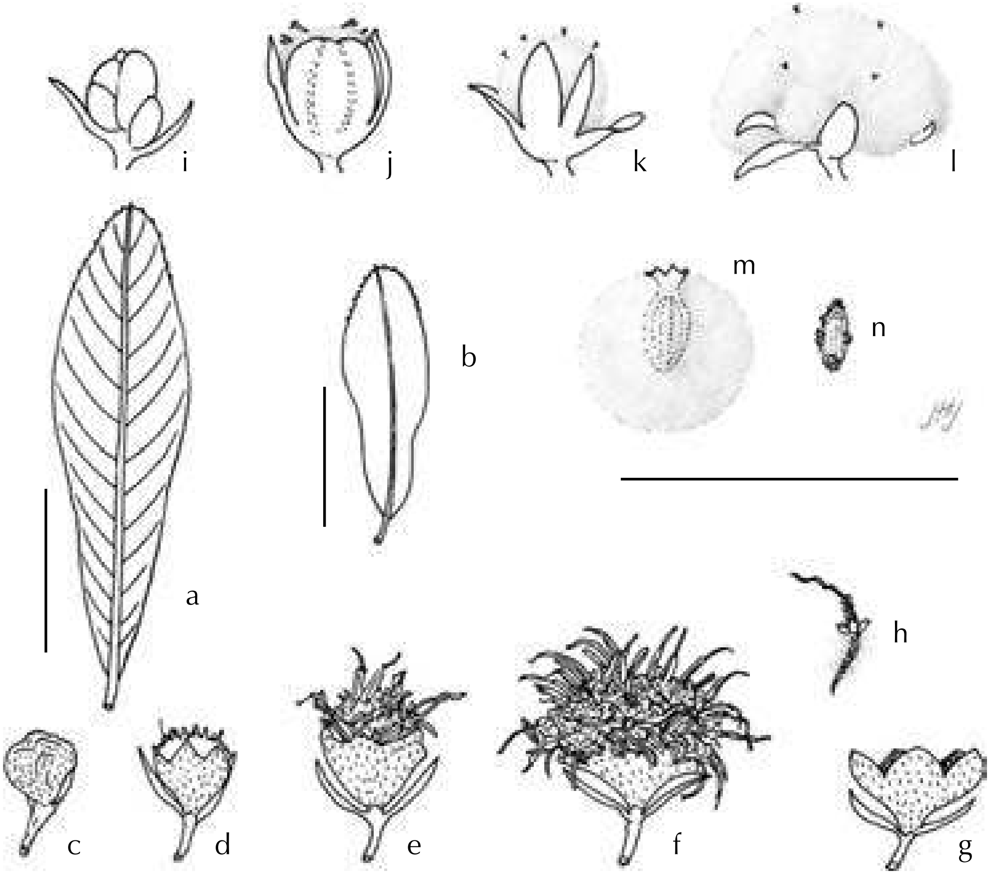

FIGURE 1.—*Tarchonanthus parvicapitulatus*, details of leaf, capitula, floret and fruit morphology: a, leaf towards upper end of size, upper surface; b, leaf towards lower end of size, lower surface; c–h, male capitulum showing developmental sequence of anthesis of florets (c–f), involucral bracts beige-felted on the outside (g) and a fading male floret (h); i–n, female capitulum showing developmental sequence ending in mature fruit (i–l), ribbed mature cypsela covered by wool (m), and as seen in side view with the wool and remains of the corolla removed (n). Vertical scale bars: a, b, 10 mm. Horizontal scale bar: c–n, 10 mm. Artist: Jenny Hyde-Johnson.

