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## ***Cebrennus* Simon, 1880 (Araneae: Sparassidae): a revisionary up-date with the description of four new species and an updated identification key for all species**

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### **Abstract**

The spider genus *Cebrennus* Simon, 1880 is revised again after thirteen years. Four new species are described: *Cebrennus atlas* **spec. nov.** from Morocco (female), *C. flagellatus* **spec. nov.** from Afghanistan (male), *C. laurae* **spec. nov.** from Canary Islands (male), and *C. rechenbergi* **spec. nov.** from Morocco (male and female). *Cebrennus clercki* (Audouin, 1826) **comb. nov.** is transferred from Philodromidae to Sparassidae and considered a nomen dubium. The holotype of *C. aethiopicus* Simon, 1880 is illustrated for the first time. *Cebrennus tunetanus* Simon, 1885 is re-described by illustrating its copulatory organs and some somatic characters, the internal duct system is shown for the first time supporting its placement in *Cebrennus*. An updated identification key for all species is provided. New records of *Cebrennus* species are listed: *C. wagaie* (Simon, 1874) is recorded from Libya and Malta for the first time, the latter representing the first record for the entire genus from Europe. *C. kochi* (O. Pickard-Cambridge, 1872) is recorded from Syria, *C. aethiopicus* from Sudan for the first time. Records from the Canary Islands and from Afghanistan extend the known generic distribution range further to the West and East. Behavioural aspects (burrowing, escaping, mating) of *C. rechenbergi* and partly of *C. villosus* (Jézéquel & Junqua, 1966) are described. Photographs of this behaviour as well as of the habitus of several species are provided.

**Key words:** taxonomy, behaviour, escaping strategy, transfer, Africa, Asia, Europe, Canary Islands, Morocco, Afghanistan, Malta

### **Introduction**

The genus *Cebrennus* Simon, 1880 contains thirteen species mainly from the south-western Palearctic (Morocco to Turkmenistan) (Jäger 2000). All species live in arid environments, are nocturnal and build their retreats either under stones, on small plants or in loose sand. Only little more is known of their biology or ecology. The genus was erected by Simon (1874) for two species (*wagaie*, *kochi*) under the preoccupied name *Cebrenis*. Six years later he provided the then valid genus name *Cebrennus* and added three species (*castaneitarsis*, *aethiopicus*, *pulcherrimus*) (Simon 1880), the latter of which was transferred to the genus *Cerbalus* as its type species (Simon 1897). Five years later he described a further species (Simon 1885: *tunetanus*). Fage (1921) reviewed the genus and described two species (*cultrifer*, *powelli*). Denis (1947: *concolor*; sub *Cerbalus*) as well as Jézéquel and Junqua (1966: *villosus*; sub *Cerbalopsis*) each added one species. Jäger (2000) revised the genus and described four new species (*intermedius*, *logunovi*, *mayri*, *rungsi*). Since this last publication no systematic paper was devoted to this genus, which may be due to the fact that *Cebrennus* species seem to be difficult to collect, which along with other reasons makes the identification of specimens to species level and differentiation between species difficult: 1. As in many Sparassidae many “series” contain only single adult specimens, thus investigations of intraspecific variation and matching male and female sex is not easy. In series containing males and females, one has to be careful, since sometimes specimens with different locality data were added subsequently (see notes in *C. castaneitarsis* and *C. wagaie*). 2. Somatic characters (including colour pattern) are very similar between all species. Therefore matching opposite sex according to Edwards (2013) is difficult. 3. In many cases only old material is available, where not all characters (e.g., internal duct system) can be examined and only imprecise locality data are known (e.g., Egypt at the time of Audouin). 4. Membranous parts in the internal duct system of females lead to a strong natural

variability of these particular parts (especially in comparison with hard and sclerotised structures), which when treated with different kind of chemicals (e.g., lactic acid) become artificially modified. Moreover, some structures are expandable and can be demolished by the slightest touch (e.g., expandable membranous atria in females of the *Cebrennus wagae*-group). Series of several males and females from one locality as well as fresh samples suitable for DNA-extraction and subsequent molecular analyses should help in the future to define boundaries between species better.

## Material and methods

Measurements are in millimetres, arising points of tegular appendages are given as clock-positions of the unexpanded left palp in ventral view. Epigynes are dissected and only some are treated with 96% lactic acid in order to recognise internal details of the internal duct system. Leg and palp measurements are given as: total (femur, patella, tibia, metatarsus, tarsus). Spination pattern given follows Davies (1994): sums of all spines are listed (prolateral, dorsal, retrolateral, ventral), when ventral spines are absent only three digits are listed. Bristles on chelicerae are indicated in illustrations by their bases. Leg formula is given as order of legs according to their length (femur to tarsus) in Arabic numbers. Size classes are used according to Jäger (2001: 14): small (<10 mm), medium (>10 and <20 mm), large (>20 and <30 mm), very large (>30 mm). Material is stored in 70% denatured ethanol. Photographs were taken by the author, exceptions are indicated in legends.

Species are listed in “Material” sections according to their distribution from North to South, within a species group according to their embolus length. Elevation when received from Google Earth is added in square brackets.

Abbreviations used in text: ALE—anterior lateral eyes, AME—anterior median eyes, AW—anterior width of dorsal shield of prosoma, OL—opisthosoma length, OW—opisthosoma width, PJ—serial number of Sparassidae examined by Peter Jäger, PL—length of dorsal shield of prosoma, PLE—posterior lateral eyes, PME—posterior median eyes, PW—width of dorsal shield of prosoma, RTA—retrolateral tibial apophysis, SD—serial number of tissue samples for molecular analyses, I–IV—legs I to IV.

Museum collections: MMBC—Moravian Museum, Brno, Czech Republic (Igor Malenovský); MNHN—Museum National d’Histoire Naturelle, Paris, France (Christine Rollard); NHMW—Natural History Museum Vienna, Austria (Christoph Hörweg); SMF—Senckenberg Research Institute, Frankfurt, Germany (Julia Altmann, Peter Jäger) TAUZM—Tel Aviv University, Zoological Museum, Israel (Efrat Gavish-Regev); ZIN—Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia (K. Mikhailov); ZMB—Zoologisches Museum Berlin, Germany (Anja Friederichs, Jason Dunlop).

## Taxonomy

### Sparassidae Bertkau, 1872

#### *Cebrennus* Simon, 1880

*Cebrenis* Simon, 1874: 263 (description of genus; name preoccupied in Coreidae, Heteroptera)

*Cebrennus* Simon, 1880: 229, 331 (nomen novum for *Cebrenis*). Levy 1989: 155–162 (revision of species from Israel); Jäger 2000: 165 (revision).

*Cerbalopsis* Jézéquel & Junqua, 1966: 969 (description of new genus; synonymy by Jäger 2000: 165).

**Note.** Usually *Cebrennus* was considered a member of the subfamily Sparassinae Bertkau, 1872 (Jäger 1998). According to a recently proposed molecular phylogeny, *Micrommata* (type genus of Sparassinae; see Jäger 1999) does not form a monophylum with the assumed Sparassinae (Moradmand et al., 2014). *Cebrennus* appeared sister to *Cerbalus*, and both sister to *Olios*.

#### Identification key to *Cebrennus* species

(except for *C. clerckii* comb nov. nomen dubium and the unidentified specimens named spec. A and spec. B in this paper). “Figs” refer to illustrations in the present paper, “figs” to those in Jäger (2000).

