

THE AFRICAN SPIDER GENUS *SINGAFROTYPA* (ARANEAE, ARANEIDAE)

Matjaž Kuntner and **Gustavo Hormiga**: Department of Biological Sciences, The George Washington University, 2023 G St. N.W., Washington, D.C. 20052, USA and Department of Systematic Biology—Entomology, National Museum of Natural History, NHB-105, Smithsonian Institution, Washington, D.C. 20560, USA. E-mail: kuntner@gwu.edu

ABSTRACT. The African spider genus *Singafrotypa* Benoit is redescribed and transferred from the tetragnathid subfamily Nephilinae to the araneid subfamily Araneinae. Cladistic analysis of the matrix of Scharff & Coddington (1997) with the addition of two *Singafrotypa* species supports this new placement. *Singafrotypa acanthopus* Simon, the type species of the genus, is described along with two new species: *Singafrotypa okavango* new species from Botswana, and *Singafrotypa mandela* new species from South Africa. *Singafrotypa goliath* Benoit is transferred to *Neoscona* Simon (Araneidae, Araneinae).

Keywords: Araneae, *Singafrotypa*, *Neoscona*, Araneidae, Araneinae, Nephilinae, Tetragnathidae, cladistics, Africa

The subfamily Nephilinae was first formally recognized by Simon (1894), although its familial placement within Araneoidea has changed repeatedly (see Hormiga et al. 1995 for history of placements), until recently placed within Tetragnathidae (Levi 1986; Levi & von Eickstedt 1989; Coddington 1990). Nephilinae as currently delimited contains eight genera with 55 species and 28 subspecies (Platnick 2000).

Hormiga et al. (1995) studied the higher level phylogenetics of Tetragnathidae and found that nephilines (represented in their matrix by five genera) were monophyletic and sister to the remaining tetragnathids. However, the status of the “nephiline” genera *Deliochus* Simon 1894 (from Australia), *Singafrotypa* Benoit 1962 (from Africa) and *Perilla* Thorell 1895 (from Myanmar and Vietnam), has remained untested. These genera are currently placed in Tetragnathidae (Platnick 1997, 2000). Until now no *Singafrotypa* males have been described, which has made its placement difficult. In this paper we redescribe *Singafrotypa acanthopus* (Simon 1907), the type species, describe two new species from southern Africa, and test the familial placement of *Singafrotypa* using quantitative cladistic methods. The results suggest that *Singafrotypa* is an araneid, not a tetragnathid.

Taxonomic history.—Simon (1907) described *Singotypha acanthopus* from the western African island of Fernando Poo (today Bioko of Equatorial Guinea). Simon (1894) previously designated *Epeira melania* L. Koch 1871 as the type species of his genus *Singotypha* Simon 1894 (later synonymized with *Phonognatha* by Dondale (1966)). Simon (1894) placed *Singotypha* in the group Phonognatheae within the subfamily Nephilinae of his family Argiopidae, today’s Araneoidea (Simon’s Argiopidae included many families recognized today). *Singotypha acanthopus* was the first species described from Africa in this otherwise Australian genus.

Lessert (1930) recorded a female of *Singotypha acanthopus* from Poko, Congo (now the Democratic Republic of Congo). Lessert (1930) apparently examined one of Simon’s original specimens from MCSNG, which he referred to as the type, as he stated that the type female is smaller than the one examined from Congo. Lessert (1930) also published a drawing of the epigynum with a redescription of the species, at the time known from two African localities.

In 1962 Benoit erected *Singafrotypa*, a new monotypic genus containing only *Singotypha acanthopus*. Benoit based his redescription of *Singafrotypa acanthopus* on one of Simon’s

original females deposited in MCSNG, which he referred to as the holotype, and retained the genus in the araneid subfamily Nephilinae (Benoit 1962). Later, Benoit (1963) described the second species of the genus, *Singafrotya goliath* Benoit 1963 from a single female from Ivory Coast. Unfortunately, the holotype of *S. goliath* is lost (R. Jocqué, *in litt.*). However, Benoit’s illustrated description is sufficient to transfer the species to the araneid genus *Neoscona* Simon 1864 (see below).

METHODS

General methods of study are described in Hormiga (1994). All morphological observations and illustrations were made using a Leica MZ APO dissecting microscope. Illustrations were made using a camera lucida and rendered on coquille board. Measurements were made using a reticle and are in millimeters. Abbreviations of the specimen depositories are explained in the Acknowledgments.

Cladistic analysis.—Upon examining the first available males of *Singafrotya acanthopus* (the type species of the genus) and *S. okavango* new species, it becomes clear that the placement of the genus within Tetragnathidae is not justified. The presence of male araneid characters such as a radix, median apophysis, a pair of male palpal patellar setae, and male coxal hook, suggests *Singafrotya* is an araneid. These features along with the female epigynal scape are absent in tetragnathids. To cladistically test the genus’ araneid placement, we used the published matrix of Scharff & Coddington (1997), which has 57 araneid genera plus 13 genera from eight outgroup families including Tetragnathidae scored for 82 morphological and behavioral characters. To this character matrix we added *S. acanthopus* and *S. okavango*. Thus the matrix we analyzed had a total of 72 taxa scored for 82 characters. The *Singafrotya* lines of the matrix are given in Table 1.

The parsimony analyses were performed using the computer programs NONA version 2.0 (Goloboff 1993) and PAUP* version 4.0b4a (Swofford 2000). In NONA we used

search parameters hold 10000, mult*500 and max under both ‘amb –’ and ‘amb =’. In PAUP we used random taxon addition for 10 replicates and TBR branch swapping. Winclada version 0.9.99m24 (Nixon 2000) was used to display and manipulate trees and matrices for NONA. The 14 multistate characters were treated as non-additive (unordered or Fitch minimum mutation model; Fitch 1971). Ambiguous character optimizations were usually resolved so as to favor reversal or secondary loss over convergence (Farris optimization or ACCTRAN).

