

# THE DELIMITATION OF THE SOUTH AFRICAN *HELIOPHILA BRACHYCARPA* AND TWO RELATED SPECIES (BRASSICACEAE)

IHSAN A. AL-SHEHBAZ<sup>1</sup>

**Abstract.** Typification of *Heliophila brachycarpa*, *H. florulenta*, *H. glauca*, and *H. sclerophylla* is established. The second species has been erroneously synonymized with the first for the past 50 years, and the first three are recognized as distinct, whereas the last is reduced to synonymy of the third.

**Keywords:** Brassicaceae, Cruciferae, *Heliophila*, Lesotho, Namibia, South Africa, Swaziland.

The genus *Heliophila* L. (Brassicaceae or Cruciferae) includes 81 species (BrassiBase, 2019) all of which are native to South Africa (65 spp. endemic), with 16 species also native to Namibia (12 spp.), Lesotho (5 spp.), and Swaziland (1 sp.; author's compilation). In his excellent account of the genus for the floras of these countries, Marais (1970) recognized 71 species in *Heliophila*, two each in *Cycloptychis* E. Mey. ex Sond. and *Thlaspeocarpa* C.A. Sm., and one each in *Brachycarpaea* DC., *Schlechteria* Bolus, and *Silicularia* Compton. Based on molecular phylogenetic studies on this complex of six genera by Mummenhoff et al. (2005), the last five genera were united by Al-Shehbaz et al. (2005) into a more inclusive *Heliophila* s.l.

The present author has been involved in the past decade in monographing *Heliophila* s.l. in its entire range. As a result of examining well over 10,000 specimens on loan, many novelties are discovered and a large number of nomenclatural adjustments are needed. These will be published in separate papers. However, the present article deals with resolving the circumscription of four closely related species described in the nineteenth century. The first (*H. glauca* Burch. ex DC.) was described by de Candolle (1821), the next two (*H. sarcophylla* Meisn. and *H. brachycarpa* Meisn.) by Meisner (1842), and the last (*H. florulenta* Sond.) by Sonder (1846). Some duplicates of the type collections of all four species and their varieties were not examined, but their digital images were carefully checked in JSTOR (2019). Marais (1970) examined only the type collections at K, PRE, and SAM and did not study those of the two species described by Meisner (1842). As a result, the delimitations two of the three species below differ significantly from the conclusions reached by Marais. Meisner's types were not identified prior to the present study, and their images (Fig. 1–2) are shown here for the first time. Because the limits of *H. florulenta* and *H. brachycarpa* have been confused since the account of Marais some fifty years ago, detailed descriptions and examined specimens are given below for the three species recognized.

**1. *Heliophila glauca*** Burch. ex DC., Syst. Nat. 2: 690. 1821. TYPE: SOUTH AFRICA. Eastern Cape: Nelson Mandela Bay, Uitenhage, between Galgebos and Melk

River, 17 February 1814, W. J. Burchell 4782 (holotype: K [000230569]; isotype: G [00207088]).

Homotypic synonym: *Heliophila glauca* var. *candida* DC., Syst. Nat. 2: 690. 1821.

Heterotypic synonyms: *Heliophila glauca* var. *purpurascens* DC., Syst. Nat. 2: 690. 1821. TYPE: SOUTH AFRICA. Western Cape: Garden Route, George, Uniondale, 14 March 1814, W. J. Burchell 4969 (holotype: K [000230571]; isotypes: G [00207088], PRE [0408604-0, image seen].

*Heliophila sarcophylla* Meisn., London J. Bot. 1: 463. 1842. TYPE: SOUTH AFRICA. Western Cape: Garden Route, George, Langkloof, 1 March 1839, C. F. F. Von Krauss 1245 (holotype: NY [03468226]; isotypes: BAS [image seen], FI [005684, image seen], M [0108058], TUB [000635, 000636, images seen], W [0009170]. Fig. 1.

