EDINBURGH JOURNAL OF BOTANY 67 (1): 141–154 (2010)

doi:10.1017/S0960428609990278

A NEW SPECIES AND SYNOPSIS OF *ADELOCARYUM* (BORAGINACEAE – CYNOGLOSSEAE) WITH NOTES ON *LINDELOFIA* AND *BRANDELLA*

R. R. Mill

Adelocaryum Brand (Boraginaceae – Cynoglosseae) is shown to be the correct name for *Paracaryopsis* (H.Riedl) R.R.Mill, and the new combination *Adelocaryum lambertianum* (C.B.Clarke) R.R.Mill is made. The new species *Adelocaryum nebulicola* R.R.Mill is described from Oman and its affinities with the Indian species *A. coelestinum* (Lindl.) R.R.Mill are discussed. A synopsis of and revised key to the entire genus is provided as well as a revised description of *Adelocaryum coelestinum*. As circumscribed here *Adelocaryum* is restricted to tall mesophytic herbs lacking long glochidiate spinules on the wing-like margin of the nutlets. The desert annual or biennial *Brandella erythraea* is here excluded from *Adelocaryum*. The new combination *Brandella erythraea* forma *subexalata* (H.Riedl) R.R.Mill is made. *Lindelofia spectabilis* Lehm., for which the current correct name is *L. longiflora* (Benth.) Baill., is designated lectotype of the genus *Lindelofia* Lehm.

Keywords. *Adelocaryum*, Boraginaceae, *Brandella*, disjunction, India, lectotypifications, *Lindelofia*, new combination, new species, Oman, *Paracaryopsis*.

Introduction

When Brand (1915a) first published the genus *Adelocaryum* Brand it comprised five species, *A. anchusoides* (Lindl.) Brand, *A. capusii* (Franch.) Brand, *A. coelestinum* (Lindl.) Brand, *A. malabaricum* (C.B.Clarke) Brand and *A. schlagintweitii* Brand. Four of these had previously been grouped in *Lindelofia* Lehm., *Cynoglossum* L. or *Paracaryum* (A.DC.) Boiss., while *Adelocaryum schlagintweitii* was new. Later Brand described two further species in the genus, namely *Adelocaryum flexuosum* Brand (Brand, 1915b) and *A. erythraeum* Brand (Brand, 1921). *Adelocaryum flexuosum* and *A. schlagintweitii*, both described from Kashmir, are still very poorly known; more recent authorities (e.g. Kazmi, 1971; Nasir, 1989) place one or both of them in *Cynoglossum* although either or both may be better placed in *Paracaryum* (see my comment *in litt.* concerning the possible conspecificity of *Paracaryum trinervium* Duthie with *Adelocaryum*/*Cynoglossum schlagintweitii*: Zhu *et al.*, 1995: 424).

Adelocaryum erythraeum was made the type of the new genus *Brandella* R.R.Mill by Mill (1986). Taxonomic and nomenclatural reasons for its segregation were set

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out in that paper. However, when I wrote my 1986 paper I had mistakenly (see Riedl, 1992) believed that Riedl (1962) had chosen *Lindelofia anchusoides* (Lindl.) Lehm. (based on *Cynoglossum anchusoides* Lindl.) as 'provisional' lectotype of *Lindelofia*, and Riedl (1971) had reclassified all Brand's original five species of *Adelocaryum* in either *Cynoglossum* or *Lindelofia*, leaving *Adelocaryum* at that time unavailable for *Brandella*. Since then, Riedl (1992) has revived the genus *Adelocaryum* and included *Brandella erythraea* (Brand) R.R.Mill within it. However, I disagree with that treatment; *Adelocaryum* as recognised by Riedl (1992), and by myself (Mill, 1991) under the name *Paracaryopsis* (H.Riedl) R.R.Mill, chiefly (in Riedl's circumscription) or wholly comprises tall woodland mesophytic herbs with large leaves from rain- and fog-forests of western India and Oman. *Brandella erythraea* on the other hand is an annual or possibly short-lived biennial herb of the deserts of the Horn of Africa and Arabia. Riedl (1992) maintained that its nutlet morphology was no different to the other species he included in *Adelocaryum* and that I 'obviously . . . did not know *Cynoglossum coelestinum* and *C. malabaricum*'. Neither of those statements is correct and there are considerable differences in the nutlet morphologies of those two members of *Adelocaryum* compared with *Brandella*. *Brandella* is, in its habit, distribution and general morphology (including its nutlets), more similar to *Microparacaryum* (Popov ex H.Riedl) Hilger & Podlech than it is to any of the other members of *Adelocaryum*. Indeed, like *Microparacaryum*, *Brandella* exhibits heteromericarpy (Riedl, 1992) which the mesophytic perennials of *Adelocaryum* sensu stricto do not. Riedl himself commented that if one recognises *Microparacaryum* 'it is necessary also to separate *Brandella* Mill from *Adelocaryum*'. For that reason I continue to exclude *Brandella erythraea* from *Adelocaryum* and will be recognising both genera in my treatment of Boraginaceae tribe Cynoglosseae for *Flora of Arabia*. Riedl (1992) regarded the heteromericarpic form with a wide, incurved nutlet margin as *Adelocaryum erythraeum* forma *erythraeum* because that was the state found on the lectotype. He described the other form, with narrow marginal wing and long flattened glochids, as *Adelocaryum erythraeum* forma *subexalata* H.Riedl. This is here recombined under *Brandella*.[1]