RESULTS

Heuristic searches in NONA, under “amb-” produced 748 most parsimonious trees of 287 steps, with consistency and retention indices of 0.34 and 0.74, respectively; allowing for more ambiguous support (“amb=”) results in 1464 trees of the same length. The parsimony heuristic searches in PAUP* produced 2005 trees of minimal length (287 steps), with consistency and retention indices of 0.34 and 0.75, respectively. When these trees are filtered to remove topologies with polytomies for which more resolved trees exist, the number of cladograms is reduced to 406. The strict consensus of these two subsets of trees is, of course, identical. Successive character weighting (Farris 1969) in PAUP using a base weight of 100 and the maximum value of the rescaled consistency index produces stable results after the fourth iteration (215 trees of 296 steps under equal weights).

All the minimal length topologies, including those from successive character weighting, have in common the placement of *Singafrotya* within the araneid subfamily Araneinae, as well as the monophyly of Araneidae and Tetragnathidae. These results are topologically congruent with those of Scharff & Coddington (1997).

In the strict consensus cladogram of the 2005 trees found by PAUP much resolution within Araneinae is lost, but the following cladistic structure is retained: *Scoloderus (Acanthepeira* plus the rest of Araneinae, including

Table 1.—Coding of morphological and behavioral characters of Scharff & Coddington (1997) for *Singafrotya acanthopus* and *S. okavango* new species.

<i>S. acanthopus</i>	001111000000000110010100000101101100001100201000111??000-000001000100210??????????
<i>S. okavango</i>	00111100000000011001010000010110110000110020110011100000-0000010001002?0??????????

Singafrotypa). This large clade of araneines, sister to *Acanthepeira*, is largely unresolved although it contains a clade which places monophyletic *Singafrotypa* as sister to *Aranella* (*Alpaida* (*Enacrosoma* + *Bertrana*)). In the strict consensus cladogram of the 1464 trees found under “amb=” in NONA, *Singafrotypa* falls into a large polytomy within the large araneine clade sister to *Acanthepeira*, but retains monophyly of both *Singafrotypa* species.

Singafrotypa acanthopus lacks the three synapomorphies currently hypothesized to support tetragnathid monophyly (Hormiga et al. 1995): absence (loss) of median apophysis, embolus and conductor spiraling with each other, and apical tegular sclerites. In *Singafrotypa*, as in other araneids, the median apophysis is present, the conductor and embolus do not spiral with each other and the tegular sclerites are not apical. *Singafrotypa acanthopus* has grooves in the booklung covers, an additional tetragnathid synapomorphy suggested by Scharff & Coddington (1997), but this character is homoplastic (see later). On the other hand, *S. acanthopus* has the following araneid synapomorphies: mesal orientation of the male palpal cymbium, presence of a radix, and the wide separation of lateral and median eyes. The presence of a sustentaculum on the fourth tarsi and grooved booklungs, both present in *S. acanthopus*, are synapomorphies of the clade containing all araneid subfamilies but excluding the genus *Chorizopes*. The presence of a tubercle on the male palpal femur and the presence of an epigynal scape, both synapomorphies of the subfamily Araneinae (Scharff & Coddington 1997), are present in *S. acanthopus*, and support the placement of *Singafrotypa* within the Araneinae.

DISCUSSION

This cladistic analysis suggests placement of *Singafrotypa* within the araneid subfamily Araneinae. The sample of tetragnathid and araneid genera in the matrix permitted *Singafrotypa* to join either family, but all most parsimonious trees place it within Araneidae. Our results should not be interpreted as a new proposal of relationships among the Araneinae. Neither Scharff & Coddington's (1997) study nor our own analysis involved studying African araneid genera hypothesized to be the

closest relatives of *Singafrotypa*, like some taxa of the “*Larinia* genus-group” revised by Grasshoff (1970a-c, 1971). Scharff & Coddington (1997: 357) designed their study to reconstruct the basic phylogenetic structure of Araneidae by detecting major lineages and their interrelationships and were mostly concerned with resolving relationships among genera of Gasteracanthinae and the whole “argiopoid clade” rather than the relationships within Araneinae.

Which genera, then, might be close relatives of *Singafrotypa*? Several features are shared between *Singafrotypa* and some other African araneid genera (see the *Singafrotypa* diagnosis below). However, in the absence of a more detailed phylogenetic context for the higher level relationships of araneids it is not possible to assess whether these shared features are plesiomorphic or apomorphic, and thus the question about the close relatives of *Singafrotypa* has to remain unanswered until we have a better understanding of the cladistic structure of Araneidae.

TAXONOMY

Family Araneidae Simon 1895
Genus *Singafrotypa* Benoit 1962

Singafrotypa Benoit 1962: 218; Brignoli 1983: 242; Platnick 1989: 299; Platnick 1993: 380; Platnick 1997: 452; Dippenaar-Schoeman & Jocqué 1997: 292. Type species, by original designation, *Singotypa acanthopus* Simon 1907.

Etymology.—The original generic name *Singotypa* Simon supposedly came from the resemblance to the cylindrical, posteriorly rounded, abdomen of the European araneid genus *Singa* C. L. Koch 1836 (cf. Simon 1894: 747). Benoit (1962) apparently conveyed the African origin of the spiders by modifying the name to *Singafrotypa*.