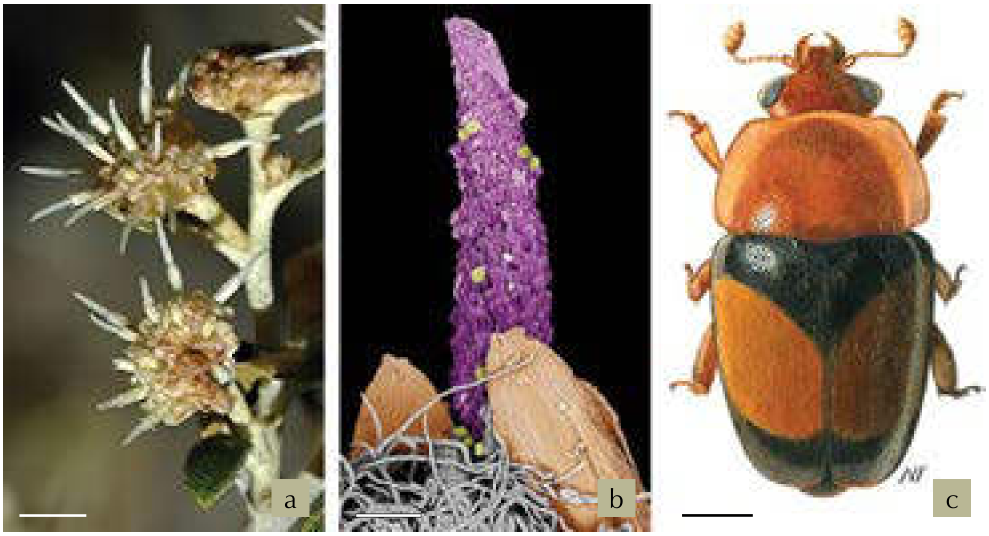

FIGURE 2.—*Tarchonanthus parvicapitulatus*, morphology of male synflorescences and associated pollen beetle (Coleoptera: Nitidulidae: Meligethinae): a, male capitula, distal one with florets still closed, the open florets showing long-exserted styles surrounded by ring of anthers; b. SEM micrograph of male floret with anthers (orange) and elongated style (purple), the latter serving as pollen presenter and still carrying a few pollen grains (yellow) (from *Barker 886* in PRE); c, *Tarchonanthogethes fasciatus*, one of at least four species of pollen beetle that have their larvae associated with the male capitula of *Tarchonanthus parvicapitulatus*. Scale bars: a, 5 mm; b, 100 μm; c, 0.25 mm. Photographs: a, J. Hyde-Johnson; b, P.P.J. Herman. Artist of c: Niccolò Falchi, from Audisio et al. (2015) in *Zootaxa* 3920: 101–152, reproduced by kind permission of Magnolia Press and P. Audisio.

source of the vernacular names camphor bushes or *kanferbosse* (Afrikaans) for members of the group. However, despite the camphor-like smell, plants were found to contain only very small amounts of camphor (0.4%), the major essential oils being α-fenchyl alcohol (29.1%), 1,8-cineole (16.5%) and α-terpineol (8.5%) (based on hydrodistillation of leaves of *T. camphoratus* s.str. from near Naivasha, Kenya) (Mwangi et al. 1994).

Following the taxonomic revision of *Tarchonanthus* by Paiva (1972), only two species of *Tarchonanthus* were recognised by most workers in Africa, the polymorphic *T. camphoratus* L. and *T. trilobus* DC., the latter with two varieties. However, based on a taxonomic reassessment of the *Tarchonanthus camphoratus* specimens housed in PRE, the complex was split into five separate species (Herman 2002). Two previously described species were reinstated, namely *T. minor* Less. and *T. obovatus*. Both had been placed in synonymy under a broadly defined *T. camphoratus* by Paiva (1972), an approach also followed by, amongst others, Hilliard (1977), Pope (1992) and Beentje (1999). In addition, two new species, namely *T. littoralis* P.P.J.Herman and *T. parvicapitulatus*, were described, leaving *T. camphoratus* in the narrower sense. Four of the five species are confined to southern Africa (the part of the African continent south of the Kunene, Okavango and Zambezi rivers), whereas *T. camphoratus* is widespread, ranging from southern Africa through East Africa to the Horn of Africa.

