

## Three new species of *Tritoniopsis* (Iridaceae: Crocoideae) from the Cape Region of South Africa

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### ABSTRACT

Three new species of the largely Western Cape genus *Tritoniopsis* L.Bolus are described, bringing the number of species in the genus to 24. *Tritoniopsis bicolor* and *T. flava* are newly discovered, narrow endemics of the Bredasdorp Mountains and the Kogelberg Biosphere Reserve, respectively, in the southwestern Cape. Both of these are areas of high local endemism. *T. toximontana*, known since at least 1965 but misunderstood, is restricted to the Gifberg–Matsikamma Mountain complex of northern Western Cape. Notes on the pollination biology of the species are provided.

### INTRODUCTION

The genus *Tritoniopsis* L.Bolus (Iridaceae: Crocoideae) is a near-endemic of the Cape Floristic Region (Goldblatt & Manning 2000a), with a single species, *T. caffra* (Ker Gawl. ex Baker) Goldblatt, extending eastwards to East London. The genus is a particularly characteristic member of the Cape Flora as almost all of the species are restricted to acidic, nutrient-poor soils derived from sandstones of the Cape system. Originally established to accommodate the single species *Tritoniopsis lesliei* L.Bolus (Bolus 1929), the genus was subsequently combined with *Exohebea* Foster (Phillips 1951; Lewis 1959), and finally expanded to include the species previously placed in *Anapalina* N.E.Br. (Goldblatt 1990). The 21 species currently recognised exhibit a wide diversity in floral morphology but are united by several highly unusual characters. The leaves of *Tritoniopsis*, which are hysteranthus in all species, are unlike most other genera of Iridaceae subfamily Crocoideae (Goldblatt *et al.* 2000) in lacking a well-developed pseudomidrib or central vein, having instead one to seven equally prominent main veins. Flowering in most species is delayed until summer or autumn, and although green leaves are often evident at flowering time, these sometimes represent vegetative growth derived from the daughter corm. The contemporary appearance of leaves and flowering shoots from successive generations is unknown among hysteranthus Iridaceae and is correlated with the persistence of corms from previous years' growth and the late flowering habit. In other hysteranthus taxa of Iridaceae, leafing of the daughter corm typically occurs only after the flowering shoot of the parent corm has died down. Alternatively, as in some species of *Gladiolus* L., leaves are produced on a separate sterile shoot later in the season. *Tritoniopsis* is also unusual in having the inner floral bracts longer than the outer and not evidently notched at the apices. The flowers, although highly diverse in form, are always strongly

herkogamous. This spatial separation of pollen and style is achieved through the recurving of the filaments a few days after anthesis, whereby they carry the anthers well away from the style, the branches of which only become receptive after the filaments have diverged. This characteristic, noted by Lewis (1960) in her revision of the species placed in *Anapalina*, was apparently overlooked in her earlier account of *Tritoniopsis s.s.* (Lewis 1959) but is characteristic of all species of the genus. Another distinctive characteristic of most of the species is the way in which the tepals gape at the tips in bud, several days before anthesis actually occurs. This feature has not been commented on before and is otherwise unknown in the family. Finally, the seeds of almost all species of *Tritoniopsis* are tetrahedral or pyramidal in shape and typically more or less winged on the angles. Species in which the seeds are larger and more prominently winged invariably produce much-inflated capsules. This range of autapomorphies accord with indications that the genus is taxonomically isolated within subfamily Crocoideae. Several of the species have restricted ranges and the three described here are no exception. One species, *T. toximontana*, appears to be restricted to the Gifberg and Matsikamma massif, while *T. bicolor* and *T. flava* are each known from single populations in the Bredasdorp Mountains and Kogelberg Biosphere Reserve in the southwestern Cape respectively. Both of these are areas of high local endemism (Goldblatt & Manning 2000a).