Diagnosis.—The genital morphology of *Singafrotypa* is similar to that of *Araneus* Clerck 1757 and *Larinia* Simon 1874. *Singafrotypa* differs from *Araneus*, *Larinia* and *Neoscona* by having a wide cephalic region in both sexes. In contrast, the *Araneus* male head region is always narrower than in females (Levi 1991). *Singafrotypa* has an elongated abdomen with parallel sides which overhang the spinnerets, unlike that found in *Araneus*. The scape of *Singafrotypa* is annulated, unlike in *Neoscona*. While *Larinia* can have an elon-

gate, oval abdomen, sometimes projecting behind and above the spinnerets (Harrod et al. 1990) as in *Singafrotya*, *Singafrotya* males have a hook on the first coxae, which is absent in *Larinia*. In *Singafrotya* the second tibia is as thick as the first, while in *Larinia* it is thicker (Harrod et al. 1990). African *Larinia* were split into several genera by Grasshoff (1970b, c, 1971); all these genera, except *Paralarinia* Grasshoff, differ from *Singafrotya* in somatic morphology. While the female abdomen and the epigynum of *S. acanthopus* resemble those of *Paralarinia incerta*, *Singafrotya* differs from *Paralarinia* in the details of the palpal sclerites (cf. Grasshoff 1970c, fig. 20): relative position of subterminal and terminal apophyses, *Singafrotya* conductor with marginal denticles and the median apophysis being denticulated.

Description.—Somatic morphology of the three known species is uniform and is illustrated for *S. acanthopus* (Figs. 1–3). Sexual dimorphism is not pronounced. Both sexes have an elongated body with stout spiny legs (Figs. 1–3), a dark brown prosoma with a wide cephalic region and widely separated median and lateral eyes (Figs. 2–3), a longer than wide sternum. Abdomen elongated and cylindrical, longer than wide, and caudally overhanging the spinnerets (Fig. 1, especially pronounced in females). While size, as well as shades of gray and brown coloration, vary within and among species, the general dorsum pattern is as illustrated in Figs. 2–3.

Males: Total length 7.49–9.0. Cephalothorax 3.47–3.78 long, 2.35–2.38 wide, 0.75–1.08 high. Sternum 1.56–1.64 long, 0.97–1.0 wide. Abdomen 4.26–5.7 long, 2.28–2.5 wide. First femur 2.82–3.13 long. Chelicerae with 5–6 prolateral and 3–4 retrolateral teeth, and 12–15 denticles in between. Pedipalp as in Figs. 4–5, 9–10.

Females: Total length 9.05–14.57. Cephalothorax 3.78–5.05 long, 2.28–3.14 wide, 1.13–1.6 high. Sternum 1.56–2.25 long, 1.06–1.36 wide. Abdomen 6.2–10.23 long, 2.64–4.9 wide. First femur 2.5–4.1 long. Chelicerae with 4–6 prolateral and 3–4 retrolateral teeth, and 15–30 denticles in between. Epigynum as in Figs. 6–8, 11–14.

Natural history.—Unknown. *Singafrotya* cylindrical body with advanced spinnerets might suggest utilization of rolled leaves or grass stems as a retreat on the web, not unlike

the behavior of the Australian *Phonognatha* (Thirunavukarasu et al. 1996), or Asian *Perrilla* Thorell (Murphy & Murphy 2000, Kuntner in prep.). Three of four examined females of *S. okavango* had broken-off emboli stuck in the epigynal copulatory openings (Figs. 11–12).

Composition.—The genus comprises three species, two of which are new.

Distribution.—Western, central, and southern Africa.

Singafrotya acanthopus (Simon 1907)

Figs. 1–8, 15

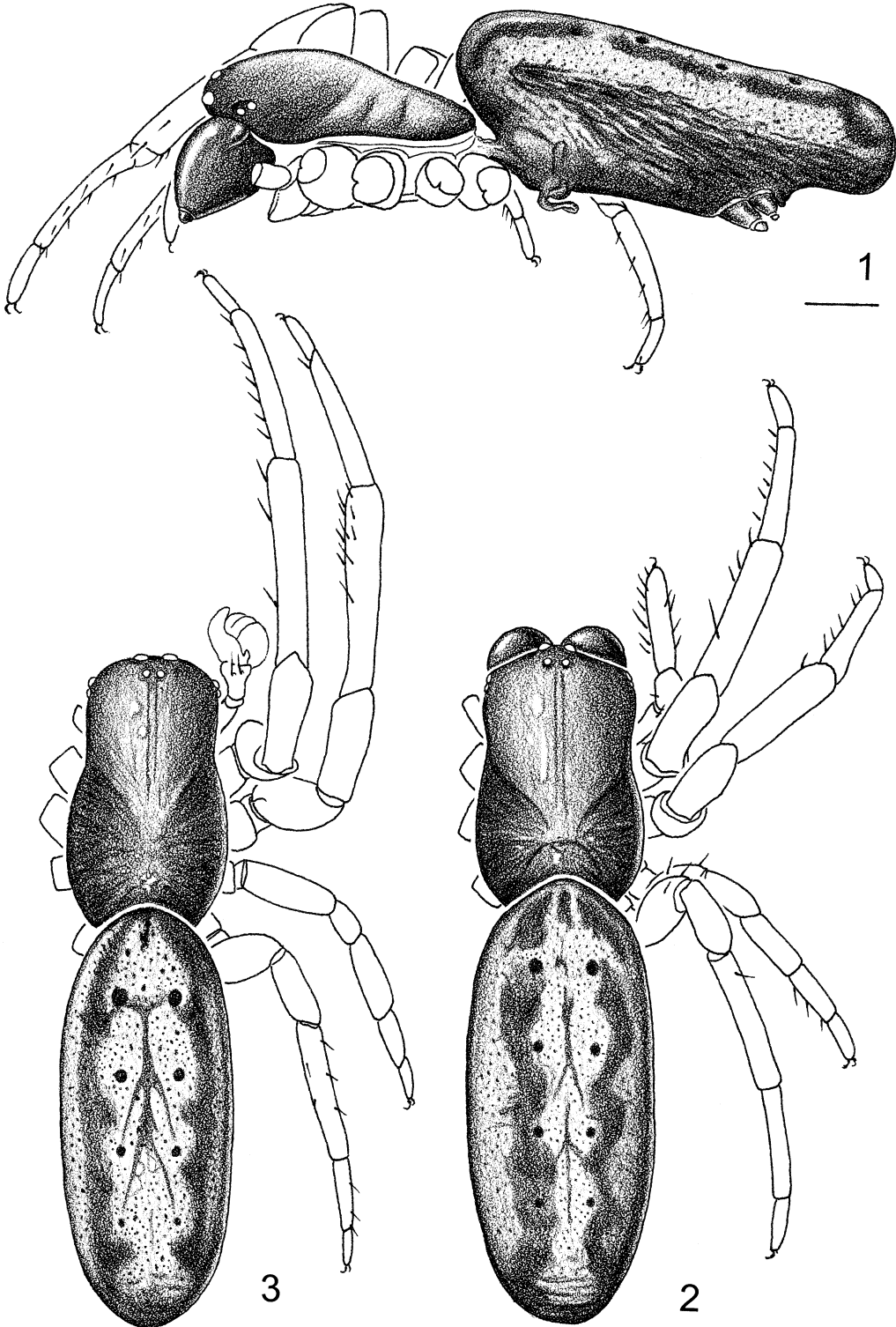
Singotyta acanthopus Simon 1907: 281–282, female, lectotype from Fernando Poo (designated herein), in MCSNG, examined; Lessert 1930: 626–627, fig. 9, female; Roewer 1942: 934; Bonnet 1958: 4060.