Apart from *Tarchonanthus trilobus*, the five species recognised by Herman (2002) in the *T. camphoratus*-complex were separated on the grounds of leaf and inflorescence

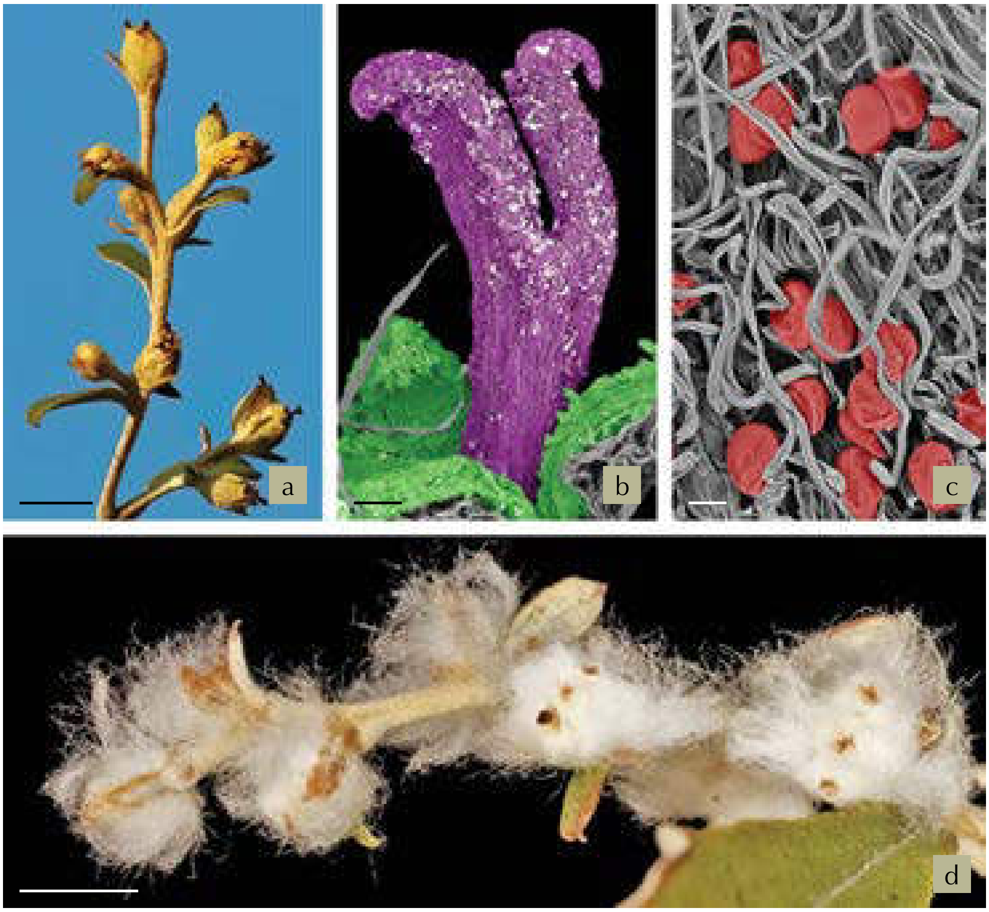

FIGURE 3.—*Tarchonanthus parvicapitulatus*, morphology of female synflorescences and fruit: a, female capitula, relatively young with exserted black styles; b. SEM micrograph of female floret with petals (green) and short style ending in two style branches (purple) (from *Ward 1402* in PRE); c, SEM micrograph of mature cypsela surface to show globular glandular hairs (red) amongst the dense cover of woolly hairs (from *Ward 2612* in PRE); d. mature fruiting capitula filled with cypselae covered by white cottony hairs. Scale bars: a, 4 mm; b, 50 µm; c, 25 µm; d, 4 mm. Photographs: a, J. Hyde-Johnson; b, c, P.P.J. Herman; d, A.E. van Wyk.

