OSTEOSPERMUM NORLINDHIANUM AND *O. NORDENSTAMII*, TWO NEW SPECIES OF *OSTEOSPERMUM* SECT. *TREFENESTRATAE* (CALENDULEAE) FROM THE GREATER CAPE FLORISTIC REGION

Calendulae is a small tribe of ± 120 spp. with a marked centre of diversity in southern Africa, where ± 80% of the species occur (Nordenstam & Källersjö 2009). Available phylogenetic analyses (Nordenstam 1994, 2006; Nordenstam & Källersjö 2009) retrieve *Garuleum* Cass. and *Dimorphotheca* Vaill. ex Moench as two early-branching lineages, with no question about their taxonomic status. Generic delimitation within the remainder of the tribe, however, remains unsatisfactory (Manning & Goldblatt 2008). The species are currently segregated among ten genera: *Calendula* L. (± 15 spp.), *Chrysanthemoides* Fabr. (2 spp.), *Gibbaria* Cass. (2 spp.), *Inuloides* B.Nord. (1 sp.), *Monoculus* B.Nord. (2 spp.), *Nephrotheca* B.Nord. & Källersjö (1 sp.), *Norlindhia* B.Nord. (3 spp.), *Oligocarpus* Less. (2 spp.), *Osteospermum* L. (± 45 spp.) and *Tripteris* Less. (20 spp.) (Nordenstam 2007; Nordenstam & Källersjö 2009). In spite of recent generic fragmentation both *Osteospermum* and *Tripteris* remain polyphyletic (Nordenstam & Källersjö 2009), necessitating the recognition of additional genera if this treatment is to be carried to its logical conclusion.

In practical terms, few synapomorphies are available for the recognition of these new segregates, most of which are mono- or oligotypic, and it is unfortunate that dismemberment of the group has been implemented piecemeal and in advance of a well-sampled and well-supported analysis of the tribe. Even with the very narrow circumscription of *Tripteris* proposed by Nordenstam (2007) to include just those species with winged, apically3-fenestrate achenes, the molecular analysis in Nordenstam & Källersjö (2009) still locates taxa with other kinds of achenes (among them the genus *Monoculus*) among typical *Tripteris* species, rendering the latter polyphyletic.

The alternative, and in our opinion more useful treatment from both a practical and theoretical perspective (Manning & Goldblatt 2008), is to adopt a synthetic view of *Osteospermum* as constituting the monophyletic clade sister to *Dimorphotheca* as resolved in the phylogenetic analyses presented by Nordenstam (2006) and Nordenstam & Källersjö (2009), thus including the genera *Calendula, Chrysanthemoides*, *Gibbaria*, *Inuloides*, *Monoculus*, *Nephrotheca*, *Norlindhia*, *Oligocarpus* and *Tripteris*. Segregate lineages within *Osteospermum sens. lat.* are then usefully treated at sectional level, as was initiated by Norlindh (1943) in the last comprehensive revision of the tribe in sub-Saharan Africa. Although the current sectional boundaries clearly require substantial revision in the light of modern phylogenetic analyses, shuffling of species among them will have no impact on the nomenclature. This is the treatment that

has been adopted in the two floras treating the species of the Greater Cape Floristic Region (Manning & Goldblatt, in press; Snijman in press.) and we follow it here in describing two new species of *Osteospermum* subg. *Tripteris* (Less.) T.Norl. from the semi-arid parts of the Greater Cape Floristic Region.