***Tritoniopsis bicolor* J.C.Manning & Goldblatt, sp. nov.**, plantae 200–400(–600) mm altae usitate eramosae, cormo globoso 20–30 mm diam. tunicis fibris brunneis dense implexis conferto, foliis 5–9 inferioribus (4)5–7 basalibus viridis vel externis siccis ad tempore floredi in pseudopetiolum subteretem 30–35 mm longum infime abrupte contractis, lamina anguste lanceolata (85–)100–150 × (5–)6–10 mm prominente 1–2(3)-nervata, foliis caulinis 1 vel 2 subsquamosis, spica 20–35-flora, bracteis infime viridibus superne siccis brunneisque, externa 7–10 mm longa acuta, interna 8–11 mm longa obtusa, floribus zygomorphis moschatis vel pungentibus odoris flavis tepalibus tribus infernis marroninus suffusis in medio atrostriatis ore tubi et basibus tepalarum minute papillois, perianthii tubo 2–5 mm longo, tepalis inaequalibus marginibus undulato-

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crispis dorsale 14–16 × 3–4 mm inferioribus tribus 9–15 mm inferioribus connatis laminis 9–10 mm longis, filamentis 6–7 mm longis, antheris ± 3 mm longis apiculis ± 0.5 mm longis ferentibus, styli ramis ± 1 mm longis.

TYPE.—Western Cape, 3419 (Caledon): western end of Bredasdorp Mtn, plateau west of Grootkop and Normanskop, (–BD), 6 Dec. 2000, Manning 2286 (NBG, holo.; K, MO, NBG, PRE, iso.).



FIGURE 1.—*Tritoniopsis bicolor*. A, corm; B, flowering spike and leaves. C–E, flower: C, front view; D, side view; E, half flower. F, capsules; G, seed. Scale bars: A–F, 10 mm; G, 10 mm. Artist: John Manning.



Plants 200–400(–600) mm high. *Corms* globose, 20–30 mm diam., tunics of densely matted fine brown fibres with well-developed neck, corms from previous seasons persistent. *Leaves* 5–9, lower (4)5–7 basal, green at flowering or the outermost drying, contracted abruptly into semiterete pseudopetiole 30–35 × 1.0–2.5 mm, blade narrowly lanceolate, acuminate, with 1 or 2(3) main veins, (85–)100–150 × (5)6–10 mm, cauline leaves evidently 1 or 2, represented by minute scales, lower cauline leaf concealed by fibrous corm neck. *Stem* moderately slender to robust, decurved just above ground level neck and then suberect or weakly inclined, unbranched, 2.5–4.0 mm diam. near base. *Spike* densely 20–35-flowered, 80–100(–150) mm long; bracts green at base but dry and brown above, leathery, oblong, outer bracts 7–10 mm long, acute, inner bracts 8–11 mm long, obtuse. *Flowers* zygomorphic, yellow, three lower tepals each flushed maroon in lower half and with darker median streak, producing strong, acrid or musty scent; perianth tube 2–5 mm long; tepals unequal, dorsal slightly larger, margins crisped or undulate, base of lower tepals and mouth of tube minutely papillate, dorsal tepal ascending and erect to slightly recurved above, narrowly oblanceolate, obtuse, 14–16 × 3–4 mm, upper laterals spreading horizontally, strongly clawed and recurved above, claw involute, 2–4 mm long, blade oblanceolate to obovate, obtuse, 7–9 × 2–3 mm, lower 3 tepals fused to one another for 1.0–1.5 mm, with or without short, channelled claw to 1.5 mm long, blade oblong, truncate, 9–10 × 2.0–4.5 mm. *Filaments* arcuate but later erect, 6–7 mm long, base of median filament minutely papillate; anthers yellow, 3 mm long with short apiculus 0.5 mm long. *Ovary* ellipsoid, ± 4 mm long; style ± 9 mm long, dividing opposite anther bases, branches ultimately 1 mm long. *Capsule* ovoid to broadly ellipsoid, inflated, 23–28 mm long. *Seeds* tetrahedral, 10–12 × 10 mm, reddish brown, winged on angles and conspicuously crested on faces. *Flowering time*: December. Figure 1.

*Distribution and biology*: *Tritoniopsis bicolor* has been collected only once from the Bredasdorp Mountains on the summit plateau west of Normanskop (Figure 2), flowering in the late spring after a fire the previous summer. The plants are restricted to seasonally waterlogged flats where they are fairly common growing in deep, humus-enriched sands. The smaller, cream-flowered species, *T. unguicularis* (Lam.) G.J.Lewis, occupies the adjacent drier, rocky slopes and the occasional hybrid plant was recorded at the interface between the populations. A few plants of *T. parviflora* (Jacq.) G.J.Lewis were found in fruit within a few hundred metres of the locality, also on drier slopes. Several individuals of the solitary bee *Amegilla spilostoma* (Apidae: Anthophorinae) were seen and captured while they visited flowers of *T. bicolor*.