*Plants* subshrubs or shrubs, glaucous. *Trichomes* absent. *Stems* woody at least along lower parts, 40–200 cm tall, smooth, terete, erect to ascending, virgate, simple or branched, glabrous. *Leaves* cauline, fleshy; petiole absent; blade simple, oblong to narrowly lanceolate, 0.8–1.5 cm × 1.5–4.0 mm, entire, unsegmented, minutely auriculate at base, without a pair stipule-like glands at node, glabrous, base articulate, not decurrent. *Racemes* terminal, lax, 15–35-flowered, elongated in fruit, not secund; rachis straight, glabrous; fruiting pedicels without a pair of basal bract-like glands, articulate at base, glabrous, slender, erect and subappressed to rachis, straight, persistent, lowermost 5–11(–14) mm long; buds oblong. *Sepals* ascending, oblong, 4.0–6.5 mm long, glabrous, caducous, lateral strongly saccate at base, median not saccate, all cucullate. *Petals* purple, mauve, or white, obovate, 7–12(–14) × (3–)4–6(–8) mm, ascending, rounded at apex, unappendaged, not papillate; claw 0.5–1.0 mm long. *Stamens* tetradynamous; filaments 2.5–7.0 mm long, glabrous, unappendaged; anthers oblong, 1.5–2.0 mm long, not apiculate at apex. *Nectar glands* lateral, lunar, median glands absent. *Ovary* glabrous; ovules 4–10 per ovary. *Fruit* dehiscent silique, capsular, narrowly oblong or subelliptic, (0.9–)1.5–2.8(–3.5) cm × 3.5–5.0 mm, latiseptate, glabrous, not moniliform, straight along replum, smooth, erect and appressed to rachis; valves

I am grateful to the directors, curators, and collection managers of the herbaria cited herein.

<sup>1</sup>Missouri Botanical Garden, 4344 Shaw Boulevard, St. Louis, Missouri 63110, U.S.A.



FIGURE 1. Holotype of *Heliophila sarcophylla* Meisn. (C. F. F. Von Krauss 1245, NY).

papery, coarsely reticulate veined, midvein distinct, margin not thickened; gynophore 0.2–1.0 mm long; style in fruit 2–6 mm long, cylindrical tapering to apex, stout, glabrous; stigma entire. *Seeds* uniseriate, suborbicular, flattened, margined, 2.5–4.0 mm in diam.

**Phenology:** flowering August–April.

**Habitat:** well-drained clay stony grounds, rocky ridges, fynbos vegetation; 450–1590 m.

**Distribution:** South Africa, Western Cape (Cape Winelands, Central Karoo, and Garden Route districts) and Eastern Cape (Nelson Mandela Bay and Sarah Baartman districts).

**Additional specimens examined:** SOUTH AFRICA. Western Cape: Cape Winelands, Langeberg, Witberg, E of Robinson Pass, *G. C. Matthews 1236* (PRE). Garden Route, Kannaland [Calitzdroop], Rooiberg Pass, *J. P. H. Acocks 20391* (BM, K, M, PRE, W), *J. M. Wurts 1635* (NBG); N side of Rooiberg Mts., *Mauve et al. 42* (MO, NBG, W); Klein Swartberg, *J. M. Wurts 1514* (NBG); Rooiberg, *J. M. Wurts 1306* (NBG), *H. C. Taylor 9627* (NBG); Rooiberg, Bailey Peak, *J. J. Meyer 437* (PRE), *J. Volk 1786* (NBG), *E. G. H. Oliver 5454* (K, NBG), *M. F. Thompson 3352* (PRE); Touwsberg, *D. J. McDonald 2369, 2448* (NBG), *J. M. Wurts 1356* (NBG); Gamke Mt. Reserve, slopes of Paddafluitjieskloof, *Erasmus 131* (NBG); N slope of Gamka Mts., *A. F. Boshoff P174* (NBG); Klein Karoo, Gamka Mt. Reserve, *P. & J. Cattell 43* (BOL), *R. Allarice 1698* (NBG). Hessequa [Riversdale], Muiskraal, *E. E. Galpin 3742* (PRE); Little Karoo, N slopes of Touwsberg, above farm Miskraal, *G. A. Verboom 7* (BOL). George [Uniondale], Uniondale: 4 miles NW of Joubertina, *J. P. H. Acocks 20023* (PRE); Misgund hills, *E. Esterhuysen 6942* (BOL, K, NBG), *H. G. Fourcade 4241* (K). Oudtshoorn: Roodeberg, *Bond 222* (NBG); N side of Outeniqua Mts. near Moeras River, *E. Esterhuysen 19459* (BOL). Central Karoo, Laingsburg, Anysberg, *E. Esterhuysen 32859* (BOL, MO). Eastern Cape: Nelson Mandela Bay [Uitenhage], Loeri- and Camtoursrivier, *C. F. Ecklon & C. L. P. Zeyher 102* (B, C, K, M, MO). Sarah Baartman, Dr Beyers Naudé [Willowmore], Antoniesberg, *P. A. Bean & J. H. T. Volk 2045* (BOL); Kouga Mountains, Willowmore, *H. C. Taylor 898* (NBG). Kouga [Humansdroop]: Witelsbos, *H. G. Fourcade 2106* (PRE); Bo-Kouga, off Long Kloof, *R. D. A. Bayliss 7124* (G, M, MO, NY, UC); Patensie Hills, *W. F. Barker 7901* (NBG); Kouga Mts., above Geelhoutboskloof, *P. A. Bean 1090* (B, MO, NBG); Kouga Mts. near Enselandkop, *J. Volk 948* (MO).