Osteospermum sect. *Trifenestratae* T.Norl. [as *Trifenestrata*], which coincides with the narrow definition of the genus *Tripteris* (*sensu* Nordenstam 2007), comprises ± 18 species of perennial herbs, subshrubs or shrubs widely distributed through Africa, with some 7 species endemic to the winter rainfall parts of South Africa and southern Namibia. It is diagnosed by 3-winged achenes with all three sides of the apical airchamber thin-walled and translucent ('fenestrate') (Norlindh 1943). Here we describe two new species in the section. *Osteospermum norlindhianum* from the Cold Bokkeveld resembles *O. dentatum* Burm.f. from sandy flats along the West Coast of Western Cape in its herbaceous, perennial habit and its heteromorphic achenes but differs in details of the foliage and fruit. It had been recognized as distinct by Norlindh during the preparation of his monograph of the tribe (Norlindh 1943) but it is only now that fruiting material has become available. *O. nordenstamii* from quartz fields in southern Namaqualand, is a recently discovered, gnarled dwarf shrublet with consistently opposite, basally connate leaves, suggesting a relationship with the common Namaqualand shrub, *O. oppositifolium* (Aiton) T.Norl.

Osteospermum norlindhianum *J.C.Manning & Goldblatt*, sp. nov.

TYPE.—WESTERN CAPE, 3219 (Wuppertal): Swartruggens, Knolfontein 60 km NE of Ceres, 32°50'49.7"S, 19°37'20.8"E, 1 260 m, (–DC), 26 Oct. 2011, *I. Jardine 1729* (NBG, holo.; MO, S, iso.).

Tufted perennial from woody crown, 300–450 mm high, caudex producing a cluster of annual flowering stems; flowering stems suberect, laxly branched, 2–3 mm diam. at base, pubescent with mix of straggling, eglandular hairs and short, gland-tipped hairs, flushed purple at base. *Leaves* congested basally, lowermost subopposite with bases imbricate but not connate, becoming alternate distally as internodes lengthen, decreasing in size acropetally and ultimately grading into linear-subulate bracts, lower leaves oblanceolate, mostly 40–90 × 6–9 mm, leathery, sparsely to densely pubescent with mix of acute, eglandular hairs and gland-tipped hairs, adaxial surface ± asperulous, abaxial surface ± glandular-pubescent intermixed with scattered, straggling, eglandular hairs, these longer and denser along margins, blade tapering below into long, petiole-like base, midrib prominent abaxially, margins sparsely and weakly dentate, apiculate. *Capitula* heterogamous, radiate, ± 20 mm diam., on slender, branched peduncles forming lax, compound corymbs, nodding in fruit; *involucre* shallowly campanulate, 7–8 mm diam.; *involucral bracts* 12–15, sub-uniseriate, lanceolate, 3.5–4.0 × 1.0–1.5 mm, acute, densely glandular-pubescent, with scarious margins 0.25–0.50 mm wide; *receptacle* flat, glabrous. *Ray florets* female-fertile, 8–10; tube sparsely glandular-pubescent, ± 1 mm long; lamina spreading but recoiling in afternoon, narrowly elliptic, 4-veined, ± 3 × as long as involucre, 9–10 × 3 mm, bright yellow, sometimes flushed reddish abaxially. *Anthers* vestigial, free, reduced to 4 subulate staminodes ± 0.8 mm long, yellow. *Ovary* obovoid, 3-angled, ± 2 mm long, densely glandular-puberulous; style terete, branching ± 0.5 mm above mouth of tube, branches narrowly elliptic-lanceolate, obtuse, ± 1 mm long, yellow, lateral margins stigmatic. *Achenes* heteromorphic in some capitula, 3-winged or unwinged: winged achenes 10–12 × 7–8 mm, body turbinate, ± 7 mm long, transversely ribbed and glandular-scabrid, with cylindrical, apical, trifen-estrate airchamber, windows ovate, ± 2.5 × 2.0 mm, wings translucent, 2–3 mm wide but sometimes one or two only partially developed; unwinged achenes 0–3, fusiform-rostrate, 10–12 × 1.5 mm, glandular-pubescent, body purplish, rostrum and stipe greenish. *Disc florets* functionally male, numerous; corolla narrowly funnel-shaped, ± 3 mm long, yellow; tube glandular-hairy, ± 2 mm long; lobes suberect, triangular, ± 1 mm long. *Anthers* 2 mm long, yellow; base tailed, tails equalling filament collar; apical appendage ovate. *Ovary* ± terete, ± 1.5 mm long, glandular-pubescent; style terete, on short stylopodium, shortly bifid, lobes deltoid, acutely papillate with basal fringe of longer trichomes. *Flowering time*: Sept.–May. Figures 1; 3A–C.