*History*: this species was brought to our attention by a local botanist, Nick Helme, who collected it during a survey of portion of the Farm Pofadderskloof.

*Diagnosis and relationships*: *T. bicolor* is most likely to be confused with *T. parviflora* and the two are clearly closely related. The flowers in both species are moderately-sized with a musky to acrid scent and are coloured bright yellow with the lower tepals prominently marked

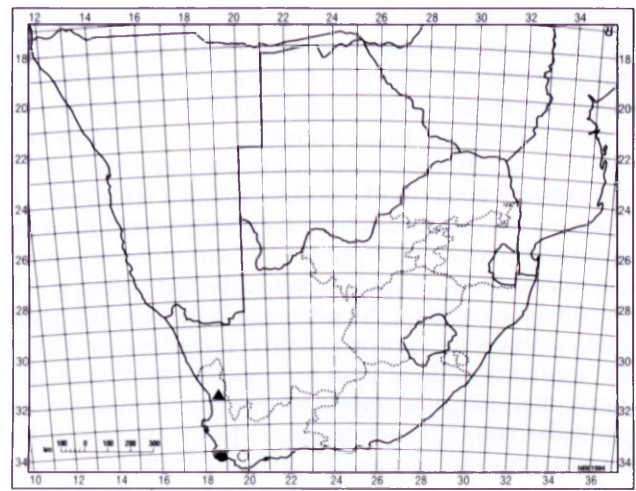


FIGURE 2.—Distribution of *Tritoniopsis bicolor*, ○; *T. flava*, ●; and *T. toximontana*, ▲, in Western Cape.

and flushed with maroon; the floral tube in both species is very short; the base of the tepals and mouth of the tube are minutely papillate; and the capsules of both species are conspicuously inflated. *Tritoniopsis parviflora* differs in its more prominently bilabiate flowers in which the lower three tepals are joined together in a distinct palate, 3–4 mm long, and in its much longer filaments, 12–14 mm long, that arch well over the lower lip. In *T. bicolor* the lower tepals are joined together for 1.0–1.5 mm without forming a well-defined lower lip and the anthers are held much closer to the mouth of the tube on short filaments 6–7 mm long. *Tritoniopsis bicolor* is distinctive in its leaves, which have a conspicuous semiterete pseudopetiole, 30–35 mm long, expanding abruptly into a narrowly lanceolate blade, 6–10 mm wide. The leaves of *T. parviflora* are linear or linear-lanceolate, 2–5 mm wide and although narrowed below are not contracted into a distinct pseudopetiole. The seeds of *T. bicolor*, measuring 10–12 mm long, also seem to be slightly larger than those of *T. parviflora*, which never exceed 9 mm in length.

Both species are restricted to acidic soils derived from sandstone rocks of the Table Mountain Series and although they both appear to flower only after a burn, they differ markedly in other aspects of their ecology and pollination biology. *Tritoniopsis parviflora* is widespread on dry, stony slopes in shallow sandy soils, from Citrusdal in the north to Bredasdorp in the south. It is unique among African Iridaceae in secreting floral oils from epithelial elaiophores on the perianth. Oil secretion is an adaptation to pollination by the large oil-collecting bee *Rediviva gigas* (Mellittidae) (Manning & Goldblatt in press) which has been captured while visiting and pollinating flowers of *T. parviflora*. *Tritoniopsis bicolor*, however, is restricted to a seasonally waterlogged site on the plateau of the Bredasdorp Mountains where it grows in deep, humus-enriched sands (pH 4.5). It is pollinated by the nectar-collecting bee *Amegilla spilostoma*. *T. bicolor* is evidently a local segregate of *T. parviflora* that has speciated on the specialised, seepage habitat on the Bredasdorp Mts at the extreme southern limits of the range of *T. parviflora*. The papillae on the palate and mouth of the tube that characterise both *T. bicolor* and *T. parviflora* are unique in the genus and are a significant synapomorphy for them. While the papillae are function-



al in oil secretion in *T. parviflora*, tests for floral oils in *T. bicolor* proved negative or at most equivocal. This suggests that the secretory function of the papillae has been suppressed in *T. bicolor* and that they remain as vestiges of an evolutionary origin from *T. parviflora*. It is possibly significant in this context that *Rediviva gigas* is not known from south of Kleinmond (Whitehead & Steiner 1993) and is therefore apparently absent from the Bredasdorp Mts. A few plants of *T. parviflora* with well-developed fruits were, however, collected within a few hundred metres of the population of *T. bicolor* indicating that a pollinating agent was active at the locality. Given the similarity in floral form between the two species it is likely that *Amegilla spilostoma* visits both species, but the difference in flowering time between the two at this locality prevents any possible hybridization.