Adelocaryum anchusoides was originally one of the two species treated in the protologue of the genus *Lindelofia* Lehm. and is correctly classified in that genus (cf. Riedl, 1967, 1971; Kazmi, 1971; Nasir, 1989; Sadat, 1989). *Lindelofia* is a genus of about 12 species distributed in the Irano-Turanian semi-deserts and mountains, from Iran through Afghanistan, Pakistan, Russia and Middle Asia to China (Riedl, 1967; Nasir, 1989), and is both very geographically disjunct and ecologically distinct from *Adelocaryum* which, as defined here and as *Paracaryopsis* by Mill (1991), is endemic to the subtropical rain- and fog-forests of the eastern and northern shores of the Arabian Sea. The morphological differences between *Adelocaryum* and *Lindelofia*

[1] **Brandella erythraea** forma **subexalata** (H.Riedl) R.R.Mill, **comb. nov.**
Adelocaryum erythraeum forma *subexalata* H.Riedl, Linzer Biol. Beitr. 24: 26 (1992). – Type: Ethiopia ['Abyssinia'], Dschadscha, 6000 ft, 29 x 1854, *Schimper* 1854: 362 (holo FI).

are set out in Riedl's emended Latin diagnosis of *Adelocaryum* (Riedl, 1992: 21), which also gives its differences from *Paracaryum* (A.DC.) Boiss. and *Cynoglossum* L. The typification of *Lindelofia* has for a long time been a minefield into which I myself (Mill, 1991) once stumbled and it is safest to agree (contrary to what Riedl, 1992 has written) with the statement in *Index Nominum Genericorum* (Farr *et al.*, 1979 and http://botany.si.edu/ing/ accessed 11 August 2009) that the type remains '*non designatus*' and to address that matter here. When first described by Lehmann (1850), *Lindelofia* comprised two species, *L. spectabilis* Lehm. and *L. anchusoides* (Lindl.) Lehm.; the correct name for the former species is *L. longiflora* (Benth.) Baill., based on *Cynoglossum longiflorum* Benth. which Lehmann included in his synonymy of what was in effect a new name for that species rather than a species new to science. A few later authors have indicated no definite type species for *Lindelofia* (e.g. Popov, 1953 who seemed to argue a case for both but designated neither). Most workers have indicated that *Lindelofia spectabilis*, or its correct name *L. longiflora*, is the type of *Lindelofia* (e.g. Brand, 1921; Riedl, 1962, 1967, 1992; Kazmi, 1971). Others have stated, or at least suggested, that *Lindelofia anchusoides* is its type species (e.g. Sadat, 1989; Mill, 1991). Riedl (1992) considered Sadat's choice of *Lindelofia anchusoides* to be a lectotypification and rejected it on the basis that he had earlier (Riedl, 1967: 137) lectotypified the genus by *L. longiflora*. However, in reality neither of these actions constituted lectotypifications; both were informal statements in floristic treatments. Both are pre-dated by a statement by Riedl (1962: 385 – 'Die erstgenannte Art, die wohl als Typus der Gattung zu betrachten ist') in which he appeared to consider that *Lindelofia anchusoides* was the type, which would have serious consequences if it were to be regarded as a formal typification statement (which in his 1992 paper Riedl emphasised it was not intended to be). In order to fix the application of the genus name, *Lindelofia spectabilis* Lehm. is therefore here designated lectotype of *Lindelofia* Lehm.[2] Either it, or *Lindelofia longiflora* of which it is a synonym, have most frequently been indicated as type (see citations above). The alternative choice of *Lindelofia anchusoides* (Riedl, 1962; Sadat, 1989) is here formally rejected since it would upset infrageneric nomenclature within *Lindelofia* (the name is the type of *Lindelofia* sect. *Brandia* M.Popov) and would also cause *Adelocaryum* to become a synonym of *Lindelofia* because Brand (1915a, 1921) had included *L. anchusoides* within *Adelocaryum*. Of the original five species of *Adelocaryum*, *A. capusii* also belongs in *Lindelofia* (Popov, 1953; Riedl, 1992).

The remaining two species in Brand's protologue of *Adelocaryum* are *A. coelestinum* and *A. malabaricum*. For these, and a third allied species previously called *Paracaryum lambertianum* C.B.Clarke, I proposed the new genus *Paracaryopsis* (H.Riedl) R.R.Mill with *P. coelestina* (Lindl.) R.R.Mill as its type (Mill, 1991). I used the name *Paracaryopsis* because at that time I believed that the type of

[2] **Lindelofia** Lehm., Neue Allg. Deutsche Garten-Blumenzeitung 6: 351 (1850). – Lectotype designated here: *Lindelofia spectabilis* Lehm., op. cit. (1850) [= *L. longiflora* (Benth.) Baill., Hist. Pl. (Baillon) 10: 379 (1890)].

Lindelofia was *L. anchusoides* (see above), and consequently that *Adelocaryum* could not be used. The following year Riedl (1992) correctly revived the name *Adelocaryum*. His generic concept of *Adelocaryum* was slightly different to my circumscription of *Paracaryopsis*; it excluded *Paracaryopsis lambertiana* (C.B.Clarke) R.R.Mill but, as discussed above, included *Brandella erythraea* as *Adelocaryum erythraeum*. I restrict *Adelocaryum* to tall mesophytic perennial herbs but unlike Riedl (1992) include one (*Paracaryopsis lambertiana*, for which a new combination is provided in the synopsis) in which the wing-like margin is particularly strongly developed in a similar manner to *Paracaryum*.

Riedl (1992) lectotypified *Adelocaryum* for the first time, choosing *Cynoglossum coelestinum* Lindl. [*Adelocaryum coelestinum* (Lindl.) Brand] as lectotype. This has the advantage of retaining *Adelocaryum* as the name of an accepted genus, whereas if *A. anchusoides* had been selected *Adelocaryum* would have become synonymous with *Lindelofia* (in part). However, Riedl's choice has the following nomenclatural consequences:

1 *Paracaryopsis* (H.Riedl) R.R.Mill, based on *Cynoglossum* L. sect. *Paracaryopsis* H.Riedl in Österr. Bot. Z. 102: 393 (1962), has the same type as *Adelocaryum* (as lectotypified by Riedl, 1992) and thus becomes a synonym of the latter generic name.