**Males** (those of *atlas spec. nov.*, *mayri* unknown)

1	Distal embolus coiled (Figs 105, 109) . . . . .	2
-	Distal embolus not coiled, but straight, bent or with distal loop. . . . .	5
2	RTA reaching (Jäger 2000: figs 68–69) or extending beyond (Figs 105) distal margin of tibia. . . . .	3
-	RTA not reaching distal margin of tibia (Figs 111–112) . . . . .	4
3	RTA long, extending beyond distal tibia, embolic coil situated distally; Canary Islands (Figs 105–108, 173) . . . . .	
	. . . . . <i>laurae spec. nov.</i>	
-	RTA short, reaching barely tibial margin, embolic coil situated retrolaterally; Egypt (Jäger 2000: figs 68–72; Fig. 173) . . . . .	
	. . . . . <i>concolor</i>	
4	RTA developed as small blunt hump, posterior teeth of chelicerae adnate in their basal half; Algeria, Tunisia (Jäger 2000: figs 73–77; Fig. 173) . . . . .	
-	RTA tooth-shaped, posterior teeth of chelicerae adnate in their apical half; Morocco (Figs 109–117, 173) . . . . .	
	. . . . . <i>rechenbergi spec. nov.</i>	
5	Distal embolus reaching proximal half of bulbus (Figs 15, 32) . . . . .	6
-	Distal embolus situated in distal half of bulbus (Figs 12, 162). . . . .	10
6	Distal embolus helical, barely reaching proximal half of bulbus, RTA short, barely extending beyond distal tibia; Saudi Arabia (Jäger 2000: figs 61–67; Fig. 173) . . . . .	
	. . . . . <i>intermedius</i>	
-	Distal embolus with large loop, reaching or extending beyond proximal tegulum, RTA long, well extending beyond distal tibia (Figs 15, 32) . . . . .	7
7	Embolic kink with flagellum; Afghanistan (Figs 32–35, 173) . . . . .	
	. . . . . <i>flagellatus spec. nov.</i>	
-	Embolic kink without flagellum (Figs 15, 30) . . . . .	8
8	Embolus arising in 6-o'clock-position; Algeria, Tunisia, Libya, Israel (Figs 15–17, 173) . . . . .	
	. . . . . <i>castaneitarsis</i>	
-	Embolus arising in 3- to 5-o'clock-position (Figs 18–31) . . . . .	9
9	Embolus base reaching usually retrolateral margin of tegulum, distal margin of RTA with slight angle between long distal branch and proximal part; Ethiopia, Saudi Arabia, Sudan, Djibouti (Figs 24–31, 173) . . . . .	
	. . . . . <i>aethiopicus</i>	
-	Embolus base not reaching retrolateral margin of tegulum, distal margin of RTA rounded, without distinct angle; Algeria, Tunisia, Libya, Malta (Figs 18–23, 173) . . . . .	
	. . . . . <i>wagae</i>	
10	RTA distally well extending beyond tibia, distad (Figs 12, 162) . . . . .	11
-	RTA only barely extending beyond tibia, short or laterad (Jäger 2000: figs 1–2, 7–8, 17–18) . . . . .	13
11	Embolus without distinct kink, embolus tip distad; Tunisia (Figs 162–166, 173) . . . . .	
	. . . . . <i>tunetanus</i>	
-	Embolus with distinct kink, embolus tip retrolaterad to proximad (Fig. 12, Jäger 2000: fig. 22) . . . . .	12
12	RTA shorter than tegulum, embolus tip retrolaterad; Morocco (Figs 12–13, 173) . . . . .	
	. . . . . <i>rungsi</i>	
-	RTA longer than tegulum, embolus tip proximad; Morocco (Jäger 2000: figs 22–33; Fig. 173) . . . . .	
	. . . . . <i>powelli</i>	
13	RTA short hook-shaped, embolus long spine-shaped; Algeria (Jäger 2000: figs 1–6; Fig. 173) . . . . .	
	. . . . . <i>cultrifer</i>	
-	RTA longer, distinctly retrolaterad, embolus shorter (Jäger 2000: figs 7, 17) . . . . .	14
14	RTA with indistinct hump, embolus tip slightly curved; Turkmenistan (Jäger 2000: figs 7–11; Fig. 173) . . . . .	
	. . . . . <i>logunovi</i>	
-	RTA with massive apophysis, embolus distinctly curved; Israel, Syria (Jäger 2000: figs 17–18; Fig. 173) . . . . .	
	. . . . . <i>kochi</i>	

**Females** (those of *concolor*, *cultrifer*, *flagellatus spec. nov.*, *intermedius*, *laurae spec. nov.* unknown)

1	Epigyne with two laterally situated curved ridges, without distinct median septum, without rims or ridges anteriorly (Figs 36–62) . . . . .	2
-	Epigyne without laterally situated curved ridges, with distinct median septum and/or rims or ridges anteriorly (Figs 1–8, 118, 167) . . . . .	3
2	Females of the following three species not distinguishable without males (see also diagnoses of particular species): <i>aethiopicus</i> (Ethiopia, Saudi Arabia, Sudan, Djibouti; Figs 55–62), <i>castaneitarsis</i> (Algeria, Tunisia, Libya, Israel; Figs 36–38), <i>wagae</i> (Algeria, Tunisia, Libya, Malta; Figs 42–54) . . . . .	
3	Median septum longer than wide (Figs 1, 118, 167) . . . . .	4
-	Median septum wider than long (Fig. 7) . . . . .	8
4	Median septum long and narrow with almost parallel margins (Figs 118, 123) . . . . .	5
-	Median septum different, margins not parallel (1, 4, 167) . . . . .	6
5	Rounded median structures of the internal duct system (glandular appendages) relatively large, i.e. their largest diameter as wide as duct system, posterior teeth of chelicerae adnate in their apical half; Morocco (Figs 118–127, 173) . . . . .	
	. . . . . <i>rechenbergi spec. nov.</i>	
-	Rounded median structures of the internal duct system (glandular appendages) relatively small, i.e. their largest diameter not as wide as duct system, posterior teeth of chelicerae adnate in their proximal half; Algeria, Tunisia (Jäger 2000: figs 78–85, Fig. 173) . . . . .	
	. . . . . <i>villosus</i>	
6	Median septum triangular (Fig. 167; Jäger 2000: fig. 56) . . . . .	7
-	Median septum not triangular, anterior and posterior part similarly wide; Israel, Syria (Figs 1–6, 173) . . . . .	
	. . . . . <i>kochi</i>	
7	Epigyne with light “windows” anteriorly, glandular appendages of internal duct system anteriorly; Tunisia (Figs 167–171, 173) . . . . .	
	. . . . . <i>tunetanus</i>	
-	Epigyne without such “windows”, glandular appendages of internal duct system posteriorly; Oman (Jäger 2000: figs 56–60; Fig. 173) . . . . .	
	. . . . . <i>mayri</i>	
8	Median septum with median structure (Jäger 2000: figs 12, 37) . . . . .	9

- Median septum without median structure (Fig. 7; Jäger 2000: fig. 28) ..... 10
- 9 Median structure of median septum longer than wide, atria of internal duct system small, glandular appendages elongated; Morocco (Jäger 2000: figs 37–41; Fig. 173) ..... *rungsi*
- Median structure of median septum as long as wide, atria of internal duct system large, glandular appendages circular; Turkmenistan (Jäger 2000: figs 12–16; Fig. 173) ..... *logunovi*
- 10 Median septum with two eyebrow-like anterior rims close to copulatory openings and one additional transversal ridge, internal duct system as wide as long; Morocco (Figs 7–11, 173) ..... *atlas spec. nov.*
- Median septum with one anterior transversal ridge, internal duct system wider than long; Morocco (Jäger 2000: figs 28–33; Fig. 173) ..... *powelli*

### ***kochi* group**

**Diagnosis.** See Jäger (2000).

**Species included.** *C. kochi*, *C. logunovi*.

**Distribution.** Israel, Central Asia (Fig. 173).

### ***Cebrennus kochi* (O. Pickard-Cambridge, 1872)**

Figs 1–6, 88–91, 173

*Heteropoda kochii* O. Pickard-Cambridge, 1872: 312, pl. 14, fig. 13 (description of male and female; syntypes from Jerusalem, Israel, HECO B.1416, not examined).

*Cebrenis kochi* Simon 1874: 266, pl. 5, fig. 2 (redescription of female, transfer to *Cebrenis*).

*Cebrennus kochi* Simon 1880: 332 (transfer to *Cebrennus*). Fage 1921: 163, figs 2a–c (illustration of male and female); Levy 1989: 155, figs 84–93 (illustration of male and female); Jäger 2000: 171, figs 17–21 (illustration of male and female).

**Material examined.** **SYRIA: Rif Dimashq:** 3 males (PJ 3392–3394), Golan, vicinity Camp Fauar, June 1981, K. Kallenberger leg. + ded. (NHMW). **ISRAEL: Northern District:** 1 female (PJ 3402, SD 391), Golan, Lake of Galilee, olive orchard, N 32°52'47", W 35°33'01", [165 m elev.], 12 September 2011 (SMF). **Central District:** 1 male (PJ 3409, SD 394), Geulim [32°17'47.35"N, 34°56'37.90"E, 63 m elev.], at home, Ron Keren leg. 1 April 2012 (TAUZM Ar 50318). **Tel Aviv:** 1 male (PJ 3401), Jaffa (SMF 5570). **Southern District:** 1 female (PJ 3400), Negev desert, between Beer Sheva and Mitzpe Ramon, Sede Boqer, Milan Rezac leg. 6–29 May 2003 (SMF).