***Tritoniopsis flava* J.C.Manning & Goldblatt, sp. nov.**, plantae 500–600 mm altae eramosae, cormo globoso 20–35 mm diam. tunicis fibris rubro-brunneis dense implexis, foliis 10, inferioribus 7 basalibus viridis ad tempore floredi in pseudopetiolum complanatum infime contractis, lamina anguste lanceolata 130–190 × (3–)5–8 mm prominente 2–3-nervata, foliis caulinis 3 supernis duobus squamosis inferno ad 60 mm longo vaginante, spica ± 25-flora, bracteis ovatis obtusis viridibus infime siccis brunneisque superne, externa 6–9 mm longa, interna 7–10 mm longa, floribus zygomorphis probabiliter odoris flavis tepalibus tribus infernis pallide flavis in medio marroninus striatis, perianthii tubo 4–5 mm longo, tepalis inaequalibus anguste unguiculatis dorsale 15–16 × 6 mm oblanceolato infime perangusto inferioribus tribus ± 2.5 mm connatis infime laminis ± 10 × 6 mm, filamentis ± 10 mm longis, antheris ± 5 mm longis apiculis ± 0.5 mm longis ferentibus, styli ramis ± 1 mm longis ad apicem dilatatis.

TYPE.—Western Cape, 3418 (Simonstown): Kogelberg State Forest, along footpath and next to stream, (–BD), 10 Dec. 1991, *Kruger 147* (NBG, holo.).

Plants 500–600 mm high. *Corms* globose, 20–35 mm diam., tunics of densely matted reddish brown fibres with short neck. *Leaves* 10, lower 7 basal, green at flowering, narrowed into flattened pseudopetiole below, blade narrowly lanceolate, 130–190 × (3–)5–8 mm, acuminate, with 2 or 3 main veins, cauline leaves 3 but upper 2 scarcely evident and represented by minute scales, lowermost reddish brown, lanceolate, up to 60 mm long, clasping throughout. *Stem* robust, decurved slightly just above ground level, unbranched, 4–5 mm diam. near base. *Spike* densely ± 25-flowered, 150–180 mm long; bracts green at base but dry and brown above, rigid and leathery but papery along margins, ovate, outer bracts 6–9 mm long, obtuse, inner bracts 7–10 mm long, obtuse. *Flowers* zygomorphic, yellow, three lower tepals each paler towards base with small maroon median streak in lower third; perianth tube slightly curved and widening to throat, 4–5 mm long; tepals unequal, dorsal slightly larger, oblanceolate and strongly narrowed in lower third, obtuse, 15–16 × 6 mm, upper laterals clawed, claw channelled, 5 mm long, blade obovate, obtuse, 8–9 × 5 mm, lower 3 tepals fused to one another for ± 2.5 mm, strongly clawed, claws channelled, 2 mm long, blades obovate-pandurate, truncate, ± 10 × 6 mm.

*Filaments* arcuate but later recurving, ± 10 mm long; anthers yellow, ± 5 mm long with short apiculus 0.5 mm long. *Ovary* ellipsoid, ± 4 mm long; style ± 9 mm long, dividing opposite anther bases, branches 1 mm long, expanded apically. *Capsule* and *seeds* unknown. *Flowering time*: December.

*Distribution and biology*: *Tritoniopsis flava* is known from a single population in the Palmiet River Valley (Figure 2). The plants grow in seasonally damp soils along a stream and flower only in the season following a burn. The vegetation at the site regenerates rapidly and within a few seasons the area is covered with a dense growth of woody vegetation.

*History*: this enigmatic species is known from a single collection made in 1999 during a survey of the flora of the Kogelberg Biosphere Reserve. The plants appeared along a small tributary of the Palmiet River following a fire and have not been seen since. The vegetation across the Palmiet River from this site burned in the summer of 2000 but several visits to apparently similar streams opposite the original site failed to rediscover the species.