2 Because Riedl (1992) restricted *Adelocaryum* to three species (*A. coelestinum*, *A. malabaricum* and *A. erythraeum*), a new combination is required for *Paracaryopsis lambertiana* (C.B.Clarke) R.R.Mill, which I still consider to be congeneric with *A. coelestinum* and *A. malabaricum*. This combination is made later in this paper.

Two of the three already described species that I recognise in *Adelocaryum*, *A. lambertianum* and *A. malabaricum*, are endemic to western India around Mahabaleshwar (Maharashtra). The third, *Adelocaryum coelestinum*, has a wider range in India, from Gujarat to Karnataka, but seems to be commonest (or at least most frequently collected) in the same area (Mahabaleshwar) as the other two. In my earlier paper (Mill, 1991), I also included within *Paracaryopsis coelestina* (with some reservations) three specimens from Oman. These obviously belonged to *Adelocaryum* as now circumscribed (= *Paracaryopsis*) and had the same general facies as *A. coelestinum*. Indeed, Johnston (1957: 283), although he at first 'believed an undescribed species was involved', eventually decided that the material was 'indistinguishable' from Indian material of the species he called *Cynoglossum coelestinum*. My earlier examination of the Arabian material revealed that it differed from the Indian material of *Adelocaryum coelestinum* in having primarily white (not blue) corollas and nutlets with a glabrous, not glochidiate, disc, but at the time I also considered the material to be, probably, conspecific with *A. coelestinum*.

I have since had the opportunity of examining more material of the Arabian plant, including colour slides taken in the field by Tony Miller (Royal Botanic Garden

Edinburgh). Although the Oman plant is certainly a close relative of *Adelocaryum coelestinum*, the differences between it and *A. coelestinum* that were mentioned in my earlier paper appear to be constant, with the exception of the flower colour as noted below under *A. coelestinum*. Additional points of difference not noticed in the course of the earlier study are that the wing of the nutlets of the Oman taxon is always very shallowly crenulate on the inner (incurved) margin, with slender glochids having non-expanded bases, whereas in all the Indian material of *Adelocaryum coelestinum* the nutlet margin is conspicuously dentate with the teeth broadened at the base and only gradually passing into a glochidiate tip. Further minor differences are that the calyces of the Oman plant are more sparsely hairy and its flowers are slightly larger in diameter. As a result of this re-evaluation of the taxonomic status of the Oman *Adelocaryum*, which is geographically disjunct from the range of *A. coelestinum* and consequently reproductively isolated from the latter, the material from Oman is described in this paper as the new species *A. nebulicola* R.R.Mill.

The genus *Adelocaryum* accordingly now comprises four species, and a revised key is given below. Full descriptions of *Adelocaryum coelestinum*, *A. lambertianum* and *A. malabaricum* were given by Mill (1991, under *Paracaryopsis*). Because the description of *Adelocaryum coelestinum* given in my earlier paper (Mill, 1991 as *Paracaryopsis coelestina*) was a composite based on Arabian specimens here assigned to *A. nebulicola* as well as true Indian *A. coelestinum*, an amended account of *A. coelestinum* is also provided below.

Synopsis of the Genus *Adelocaryum*

Adelocaryum Brand, Repert. Spec. Nov. Regni Veg. 13: 547 (1915). – *Cynoglossum* L. subgen. *Eleutherostylum* (Brand) H.Riedl sect. *Paracaryopsis* H.Riedl, Österr. Bot. Z. 102: 393 (1962). – *Paracaryopsis* (H.Riedl) R.R.Mill, Edinburgh J. Bot. 48: 56 (1991), nom. superfl. – Lectotype (Riedl, 1992: 21): *Adelocaryum coelestinum* (Lindl.) Brand based on *Cynoglossum coelestinum* Lindl., Edwards' Bot. Reg. 25: t. 36 (1839).

Emended description: as that given for *Paracaryopsis* (H.Riedl) R.R.Mill by Mill (1991: 56). Differs from *Brandella* R.R.Mill by tall mesophytic perennial habit; stamens inserted ± at same level as throat scales (not slightly below them); nutlets with few scattered short glochids or none at all on wing-like margin, and few or none on disc (in *Brandella* with disc densely covered with slender glochids and numerous long glochids at the edge of the wing-like margin).

Revised key to the species of Adelocaryum

1a. Nutlets 10–14 × 8–10.5 mm, smooth, the margin ± flat; radical leaves with cuneate base _____ **4. A. lambertianum**

1b. Nutlets 4.5–6.5 × 3–5.5 mm, glochidiate at least on the erect, ± incurving margin; radical leaves truncate to ± deeply cordate at base ____ 2

2a. Flowers 8–11 mm long, uniformly dark blue; anthers with apices just exserted from corolla tube ____ **3. A. malabaricum**

2b. Flowers 4–5 mm long, pale blue or white with darker centre; anthers included in corolla tube ____ 3

3a. Disc of nutlet with scattered glochids; incurved margin of nutlet rather coarsely dentate, the teeth triangular, c.0.5 × 0.5 mm excluding their glochids ____ **1. A. coelestinum**

3b. Disc of nutlet completely glabrous; incurved margin of nutlet shallowly crenulate or undulate, the undulations 0.1–0.3 × 0.5–0.7 mm excluding their glochids ____ **2. A. nebulicola**

1. Adelocaryum coelestinum (Lindl.) Brand, Repert. Spec. Nov. Regni Veg. 13: 549 (1915). – *Cynoglossum coelestinum* Lindl., Edwards' Bot. Reg. 25: t. 36 (1839). – *Paracaryum coelestinum* (Lindl.) Benth. & Hook.f., Gen. Pl. 2: 850 (1876) in adnot.; C.B.Clarke in Hook.f., Fl. Brit. India 4: 160 (1883). – *Paracaryopsis coelestina* (Lindl.) R.R.Mill, Edinburgh J. Bot. 48: 57 (1991) [q.v. for additional synonymy, citation of Indian specimens and discussion (excluding its first paragraph)]. – Described from cultivated material raised in England by the Horticultural Society from seeds presented by John Nimmo Esq. of Bombay and which flowered for the first time in August 1838. No type indicated.