Singafrotya acanthopus (Simon): Benoit 1962: 219–220, female; Brignoli 1983: 242; Platnick 1993: 380.

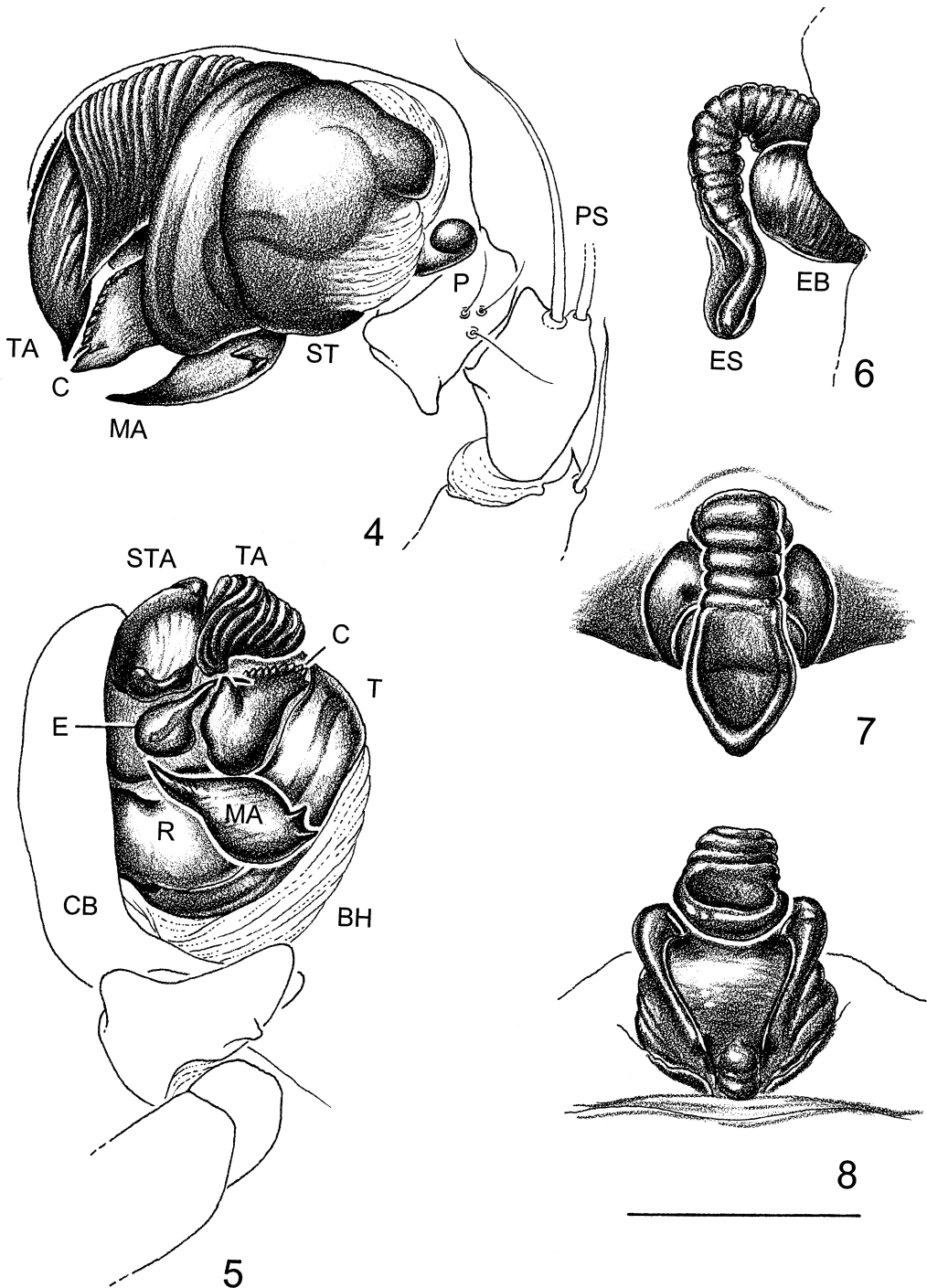
Types.—Simon (1907) described *Singotyta acanthopus* from specimens from Fernando Poo but did not designate a holotype, nor did he state how many females he examined in his type series. Since in his original description Simon reported the range of 8–9 mm as the total female length, we believe his type series included more than one female. Lessert (1930) and Benoit (1962) referred to the single female from MCSNG as the type and holotype, respectively. Since the existence of more than one female from Simon's type series is possible, we here fix the syntype female examined as the lectotype to become the unique bearer of the name *S. acanthopus*.