Distribution and ecology: restricted to the drier, eastern edge of the Cedarberg and Cold Bokkeveld, where it has been recorded from Matjiesrivier in the southern Cedarberg and the Skurweberg and Swartruggens ranges in the Cold Bokkeveld (Figure 2) between 1 000 and 1 260 m. The species is a component of arid fynbos communities on the drier, hotter, northern slopes and the plants, like many species in the genus, are highly aromatic.

Diagnosis and relationhips: *Osteospermum norlindhianum* belongs to the small group of species in sect. *Trifenestratae* that includes *O. dentatum* and *O. connatum* DC. and that is characterized by a tufted, perennial habit with the lower leaves congested and opposite or subopposite, and annual flowering stems developing lax, corymbose synflorescences of moderately-sized capitula with the tendency to produce dimorphic achenes. Most fruits develop three conspicuous wings but in some heads up to half of the achenes are unwinged and fusiform-rostrate, with reduced or obsolete apical windows. In this group, *O. connatum* from the Cedarberg is distinctive in its mostly subsessile, semi-amplexicaul or conspicuously auriculate leaves, and relatively small winged achenes, 5–6 mm long. Both *O. norlindhianum* and *O. dentatum* (Figure 4) from sandy coastal flats between Saldanha and Hermanus (Figure 2), in contrast, have leaves narrowed to a petiole-like base and larger achenes, 9–12 mm long, and the two are superficially very similar.

Apart from their eco-geographical separation, the two species are distinguished by details of their foliage and fruits. The leaves of *O. norlindhianum* are oblanceolate without basal auricles, mostly 6–9 mm wide and obscurely toothed, with scattered, relatively long, straggling eglandular hairs on the underside and also along the margins, rendering them ± ciliate; the involucral bracts are glandular-puberulous with scarious margins 0.25–0.50 mm wide (Figure 3A); and the seed body in