Perennial herb (possibly biennial, as described by Riedl, 1992). *Stems* (30–)90–150 cm, stout, erect, reddish, lower part appressed-pubescent when young, later glabrate, upper part sparsely retrorse adpressed-pubescent. *Radical leaves* with long petiole (to 15 cm or longer); lamina broadly ovate, to at least 13–15 × 10.5–15 cm, acute at apex, base distinctly cordate; total number of principal veins (including midvein) 17–23, veins arcuately ascending, their hairs retrorse, dense with some hairs deflexed-patent; upper surface dark green with rather sparse ± antrorse setules arising from calcifying tuberculate bases, lower surface paler, setulose only on veins, the hairs dense and mostly retrorse. *Cauline leaves* ovate, 4–10.5 × 2–4 cm (possibly larger), lower ones very shortly petiolate, upper ones sessile with cuneate base. *Inflorescence* a panicle of numerous furcate or simple terminal and subterminal scorpioid cymes, the primary dichotomies occasionally simple but usually with at least secondary and frequently tertiary bifurcations; *primary branches* of inflorescence 12–20 cm in fruit including cyme; cymes of primary branches up to 30-flowered, secondary and tertiary branches shorter and fewer-flowered. *Pedicels* 0.5–2 mm in flower, up to c.4 mm in fruit but often hidden by the group of nutlets which thus appears subsessile, somewhat curved downwards in fruit. *Flowers* all ebracteate. *Calyx* lobed almost to base; lobes ovate or ovate-elliptic, 2–3 × 1–1.5 mm in flower, 4–5 × 1.8–2.5 mm in fruit, densely hairy at base and with a thin line of hairs along

midvein and around margin, otherwise glabrous. *Corolla* apparently normally pale blue (white with blue centre according to the original description and as photographed at one locality; see note), shortly campanulate, 4–5 mm long, at least 6–8 mm in diameter (according to Riedl, 1992 up to 10–12 mm in diameter), the corolla lobes c.3 mm, the midvein normally not noticeably darker than the rest of the lobe (but contrasting at one locality; see note). *Faucal scales* semilunar, c.0.5–0.6 × 0.9–1 mm, emarginate. *Gynobase* in fruit 4–5 mm, narrowly pyramidal, the very short style comprising the uppermost c.0.5 mm and hardly projecting beyond the nutlets; stigma capitate. *Nutlets* 4 (all maturing), light ivory-grey when mature, triangular-napiform (the three distinct edges almost equilateral), 4–6 × 3.5–4.5 mm; wing c.2 mm high, its inner margin incurving slightly over the disc and coarsely dentate with c.5–6 glochidiate teeth on each of the three edges, the teeth 0.6–1 mm, narrowed from a slightly expanded base into a glochidiate tip; disc with scattered, short, erect glochids mainly in its central part, the midline ± faintly raised; ventral surface glochidiate all over except on the attachment scar.

Distribution and ecology. India (Gujarat, Maharashtra, Karnataka). Wet rainforest on the Western Ghats, up to at least 1370 m. Flowering from August to April. A calcicolous species that occurs in two distinct associations, the *Arthraxoetum inermi* Bharucha, dominated by *Arthraxon inermis* Hook.f. and *Begonia concanensis* A.DC., and the *Arthraxoetum purandharensis* Bharucha, dominated by *Arthraxon purandharensis* Bharucha and a species of *Nepeta* (Bharucha & Satyanarayan, 1954 – these authors mistakenly believed that *Paracaryum coelestinum* was a different species from *Adelocaryum coelestinum* whereas they are homotypic synonyms).

Photographs of *Adelocaryum coelestinum* taken on the Kas Plateau (Maharashtra) by Dinesh Valke show a plant having corollas whose lobes are white distally but are marked with a star-like pattern of blue midvein lines and blue shading in the centre, very similar to the pattern found in *A. nebulicola* described below. Herbarium material seen all has sky blue corollas with no contrast either between the proximal and distal parts of the lobe or between the midvein and the rest of the lobe. Until I saw these photographs in 2009, I had consequently believed that the corollas of *Adelocaryum coelestinum* were always wholly sky blue while those of *A. nebulicola* were white with a blue centre, providing a floral distinction between the two species. That would appear to be not always the case. The protologue of *Cynoglossum coelestinum* indeed illustrates a plant with bicoloured flowers and calls it the 'Blue and White Hounds-tongue', stating in the Latin description 'Corolla cyanea, margine alba' (Lindley, 1839). More studies are therefore needed concerning flower colour variation in this species, to understand both whether or not there are colour changes that take place on drying (herbarium material of *Adelocaryum nebulicola* retains its fresh colour) or with age, and whether there is any geographical variation in flower colour.

2. Adelocaryum nebulicola R.R.Mill, **sp. nov. Figs 1, 2.**

Adelocaryo coelestino (Lindl.) Brand habitu et forma foliorum valde similis, a quo nuculae disco glaberrimo (haud glochidiato) et ala levissime tantum crenulata vel undulata (haud argutiuscule dentata) constanter differt, ut videtur venis foliorum radicalium paucioribus (lateralibus in toto 9–15 non 18–22) pilis antrorsis non retrorsis tectis etiam recedit. – Type: Sultanate of Oman, Dhofar, Jebel Qara, Salalah to Ashanhaib road, c.10 km S of Ashanhaib, 800 m, 6 ix 1989, *A.G. Miller & J.A. Nyberg* M. 9131 (holo E; iso K, KTUH n.v., ON n.v.).