characters, flowering time, distribution and habitat in South Africa. In *T. minor* both the male and female synflorescences are densely spicate, the involucral bracts of both the male and female capitula (flower heads) are free and its peak flowering time extends from September to December (spring to early summer in the southern hemisphere). In *T. parvicapitulatus*, *T. camphoratus*, *T. obovatus* and *T. littoralis*, the male and female synflorescences are laxly paniculate, the involucral bracts of the male capitula are fused halfway (Figure 1d–g) while those of the female capitula are free (Figure 1k, l), and the peak flowering season of these four taxa extends from February to August (late summer, autumn and winter in the southern hemisphere). In *T. parvicapitulatus* and *T. littoralis* the leaf margins are usually faintly denticulate, at least towards the apex of the leaves (Figures 1a, b, 4c), whereas the leaf margins of *T. camphoratus* and *T. obovatus* are always entire. *Tarchonanthus*

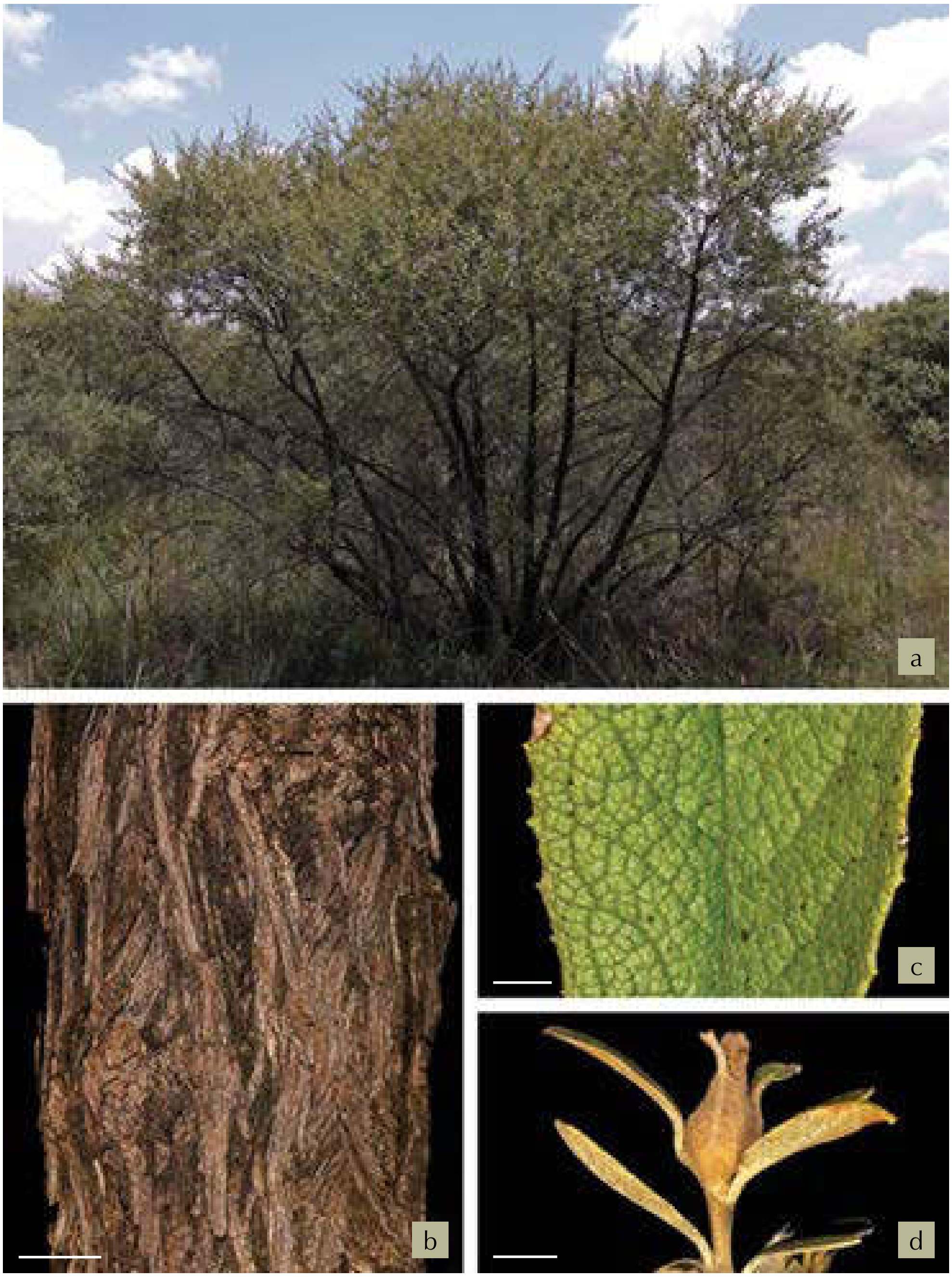

FIGURE 4.—*Tarchonanthus parvicapitulatus*, habit and vegetative morphology: a, multi-stemmed shrub, ± 4 m tall, growing as part of a dense population of the species in grassland on dolomite at Kalkheuvel West, Broederstroom, Gauteng; b, bark; c, middle portion of leaf blade viewed from above and showing puckered surface, glandular reticulations and faintly denticulate margin (though often entire); d, characteristic stem-tip gall, most probably caused by an insect. Scale bars: b, 20 mm; c, 2 mm; d, 5 mm. Photographs: A.E. van Wyk.

parvicapitulatus is distinguished from *T. littoralis* by the small capitula (fruiting capitula up to 10 mm in diameter), the smaller leaves with shorter petioles and its inland distribution. *Tarchonanthus littoralis* has large capitula (fruiting capitula up to 15 mm in diameter), large leaves on fairly long petioles and occurs along the coast from southern KwaZulu-Natal to the Western Cape. *Tarchonanthus camphoratus* differs from *T. obovatus* by the usually creamy or yellowish cottony hairs enveloping the cypselae (fruits), the narrowly elliptic to slightly narrowly oblanceolate leaves with a grey-green or khaki-green colour. In *T. obovatus* the cottony hairs enveloping the cypselae are usually