Note.—In his description of *Singafrotya goliath*, Benoit (1963: 31, 32) erroneously referred to the name of the other species of *Singafrotya* as "*S. clathrata* Simon". The error stems from Benoit confusing two of Simon's type specimens from MCSNG, *Singotyta acanthopus* Simon and *Clitaetra clathrata* Simon 1907. The species Benoit (1963: 31, 32) was referring to as "*S. clathrata* Simon", of course, is *S. acanthopus* Simon.

Diagnosis.—The males of *S. acanthopus* can be distinguished from those of *S. okavango* by the (Figs. 4–5) distal end of the terminal apophysis being shorter and not curved, larger embolus resting on conductor notch, conductor with marginal teeth pointing apically (mesally in *S. okavango*).



Figures 1–3.—*Singafrotypa acanthopus* (Simon 1907). 1–2. Female lectotype from Bioko, Equatorial Guinea; 1. Lateral; 2. Dorsal; 3. Male from Lamto, Ivory Coast, dorsal. Scale bar = 1.0 mm.



Figures 4–8.—*Singafrotypa acanthopus* (Simon 1907). 4–5. Left male palpus (Lamto, Ivory Coast); 4. Ectal; 5. Mesal; 6–8. Epigynum (lectotype); 6. Lateral; 7. Ventral; 8. Caudal. Scale bar = 0.5 mm. *Abbreviations*: BH = basal hematodocha; C = conductor; CB = cymbium; E = embolus; EB = epigynal base; ES = epigynal scape; MA = median apophysis; P = paracymbium; PS = palpal patellar setae; R = radix; STA = subterminal apophysis; ST = subtegulum; T = tegulum; TA = terminal apophysis.

Singafrotypa acanthopus females can be distinguished from *S. mandela* by the absence of stout macrosetae on palpal tarsus, and the absence of stout short macrosetae laterally on paturon, both present in the latter species. *Singafrotypa acanthopus* differs from both *S. okavango* and *S. mandela* by the epigynum shape (Figs. 6–8); epigynum base not heart-shaped (as it is in *S. okavango*), copulatory openings (ventral view) in the middle part of the epigynum base unlike in both other species. Scape with many wrinkles (fewer in *S. mandela*).

Description.—*Male* (from Lamto, Ivory Coast, Figs. 3–5). Total length 9.0. Cephalothorax 3.78 long, 2.35 wide, 1.08 high. Sternum 1.64 long, 1.0 wide. Abdomen 5.7 long, 2.5 wide. First femur 2.82 long. Chelicerae with 6 prolateral and 3 and 4 retrolateral teeth, and approximately 15 denticles in between. Pedipalp as in Figs. 4–5.

Female (lectotype): (Figs. 1–2, 6–8, 15): Total length 9.05. Cephalothorax 3.78 long, 2.28 wide, 1.19 high. Sternum 1.56 long, 1.08 wide. Abdomen 6.2 long, 2.64 wide. First femur 2.5 long. Chelicerae with 4 (+2 small) prolateral and 3 (+1 small) retrolateral teeth, and approximately 20 denticles in between. Palpal tarsus not conical (width/length = 0.35; Fig. 15). Epigynum as in Figs. 6–8.

Variation.—*Female* (n = 3, including the published data of Lessert and measurements of the two females examined here): Cephalothorax length 3.78–4.2. Total length 9.05–12.21. The coloration of the female abdomen dorsum varies substantially from the lectotype (pale) and the female from Ivory Coast (darker), but the general pattern is the same (Fig. 2). Two small denticles of the cheliceral promargin and one denticle of the retromargin in the lectotype observed as smaller and not in the same line with other denticles are clearly homologous to the more pronounced denticles in the female from Ivory Coast. The number of male cheliceral retrolateral denticles varied in the same specimen (3 on one side and 4 on the other).

Additional material examined.—IVORY COAST: Lamto, XII.1974, 1♂, R. Jocqué, in RMCA, no. 149.800; Lamto, V.1962, 1♀, L. Bigot, in RMCA, no. 131.528.

Distribution.—Western and central Africa.

Singafrotypa okavango new species

Figs. 9–12, 17

Types.—Holotype male and paratype female from BOTSWANA: Okavango swamps, Xugana Lagoon, approx. 19°00'S, 23°00'E, 1978, U. Wilmot, in NMP, no. 11720. 3 female paratypes from BOTSWANA: Okavango Delta, Lechwee Camp, 19°02'S, 23°15'E, 130 km N of Maun, Mopane forest margin and Okavango Delta margin, 16–17 November 1980, B. H. Lamoral, in NMP.