Stout-stemmed, erect perennial or biennial herb 1–1.5 m tall. *Stem* 5–10 mm thick or more, hollow, glabrous in lower part, appressed crispate-pubescent above and more densely so in inflorescence. *Radical leaves* very long-petiolate; petiole to at least 30 cm, channelled, sparsely pubescent; lamina broadly ovate-cordate, 11–25 × 11–30 cm (the larger dimensions when in fruit), the apex acute or shortly acuminate, the base shallowly cordate or cordate-truncate, entire or the margin occasionally appearing 3-lobed (e.g. *Collenette* 8387), the upper surface deep green with scattered short ± antrorse setules arising from large many-celled calcifying bases, the lower surface much paler green and totally glabrous except for rather dense antrorsely appressed non-setiform hairs on veins and margin; total number of principal veins (including midvein) 9–15, veins arcuately ascending, their hairs antrorse, short, fairly dense but less so than *Adelocaryum coelestinum* and all ± appressed. *Lower cauline leaves* similar to radical but more shortly petiolate, middle and upper ones elliptic, 3–22 × 0.8–12 cm, the apex acute, the base cuneate, subsessile or sessile; indumentum as radical; veins c.6 each side of midrib. *Inflorescence* a panicle of furcate or simple terminal scorpioid cymes, the primary dichotomies often then simple but sometimes with secondary and occasionally tertiary bifurcations; *primary branches* of inflorescence 9–23 cm in fruit including cyme; cymes of primary branches 12–21-flowered, 7–17 cm in fruit, those of secondary and tertiary branches shorter and fewer-flowered. *Pedicels* not more than 1.5–2 mm in flower, 2–4.5 mm in fruit, erecto-patent but finally becoming hamately curved downwards in fruit. *Flowers* all ebracteate. *Calyx* lobed almost to base; lobes rather broadly elliptic or elliptic-obovate, 2.5–4 × 1.5–2.5 mm in flower, 4.5–6 × 2.5–4 mm in fruit, with a thin line of short appressed hairs along the midvein and around the margin, the rest of the calyx lobe glabrous or with very few scattered hairs. *Corolla* white with blue or pinkish-blue centre, subrotate or shortly campanulate, 7–9.5 mm in diameter, the corolla lobes suborbicular-ovate, 3.5–4 × 3.5–4 mm, each (when dry) with a narrow blue midvein. *Faucal scales* transversely subquadrate, c.0.5 × 1 mm, with emarginate apex, densely papillate. *Anthers* c.0.8 mm, ellipsoid. *Gynobase* in fruit c.2.5 mm, narrowly pyramidal, the short style comprising the uppermost 0.7–1 mm; stigma capitate. *Nutlets* 4 (all maturing), greenish becoming olive-brown, ovate-napiform, 4.5–6 × 3–4 mm; wing erect, 2–2.5 mm high, its inner margin incurving over the disc and shallowly undulate or crenulate with slender marginal glochids 0.3–0.4 mm not broadened at their base, and with similar slightly longer (0.3–0.5 mm) glochids around the upper half of the