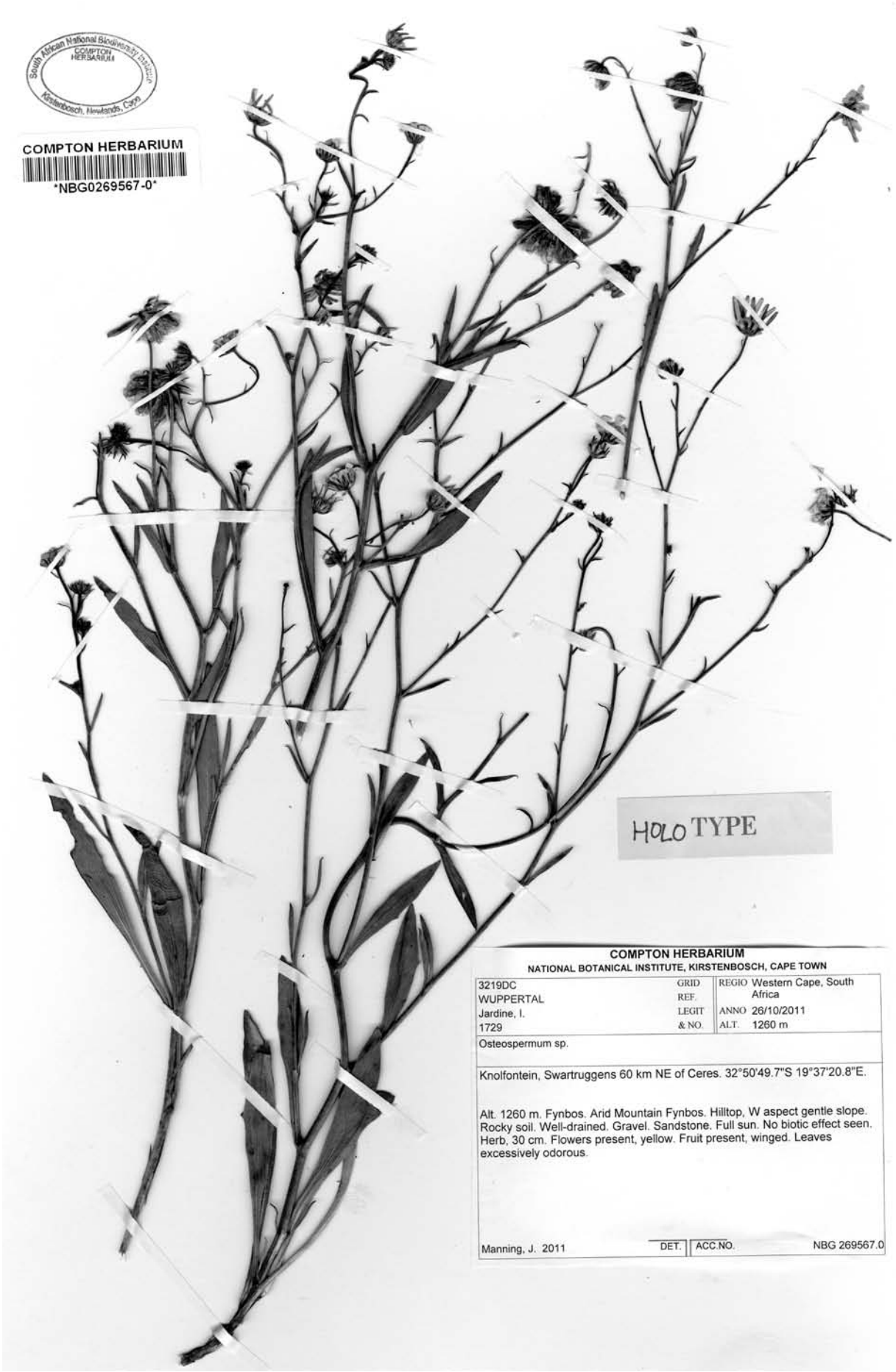

FIGURE 1.—*Osteospermum norlindhianum*, Swartruggens, *Jardine 1729* (NBG).

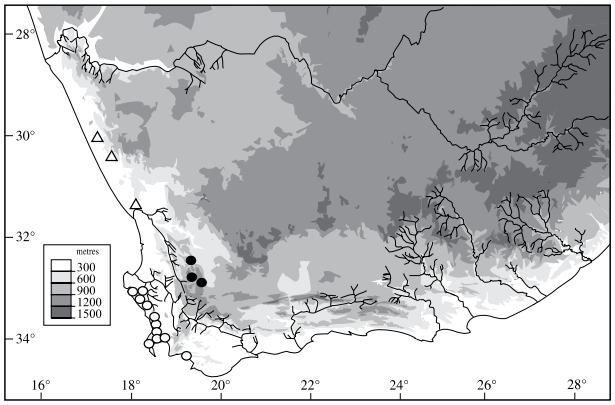

FIGURE 2.—Distribution of *Osteospermum dentatum*, ○; *O. norlindhianum*, ●; *O. nordenstamii*, Δ.

the winged achenes is conspicuously glandular-scabrid and ± turbinate, with a broadly cylindrical distal third containing the air chamber, a broadly ovoid and transversely ribbed central section with a median longitudinal sulcus, and an abruptly narrowed slender basal third (Figure 3B). The leaves of *O. dentatum* are oblong to obovate and generally broader, 10–20 mm wide, mostly with basal auricles, and usually more coarsely toothed or lacerate, with both surfaces and the margins scabridulous with short, stiff eglandular hairs; the involucral bracts are scabridulous with narrow scarious margins 0.10–0.25 mm wide (Figure 3D); and the fruit body is smoothly ellipsoid and subglabrous, with a median longitudinal sulcus through the entire distal two thirds (Figure 3E).