**Diagnosis.** Small to medium-sized Sparassinae, body length of males: 8.2–13.0, females: 14.3–19.6. Males and females see Jäger (2000).

**Description.** See Levy (1989). Some additional characters are given here for 1 female (PJ 3400): AME 0.41, ALE 0.33, PME 0.26, PLE 0.26, AME–AME 0.25, AME–ALE 0.38, PME–PME 0.51, PME–PLE 1.25, AME–PME 0.40, ALE–PLE 0.93, clypeus AME 0.23, clypeus ALE 0.25. Spination: Palp: 020, 000, 1000, 1000; legs: femur I–II 323, III 322(1), IV 321; patella 000; tibia I 202(3)4, III–IV 2024; metatarsus I, III 2024, II 202(1)4, IV 3036. Ventral metatarsi I–IV with scopula in distal half, without spines or bristles distally. Palpal claw with ca. 10 teeth.

**Variation.** Males (n=5): PL 4.9–6.4, PW 4.3–6.0, AW 3.1–4.2, OL 5.3–6.9, OW 3.8–5.0; chelicerae with 2 anterior and 4–6 adnate posterior teeth. Females (n=1): PL 6.0, PW 4.9, AW 3.9, OL 5.1, OW 3.7; chelicerae with 2 anterior and 5/6 adnate posterior teeth. Females show a strong variation in the shape of epigynal field, median septum as well as the anterior membranous parts (atria) of the internal duct system (Figs 1–6).

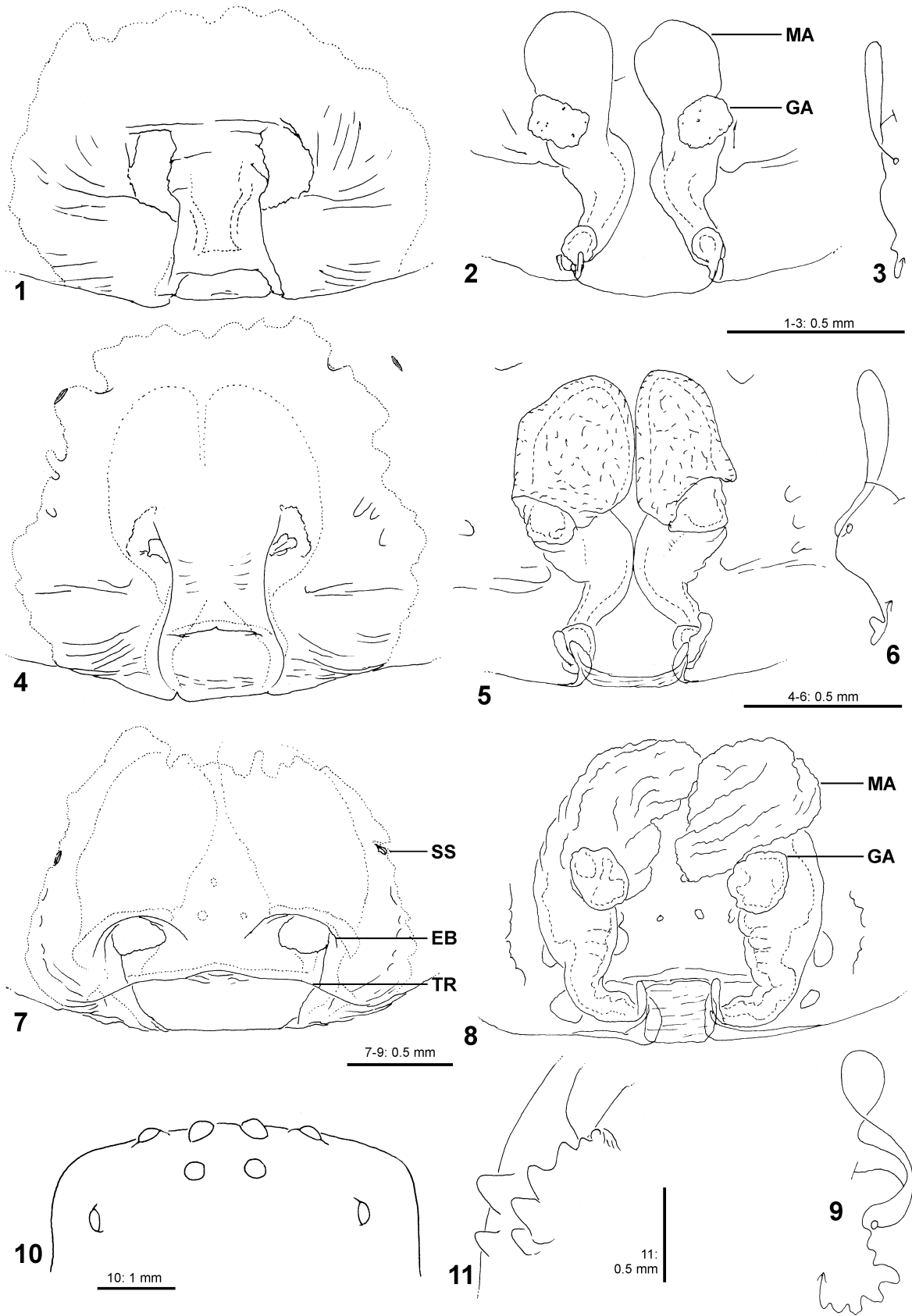
**Distribution.** Syria, Israel (Fig. 173).

### ***wagae* group**

**Diagnosis.** See Jäger (2000).

**Species included.** *C. powelli*, *C. atlas spec. nov.*, *C. rungsi*, *C. aethiopicus*, *C. castaneitarsis*, *C. wagae*, *C. flagellatus spec. nov.*

**Distribution.** Northern Africa (Morocco to Ethiopia), Europe (Malta), Asia (Afghanistan, Israel, Saudi Arabia) (Fig. 173).



**FIGURES 1–11.** 1–6 *Cebrennus kochi* (O. Pickard-Cambridge, 1872), females from Israel (1–3 Lake of Galilee; 4–6 Sede Boquer); 7–11 *Cebrennus atlas* **spec. nov.**, holotype female from Atlas, Morocco. 1, 4, 7 Epigyne, ventral; 2, 5, 8 Vulva, dorsal; 3, 6, 9 Schematic course of internal duct system, dorsal; 10 Eye arrangement, dorsal; 11 Cheliceral dentition, ventral. EB—eyebrow-like rims, GA—glandular appendages, MA—membranous atrium, SS—slit sense organ, TR—transversal rim of median septum.

***Cebrennus atlas* spec. nov.**

Figs 7–11, 94–96, 173

**Type material. MOROCCO: Marrakesh-Tensift-El Haouz:** Holotype female (PJ 3403), Atlas, ca. 15 km N of pass Tizi N'Test, under stone with egg sac, S. Huber leg. 24 July 2000 (SMF).

**Diagnosis.** Medium-sized Sparassinae, body length of female: 12.8. Copulatory organ similar to that of *C. powelli* Fage, 1921 in having the median septum wider than long and the general bauplan of the vulva (Figs 7–9). It is distinguished by the distinct transverse rim halfway between copulatory openings and epigastral furrow (at level of and between copulatory openings in *C. powelli*), epigynal ledges anterior of copulatory openings (situated laterally in *C. powelli*), sclerotized (posterior) part of internal duct system roughly as long as wide (ca. twice as wide as long in *C. powelli*), diameter of glandular appendages larger than half diameter of copulatory duct (smaller in *C. powelli*).