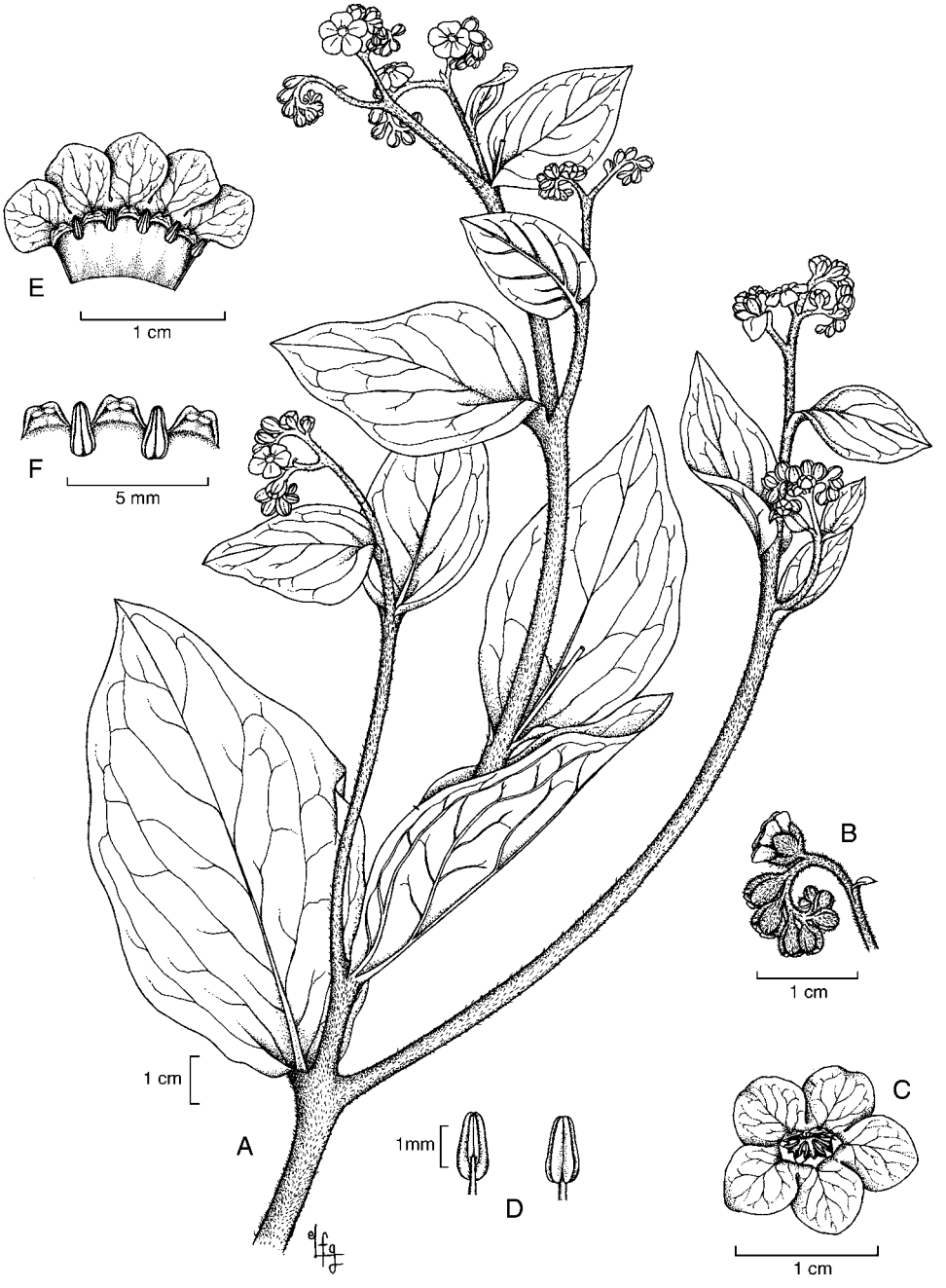

FIG. 1. *Adelocaryum nebulicola* R.R.Mill. A, upper part of flowering stem with inflorescences; B, single cyme with lowest flower open; C, flower viewed from above; D, anthers: left, adaxial view showing filament attachment; right, abaxial view; E, corolla opened out; F, throat scales and stamens. Drawn by Işik Güner.

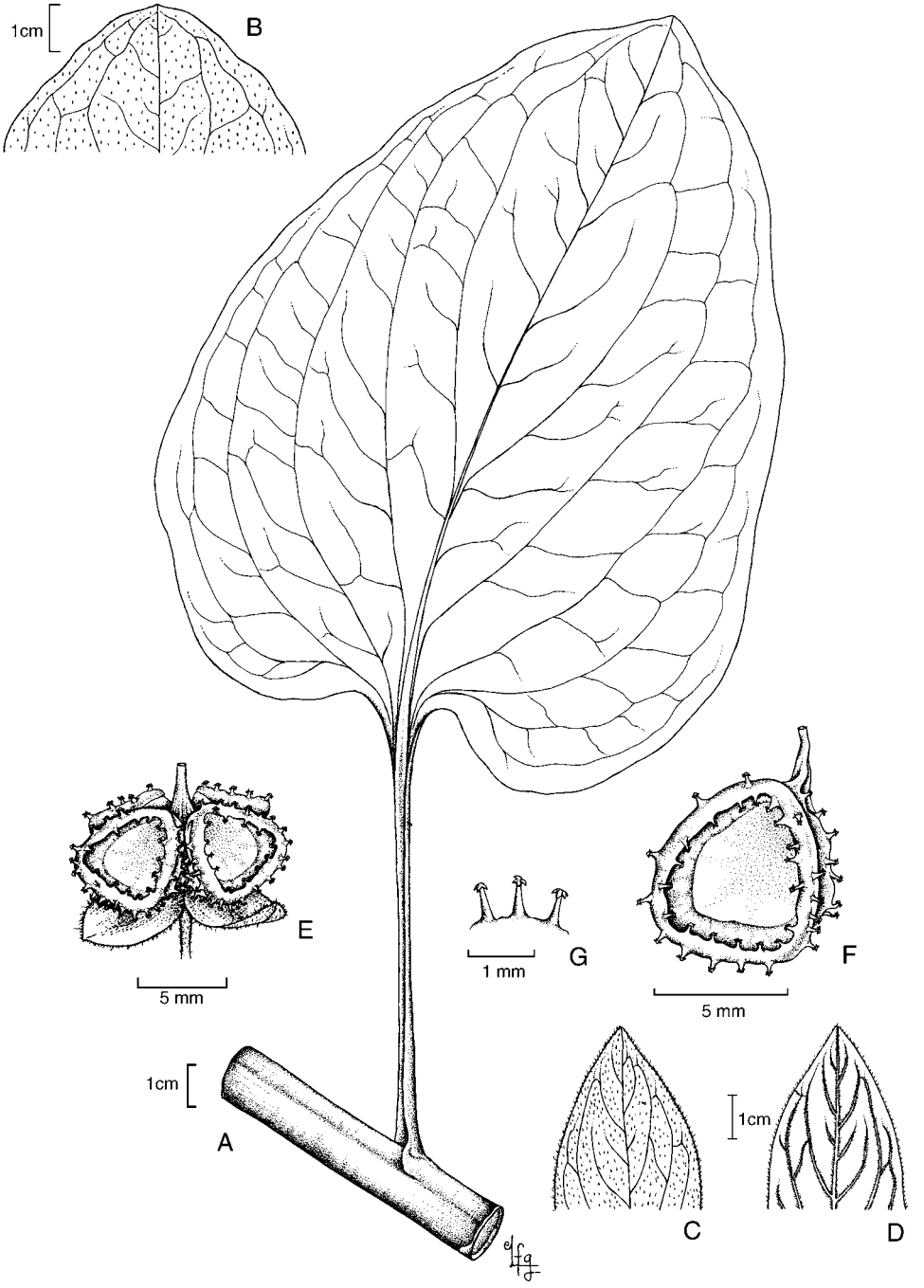

FIG. 2. *Adelocaryum nebulicola*. A, basal leaf and petiole; B, detail of basal leaf venation and indumentum; C, upper cauline leaf, abaxial surface: detail of venation and indumentum; D, upper cauline leaf, adaxial surface: detail of venation and indumentum; E, fruiting calyx, group of four nutlets and style; F, single nutlet, abaxial view; G, detail of marginal glochids of nutlet. Drawn by Işik Güner.

outer surface; disc completely glabrous, with or without a narrow, slightly raised midline; ventral surface with slender glochids scattered over whole surface except for attachment scar.