*Diagnosis and relationships*: *T. flava* is one of a small group of closely allied species that includes *T. caledonensis* (R.C.Foster) G.J.Lewis, *T. unguicularis*, *T. parviflora* and *T. bicolor*. The alliance is characterised by relatively small, fragrant, cream-coloured to yellow flowers with abruptly clawed tepals in which the claws are channelled or involute, and by the short style branches. The species are distinguished on details of flower colour, size and proportions, and by leaf shape and venation. The alliance is restricted to the mountains of the southwestern Cape between the Cederberg and Bredasdorp. *T. flava* is most likely to be confused with *T. parviflora* or *T. bicolor* on account of the size of its flowers but is distinguished from these species by its robust habit, narrowly lanceolate leaves mostly 5–8 mm wide with 2 or 3 main veins, and by the lack of extensive maroon coloration on the lower tepals. It also lacks the papillate mouth of the tube and palate that characterises the flowers of these two species. All three of these species appear to flower only in the season following a summer burn.

***Tritoniopsis toximontana* J.C.Manning & Goldblatt, sp. nov.**, plantae 300–650 mm altae usitate eramosae vel 1–2-ramosae, cormo globoso 30–50 mm diam. tunicis fibris dense implexis rubrobrunneis conferto, foliis 4 vel 5 inferioribus 1–2 basalibus siccis ad tempore floredi in pseudopetiolum teretem 100–150 mm longum abrupte infime contractis, lamina linearo-lanceolata 200–300 × 5–10 mm prominente trinervata, foliis caulinis 3 vaginantibus omnino, spica 5–9-flora, bracteis viridibus infime siccis roseis superne, externa 10–12 mm longa acuta, interna 14–16 mm longa acuminata, floribus zygomorphis inodoris pallide roseis tepalibus inferne albis atrorubrisque notatis basibus filamentarum et ore tubi atrorubris coloratis, perianthii tubo 20–21 mm longo, tepalis inaequalibus dorsale 23–25 × 7–9 mm inferioribus tribus 22–25 mm longis infime 5–6 mm connatis, filamentis 13–15 mm longis, antheris 7–8 mm longis apiculis ± 2 mm longis usitate bifurcatis ferentibus, styli ramis 3–4 mm longis ad apicem parum dilatatis.



TYPE.—Western Cape, 3118 (Vanrhynsdorp): Gifberg, near top of pass, sheltered sandstone slope in arid fynbos, (–DD), 22 Mar. 2000, Manning 2234 (NBG, hol.; K, PRE, iso.).

Plants 300–650 mm high. *Corm* globose, 30–50 mm diam., tunics of densely matted reddish brown fibres with thick neck to 150 mm long. *Leaves* 4 or 5, the lower 1 or 2 basal, dry at flowering, contracted abruptly into slender, terete pseudopetiole 100–150 mm long, blade linear-lanceolate, 200–300 × 5–10 mm, attenuate, oblique at base, with 3 main veins, abaxial vein diverging first, cauline leaves 3, reddish brown, lanceolate, clasping throughout, lowermost to 60 mm long, upper reduced and bract-like. *Stem* slender, straight or slightly flexuose, usually unbranched, rarely with one or two single-flowered branches; branches filiform and suberect. *Spike* laxly 5–9(–12)-flowered, 300–600 mm long, lateral spikes 1-flowered; bracts green at base but dry and flushed pink in upper half at flowering, soft and more or less membranous, oblong, outer bracts 10–12 mm long, acute, inner bracts 14–16 mm long, acuminate. *Flowers* zygomorphic, unscented, pale pink, three lower tepals each with dark red median streak outlined in white and flanked at base by dark pink streak, upper laterals usually with darker median streak near apices, mouth of tube and bases of filaments flushed dark red; perianth tube straight or slightly curved, very slightly widened to throat, 20–21 mm long; tepals unequal, dorsal slightly ascending and recurved above, others directed forward below and recurved above, dorsal largest, oblanceolate, 23–25 × 7–9 mm, narrowed below, upper laterals 22–25 × 3.5–5.0 mm, lower tepals as long as upper laterals but usually slightly narrower, fused to one another for 5–6 mm. *Filaments* arcuate but later recurving, 13–15 mm long; anthers purple, 7–8 mm long including recurved, usually bifid apiculus ± 2 mm long. *Ovary* ellipsoid, ± 4 mm long; style 35–37 mm long, dividing slightly beyond anther apices, branches ultimately 3–4 mm long, slightly expanded apically. *Capsule* ovoid to ellipsoid, somewhat inflated, 15–23 mm long. *Seeds* tetrahedral, ± 6 × 4 mm, reddish brown, winged on angles and rugose on faces. *Flowering time*: March to early May. Figure 3.