pure white, the leaves are obovate to elliptic and usually distinctly discolorous with a bright green upper surface and a densely white pubescent lower surface. It also has a narrow geographical range, being confined to the Griqualand West Centre of Endemism (Van Wyk & Smith 2001; Frisby et al. 2019), whereas *T. camphoratus* s.l. has a much wider distribution. In a recent publication, Aro et al. (2021) described the usage of additional characters to distinguish between *T. camphoratus* and *T. parvicapitulatus* as well as the medicinal properties of the two taxa.

Based on the flowering times of *Tarchonanthus parvicapitulatus*, *T. camphoratus*, *T. obovatus* and *T. littoralis* reported by Herman (2002) and those of *Brachylaena* species supplied in correspondence by one of us (PPJH), the Italian entomologist P. Audisio and co-workers were able to identify, for the first time, the previously unknown larval host-plants of African members of the pollen beetles in the *Anthystrix*-complex of beetle genera, namely species of *Tarchonanthus* and *Brachylaena* (Audisio et al. 2008). They subsequently described the new genus *Tarchonanthogethes* (Audisio et al. 2009, 2015) for the pollen beetles associated with the male capitula of *Tarchonanthus* and *Brachylaena* species. At least four species of pollen beetles (Coleoptera: Nitidulidae: Meligethinae) of which the larvae are associated with the male capitula of *T. parvicapitulatus* were described, namely *Anthystrix endroedyi*, *Tarchonanthogethes hystrix*, *Tarchonanthogethes fasciatus* (Figure 2c) and *Xenostrongylogethes cychramoides* (Audisio et al. 2015). As far as other insect-associates are concerned, we have recorded a characteristic swollen stem-tip gall (Figure 4d), presumably by the larva of a moth, on plants in Gauteng. A noteworthy feature of trees of our species in the vicinity of the Magaliesberg is the presence in late summer to winter of clusters of curved and fragile white 'tubes' (5–8 × 2–3 mm), resembling snail shells, glued to leaves and twigs. These are the nymphal tubes of the spittlebug *Tremapterus* sp. (Hemiptera: Cercopoidea: Clastopteridae sensu Cryan & Svenson 2010). The tubes are constructed from dried spittle masses (Hamilton 2015; S. Neser pers. comm.; R. Stals pers. comm.).