The holotype of *Heliophila sarcophylla* consists of two branches on the left of sheet with a small label in the middle handwritten by Krauss and a fully detailed label on the left hand written by Meisner. The FI and M sheets of the type collection lack the collection number, but all of the other gathering data are identical to that of the holotype and, therefore, they are recognized here as isotypes.

As indicated by Stafleu and Cowan (1981), Meisner's herbarium is housed in NY, not BAS where he worked most of his life. His label of the species reads: "Heliophila (Lanceolaria) sarcophylla nob[is] in Hook. Lond. Journ.

1: p. 463. Differt a *H. macrosperma* seminibus angusta membranaceo-marginatis, etc. Non differt a *H. glauca* Burch DC.! Sonder in Litt. D. 7 Febr. 1845."

A controversial specimen of Krauss in the Bernhardt Herbarium, MO [1925794], has a label that reads "N. 1245. *Heliophila sarcophylla* n.sp. Meiss. In Landekloof, George, Mart." The label is identical to that of the holotype the above, but the plant definitely belongs to *H. florulenta*. Clearly, there is a mix-up of the label and the plant, and the specimen is not a type material of any taxon. It has the characteristic gland pairs at the bases of leaves and pedicels that *H. glauca* (including *H. sarcophylla*) lacks.

*Heliophila glauca* is easily distinguished among the shrubby members by having articulate leaves and fruiting pedicels lacking the basal pair of glands, minutely auriculate leaves, fruit and fruiting pedicels appressed to rachis, and narrowly oblong to subelliptic fruit.

**2. *Heliophila florulenta*** Sond., Abh. Naturwiss. Verein Hamburg 1: 263. 1846. TYPE: SOUTH AFRICA. Eastern Cape: Zwartkopsrivier, 1829, *C. F. Ecklon* (lectotype designated by Nordenstam (1980: 262): S [G8767]; isolectotypes: B [100153871, 100299439], C, GOET [002608, image seen], K, M [0108069], MO [925695], P [00739548], PRC [451618], PRE, SAM [0028064-0], UPS, W [0009167, 18890303895]).

Heterotypic synonym: *Heliophila florulenta* var. *obliqua* E.Mey. ex Sond., Abh. Naturwiss. Verein Hamburg 1: 263. 1846. TYPE: SOUTH AFRICA. Eastern Cape: Witpoortberg, *J. F. Drège s.n.* (lectotype designated by Nordenstam (1980: 262): S [G8766]; isolectotypes: B [100153870], P [05445366, 00739545], PRE [0408614-0, 0408615-0, images seen], W [0009168]).