Hilliard & Burtt (1985) commented on the spatial/altitudinal separation within species pairs in Calenduleae in *O. attenuatum* Hilliard & Burtt (± 1 675 to 2 300 m) and *O. grandidentatum* DC. (sea level to ± 1 500 m); and in *Dimorphotheca fruticosa* (L.) B.Nord. (near sea level) and *D. caulescens* (Harv.) Harv. (± 1 650 m). The new *O. norlindhianum* (± 1 000 to 1 260 m) and *O. dentatum* (near sea level) constitute a third example of this.

Etymology: named for Tycho Norlindh, whose monograph on the sub-Saharan members of the tribe (Norlindh 1943) remains current. Norlindh also correctly annotated the flowering collection *Esterhuysen 12709* (BOL) as representing an unnamed species related to *O. dentatum* but was prevented from formally describing and naming it by the lack of fruits. The species was recently re-collected, in flower and in fruit, by Ivor and Cora Jardine during their survey of their property in the Swartruggens.

Additional specimens seen

WESTERN CAPE.—3219 (Wuppertal): Cedarberg, Matjiesrivier Nature Reserve, above Easter Cave, 950 m, 32°28'38"S, 19°22'43"E, (–AD), 24 Apr. 1996, *Lechmere-Oertel 15* (NBG); Matjiesrivier Nature reserve, W of Zuurfontein west gate, 1 000 m, 32°27'S, 19°24'E (–AD), 5 Oct. 1997, *Lechmer-Oertel 873* (NBG); rocky ridge above Winkelhaaks River, E of Bokkeveld Sneeukop, (–CD), 20 Apr. 1946, *Esterhuysen 12709* (BOL); Swartruggens, Knolfontein, 60 km NE of Ceres, 1 259 m, 32°50'58.2"S, 19°37'25.4"E, (–DC), 11 Feb. 2009, *Jardine & Jardine 1093* (NBG).

Osteospermum nordenstamii *J.C.Manning & Goldblatt*, sp. nov.

TYPE.—Northern Cape, 3017 (Hondeklipbaai): Riethuis quartz fields, 100 m E of road to Kommagas from Riethuis, 30°04'52.5"S, 17°26'08.7"E, 170 m, (–AB), 24 Aug. 2011, *Helme 7342* (NBG, holo.).