Tarchonanthus parvicapitulatus is characterised by the very small male and female capitula (hence the specific name, from the Latin *parvus* meaning small, and *capitulum* meaning head), and the narrowly to very narrowly obovate leaves with the margins faintly denticulate towards at least the apex of the leaves (Figures 1a, b, 4c). Vernacular names recorded for the species include small-headed camphorbush, camphorbush; *kleinhofiekanferbos*, *kanferbos* (Afrikaans); *monokanekane*, *sefahla*, *sefahlane* (Northern Sotho); *igqeba elimhlope*, *igqebe-elimhlophe* and *isiduli sehlathi* (Zulu) (Van Wyk et al. 2011). *Tarchonanthus parvicapitulatus* is widespread, not in danger of extinction and is listed as Least Concern in the Red List of South African Plants (Von Staden 2018). It occurs in Limpopo, North West, Gauteng, Mpumalanga, KwaZulu-Natal and Eastern Cape provinces of South Africa, as well as in Eswatini (formerly Swaziland), Namibia and Zimbabwe (Figure 5). Plants are associated with grassland, bushveld and thicket, rarely forest; in valleys, on mountain slopes, hills and river

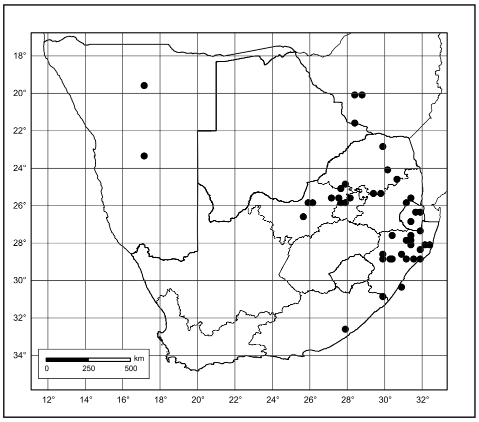

FIGURE 5.—Known distribution of *Tarchonanthus parvicapitulatus*.

banks. In areas where the range of *T. parvicapitulatus* overlaps with that of *T. camphoratus*, it tends to prefer rocky places with relatively shallow soils, whereas the latter seems to favour deeper sandy soils. The rocky habitat provides some protection (especially to the plant's volatile contents) against fire, although the plants are clearly fire-adapted with their thick, tough bark (Figure 4b) on older trunks and stems – often scorched black, a sign of their having survived many veld fires. *Tarchonanthus camphoratus*, on the other hand, is clearly a resprouter and fire-damaged plants rapidly recover. Plants of *T. camphoratus*, in particular, are browsed by game and stock, especially in times of drought (Van Wyk & Van Wyk 2013). *Tarchonanthus parvicapitulatus* is suspected to be utilised in a similar way, with *Ward 7719* (PRE) mentioning that antelope browse coppice shoots of this species. The milk of cows that browsed on leaves of *Tarchonanthus* species is tainted, presumably by the presence of the essential oils (T.W. Naudé pers. comm.).