Distribution and ecology. Sultanate of Oman; endemic to Jebel Qara, Dhofar. Escarpment woodland dominated by *Anogeissus dhofarica* A.J.Scott and in thickets and scrub, typically associated with *Ficus vasta* Forssk.; sometimes in the contact zone between this vegetation type and adjacent drier *Euphorbia balsamifera* Aiton scrub but never in the scrub proper; 360–850 m. Collenette's collection is labelled as being collected in 'open grassland'. This is apparently atypical (although Vesey-FitzGerald's specimen, the earliest known, was also collected in 'upland grassland' the plant was apparently shaded by a fig tree). Her gathering was also made at the lowest altitude; other collections with altitude indicated have all been made above 600 m. Flowering commences at the beginning of August, for c.5 weeks until mid-September; fruits ripe September–mid-October.

Etymology. The specific epithet *nebulicola* (fog- or mist-inhabiting, from Latin *nebula*, fog or mist, and indeclinable suffix *-cola*, dweller) alludes to the plant's ecological requirement, it being confined to escarpment woodlands which, during its growing season (see above), are subjected to constant mist drip.

Additional specimens examined. SULTANATE OF OMAN. Dhofar, Jebel Qara, under shade of *Ficus* only, 4 x 1943, *D. Vesey-FitzGerald* 12448/4 (BM, 2 sheets); Dhofar, Jebel Qara, Salalah to Thumrait road, 5 km S of Ayun turnoff, 600 m, 13 x 1979, *A.G. Miller* 2709 (E); Jebel Qara, nr Kaftawt, 790 m, 1 viii 1985, *A.G. Miller* 7202 (E); Thumrait to Salalah road, by Hagaif turnoff, 850 m, 7 ix 1985, *A.G. Miller* 7509 (E, K); Nashib road, east of Salalah, open grassland, 1200 ft, 3 x 1992, *I.S. Collenette* 8387 (E).

Adelocaryum nebulicola has so far only been collected from Jebel Qara, the central of the three ranges of fog-affected escarpment mountains that make up the so-called 'Dhofar fog oasis' (Miller, 1994). Here, dense fogs caused by upwelling of cold water off the coast build up on the escarpments during the southwest monsoon (mid-June to mid-September). (In Mill, 1991, the collection date of *Miller* 7509 was incorrectly given as '7 xi 1985', an error which led to the flowering time of Arabian '*A. coelestinum*' being wrongly given in that paper as 'August–November'.) The life cycle of *Adelocaryum nebulicola* would appear to coincide almost exactly with this monsoon; germination, or regrowth of the underground parts, presumably commences with the breaking of the monsoon, with flowering beginning about a month later in late July/early August and being completed about 5 weeks afterwards in mid-September, and the fruits being fully ripe from about the end of the monsoon (mid-September) onwards. In its habit and life cycle *Adelocaryum nebulicola* thus resembles the other species of *Adelocaryum* as here circumscribed, all of which are tall mesophytic herbs of the rainforests and forest margins on the western seaboard of India. Dhofar is the only part of Arabia with a comparable climate to this area of India. The occurrence of the genus *Adelocaryum* in Dhofar is thus of particular interest; the apparent disjunction between Dhofar and western India is a natural and

not unexpected one despite the considerable distance. The genus is very unlikely to occur anywhere else in Arabia although it should be looked out for on the other ranges of the Dhofar fog oasis. These, especially Jebel Qamar to the west, have similar *Anogeissus dhofarica* escarpment woodlands to those on Jebel Qara in which *Adelocaryum nebulicola* has been collected and thus the occurrence of *Adelocaryum* in similar habitats elsewhere in Dhofar is not unlikely. Jebel Samhan, to the east of Jebel Qara, is somewhat drier and conditions may not be ideal for *Adelocaryum nebulicola* to thrive. The Dhofar mountain ranges are a local centre of endemism: of c.900 species, c.60 are endemic, including two genera (*Cibirhiza* P.Bruyns and *Dhofaria* A.G.Mill.: Miller, 1994). To this total must now be added this new species of *Adelocaryum*. Its existence on Jebel Qara was first noted by I. M. Johnston (Johnston, 1957: 283), under the name *Cynoglossum coelestinum*. Johnston (annotated drawing *in sched.*) also examined the pollen of *Vesey-FitzGerald* 12448/4 and found it to be 9–12 × 6–8 μm with a very shallow equatorial constriction.

Adelocaryum nebulicola is closest in its morphology to *A. coelestinum*, which has the widest range of habitats and geographical distribution of the three Indian species. It is more tolerant of drier habitats than *Adelocaryum lambertianum* and *A. malabaricum*, both of which seem to be restricted to rainforest around Mahabaleshwar in Maharashtra. *Adelocaryum coelestinum* extends as far north as Gujarat (Mill, 1991). *Adelocaryum nebulicola* has presumably evolved from an *A. coelestinum*-like ancestor and has diverged sufficiently due to its geographical isolation for its differential characters to have become constant. Specific rank therefore seems fully justified, although more study on flower colour variation in Indian *Adelocaryum coelestinum* is clearly needed, given the existence of plants with *A. nebulicola*-like corolla colouring on the Kas Plateau in Maharashtra (see note under *A. coelestinum*). Interestingly, the Kas Plateau is on almost exactly the same latitude as the locality of *Adelocaryum nebulicola*, but 2000 km to the east on the opposite side of the Arabian Sea and on the inland (leeward) side of the Western Ghats.