**Etymology.** The specific name is derived from the type locality; noun in apposition.

**Description.** Female: PL 6.1, PW 5.8, AW 4.6, OL 6.7, OW 3.7. AME 0.40, ALE 0.32, PME 0.26, PLE 0.28, AME–AME 0.27, AME–ALE 0.33, PME–PME 0.55, PME–PLE 1.12, AME–PME 0.40, ALE–PLE 1.05, clypeus AME 0.25, clypeus ALE 0.21 (Fig. 10). Spination: Palp: 020, 000, 1000, 1000; legs: femur I–II 323, III–IV 321; patella 000; tibia I–IV 2024; metatarsus I–III 2024, IV 3036. Ventral metatarsi I–IV with scopula in distal half, without spines or bristles distally. Leg formula: 2413. Measurements of palp and legs: Palp 7.1 (2.3, 1.0, 1.3, -, 2.5), leg I 22.7 (6.5, 2.9, 5.8, 6.0, 1.5), leg II 25.6 (7.5, 3.0, 6.5, 6.8, 1.8), leg III 19.5 (6.0, 2.4, 4.7, 4.8, 1.6), leg IV 23.0 (7.1, 2.5, 5.5, 6.3, 1.6). Cheliceral furrow with 2 anterior and 6 adnate posterior teeth, without denticles (Fig. 11). Margin of chelicerae close to fang base with 2(3) bristles. Palpal claw with ca. 12 teeth.

Copulatory organ as in diagnosis (Figs 7–9). Epigynal field wider than long, without anterior bands, with one slit sensillum on each side integrated within epigynal field. Membranous parts of internal duct system (atria) developed as anteriorly situated sacs of different shapes. Sclerotised, posterior part wide, narrowing posteriorly, slightly twisted, posterior part bent at right angle. Fertilisation ducts flattened, parallel, anteriad.

Colouration in ethanol (Figs 94–96): Yellowish- to reddish-brown. Dorsal prosoma yellowish-brown with fovea and anterio-lateral margin darker. Sternum, ventral coxae and femora pale yellowish-brown. Gnathocoxae and labium reddish-brown with distinct proximal patch and light yellowish-brown distal lip. Chelicerae deep reddish-brown with 3 dark longitudinal bands frontally. Palp and legs yellowish-brown with distal segments darker. Opisthosoma shrunken with pattern badly recognisable: dorsally with indistinct median row of small patches, laterally spotted.

Male: unknown.

**Distribution.** Only known from the type locality (Fig. 173).

***Cebrennus rungsi* (Jäger, 2000)**

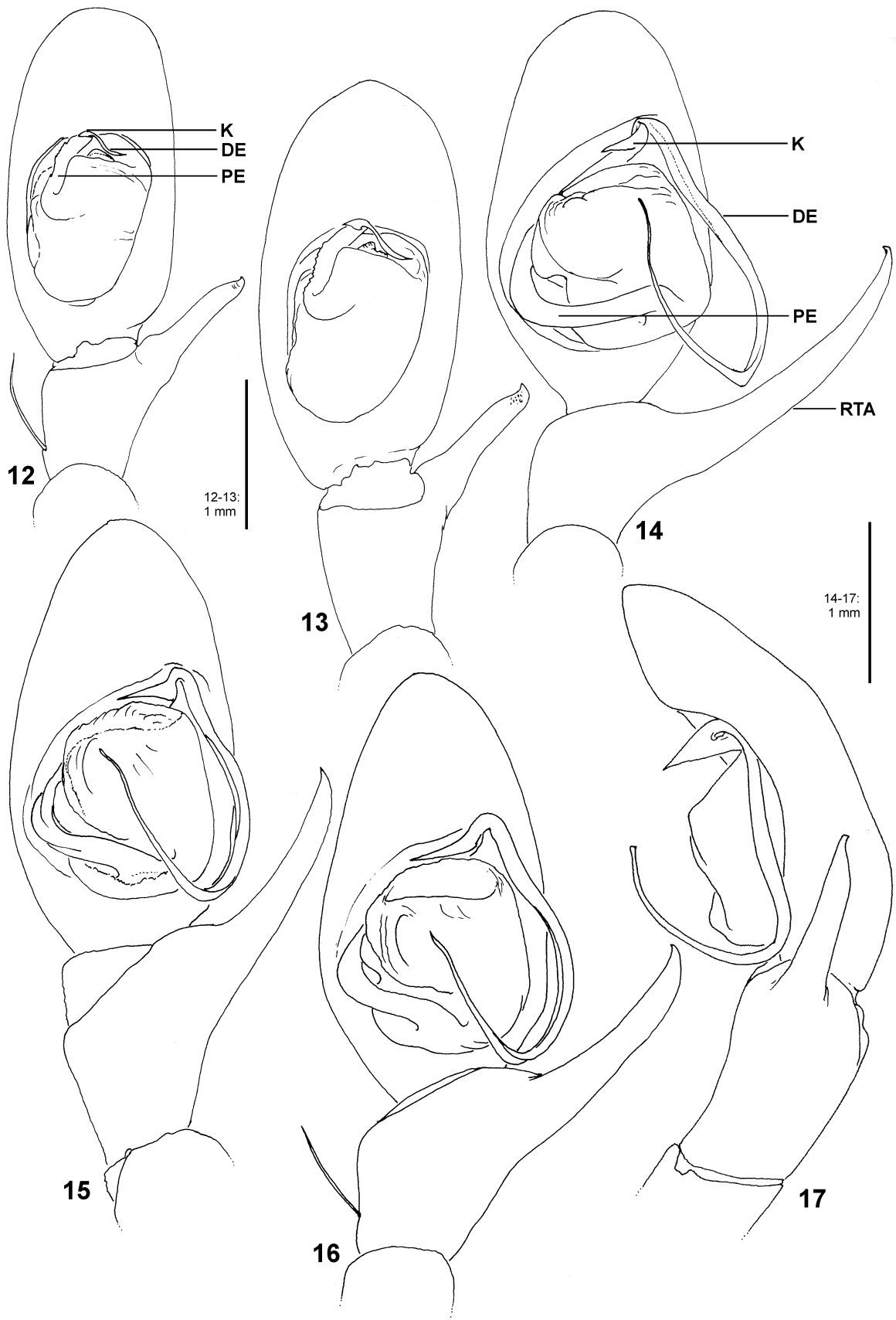
Figs 12–13, 92–93, 173

*Cebrennus rungsi* Jäger, 2000: 172, figs 34–41 (description of male and female).

**Material examined. MOROCCO: Souss-Massa-Drâa:** 1 male (PJ 3391), Agadir, Hering leg. 2 November 1986 (ZMB); 1 male (PJ 3396, SD 645), Anti-Atlas Range, Ighil, ca. 110 air km ESE of Agadir, N 30°8'29.98", W 8°29'6.76", [1584 m elev.], point 54, desert, S. Henriques leg. 29 September 2011 (SMF); 1 male (PJ 3397, SD 646), Anti-Atlas Range, between Sdass and Ououferrha, ca. 98 air km E of Agadir, N 30°21'14.54", W 8°34'38.96" [1000 m elev.], point 51, desert, S. Henriques leg. 29 September 2011 (SMF); 1 male (PJ 3398, SD 647), 1 male (PJ 3399, SD 648), Anti-Atlas Range, between Irherm and Armdaz, ca. 115 air km ESE of Agadir, N 30° 3'17.53", W 8°27'48.96" [1640 m elev.], point 48, desert, S. Henriques leg. 29 September 2011 (SMF).

**Description.** See Jäger (2000).

**Variation.** Males (n=4): PL 5.4–6.5, PW 4.7–5.5, AW 3.0–3.9, OL 5.3–7.2, OW 3.5–5.0; chelicerae with 2 anterior, 5–8 adnate posterior teeth, and 2–3 bristles at the posterior distal margin close to fang base. Structures of the copulatory organ correspond in most cases fully with those of the holotype. In the two males from between Irherm and Armdaz (Figs 12–13) the distal part of the embolus was distinctly shorter than that of the holotype.



**FIGURES 12–17.** 12–13 *Cebrennus rungsi* Jäger, 2000, males from Anti-Atlas, Morocco; 14 *Cebrennus* spec. A, male from Beni Abbes Algeria; 15–17 *Cebrennus castaneitarsis* Simon, 1880, males (15 Algeria, 16–17 holotype male from Wahran, Algeria). Left male palp (12–16 ventral, 17 retrolateral). DE—distal part of embolus, K—embolic kink, PE—proximal part of embolus, RTA—retrolateral tibial apophysis.

Since all other characters (shape and size of RTA, shape of tegulum, reduced conductor and basal embolus, shape of cymbium) are congruent with the holotype, the shorter distal embolus is considered intraspecific variation.

**Distribution.** All known records (including the type locality Sous) lie in the West of the region Souss-Massa-Draâ in an altitudinal range from sea level to 1650 metres (Fig. 173).