*Distribution and biology*: *Tritoniopsis toximontana* is known only from the Gifberg and Matsikamma Mountains (Figure 2), where it is quite common in arid fynbos on the summit plateau, although apparently absent from the highest reaches of the Matsikamma. It is possible that the species extends northwards along the Bokkeveld Mountains but a search there in March 2000, failed to discover the species. The plants grow tightly wedged among sandstone boulders in sheltered situations, often on cooler slopes. The leaves are dry at flowering time or sometimes those of the next season's growth are emergent.

The pink, long-tubed perianth with dark red throat and tepal markings of *T. toximontana* are typical of plants adapted to pollination by long-proboscid nemestrinid and tabanid flies in South Africa (Goldblatt & Manning 2000b). The floral tube is shorter than is usual among such plants, however, and *T. toximontana* is visited and

pollinated by bees in the genus *Amegilla* (Apidae: Anthophorinae) as well as a moderate-sized nemestrinid fly in the genus *Prosoeca* (unpublished observations). The nemestrinid was also observed visiting the pink flowers of *Brunsvigia striata* in the same area. Both of these plant species appear to belong to an autumn-flowering guild that is pollinated by this as yet unnamed species of long-proboscid fly.

*History*: the species was first collected by Nan Horrocks, an assistant in the Compton Herbarium, in 1965, several years after Lewis' revision of the genus (Lewis 1959). Although Lewis subsequently saw this collection, she identified it as *T. ramosa* var. *unguiculata* (Baker) G.J.Lewis, apparently on the basis of the long perianth tube. *Tritoniopsis toximontana* was collected only twice in the thirty years following Lewis' death in 1967. The most recent collection, by Cape Town environmentalist and botanist Nick Helme, alerted us to the fact that it represented an undescribed species. *Tritoniopsis toximontana* is quite common on the Gifberg plateau and its late flowering habit must account for the fact that it has not been collected more frequently from a locality that is relatively well-visited by botanists.

*Diagnosis and relationships*: the long-tubed pink flowers of *T. toximontana* are superficially similar to those of *T. revoluta* (Burm.f.) Goldblatt and *T. flexuosa* (L.f.) G.J.Lewis but these species are both characterised by large, usually firm floral bracts, 15–35 mm long. The bracts of *T. toximontana* are softer and membranous and only 12–15 mm long. Although the leaves in most species of *Tritoniopsis* are narrowed towards the base of the blade into a flattened pseudopetiole, there are only four in which the pseudopetiole is terete and completely lacking in marginal flanges of blade tissue. This shared character seems to indicate that *T. burchellii* (N.E.Br.) Goldblatt, *T. triticea* (Burm.f.) Goldblatt, *T. flexuosa* and *T. toximontana* comprise a monophyletic group. However, the differences between the species in bract shape and texture, and particularly in the form of the cauline leaves suggests that this relationship, if correct is not a close one. The closely related red-flowered *T. burchellii* and *T. triticea* are unusual in the genus in their aristate cauline leaves and small, woody capsules and cannot be confused with any other species. Among the pink-flowered species with terete leaf bases, *T. toximontana* differs from *T. flexuosa* not only in the bracts but also in the leaf. The leaf blade in *T. flexuosa* is unique in the genus in being oblong and at most 60 mm in length, whereas the blade in *T. toximontana* is narrowly lanceolate-attenuate and 200–300 mm long.

#### Additional material examined

WESTERN CAPE.—3118 (Vanrhynsdorp): Matsikamma Mountains, Op de Berg 314, just west of Koelkop Trig Beacon, (–DB), 1 Apr. 1997, Helme 1254 (NBG); Gifberg Mtn top, (–DD), 7 May 1965, Horrocks 205 (NBG); 12.7 km from Zandkraal turnoff at top of Gifberg Pass, (–DD), 30 Mar. 1982, Snijman 595 (NBG).

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FIGURE 3.—*Tritoniopsis toximontana*. A, corm; B, flowering spikes and leaves. C, D, flower: C, front view; D, half flower. E, capsules; F, seed. Scale bars: A–E, 10 mm; F, 5 mm. Artist: John Manning.

help in the field, and to both the Western Cape Nature Conservation Board and the Northern Cape Nature Conservation Service for collecting permits.

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