Members of *Tarchonanthus* are widely used in traditional medicine as well as for many other biocultural purposes (for a review see Nanyonga 2012). Most published information on the uses, chemistry and medicinal properties of the group are based on *T. camphoratus* in a broad sense. No doubt most of these would also apply to *T. parvicapitulatus* and the other segregate species recognised by Herman (2002). Note that although the chemical and pharmacological research by Nanyonga and co-workers referred to in the present contribution are said to be on *T. camphoratus*, it is based on the entity here treated as *T. parvicapitulatus* (plant material collected in the vicinity of Sangoyana in northern KwaZulu-Natal). Volatile extracts of *T. parvicapitulatus* leaves contain a rich assemblage of essential oils with demonstrated antimicrobial and insecticidal properties (Nanyonga et al. 2012, 2013a, 2015). Leaf and bark extracts of this species also showed antioxidant activity, but no significant cytotoxicity (Nanyonga et al. 2013b, c). The oldest validated use of *T. parvicapitulatus* by humans dates from the Middle Stone Age, ~58 000 years ago (Lennox & Bamford 2017; Lennox et al. 2017). The presence of charcoal of *T. parvicapitulatus* associated with heaths was confirmed in the Sibudu rockshelter, an archaeological site with a long history of human occupation in north-central KwaZulu-Natal. These authors suggested that the heavy, hard and aromatic wood (most probably also the leaves) of this species were probably deliberately burned by the early occupants of the cave for its insect-repellent smoke.

The plants illustrated here in the plate and line drawings came from Kalkheuvel West near Broederstroom, northwest of Pretoria, Gauteng, South Africa, and were growing in shallow soil on chert-impregnated dolomite in the transition zone between Highveld grassland and bushveld. In this area, the species prefers fire-protected gullies and the southern aspect of hills. Plants tend to grow gregariously (Figure 4a), a pattern also seen elsewhere in the distribution range of *Tarchonanthus parvicapitulatus*, as well as for some of the other species – notably *T. camphoratus* in the narrow sense. At Kalkheuvel West it had been noted that antelope such as eland, kudu, gemsbok, hartebeest and duiker prefer to overnight in one particularly dense stand (thicket) of *T. parvicapitulatus* in winter. This is most probably due to shelter provided by the dense stand of leafy shrubs and small trees.

Although little is known about the pollination biology of species of *Tarchonanthus*, the presence of dioecy in all the species, accompanied by mass flowering of the plants, small and inconspicuous florets, the elongated pollen-presenting styles in male florets (Figures 1e, f, h, 2a, b), no detectable floral scent, and the apparent lack of reward in female florets, suggest wind-pollination as one potential mechanism of pollen transfer. This possibility is supported by gregariousness, a trait suggested as being part of the syndrome for wind pollination (Daru et al. 2016). However, counting against wind-pollination is the slightly sticky pollen grains, although this would be a consequence of the need for the pollen to adhere to the stigmatic areas on the style branches. The pollen-carrying styles are well exserted from the male capitula and fully exposed to the wind. Pollen grains are only sparsely present on mature pollen presenters and is presumed to have been dislodged by the wind. In female florets the style with the style branches containing the stigmatic areas, the latter often tinged pink or purple in the fresh state, is also well exserted, but no obvious pollen entrapment mechanisms such as hairy or feathery adaptations are evident. On the other hand, considering that each female floret produces only a single seed, at least theoretically only one viable pollen grain ought to reach the stigmatic areas to ensure fertilisation.