Gnarled, dwarf shrublet to 100 mm high, flowering on densely leafy short-shoots; vegetative shoots prostrate and laxly leafy with internodes 10–15 mm long, stems smooth and weakly compressed when young and flushed reddish, ± 2 mm diam., glabrescent with thinly scattered, eglandular hairs, developing a pale brownish, corky bark, greyish and rectangularly fissured when old, 3–4 mm diam. *Leaves* opposite, decussate, suberect, oblanceolate, (9–)15–30(–35) × (3–)4–8 mm, sessile, connate for up to 3 mm and shortly sheathing at base of short shoots, obtuse or rarely apiculate, leathery or sub-succulent, pubescent when young with mix of straggling, eglandular hairs and short, gland-tipped hairs, especially along margins but subglabrous when fully expanded, densely woolly in axils, adaxial surface flat or shallowly concave, margins yellowish-translucent and horny, prominent when dry, abaxial midrib prominent basally and decurrent on stem. *Capitula* heterogamous, radiate, ± 25 mm diam., shortly pedunculate, solitary and terminal on short shoots, rarely a second capitulum developing from an axillary shoot near apex, nodding in fruit; peduncles 15–25 mm long and 0.5–0.8 mm diam. but up to 1.0 mm diam. in fruit, leafless but with 1 or 2 scattered, linear-subulate bracts 3–5 mm long, thinly pubescent with a mix of straggling, eglandular hairs and short, gland-tipped hairs, flushed purple; *involucre* shallowly campanulate, ± 10 mm diam.; *involucral bracts* 15–17, sub-uniseriate or biseriate, lanceolate, 5–6 × 1.5–2.0 mm, acute, ± glabrous or thinly puberulous with scattered gland-tipped hairs, with scarious margins 0.3–0.5 mm wide; *receptacle* flat, glabrous. *Ray florets* female-fertile, 20 to 22, tube glandular-pubescent, ± 1 mm long, lamina spreading but recoiling in afternoon, narrowly elliptic, 4-veined, ± twice as long as involucre, 11–12 × 4 mm, dull yellow; *anthers* vestigial, free, reduced to 4 subulate staminodes, yellow; *style* terete, branching ± 1 mm above mouth of tube, branches narrowly elliptic-lanceolate, obtuse, ± 1.5 mm long, yellow, lateral margins stigmatic; *ovary* obovoid, 3-angled, ± 2 mm long, glandular-pubescent; *achenes* homomorphic, 3-winged, 10–12 × 8–10 mm, body narrowly turbinate, ± 7 mm long, subglabrous or sparsely glandular-pubescent, with apical, trifenestrate airchamber, windows subrotund, ± 1 mm diam., wings translucent, flushed purple, 3–4 mm wide. *Disc florets* functionally male, numerous; corolla narrowly funnel-shaped, ± 4 mm long, yellow tipped blackish; tube glandular-pubescent, ± 3 mm long; lobes suberect, triangular, ± 1 mm long; *anthers* 2 mm long, dark purple with yellow filaments; base tailed, tails equalling filament collar; apical appendage ovate. *Ovary* compressed-ovoid with lateral ribs, ± 1 mm long, glabrous; style terete, bifid, lobes deltoid, acutely papillate with basal fringe of longer trichomes. *Flowering time*: July–Sept. Figures 3F, G; 5; 6.

Distribution and ecology: restricted to the coastal plain of southern Namaqualand, where it has been collected northeast and southeast of Riethuis in Northern Cape, and near Koekenaap and Vredendal in Western Cape (Figure 2). *Osteospermum nordenstamii* is