The following four species (*castaneitarsis*, *wagae*, *aethiopicus*, *flagellatus* **spec. nov.**) have very similar copulatory organs, differentiation of the species is in some cases difficult. Apparently, the male emboli have been elongated in the course of evolution as hypothesised by Jäger (2006). The same is true for the so-called “combined morphological changes” as the elongation of the RTA or the reduction of the palpal tibia length. In general, males are easier to identify than females. Easiest to distinguish is *C. flagellatus* **spec. nov.** (only known by the male sex) by its flagellum at the embolic kink and the distal RTA at right angles with the proximal part (Figs 32–35). Males of *C. castaneitarsis* can be distinguished from those of the three other species by the shorter embolus, i.e. the arising point situated distinctly in prolateral position of the tegulum and the proximal part of the distal loop does not, or only barely so, extend beyond the tegulum proximally (Figs 15–17); moreover the RTA is as short as in *C. flagellatus* **spec. nov.**, but builds a larger angle with the distal tibia. *Cebrennus wagae* and *C. aethiopicus* were differentiated by Fage (1921) through the absence (*wagae*) or presence (*aethiopicus*) of a distal spine on metatarsus III. Although there were two of three specimens of *C. aethiopicus* examined with a spination formula 3034 at metatarsus III, one had the usual 2024. Therefore, the spination cannot act as single diagnostic character. Simon (1880: 331, key) used mainly the RTA as differentiating character and his distinctions are still valid: *C. wagae* has the longest RTA (Figs 18–23), *C. castaneitarsis* an almost straight RTA (Figs 15–17), *C. aethiopicus* exhibits a bend at the base of the RTA (especially in comparison to *C. castaneitarsis*) (Figs 24–29). Females of this sub-unit of the *wagae* species-group are either not known (*C. flagellatus* **spec. nov.**) or not clearly distinguishable. However, in *C. aethiopicus* the epigyne tends to be relatively (Figs 55–62) wider than in *C. wagae* (Figs 44–54) and *C. castaneitarsis* (Figs 36–38). A distinct difference between the two latter species could not be found yet. Diagnoses contain a combination of characters, but few specimens (Figs 14, 39–41) show that either transitions or even new species exist, which make a distinction in some cases difficult.

### ***Cebrennus* spec. A**

Figs 14, 173

**Material examined. ALGERIA: Bechar Province:** 1 male (PJ 3466), Grand Erg occidental, Beni Abbes [N 30° 8'0.01", W 2° 9'59.98", ca. 500 m elev.], Coll. Denis, December 1949 (MNHN).

**Diagnosis.** Medium-sized Sparassinae, body length of male: 10.6. Male copulatory organ similar to those of *C. wagae*, *C. flagellatus* **spec. nov.**, *C. aethiopicus* and *C. castaneitarsis* in having a very long embolus with distal loop as long as the tegulum or larger (Fig. 14), but distinguished from *C. flagellatus* **spec. nov.** by the absence of an additional flagellum at the embolus kink, from *C. castaneitarsis* and *C. flagellatus* **spec. nov.** by its relatively long embolus (in retrolateral view the RTA is longer than the tibia length, i.e. the ratio RTA/tibia is 1.21), from *C. aethiopicus* distinctly and from *C. wagae* slightly in having the embolus arising point shifted prolaterally. Chelicerae with 2 anterior and 4 posterior teeth. Margin of chelicerae close to fang base with 3 and 5 bristles, respectively.

**Description.** Male: PL 5.1, PW 3.9, AW 2.8, OL 5.4, OW 3.5; AME 0.40, ALE 0.29, PME 0.25, PLE 0.26, AME–AME 0.17, AME–ALE 0.13, PME–PME 0.43, PME–PLE 0.50, AME–PME 0.30, ALE–PLE 0.45, clypeus AME 0.12, clypeus ALE 0.15. Spination: Palp: 130, 000, 1000; legs (II lacking): femur I, III 323, IV 322; patella I, III–IV 000; tibia I 2024, III 2024, IV 2023; metatarsus I, III 2024, IV 3026. Ventral metatarsi I–IV with scopula in distal half, without spines or bristles distally. Measurements leg I: 25.0 (7.2, 2.3, 6.6, 7.1, 1.8).

Colouration: pale yellowish brown, without pattern.

**Note.** This male specimen cannot be assigned clearly to one of the known species. Its intermediate position between *C. wagae* and *C. castaneitarsis* and the absence of sufficient data on intraspecific variability (see introduction) makes it difficult to decide whether the male possibly belongs to an own species or not. Considering its geographic distribution (1000 km SW of type locality of *C. wagae*, 640 km SSW of type locality *C.*



*castaneitarsis*, 760 km E of locality of the female listed below; Fig. 173) and considering that no other records of the species involved are known from the region around Beni Abbes, the specimen is left unidentified until more material is available.

### ***Cebrennus spec. B***

Figs 39–41, 63, 173

**Material examined. MOROCCO: Guelmim-Es Semara:** 1 female (PJ 3467), Aouinet Torkoz [N 28°29'10.97", W 9°51'16.11", ca. 300 m elev.], 27 December 1969, Yves Vial leg., MP 62 (A) (MNHN).

**Diagnosis.** Medium-sized Sparassinae, body length of female: 18.1. Female copulatory organ similar to those of *C. wagaе*, *C. flagellatus spec. nov.*, *C. aethiopicus* and *C. castaneitarsis* in having two moderately bend lateral ledges, a strongly sclerotised part of the copulatory duct plus a membranous (functionally posterior) part including a pair of blind ending tubes with glandular tissue attached to the apical end (Figs 39–41). The lateral slits at ledges are relatively wide in comparison to those of females of other species. From the similarity of the sclerotised part of the internal duct system with that of *C. aethiopicus*, it might belong to this species. However, the locality of the present female is far away from the otherwise continuous range of that species. Chelicerae with 2 anterior and 5 posterior teeth (Fig. 63). Margin of chelicerae close to fang base with 6 bristles.

**Description.** Female: PL 6.4, PW 5.6, AW 4.3, OL 11.7, OW 10.6; AME 0.41, ALE 0.31, PME 0.30, PLE 0.32, AME–AME 0.29, AME–ALE 0.31, PME–PME 0.60, PME–PLE 0.94, AME–PME 0.39, ALE–PLE 0.82, clypeus AME 0.20, clypeus ALE 0.20. Spination: Palp: 130, 000, 1000, 1011; legs: femur I–III 323, IV 321; patella I–IV 000; tibia I–IV 2024; metatarsus I–II 2024, III 2024(3), IV 3036(5). Ventral metatarsi I–IV with scopula in distal half, without spines or bristles distally. Measurements leg I: 23.0 (6.5, 2.8, 5.9, 6.2, 1.6). Palpal claw with 7 to 8 teeth.

Colouration: pale yellowish brown, without pattern; distal appendages slightly darker.

**Note.** It cannot be stated whether this female belongs to one of the described species or represents a species on its own. Neither cheliceral dentition nor the ratio of epigynal width and length can help in this respect. The same is true —by the current state of the knowledge— for the female copulatory organ.

### ***Cebrennus castaneitarsis* Simon, 1880**

Figs 15–17, 36–38, 173

*Cebrennus castaneitarsis* Simon, 1880: 333 (description of male; male syntypes from Algeria, Oran [= Wahran], MNHN 1614-3548, examined). Simon 1897: 38, figs 36, 38, 40 (illustration of male), Fage 1921: 162, figs 1a–c (illustration of male); Levy 1989: 159, figs 94–99 (illustration of male and female, synonymy of *C. sparassoides*); Jäger 2000: 174, figs 42–46 (modified illustration of male and female after Fage 1921 and Levy 1989).

*Cebrennus sparassoides* Caporiacco, 1928: 94, fig. 6 (description of male).

**Note.** In MNHN 1614-3548, 13 males and 2 females are present. One label [extra: Casablanca, Morocco, Benoit st. VI-18] suggests that specimens have been added later to the original specimen(s)/series as it is known from other cases (e.g., in *Heteropoda javana* MNHN 1677-290, see Jäger 2002: 45). Jäger (2000) followed Levy (1989) and assumed a holotype male. The series only now examined showed that at least some males could constitute a series of syntypes. It is not clear, whether males were added from Casablanca or not.

**Material examined. ALGERIA: Oran:** 13 males, 2 females (PJ 3443–3455, 3456–3457; among these the male syntypes), Oran (MNHN 1614-3548; but see also note above for potential additional locality in Morocco). 1 male (PJ 3458), without further data, E. Simon det. 1883 (MNHN).