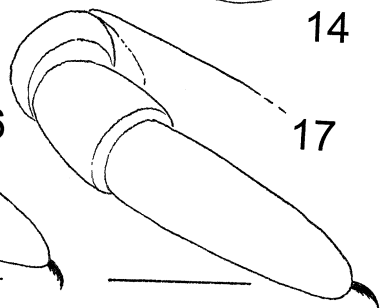
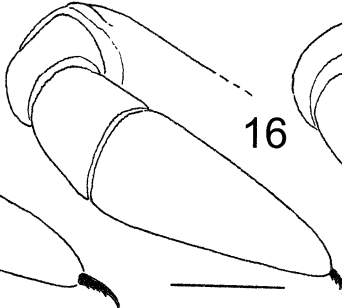
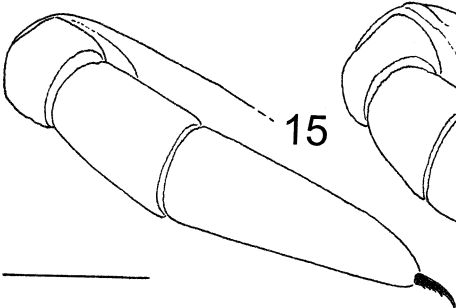
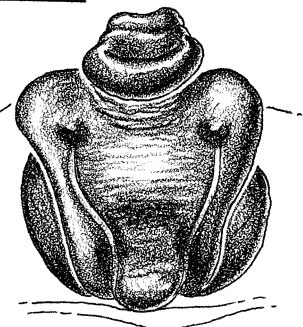
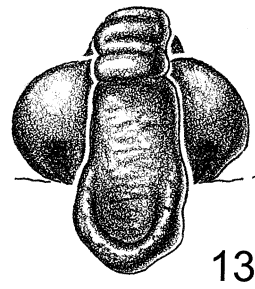
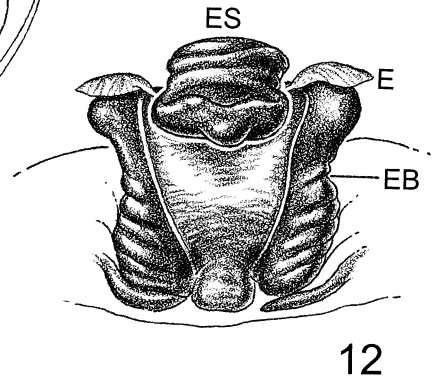
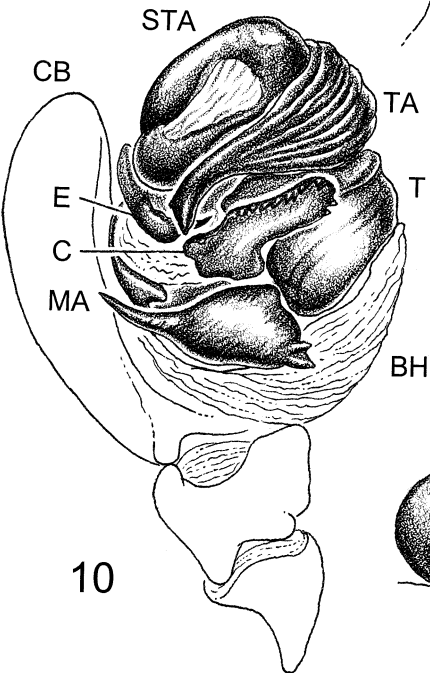
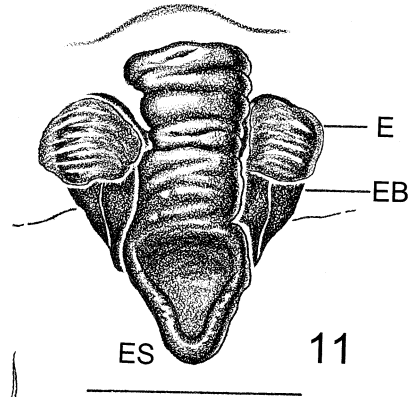
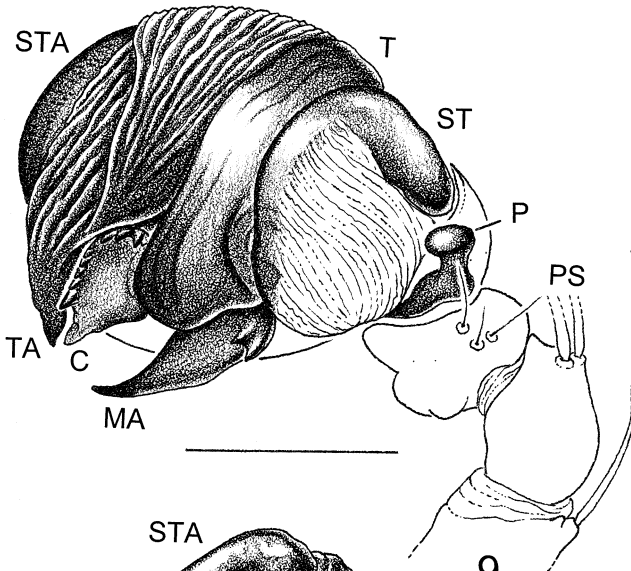
Etymology.—The species is named after Okavango Delta, its type locality. The specific epithet is a noun in apposition.

Diagnosis.—Males of *S. okavango* can be distinguished from those of *S. acanthopus* by the longer and curved terminal apophysis (Figs. 9–10), smaller embolus, not resting on the conductor notch (although this may be due to the fact that the palps of the only available male of *S. okavango* were partly expanded), marginal teeth of conductor pointing mesally (apically in *S. acanthopus*).

Singafrotypa okavango females can be distinguished from *S. mandela* by the absence of stout macrosetae on palpal tarsus, and the absence of stout short macrosetae laterally on paturon, both present in the latter species. *Singafrotypa okavango* differs from both *S. acanthopus* and *S. mandela* by the heart-shaped epigynum base (Figs. 11–12) with copulatory openings (ventral view) in the anterior part of the epigynum base unlike in both other species. Scape with many wrinkles (fewer in *S. mandela*).

Description.—*Male* (holotype, Figs. 9–10): Total length 7.49. Cephalothorax 3.47 long, 2.38 wide, 0.75 high. Sternum 1.56 long, 0.97 wide. Abdomen 4.26 long, 2.28 wide. First femur 3.13 long. Chelicerae with 5 prolateral and 3 retrolateral teeth, and approximately 12 denticles in between. Pedipalp as in Figs. 9–10.

Female (paratype from Xugana Lagoon, Figs. 11–12, 17): Total length 9.61. Cephalothorax 3.9 long, 2.38 wide, 1.19 high. Sternum 1.64 long, 1.13 wide. Abdomen 6.51 long, 3.13 wide. First femur 2.95 long. Chelicerae with 5 prolateral and 3 retrolateral teeth, and approximately 30 denticles in between. Palpal tarsus not conical (width/length = 0.33; Fig. 17). Epigynum as in Figs. 11–12. General so-



matic morphology except for the diagnostic characters is as in *S. acanthopus* (Figs. 1–3).