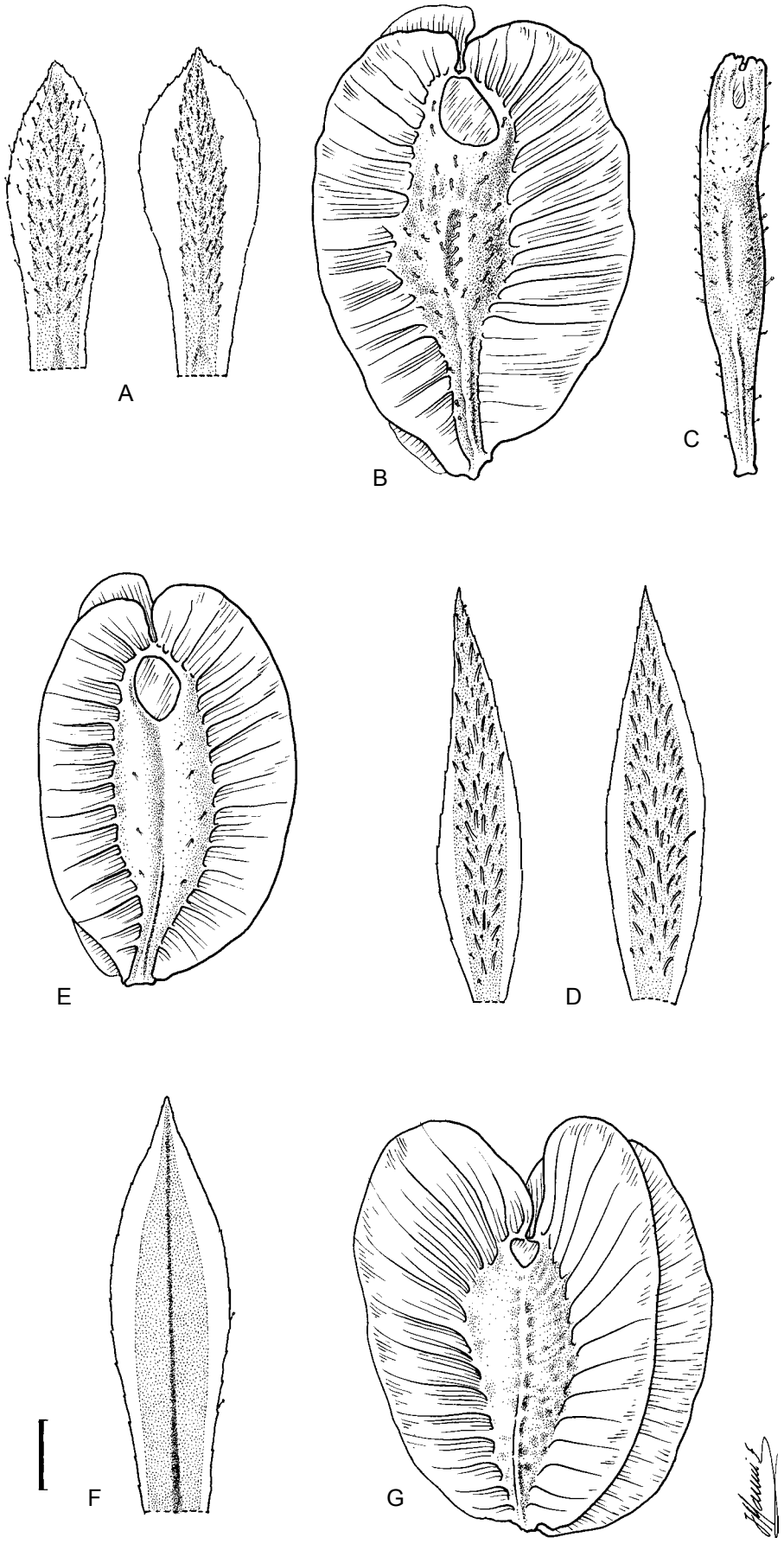

FIGURE 3.—Achenes and involucral bracts. A–C, *Osteospermum norlindhianum*, *Jardine 1729* (NBG); A, involucral bracts; B, winged achene; C, wingless achene; D, E, *O. dentatum*; D, involucral bracts [Langebaan, *Bosenberg & Rutherford 89* (NBG)]; E, winged achene [Wildevoëlvlei, *O'Callaghan 704* (NBG)]; F, G, *O. nordenstamii, Helme 7342* (NBG)]; F, involucral bract; G, winged achene. Scale bar: A, D, F, 1 mm; B, C, E, G, 2 mm. Artist: J.C. Manning.

locally common among white quartz pebbles, mainly on north-facing slopes, and is yet another highly localized endemic of the Namqualand lowland quartz fields (Schmiedel & Jürgens 1999). The two known areas of occurrence at Koekenaap and Riethuis are some 175 km apart with very little suitable quartz patch habi-

FIGURE 4.—*Osteospermum dentatum,* Kommetjie, *Bolus 23203* (NBG).

FIGURE 5.—Flowering plant of *Osteospermum nordenstamii* at the type locality near Riethuis. Photographer: N.A. Helme.

FIGURE 6.—Fruiting plant of *Osteospermum nordenstamii* at the type locality near Riethuis. Photographer: N.A. Helme.

tat between them. Low rainfall at both places is supplemented by substantial precipitation from coastal fog, especially in autumn and winter.

At the type locality near Riethuis the species grows with the locally endemic succulents *Drosanthemopsis vaginata*, *Meyerophytum meyeri*, *Conophytum concavum* and *Monilaria globosa* (Aizoaceae), and with the more widespread *Hirpicium alienatum* (Asteraceae) and *Cheiridopsis robusta* (Aizoaceae). An undescribed species each of *Othonna* (Asteraceae) and of *Eriospermum* (Ruscaceae) were also recorded in the area. The two southern localities fall within the Knersvlakte centre of endemism (Van Wyk & Smith 2001).