**Diagnosis.** Medium-sized Sparassinae, body length of males: 12.7 (Levy 1989: males 10.1–13.9, females 12.4–16.4). Male copulatory organ similar to those of *C. wagaе*, *C. flagellatus spec. nov.* and *C. aethiopicus* in having a very long embolus with distal loop as long as the tegulum or larger (Figs 15–17). Distinguished from *C. flagellatus spec. nov.* by the absence of an additional flagellum at the embolus kink, from *C. aethiopicus* and *C. wagaе* by the distinctly shorter RTA: in retrolateral view the RTA is shorter than the tibia length in *C. castaneitarsis*, i.e. the ratio RTA/tibia ranges from 0.7 to 0.9. Males differ from those of the three other species by having the embolus arising in a 6 o'clock-position from tegulum. There were only few females available (Figs.

36–38), therefore the following data are preliminary. Epigynal field's ratio width/length ranges from 1.35 to 1.41. Lateral epigynal ledges with their anterior ends closer to each other than posterior ends or of equal distance (as in *C. waga*). Males with 5 to 6 posterior cheliceral teeth, females with 4 to 6 (Levy 1989).

**Description.** See Levy (1989). Some additional characters are given here for 1 male (PJ 3458): PL 6.3, PW 5.2, AW 3.8, OL 6.4, OW 4.9; AME 0.42, ALE 0.30, PME 0.28, PLE 0.30, AME–AME 0.20, AME–ALE 0.25, PME–PME 0.52, PME–PLE 0.81, AME–PME 0.39, ALE–PLE 0.68, clypeus AME 0.15, clypeus ALE 0.16. Spination: Palp: 030, 000, 1000; legs: femur I–II 323, III 3(2)23, IV 332(222); patella 000; tibia I 2024(3), II–III 2024, IV 2024(3); metatarsus I–III 2024, IV 3026. Ventral metatarsi I–IV with scopula in distal half, without spines or bristles distally. Measurements leg I: 30.9 (8.2, 3.0, 7.6, 8.8, 2.3). Margin of chelicerae close to fang base with 4 bristles.

Colouration: yellowish to greyish brown, without distinct pattern. Distal leg segments darker, esp. in leg I.

**Distribution:** Algeria to Israel (Fig. 173).

### ***Cebrennus waga* (Simon, 1874)**

Figs 18–23, 42–54, 64–69, 77–81, 173

*Cebrenis waga* Simon, 1874: 265, pl. 5, fig. 1 (description of male; holotype male, Algeria, Constantine Province, Prof. Waga leg., not found in MNHN, not examined).

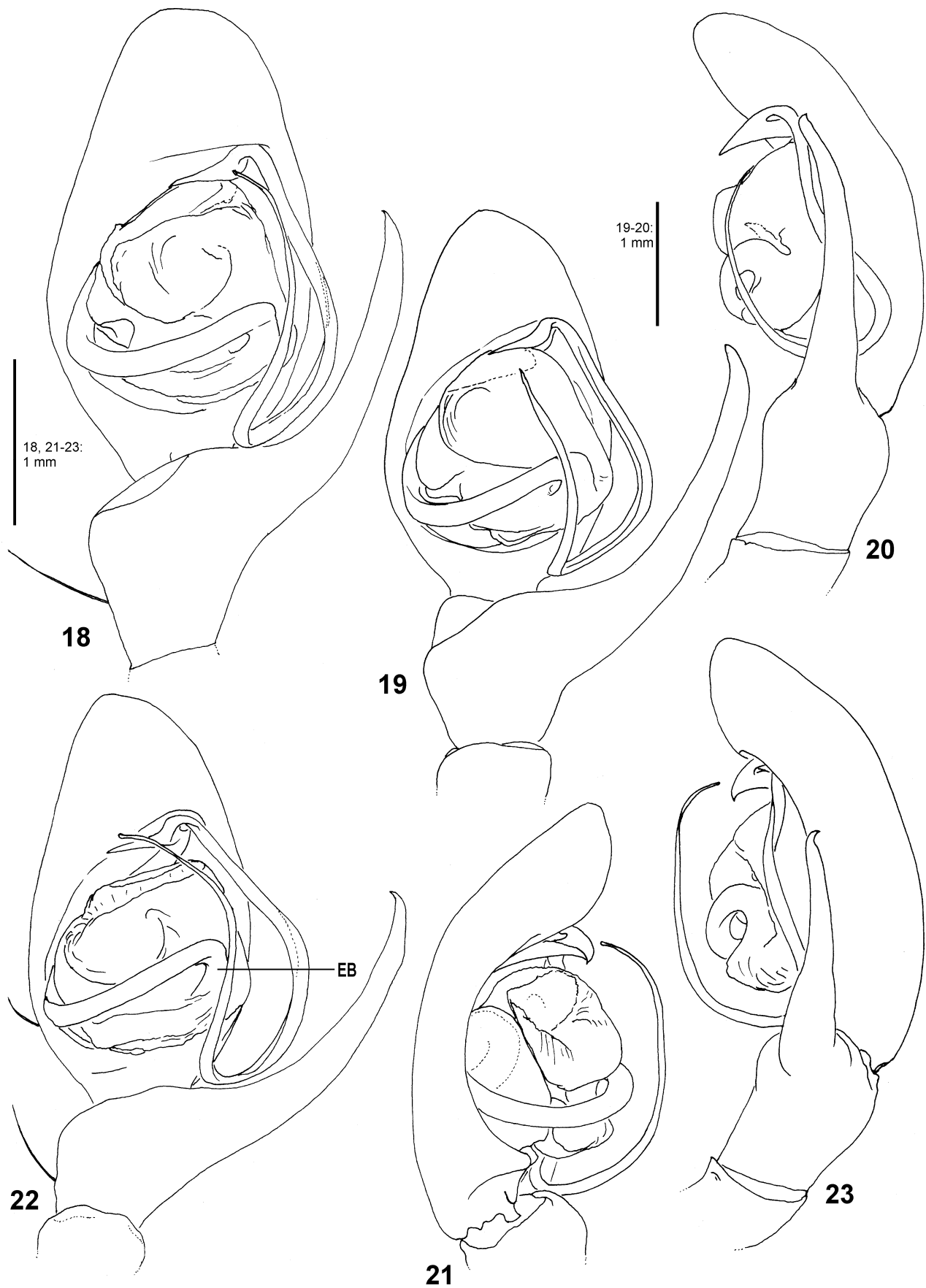
*Cebrennus waga* Simon, 1880: 332 (transfer to *Cebrennus*, listed male[s] from Bou Saada, Ch. Leprieur leg., see below). Fage 1921: 162, figs 1f–g (illustration of male; not description of female contra Platnick 2014); Jäger 2000: 178, figs 47–48 (modified illustration of male after Fage 1921).

**Material examined.** **ALGERIA:** *M'Sila*: 3 males (PJ 3460–3462), Bou Saada (MNHN 1613-4542). *Biskra*: 2 females (PJ 3463–3464), Biskra district, Biskra (MNHN 1613-4542). *Algiers*: 1 female (PJ 3468), surroundings of Algier, 15 May 1971, J. Horak leg., ex Coll. Brno, Hula ded., SD 556 (SMF). *Ouargla*: 1 female (PJ 3470), Chott [N 31°57'53.29", E 5°23'11.53", ca. 130 m elev.], 1874–1875, 103-99 (MNHN). 1 female (PJ 3469), without further data, Jacquemont leg. 1876, E. Simon det. (MNHN). **TUNISIA:** *Kasserine*: 1 male (PJ 3015), Chambi National Park, surroundings of the park's guest house, N 35°10.139', E 08°40.486, 950–1000 m elev., *Pinus halepensis*, *Stipa tenacissima*, *Thuya*, under stones, logs and leaf litter of *Pinus halepensis*, Stoev, P. and N. Akkari leg. 8 March 2008, ded. 2008 (SMF). 1 female (PJ 3440), Central Tunisia, highland, #48-98, May 1898 (ZIN). **LIBYA:** 1 male (PJ 3465), Brandt leg. (SMF). **MALTA:** 1 female (PJ 3471), without further data, February 1927 (MNHN).