*Plants* shrubs or small trees, glaucous. *Trichomes* papillate on stamens and petal claws, absent elsewhere. *Stems* woody, 0.5–2.2 m tall, striate, ridged and with contiguous papilla-like tubercles, erect to ascending, branched above, glabrous. *Leaves* cauline, fleshy; petiole undifferentiated; blade simple, linear to oblanceolate, 1.5–5.0 cm × 1–4 mm, entire, not auriculate at base, with a pair stipule-like subulate glands at node, glabrous, base decurrent, apex attenuate into pointed apicula. *Racemes* terminal on lateral branches, corymbose, 5–30-flowered, elongated slightly and remaining subcorymbose in fruit, not secund; rachis straight, papillate or smooth; fruiting pedicels with a pair of basal bract-like glands, not articulate at base, glabrous, slender or slightly stout, much expanded at receptacle, ascending to divaricate, straight, persistent, lowermost 5–10(–15) mm long; buds oblong. *Sepals* erect to ascending, oblong, 3–5 mm long, glabrous, caducous, lateral pair strongly saccate at base, median not saccate, all not cucullate. *Petals* white to creamy white, obovate-spatulate, 6–8 × 1.0–2.5 mm, ascending, rounded at apex, unappendaged; claw 2–4 mm long, strongly differentiated from blade, papillate. *Stamens* subequal; filaments 3.5–5.0 mm long, densely papillate at least along proximal half or third, unappendaged; anthers oblong, 0.6–0.8 mm long, not apiculate at apex. *Nectar glands* lateral, lunar; median

glands absent. *Ovary* glabrous; ovules 4–6 per ovary. *Fruit* dehiscent silique, capsular, elliptic-lanceolate, 2.0–3.7 cm × (3.0–)4.5–6.0 mm, latiseptate, glabrous, not moniliform, straight along replum, smooth, ascending to divaricate; valves papery, midvein and lateral veins prominent, forming a reticulum, margin not thickened, apex attenuate into style; gynophore (0.5–)1.0–3.0 mm long; style in fruit (0.7–)1.0–2.0(–2.7) mm long, attenuate, glabrous; stigma entire. *Seeds* uniseriate, suborbicular, flattened, minutely reticulate, wingless, not margined, 2.5–4.0 mm in diam.

**Phenology:** flowering in July through August, rarely as early as May or as late as December.

**Habitat:** barren mountain slopes, scrubland, sandy soil on rocky ridge, rocky loams soil in arid fynbos; 50–1200 m.

**Distribution:** South Africa, Western Cape (Garden Route District) and Eastern Cape (Nelson Mandela Bay and Sarah Baartman districts).

**Additional specimens examined:** SOUTH AFRICA. Western Cape: Garden Route, Mossel Bay, Hounsloew Farm, ridge after Brakriver, *T. Dold & A. D. Booij* 380 (GRA, NGB). Eastern Cape: Nelson Mandela Bay, Port Elizabeth, *J. F. Drège* 9283 (PRE), *J. F. Drège* 1711 (SAM), *R. Marloth* 1703 (E); New Brighton, near Port Elizabeth, *E. West* 312 (BOL). Sarah Baartman, Dr Beyers Naudé, Steytlerville, 10 miles from Steytlerville on Mt. Steeward Rd, *R. Storey* 2490 (PRE); 25 miles E of Willowmore, *R. H. Compton* 19649 (BOL, NGB). Makana, Coombes Valley, *R. D. A. Bayliss* 4314 (NGB, UC). Kouga [Humansdorp], Lower Papiessfontein, *R. M. Cowling* 776 (GRA); W bank of Gamloos River, near Hankey, *H. G. Fourcade* 2272 (K).

Sonder (1846) listed two collections by Ecklon and Zeyher from Zwartkopsrivier and Bethelsdorp. However, as indicated by Nordenstam (1980), both collections were distributed mixed in all isolectotype sheets as *Ecklon & Zeyher* 101, and it is impossible to tell which specimen on a given sheet belongs to which locality.

Sonder (1846) had an isotype of *Heliophila brachycarpa* in his herbarium and recognized the species as distinct from the material he described in the same work as *H. florulenta*. Indeed, he placed the two species in different sections and indicated in the species descriptions that former has short-clawed, oblong-spatulate petals 2 lines wide, whereas the latter has puberulent long claws and ovate [actually obovate] petal blades 1 line wide. In that, Sonder's description of *H. brachycarpa* was more detailed than and fully in agreement with original of Meisner (1842). Despite these very significant differences in petal morphology, Marais (1970), who did not examine any specimen in Sonder's herbarium or authentic material of *H. brachycarpa*, reduced *H. florulenta* to synonymy of the earlier-published former species. Unfortunately, this misinterpretation by Marais continues for the past 50 years, and one still finds the two distinct species united in all herbaria of the world.