Variation.—*Female* (n = 4): Total length 9.61–14.57. Cephalothorax 3.9–5.05 long, 2.38–3.14 wide, 1.19–1.6 high. Sternum 1.64–2.25 long, 1.13–1.36 wide. Abdomen 6.51–10.23 long, 3.13–4.9 wide. First femur 2.95–4.1 long.

Additional material examined.—None.

Distribution.—Okavango Delta, Botswana.

Singafrotypa mandela new species
Figs. 13–14, 16

Types.—Holotype female from SOUTH AFRICA: near Cape Town (no further data), in NMP.

Etymology.—The species is named after Nelson Mandela in honor of his struggle against Apartheid. The specific epithet is a noun in apposition.

Diagnosis.—*Singafrotypa mandela* female can be distinguished from *S. acanthopus* and *S. okavango* by the presence of stout macrosetae on palpal tarsus, stout short macrosetae laterally on paturon, both absent in the latter two species. Epigynum base not heart-shaped (Figs. 13, 14) as in *S. okavango*, copulatory openings in the lower (posterior) part of the epigynum base (ventral view) unlike in both other species, and scape with fewer wrinkles. Posterior epigynal median plate (Fig. 14) wider than in *S. acanthopus* and *S. okavango* (Figs. 8, 12).

Description.—*Female* (holotype, Figs. 13–14, 16): Total length 9.3. Cephalothorax 3.9 long, 2.5 wide, 1.13 high. Sternum 1.56 long, 1.06 wide. Abdomen 6.63 long, 3.13 wide. First femur 2.63 long. Palpal tarsus conical (width/length = 0.44; Fig. 16). Epigynum as in Figs. 13–14. General somatic morphology except for the diagnostic characters as in *S. acanthopus* (Figs. 1–2), but the species is smaller.

Additional material examined.—None.

Distribution.—Cape Town region in South Africa.

Misplaced taxa
Neoscona goliath (Benoit 1963)
new combination

Singafrotypa goliath Benoit 1963: 30–32, figs. 1, 2, female; Platnick 1993: 380.

Types.—Benoit's (1963) female holotype in RMCA is lost (R. Jocqué, *in litt.*).

Diagnosis.—*Neoscona goliath* can be distinguished from other African *Neoscona* species (cf. Grasshoff 1986) by the following female characteristics described here from the illustrations of the female holotype of Benoit (1963: 30, figs. 1, 2): absence of abdominal humps, the abdomen as long as wide and rounded, the extremely narrow eye region, and the shape of the epigynal scape, which is long and narrow, narrowest in the middle, not apically (cf. species of the subgenus *Afraranea* in Grasshoff 1986). The latter characteristic separates *N. goliath* from the similar *Neoscona penicillipes* (Karsch 1879) of central and western Africa.

Distribution.—Ivory Coast. The only record of the species is that of the lost holotype.

Comments.—*Neoscona goliath* exhibits morphology of the genus *Neoscona* (cf. Grasshoff 1986), namely the narrow eye region and a long unwrinkled epigynal scape and lacks the folded scape of the epigynum, wide head region of the carapace and abdomen longer than wide characteristic of *Singafrotypa*.

ACKNOWLEDGMENTS

Material for this study was kindly loaned by Rudy Jocqué (Musée Royal de l'Afrique Centrale, Tervuren, Belgium; RMCA), Guy Redman (Natal Museum, Pietermaritzburg, South Africa; NMP) and Giuliano Doria (Museo Civico di Storia Naturale, Genova, Italy;

←

Figures 9–12.—*Singafrotypa okavango* new species 9–10. Left male palpus (holotype from Xugana Lagoon); 9. Ectal; 10. Mesal; 11–12. Epigynum (female paratype from Xugana Lagoon)—Note male embolus stuck in each copulatory opening; 11. Ventral; 12. Caudal.

Figures 13–14. *Singafrotypa mandela* new species, female epigynum (holotype from Cape Town). 13. Ventral; 14. Caudal.

Figures 15–17. Female pedipalps. 15. *Singafrotypa acanthopus* (Simon); 16. *Singafrotypa mandela* new species; 17. *Singafrotypa okavango* new species. Scale bars = 0.5 mm. Abbreviations as in Figs. 4–8.

MCSNG). We thank Herbert Levi, Nikolaj Scharff and Jonathan Coddington for their useful comments; the latter two made their character data available for reanalysis. Ingi Agnarsson, Jeremy Miller and Fernando Alvarez also provided comments and suggestions at various stages of this work. We thank Mark Harvey, Herbert Levi, Petra Sierwald, and an anonymous referee for their comments on the manuscript. This project was supported by a U.S. National Science Foundation grant (DEB-9712353) and by a Research Enhancement Fund grant from The George Washington University. The first author acknowledges support of the Slovenian Ministry of Science and the Institute of Biology of the Slovene Academy of Sciences and Arts.