**Note.** The series MNHN 1613-4542 contains 3 males and 2 females. Most likely males are from Algeria, Bou Saada as mentioned in Simon 1880: 332 (the largest is illustrated here: Figs 19–20). The two females have been previously dried up and were likely added later to this series (an established procedure by Eugene Simon or subsequent workers as shown in Jäger 2002 for *Heteropoda javana* or in *C. castaneitarsis* above). Since both localities are 150 km apart and show an altitudinal difference of approximately 400 m, they need not to be conspecific.

**Diagnosis.** Small to medium-sized Sparassinae, body length of males: 8.2–13.3, females: 9.3–15.2. Copulatory organ similar to those of *C. flagellatus* **spec. nov.**, *C. castaneitarsis* and *C. aethiopicus* in having a very long embolus with distal loop as long as the tegulum or larger (Figs 18–23). Distinguished from *C. flagellatus* **spec. nov.** by the absence of an additional flagellum at the embolus kink, from all other three species by the distinctly longer RTA: in retrolateral view the RTA is longer than the tibia length, i.e. the ratio RTA/tibia ranges from 1.35 to 1.78. Males differ from those of the three other species by having the embolus arising in a 4 o'clock-position from tegulum, embolus base not reaching the retrolateral margin of tegulum. There were some females available which fall in the potential distribution range and are here considered belonging to *C. waga* (Figs 42–54). Epigynal field's ratio width/length ranges from 1.25 to 1.38. Lateral epigynal ledges with their posterior ends closer to each other than anterior ends. Males with 4 posterior cheliceral teeth (Figs 65–66), females with 4 to 5 (Figs 64, 67–69).

**Redescription.** Male: (n=5): PL 4.0–6.8, PW 3.5–5.5, AW 2.2–3.8, OL 4.2–6.5, OW 2.8–5.1; [n=2] AME 0.35–0.42, ALE 0.26–0.31, PME 0.25–0.31, PLE 0.25–0.30, AME–AME 0.14–0.21, AME–ALE 0.12–0.22, PME–PME 0.39–0.49, PME–PLE 0.50–0.82, AME–PME 0.29–0.34, ALE–PLE 0.45–0.65, clypeus AME 0.14–0.18, clypeus ALE 0.18–0.22 (Figs 79, 81). Spination: Palp: 130, 000, 10(1)00 [all thin bristles]; legs: femur



**FIGURES 18–23.** *Cebrennus wagaе* (Simon, 1874), males (18 Libya, 19–20 Bou Saada, Algeria, 21–23 Chambi, Tunisia). Left male palp (18–19, 22 ventral, 20, 23 retrolateral, 21 prolateral). EB—embolus base.

I–III 323, IV 322; patella I–IV 000; tibia I–IV 2024; metatarsus I–III 2024, IV 3036. Ventral metatarsi I–IV with scopula in distal half, without spines or bristles distally. Measurements leg I: [n=1] 22.4 (6.3, 2.2., 5.9, 6.3, 1.7). Margin of chelicerae close to fang base with 3 bristles.

Colouration: pale yellowish (white) brown, without pattern; distal appendages (especially metatarsus and tarsus) slightly darker.

Female (n=5): PL 5.6–6.6, PW 4.4–5.3, AW 3.4–4.5, OL 6.2–8.9, OW 4.8–7.8; AME 0.41–0.43, ALE 0.26–0.32, PME 0.26–0.27, PLE 0.28–0.31, AME–AME 0.23–0.33, AME–ALE 0.20–0.40, PME–PME 0.46–0.59, PME–PLE 0.70–1.10, AME–PME 0.32–0.47, ALE–PLE 0.59–0.91, clypeus AME 0.17–0.24, clypeus ALE 0.21–0.30 (Figs 77–78, 80). Spination: Palp: 130, 000, 100(1)0, 1000 (1010, 1013/1012); legs: femur I 323 (123, 223), II 323 (320, 222), III 323 (110, 320, 321), IV 321 (322, 221, 222, 111); patella I–IV 000; tibia I–II 2024, III 2024 (2023), IV 2024 (2023, 3023); metatarsus I–II 2024, III 2024 (2023), IV 3036 (3035). Ventral metatarsi I–IV with scopula in distal half, without spines or bristles distally. Measurements leg I: [n=5] 19.3–22.2 (5.7–6.6., 2.2–2.7, 5.0–5.8, 5.0–6.2, 1.4–1.9). Palpal claw with 7 to 10 teeth. Margin of chelicerae close to fang base with 3–7 bristles (Figs 64, 67–69).

Colouration: pale yellowish brown, without pattern; distal appendages slightly darker. One female showed a very slight pattern on dorsal opisthosoma.

**Distribution.** Algeria, Tunisia, Libya [not mapped], Malta (Fig. 173).

### ***Cebrennus aethiopicus* Simon, 1880**

Figs 24–31, 55–62, 70–75, 82–86, 173

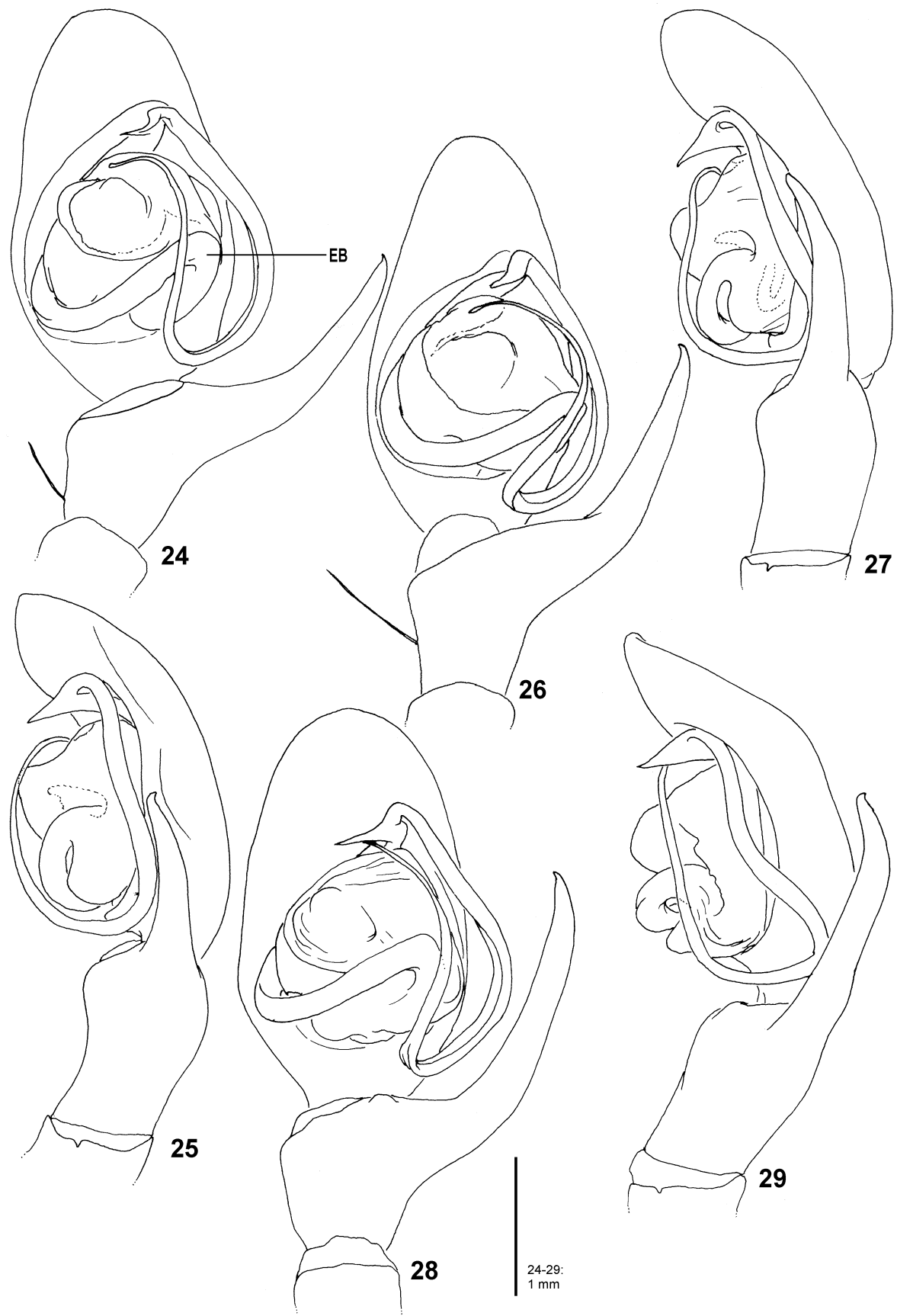
*Cebrennus aethiopicus* Simon, 1880: 334 (description of male; holotype male, Eritrea, Massaua, MNHN 1613-3274, examined). Fage 1921: 162, figs 1d–e (illustration of male); Jäger 2000: 176, figs 49–55 (illustration of male, description of female); Jäger and Kunz 2005: 169, figs 283–291 (illustration of male and female from A [Ain/Al/As?] Sefza [Sefra/Safra?]).