3. Adelocaryum malabaricum (C.B.Clarke) Brand, Repert. Spec. Nov. Regni Veg. 13: 549 (1915). – *Paracaryum malabaricum* C.B.Clarke in Hook.f., Fl. Brit. India 4: 160 (1883). – *Cynoglossum malabaricum* (C.B.Clarke) H.Riedl, Österr. Bot. Z. 119: 71 (1971). – *Paracaryopsis malabarica* (C.B.Clarke) R.R.Mill, Edinburgh J. Bot. 48: 59 (1991). – Type: [India] Western Deccan Peninsula, Canala and Mysore, *Law* (holo K, as '*Cynoglossum* no. 13'; iso W n.v.).

For description and other information see Mill (1991: 59, under *Paracaryopsis*) and Riedl (1992: 24–25).

4. Adelocaryum lambertianum (C.B.Clarke) R.R.Mill, **comb. nov.**

Paracaryum lambertianum C.B.Clarke in Hook.f., Fl. Brit. India 4: 161 (1883). – *Mattiastrum lambertianum* (C.B.Clarke) Brand in Engler, Pflanzenr. IV, 252 (Heft 78): 61 (1921). – *Paracaryopsis lambertiana* (C.B.Clarke) R.R.Mill, Edinburgh J.

Bot. 48: 59 (1991). – Type: [India] Bombay, *Lambert* s.n. as '*Omphalodes*' (holo K; photo E).

For description and full taxonomic account see Mill (1991: 59–61, under *Paracaryopsis*).

Acknowledgements

I thank A. G. Miller (Royal Botanic Garden Edinburgh) for making available the colour slides of *Adelocaryum nebulicola* which he took during his expedition to Oman. Işik Güner drew the illustrations. John McNeill and an anonymous referee are thanked for their comments that have helped to improve this paper. The Royal Botanic Garden Edinburgh is supported by The Scottish Government Rural and Environment Research and Analysis Directorate (RERAD). I also thank the Centre of Excellence in Biodiversity Research, King Saud University, Riyadh, Saudi Arabia for funding the illustrations.

References

Bharucha, F. R. & Satyanarayan, Y. (1954). Calcicolous associations of the Bombay State. *Vegetatio* 5–6: 129–134.

Brand, A. (1915a). Neue Gattungen und Arten der *Cynoglosseae*. *Repert. Spec. Nov. Regni Veg.* 13: 545–550.

Brand, A. (1915b). Neue Borraginaceen-Studien. *Repert. Spec. Nov. Regni Veg.* 14: 146–156.

Brand, A. (1921). *Borraginaceae–Borraginoideae–Cynoglosseae*. In: Engler, A., *Das Pflanzenreich* IV, 252 (Heft 78). Leipzig.

Farr, E. R., Leussink, J. & Stafleu, F. A. (1979). *Index Nominum Genericorum (Plantarum)*, Vol. II. *Eprolithus–Peersia*. Regnum Veg. 101. Utrecht: Bohn, Scheltema & Holkema; The Hague: W. Junk. Also website at http://botany.si.edu/ing/.

Johnston, I. M. (1957). Studies in the *Boraginaceae*, XXIX. *Echiochilon* and related genera. *J. Arnold Arbor.* 38: 255–293.

Kazmi, S. M. A. (1971). A revision of the *Boraginaceae* of West Pakistan and Kashmir [part 2]. *J. Arnold Arbor.* 52: 334–363.

Lehmann, J. G. C. (1850). [Protologue of genus *Lindelofia*.] *Neue Allg. Deutsche Garten-Blumenzeitung* 6: 351–352. Original not seen; reprinted in *Linnaea* 24: 215–216 (1851).

Lindley, J. (1839). *Cynoglossum cœlestinum*. *Edwards' Bot. Reg.* 25: t. 36 + 2 unnumbered pp. of accompanying text.

Mill, R. R. (1986). A new name for *Adelocaryum erythraeum*. *Notes Roy. Bot. Gard. Edinburgh* 43: 477–480.

Mill, R. R. (1991). The generic position of C. B. Clarke's species of *Paracaryum* (*Boraginaceae*). *Edinburgh J. Bot.* 48(1): 55–61.

Miller, A. G. (1994). Dhofar fog oasis. Somali-Masai Regional Centre of Endemism: CPD Site SWA1. In: Davis, S. D., Heywood, V. H. & Hamilton, A. P. (eds) *Centres of Plant Diversity: A guide and strategy for their conservation*, Vol. 1, pp. 309–311. WWF & IUCN. Cambridge: IUCN Publications Unit.

Nasir, Y. J. (1989). *Boraginaceae. Flora of Pakistan* fascicle no. 191. Islamabad: National Herbarium, Pakistan Agricultural Research Council.

POPOV, M. G. (1953). *Boraginaceae*. In: SHISKIN, B. K. (ed.) *Flora URSS* 19: 97–691. (Translated by Israel Program for Scientific Translations, Jerusalem, 1974.)
RIEDL, H. (1962). Bemerkungen über *Cynoglossum coelestinum* Lindl. und *C. glochidiatum* Wall., sowie Versuch einer Neugliederung der Gattung *Cynoglossum* L. *Österr. Bot. Z.* 109: 385–394.
RIEDL, H. (1967). *Boraginaceae*. In: RECHINGER, K. H., *Flora Iranica* 48. Graz: Akademische Drück- und Verlagsanstalt.
RIEDL, H. (1971). Die Gattung *Adelocaryum* Brand. *Österr. Bot. Z.* 119: 68–73.
RIEDL, H. (1992). *Adelocaryum* Brand and *Brandella* R. Mill (*Boraginaceae*). *Linzer Biol. Beitr.* 24: 19–27.
SADAT, F. (1989). Revision ausgewählter kritischer Gattungen der Boraginaceen aus der Flora Afghanistans. *Mitt. Bot. Staatssamml. München* 28: 1–210.
ZHU, G.-L., RIEDL, H. & KAMELIN, R. (1995). Boraginaceae. *Flora of China* 16: 329–427.

Received 12 February 2009; accepted for publication 27 November 2009