The entire species description of *Heliophila brachycarpa* in Marais (1970) is a perfect fit for *H. florulenta*, and his description of the floral and fruit morphology do not apply to the type collection of the former, which he never studied.

Both Meisner (1842) and Sonder (1846) did not describe the mature fruit of *H. brachycarpa*, and that may have misled Marais to overlook the fact that the two species have very different fruit morphology, as evidenced from his 1 March 1962 annotation and his (Marais, 1970: 68) citation of the isolectotype sheet of *H. florulenta* (K) as *H. brachycarpa*. This sheet consists of a flowering branch of the isolectotype on the right and a fruiting branch near its base, and it is a mixed collection with *MacOwan* 845 that includes two large flowering branches of *H. florulenta* (one on the left and the other in the center center) and a smaller fruiting branch of *H. brachycarpa*. I have not examined all of the specimens cited by Marais under his *H. brachycarpa*, but for at least two collections, *Compton* 19649 (BOL, NGB) and *Fourcade* 2272 (K), the plants definitely belong to *H. florulenta*. He cited *Compton* 11216 (perhaps in NGB) from Whitehill that I did not examine. However, from the same locality he annotated on 8 Oct. 1963 *Compton* 10880 (NGB), but this one has glabrous filaments and petal claws and definitely belongs to *H. brachycarpa* (sensu this author, not Marias; see below). Therefore, in order to avoid any future confusion, all material of the two species examined for this study are cited below. MacOwan's collection is a good indication that the two species grow sympatrically, at least for part of their ranges.

*Heliophila florulenta* is easily distinguished from *H. brachycarpa* in flower, fruit, and young sterile stems. It has white to creamy white, spatulate-obovate petals 6–8 × 1.0–2.5 mm, papillate petal claws strongly differentiated from blade and 2–4 mm long, densely papillate filaments along at least proximal half or third, anthers 0.6–0.8 mm long, elliptic-lanceolate fruit (3.0–)4.5–6.0 mm wide, and gradually attenuate styles (0.7–)1–2(–2.7) mm long (Fig. 3A, B, C). By contrast, *H. brachycarpa* has pale mauve to pink, oblanceolate petals 9–14 × (2.5–)3.0–5.0 mm, glabrous petal claws 1–2 mm long and hardly differentiated from blade, glabrous filaments, anthers 1.2–1.5 mm long, ovate-lanceolate fruit (6–)7–9 mm wide, and cylindrical style (4–)5–10 mm long, abruptly terminating fruit apex (Fig. 3D, E, F). When lacking both flower and fruit, plants *H. florulenta* are distinguished by having young stems with contiguous, minute, papilla-like tubercles that *H. brachycarpa* lacks.

**3. *Heliophila brachycarpa*** Meisn., London J. Bot. 1: 465. 1842. TYPE: SOUTH AFRICA. Eastern Cape: Nelson Mandela Bay, Uitenhage, *C. F. F. Von Krauss* 1254 (holotype: NY [03468302]; isotypes: M [0152274], MO [1925731], S [1216058], TUB [000630, 000631, images seen]). Fig. 2.

*Plants* small trees or scrambling shrubs, not glaucous. *Trichomes* absent. *Stems* woody, 1–2 m tall, slightly striate, ridged, without papilla-like tubercles, erect to ascending, many branched, glabrous throughout. *Leaves* cauline, not fleshy; blade simple, linear to linear-oblong, (1.3–)2.5–6.0 cm × 1–2 mm, attenuate to petiole-like base, margin entire, not auriculate at base, with a pair of stipule-like glands at node, glabrous, base not articulate, somewhat decurrent. *Racemes* terminal and lateral, not intercalary,