Diagnosis and relationships: *Osteospermum nordenstamii* is readily distinguished from all other species by its dwarf habit (Figures 5 & 6), forming small, gnarled, ± creeping shrublets less than 10 cm high, with decussate, oblanceolate leaves with entire margins, mostly obtuse apices, and distinctly woolly axils. Plants produce prostrate or spreading, relatively distantly leafy vegetative shoots but flower only from closely leafy short-shoots, which produce solitary, dull-yellow capitula on short, terminal peduncles. The leaves have distinctive translucent, horny margins especially evident in dried herbarium material.

The opposite, entire, subglabrous leaves of *Osteospermum nordenstamii* are otherwise found only in *O. oppositifolium* among the species of sect. *Trifenestratae*, and suggest that its relationships lie here. The two species are readily separated by their habit and also by bark, foliage and inflorescence. *O. oppositifolium* is common thoughout western Namaqualand as far south as Clanwilliam, forming colonies on stony and rocky slopes. It is a rounded shrub, mostly 0.5–1.0 m high but occasionally as low as 30 cm, with linear to oblanceolate, mostly acute leaves, 20–60 × 2–10(–12) mm, with the margin only weakly thickened and without woolly axils (rarely a few sparse hairs are present). The stems develop relatively thin, longitudinally striate bark quite unlike the corky, quadrately fissured bark of *O. nordenstamii*, and the capitula are typically borne in lax corymbs at the ends of the branches, not on short shoots. They are mostly larger than in *O. nordenstamii*, 25–35 mm diam., and the ray florets vary in colour from rich golden yellow in Namaqualand to pale yellow in the Olifants River Valley. Both species have been recorded at the same locality north of Koekenaap (*Nordenstam 907*).

Etymology: named for Bertil Nordenstam, who has published extensively on Asteraceae in general and on the tribe Calendulae in particular, and who first collected the species in 1962.

Other specimens seen

NORTHERN CAPE.—3017 (Hondeklipbaai): Riethuis/Oubees, 30°7'49"S, 17°25'20"E, quartz patch, 150 m, (–AB), 24 Aug. 1999, *Desmet 244* (NBG); S of Riethuis on track to Taaibosduin, quartzite koppie, (–AB), 13 Aug. 2006, *Koekemoer 3342* (PRE); along road to Soebatsfontein from Wallekraal/Hondeklipbaai road, 161 m, (–BC), 16 Sept. 2000, *Koekemoer & Funk 1957* (PRE).

WESTERN CAPE.—3118 (Vanrhynsdorp): 3 miles [4.8 km] NE of Koekenaap, (–AD), 15 July 1962, *Nordenstam 581* (S); Moedverloor, 4 miles [6.4 km] N of Holrivier Bridge, quartzite fields and patches, (–AD), 10 Aug. 1962, *Nordenstam 907* (S); 4 miles [6.4 km] N of Koekenaap, quartzite kopje W of road, (–AD), 25 Aug. 1962, *Nordenstam 1022* (S); 4 km N of Koekenaap, quartzite outrcrop, (–AD), 6 Sept. 1974, *Nordenstam & Lundgren 1686* (S); Koekenaap, 31.46°S, 18.31°E, (–AD), without date, *Desmet 3636* (NBG); Koekenaap, portion of old Farm 630, 50 m, (–CB), 16 Aug. 1997, *Desmet & Ellis 1243* (NBG).

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J.C. MANNING*,** P. GOLDBLATT*** & N.A. HELME****

* Compton Herbarium, South African National Biodiversity Institute, Private Bag X7, 7735 Claremont, Cape Town. E-mail: j.manning@sanbi.org.za.

** Research Centre for Plant Growth and Development, School of Life Sciences, University of KwaZulu-Natal, Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa.

***B.A. Krukoff Curator of African Botany, Missouri Botanical Garden, P. O. Box 299, St. Louis, Missouri 63166, USA.

**** P.O. Box 22652, Scarborough 7975, South Africa.

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