LITERATURE CITED

- Benoit, P.L.G. 1962. Les Araneidae-Nephilinae africains. *Revue de Zoologie et de Botanique Africaines* 65:217–231.
- Benoit, P.L.G. 1963. Araneidae-Nephilinae africains nouveaux ou peu connus. *Revue de Zoologie et de Botanique Africaines* 67:29–32.
- Bonnet, P. 1958. *Bibliographia Araneorum*, Vol. 2, Part 4, (N-S). Toulouse, Les Frères Douladoure.
- Brignoli, P.M. 1983. *A Catalogue Of The Araneae Described Between 1940 And 1981*. Manchester, Manchester University Press in association with The British Arachnological Society.
- Coddington, J.A. 1990. Ontogeny and homology in the male palpus of orb weaving spiders and their relatives, with comments on phylogeny (Araneocladia: Araneoidea, Deinopoidea). *Smithsonian Contributions to Zoology* 496:1–52.
- Dippenaar-Schoeman, A.S. & R. Jocqué. 1997. *African Spiders—An Identification Manual*. Pretoria, ARC—Plant Protection Research Institute. 392 pp.
- Dondale, C.D. 1966. The spider fauna (Araneida) of deciduous orchards in the Australian capital territory. *Australian Journal of Zoology* 14: 1157–1192.
- Farris, J.S. 1969. A successive approximations approach to character weighting. *Systematic Zoology* 18:374–385.
- Fitch, W.M. 1971. Towards defining the course of evolution: Minimal change for a specific tree topology. *Systematic Zoology* 20:406–416.
- Goloboff, P.A. 1993. NONA version 2.0. Available at <http://www.cladistics.com/>.
- Grasshoff, M. 1970a. Die Gattung *Kilima* n. gen. (Arachnida, Araneae, Araneidae). *Senckenbergiana Biologica* 51(1–2):119–128.
- Grasshoff, M. 1970b. Die Tribus Mangorini I.—Die Gattungen *Eustala*, *Larinia* s. str., *Larinopa* n. gen. (Arachnida, Araneae, Araneidae-Araneinae). *Senckenbergiana Biologica* 51(3–4):209–234.
- Grasshoff, M. 1970c. Die Tribus Mangorini II.—Die neuen Gattungen *Siwa*, *Paralarinia*, *Mahembea* und *Larinaria* (Arachnida, Araneae, Araneidae-Araneinae). *Senckenbergiana Biologica* 51(5–6):409–423.
- Grasshoff, M. 1971. Die Tribus Mangorini III. Die Gattung *Drexelia* MacCook (Arachnida, Araneae, Araneidae, Araneinae). *Senckenbergiana Biologica* 52(1–2):81–95.
- Grasshoff, M. 1986. Die Radnetzspinnen-Gattung *Neoscona* in Afrika (Arachnida: Araneae). *Annales—Musée royal de l’Afrique centrale. (Sciences zoologiques)* 250:1–123.
- Harrod, J.C., H.W. Levi & L.B. Leibensperger. 1990. The Neotropical orbweavers of the genus *Larinia* (Araneae: Araneidae). *Psyche* 97(3–4): 241–265.
- Hormiga, G. 1994. A revision and cladistic analysis of the spider family Pimoidae (Araneoidea: Araneae). *Smithsonian Contributions to Zoology* 549:1–104.
- Hormiga, G., W.G. Eberhard, & J.A. Coddington. 1995. Web-construction behaviour in Australian *Phonognatha* and the phylogeny of nephiline and tetragnathid spiders (Araneae: Tetragnathidae). *Australian Journal of Zoology* 43(4):313–364.
- Lessert, de R. 1930. Araignées du Congo recueillies au cours de l’expédition par l’American Museum (1909–1915). Quatrième et dernière partie. *Revue suisse de zoologie* 37(22):613–672.
- Levi, H.W. 1986. The Neotropical orb-weaver genera *Chrysometa* and *Homalometa* (Araneae: Tetragnathidae). *Bulletin of the Museum of Comparative Zoology* 151(3):91–215.
- Levi, H.W. 1991. The Neotropical and Mexican species of the orb-weaver genera *Araneus*, *Dubiepeira*, and *Aculepeira* (Araneae: Araneidae). *Bulletin of the Museum of Comparative Zoology* 152(4):167–315.
- Levi, H.W. & V.R.D. von Eickstedt. 1989. The Nephilinae spiders of the Neotropics (Araneae: Tetragnathidae). *Memorias del Instituto de Butantan* 51(2):43–56.
- Murphy, F. & J. Murphy. 2000. *An introduction to the spiders of South East Asia*. Malaysian Nature Society, Kuala Lumpur.
- Nixon, K. 2000. Winclada version 0.9.99m24 (BETA). Available at <http://www.cladistics.com/>.
- Platnick, N.I. 1989. *Advances In Spider Taxonomy: A Supplement To Brignoli’s A Catalogue Of The Araneae Described Between 1940 And 1981*. Manchester University Press.
- Platnick, N.I. 1993. *Advances In Spider Taxonomy 1988–1991: With Synonymies And Transfers 1940–1980*. New York Entomological Society and The American Museum of Natural History.

- Platnick, N.I. 1997. *Advances In Spider Taxonomy 1992–1995: With Redescriptions 1940–1980*. New York Entomological Society And The American Museum Of Natural History.
- Platnick, N.I. 2000. *The World Spider Catalog*. The American Museum of Natural History. Available at <http://research.amnh.org/entomology/>.
- Roewer, C. F. 1942. *Katalog der Araneae von 1758 bis 1940, bzw. 1954.*, Vol. 1. Bremen.
- Scharff, N. & J.A. Coddington. 1997. A phylogenetic analysis of the orb-weaving spider family Araneidae (Arachnida, Araneae). *Zoological Journal of the Linnean Society* 120(4):355–434.
- Simon, E. 1894. *Histoire naturelle des araignées*. Paris, 1:489–760.
- Simon, E. 1907. *Arachnides recueillis par L. Fea sur la côte occidentale d’Afrique*. 1re partie. *Annali del museo civico di storia naturale di Genova* 43:218–323.
- Swofford, D.L. 2000. PAUP*, Version 4.0b4a. Sinauer Publishers, Sunderland.
- Thirunavukarasu, P., M. Nicolson & M.A. Elgar. 1996. Leaf selection by the leaf-curling spider *Phonognatha graeffei* (Keyserling) (Araneoidea: Araneae). *Bulletin of the British Arachnological Society* 10(5):187–189.

Manuscript received 15 February 2001, revised 1 November 2001.