In gardening circles, *Tarchonanthus parvicapitulatus* is still an essentially unknown species. With its relatively small size and dense, evergreen and aromatic foliage, this is certainly a shrub or tree that offers considerable potential as a garden ornamental, bearing in mind that the species is dioecious with the decorative cottony fruiting heads only borne by female plants. Gardens are getting smaller and this necessitates smaller trees that are more suitable than traditional choices. Multi-stemmed plants of this species would also be suitable for planting as a hedge or windbreak (Carr 1994). In nature the most southern populations of the species in Gauteng (Klipriviersberg) can tolerate subzero temperatures, equivalent to at least USDA cold-hardiness Zone 9 (–1 to –7°C; Glen & Van Wyk 2016). Plants in Gauteng are also drought-tolerant and capable of surviving a dry season without significant rainfall of up to about eight months, a period during which they also flower and fruit. Plants from this area should be looked at as a potential resource for selecting horticultural introductions with a combination of cold-hardiness and drought tolerance. No published information on the propagation of this specific species exists. However, Carr (1994) reported that the seeds (with woolly hairs still attached) of *T. camphoratus* in the broad sense sown by him started germinating after 30 to 35 days. Once transplanted into bags, plants were kept under a protective fibreglass cover for the first winter, but thereafter they were quite frost-hardy and progressed rapidly. According to Carr, he made extensive use of the species (most probably the narrowly defined *T. camphorathus*) on his property just north of Johannesburg. Nichols (2005) recommended that when taking cuttings from woody Asteraceae such as *Tarchonanthus*, hard wood from the previous season's growth should be used. In the case of the related *T. littoralis*, cuttings taken in early summer, treated with a rooting hormone and placed in a mistbed with bottom heat, rooted with about 50% success rate (Notten 2008).

Description (mainly after Herman 2002).—Evergreen to semi-deciduous, dioecious shrub or small, multi-stemmed tree, up to 5 m high. *Bark* thick, hard and fibrous, deeply and irregularly longitudinally cracked into anastomosing grooves and ridges. *Leaves* aromatic, alternate, shortly petiolate; petiole 1.5–5.0 mm long; blade narrowly to very narrowly obovate, (22–)25–60(–70) × 7–20(–25) mm; apex obtuse to obtuse-mucronate, sometimes acute; base cuneate; margin often faintly denticulate, at least in distal part, rarely entire; discolorous, upper surface medium to dark green, minutely puckered, hairy when young, becoming glabrous, glandular in reticulations on upper surface, midrib sunken and hairy on the upper surface in lower part of leaf; lower surface densely whitish hairy, main and secondary veins prominent. *Synflorescences* terminal, paniculate. *Male plants*: capitula homogamous discoid, functionally male, 5–9 mm diam., 10–30-flowered; peduncle 0–7 mm long. *Involucral bracts* in single row, fused halfway, 5-lobed, beige-felted abaxially; tube 1–2 mm long, lobes 1.0–1.5 mm long. *Corolla* funnel-shaped, white, fading through pale cream to brownish, glandular and hairy, tube 1.5–2.0 mm long, lobes 5, 1.0–1.5 mm long, apex papillate. *Anthers* 5, exserted, 1.0–1.5 mm long, calcarate, caudate, tails 0.5 mm long, branched; filaments 2–3 mm long. *Style* well exserted, 4.0–5.5 mm long, unbranched or with 2 small lobes. *Ovary* sterile, rod-shaped, 0.5 mm long, covered with septate hairs. *Pappus* absent. *Female plants*: capitula homogamous discoid, functionally female, 3–4 mm diam., 1–3-flowered; peduncle mostly absent or up to 5 mm long. *Involucral bracts* free, in 2 or 3 rows, 2–5 mm long, ± beige-felted abaxially, very narrowly obovate, narrowly ovate or elliptic, acute. *Corolla* funnel-shaped, white, fading through pale cream to brownish, glandular and hairy; tube 0.5–1.0 mm long, lobes (4)5, 0.5–1.0 mm long, papillate. *Style* exserted, 1–2 mm long, bifurcate; style branches 0.5 mm long, often tinged pink or purple in the fresh state. *Ovary* obovate to elliptic, 1.5–3.5 mm long, glandular and septate hairy. *Cypselae* pale or dark brown, obovate, ribbed, 1.5–3.0 mm long, glandular and with pure white cottony, septate hairs. *Pappus* absent. *Flowering time*: March to October with a peak from April to June (autumn to winter in southern hemisphere). Plate 2380.

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