corymbose, 4–23-flowered, elongated in fruit, not secund; rachis straight, glabrous; fruiting pedicels with a pair of basal bract-like glands, not articulate at base, glabrous, slightly stout, divaricate-ascending to divaricate, straight or slightly curved, persistent, lowermost (6–)10–25 mm long; buds oblong-ovate. *Sepals* ascending, oblong, 5–6 mm long, glabrous, caducous, lateral pair not cucullate at apex, saccate at base, median pair slightly cucullate, not saccate. *Petals* pale mauve to pink, oblanceolate, 9–14 × (2.5–)3.0–5.0 mm, ascending, rounded at apex, unappendaged, not papillate; claw 1–2 mm long, hardly differentiated from blade. *Stamens* tetradynamous; filaments 3.5–6.0 mm long, glabrous at base, unappendaged; anthers oblong, 1.2–1.5 mm long, not apiculate at apex. *Nectar glands* lateral, median glands absent. *Ovary* glabrous; ovules 6–8 per ovary. *Fruit* dehiscent siliqua, capsular, ovate-lanceolate, 2.2–3.0 cm × (6–)7–9 mm, latisepate, glabrous, not moniliform, straight along replum, not torulose, apex abruptly ending in style, ascending to suberect; valves thick papery, midvein and lateral veins prominent, margin not thickened; gynophore 1–2 mm long; style in fruit (4–)5–10 mm long, cylindrical, stout, glabrous; stigma entire. *Seeds* uniseriate, ovate, flattened, wingless, not margined, 4.0–4.5 × 3.0–3.5 mm; sinus shallow, wide.

**Phenology:** flowering March, July–Aug; fruiting September into October.

**Habitat:** arid areas in shale, rocky places, flats at foot of mountains; ca. 600 m.

**Distribution:** South Africa, Western Cape (Central Karoo District) and Eastern Cape (Nelson Mandela Bay and Sarah Baartman districts).

**Additional specimens examined:** SOUTH AFRICA. Western Cape: Central Karoo, Laingsburg, Karoo Garden, Whitehill, *R. H. Compton 10880* (NBG). Eastern Cape: Sarah Baartman, Dr Beyers Naudé, Ganna Leege, *M. R. Levyns 6468* (BOL). Makana: 27 miles on East London road from Grahamstown [=Mokhanda], *E. Brink 188* (GRA); near Trumpeters Drift, Albany, *L. L. Britten 7045* (GRA, PRE); Fish River Pass, *R. D. A. Bayliss 2257* (A, G, MO, NBG, NY, UC).

Meisner's annotation on the label of the holotype of *Heliophila brachycarpa* reads "H. (Carpopodium) brachycarpam, nob[is]. M[jhi]. Hook. Lond. Journ. 1 p. 465." The above isotypes at M and the Bernhardt Herbarium (MO) have the exact locality data as that of the holotype but without the collection number.

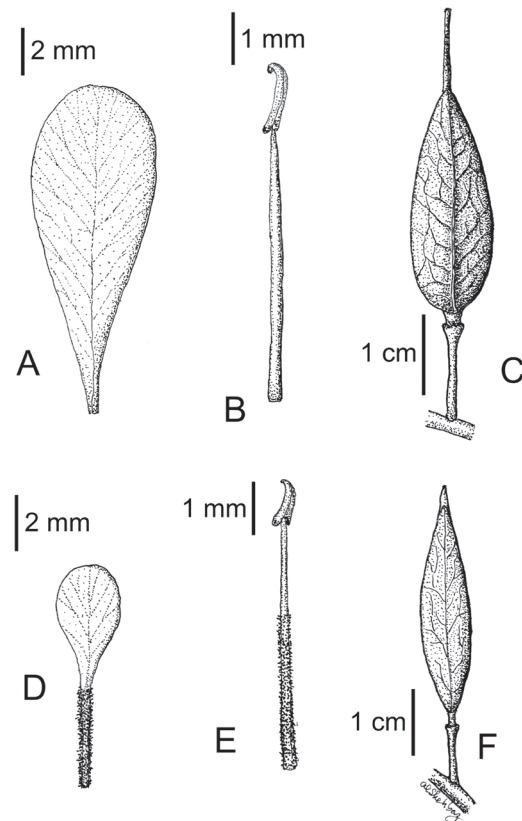


FIGURE 3. *Heliophila brachycarpa* Meisn. (A–C) and *H. florulenta* Sond. (D–F). A, D, Petals; B, E, Median stamens; C, F, Fruit and fruiting pedicel. Drawn by Al-Shehbaz: A–C from *R. D. A. Bayliss 2257* (MO [2007181]); D, E from *R. H. Compton 19649* (NBG); F, from *R. D. A. Bayliss 4314* (UC).

#### LITERATURE CITED

- AL-SHEHBAZ, I. A. AND K. MUMMENHOFF. 2005. Transfer of the South African genera *Brachycarpaea*, *Cycloptychis*, *Schlechteria*, *Silicularia*, and *Thlaspeocarpa* to *Heliophila* (Brassicaceae). *Novon* 15: 385–389.
- BRASSIBASE. 2019. brassibase.cos.uni-heidelberg.de (accessed August 16–27, 2019).
- CANDOLLE, A. P. DE 1821. *Syst. Nat.* 2: 277–697. Treuttel & Würtz, Paris.
- JSTOR. 2019. Global Plants. <https://plants.jstor.org> (accessed August 9–21, 2019).
- MARAIIS, W. 1970. Cruciferae. Pages 1–118 in L. E. CODD, B. DE WINTER, D. J. B. KILLICK, AND H. B. RYCROFT, EDS., *Flora of Southern Africa*. Vol. 13. National Botanic Gardens, Kirstenbosch.
- MEISNER, C. F. 1842. Contributions towards a flora of South Africa. *London J. Bot.* 1: 459–476.
- MUMMENHOFF, K., I. A. AL-SHEHBAZ, F. T. BAKKER, H. P. LINDER AND A. MÜHLHAUSEN. 2005. Phylogeny, morphological evolution, and speciation of endemic Brassicaceae genera in the Cape flora of southern Africa. *Ann. Missouri Bot. Gard.* 92: 399–423.
- NORDENSTAM, B. 1980. Nomenclatural notes on South African Cruciferae. *J. S. African Bot.* 46: 251–263.
- SONDER, W. 1846. Revision der Heliophileen. *Abh. Geb. Naturw. Hamb.* 1: 173–271.
- STAFLEU, F. A. AND R. S. COWAN. 1981. *Taxonomic Literature*. Ed. 2, vol. 3. Dr. W. Junk b.v., Publishers, The Hague/Boston.

APPENDIX  
INDEX TO NUMBERED COLLECTIONS

- J. P. H. Acocks* 20023 (1); 20391 (1).  
*R. Allarice* 1698 (1).  
*W. F. Barker* 7901 (1).  
*R. D. A. Bayliss* 2257 (3); 4314 (2); 7124 (1).  
*P. A. Bean* 1090 (1).  
*P. A. Bean & J. H. T. Volk* 2045 (1).  
*P. Bond* 222 (1).  
*A. F. Boshoff* P174 (1).  
*E. Brink* 188 (3).  
*L. L. Britten* 7045 (3).  
*W. J. Burchell* 4782(1); 4969 (1).  
*P. Cattell & J. Cattell* 43 (1).  
*R. H. Compton* 10880 (3); 19649 (2).  
*R. M. Cowling* 776 (2).  
*T. Dold & A. D. Booij* 380 (2).  
*J. F. Drège* 1711 (2); *Drège* 9283 (2); *s.n.* [no date] (2).  
*C. F. Ecklon s.n.* [no date] (2).  
*C. F. Ecklon & C. L. P. Zeyher* 102 (1).  
 [?] *Erasmus* 131 (1).  
*E. Esterhuysen* 6942 (1); 19459 (1); 32859 (1).  
*H. G. Fourcade* 2106 (1); 2272 (2); 4241 (1).  
*E. E. Galpin* 3742 (1).  
*C. F. F. Von Krauss* 1245 (1); 1254 (3).  
*M. R. Levyns* 6468 (3).  
*R. Marloth* 1703 (2).  
*G. C. Matthews* 1236 (1).  
*A. Mauve et al.* 42 (1).  
*D. J. McDonald* 2369 (1); 2448 (1).  
*J. J. Meyer* 437 (1).  
*E. G. H. Oliver* 5454 (1).  
*R. Storey* 2490 (2).  
*H. C. Taylor* 898 (1); 9627 (1).  
*M. F. Thompson* 3352 (1).  
*G. A. Verboom* 7 (1).  
*J. Volk* 948 (1); 1786 (1).  
*E. West* 312 (2).  
*J. M. Wurts* 1306 (1); 1356 (1); 1514 (1); 1635 (1).