**Material examined. SUDAN: Red Sea:** 1 male (PJ 3474), open alkaline plain, Gowb, C. Dewhurst leg. March 2001 (RMCA 236151). **ERITREA: Anseba:** 1 female (PJ 3408), Gheleb, RII 12975 (SMF 9912975). **Northern Red Sea:** Holotype male (PJ 3441), Massaua, 1613-3274 (MNHN); 1 female (PJ 3473), Red Sea Coast, in sand on Red Sea, C. Dewhurst leg. 9 November 1996 (RMCA 236132). **DJIBOUTI.** 1 male (PJ 3442; + 1 immature), Djibouti, 1613-1944 (MNHN).

**Diagnosis.** Medium-sized Sparassinae, body length of males: 10.5–11.1, females: 12.7–17.5. Copulatory organ similar to those of *C. wagaе*, *C. castaneitarsis* and *C. flagellatus spec. nov.* in having a very long embolus with distal loop as long as the tegulum or larger (Figs 24–31). Distinguished from *C. flagellatus spec. nov.* by the absence of an additional flagellum at the embolus kink. In males, the RTA in retrolateral view is as long as the tibia or slightly longer, i.e. the ratio RTA/tibia ranges from 1.00 to 1.16, which is intermediate between *C. castaneitarsis* and *C. flagellatus spec. nov.* on the one hand and *C. wagaе* on the other hand. Moreover, males differ from those of the three other species by having the embolus arising in a 3 to 3.30 o'clock-position from tegulum, embolus base reaching the retrolateral margin of tegulum. Females (Figs 55–62): Epigynal field's ratio width/length ranges from 1.46 to 1.58, i.e. generally wider than the other *Cebrennus* spp. Lateral epigynal ledges with their posterior ends closer to each other than anterior ends or as close as these. Males and females with 5 to 6 cheliceral posterior teeth (Figs 70–75).

**Description.** See Jäger (2000). Additional data of PJ 3474 as following (with data, if present, of holotype in parentheses): Male. PL 5.8 (6.2), PW 5.3 (5.0), AW 3.4 (3.6), OL 4.7 (4.9), OW 3.7 (3.3). Spination: Palp: 130, 000, 1000 [thin bristle]; legs: femur I–III 323, IV 322(3); patella I–IV 000; tibia I–IV 2024; metatarsus I–III 3034, IV 3036. Ventral metatarsi I–IV with scopula in distal half, without spines or bristles distally. Measurements leg I: 29.9 (8.6, 2.7, 7.7, 8.7, 2.2). Chelicerae with 2 anterior teeth and with 5 (6) posterior teeth. Margin of chelicerae close to fang base with 5 bristles (Figs 73, 75).

Colouration: pale yellowish brown, without distinct pattern, but chelicerae, dorsal prosoma and opisthosoma with indistinct markings; distal appendages slightly darker.



**FIGURES 24–29.** *Cebrennus aethiopicus* Simon, 1880, males (24–25 holotype male, Massaua, Eritrea, 26–27 Djibouti, 28–29 “A Sefza”). Left male palp (24, 26, 28 ventral, 25, 27, 29 retrolateral). EB—embolus base.

Female (n=2): PL 7.1–7.7, PW 5.6–6.5, AW 4.5–5.5, OL 8.3–10.4, OW 7.4–8.2; AME 0.45–0.56, ALE 0.35–0.47, PME 0.31–0.41, PLE 0.28–0.42, AME–AME 0.30–0.39, AME–ALE 0.32–0.39, PME–PME 0.62–0.67, PME–PLE 0.93–1.21, AME–PME 0.42–0.47, ALE–PLE 0.89–0.93, clypeus AME 0.24–0.31, clypeus ALE 0.29–0.38 (Figs 83, 85). Spination: Palp: 130, 000, 1000 (0001), 1000 (0002); legs: femur I–II 323, III 323(2), IV 322; patella I–IV 000; tibia I 202(1)4, II–IV 2024; metatarsus I 2024 (3034), II 2024 (2034, median prolateral missing), III 2024 (3034), IV 3036. Ventral metatarsi I–IV with sparse scopula in distal half, without spines or bristles distally. Measurements leg I: [n=2] 23.1–28.3 (6.6–7.8, 2.7–3.4, 5.5–7.0, 6.5–8.0, 1.8–2.1). Palpal claw with 8 to 9 teeth. Margin of chelicerae close to fang base with 3–5 bristles (Figs 70–72, 74).

Colouration: (pale) yellowish brown, without distinct pattern, dorsal opisthosoma with indistinct dots; chelicerae (light) reddish brown, distal appendages slightly darker.

**Distribution.** Sudan, Eritrea, Djibouti, Ethiopia [not mapped], Saudi Arabia (Fig. 173).

### ***Cebrennus flagellatus spec. nov.***

Figs 32–35, 76, 87, 97–100, 173

**Type material.** AFGHANISTAN: *Nangarhar*: Holotype male (PJ 3406), 12–20 km ESE Jalalabad, Povolný & Tenora leg. 16 March 1966, #36 (MMBC).

**Diagnosis.** Medium-sized Sparassinae, body length of male: 11.6. Copulatory organ (Figs 32–35) similar to those of *C. wagaе*, *C. castaneitarsis* and *C. aethiopicus* in having a very long embolus with distal loop as long as the tegulum or larger, but distinguished from these three species by the additional flagellum at the embolus kink. RTA with distinct wrinkle (W) basally and building almost a right angle with this wrinkle in ventral view.

**Etymology.** The specific name refers to the additional flagellum at the embolic kink (Latin “flagellatus, -a, -um”, meaning verbatim “whipped”, in the figurative sense “equipped with a whip”); adjective.

**Description.** Male: PL 5.3, PW 4.5, AW 3.0, OL 6.3, OW 4.5. AME 0.41, ALE 0.31, PME 0.25, PLE 0.26, AME–AME 0.16, AME–ALE 0.15, PME–PME 0.52, PME–PLE 0.55, AME–PME 0.32, ALE–PLE 0.45, clypeus AME 0.15, clypeus ALE 0.19 (Fig. 87). Spination: Palp: 130, 000, (1201; stiff setae rather than spines), 1000; legs: femur I–III 323, IV 322; patella 000; tibia I–IV 2024; metatarsus I–III 2024, IV 3036. Ventral metatarsi I–IV with sparse scopula in distal half, without spines or bristles distally. Leg formula: 2143. Measurements of palp and legs: Palp 7.7 (2.2, 1.1, 1.4, -, 3.0), leg I 25.7 (7.1, 2.5, 6.8, 7.3, 1.8), leg II 28.1 (8.1, 2.6, 7.5, 7.9, 2.0), leg III 20.8 (6.3, 2.3, 5.2, 5.5, 1.5), leg IV 25.4 (7.8, 2.4, 6.4, 7.0, 1.8). Cheliceral furrow with 2 anterior and 5 posterior teeth (3 adnate + 2 smaller single teeth), without denticles (Fig. 76). Margin of chelicerae close to fang base with 3 bristles. Epiandrium with two darker sockets with each 6–10 distal setae (spigots?).

Palp as in diagnosis (Figs 32–35). Distal third of cymbium with dorsal scopula. RTA with voluminous base (in retrolateral view), reaching almost middle part of tegulum, distal tip bent. Embolus arising in a 4-o’clock-position, embolic kink situated at 12-o’clock.

Colouration in ethanol (Figs 97–100): Yellowish-brown with antero-lateral margin of dorsal shield of prosoma and distal chelicerae darker. Sternum, ventral coxae, gnathocoxae, labium and ventral femora pale yellowish-brown. Palp and legs yellowish-brown with distal segments darker. Dorsal and lateral opisthosoma with elongate small patches.

Female: unknown.

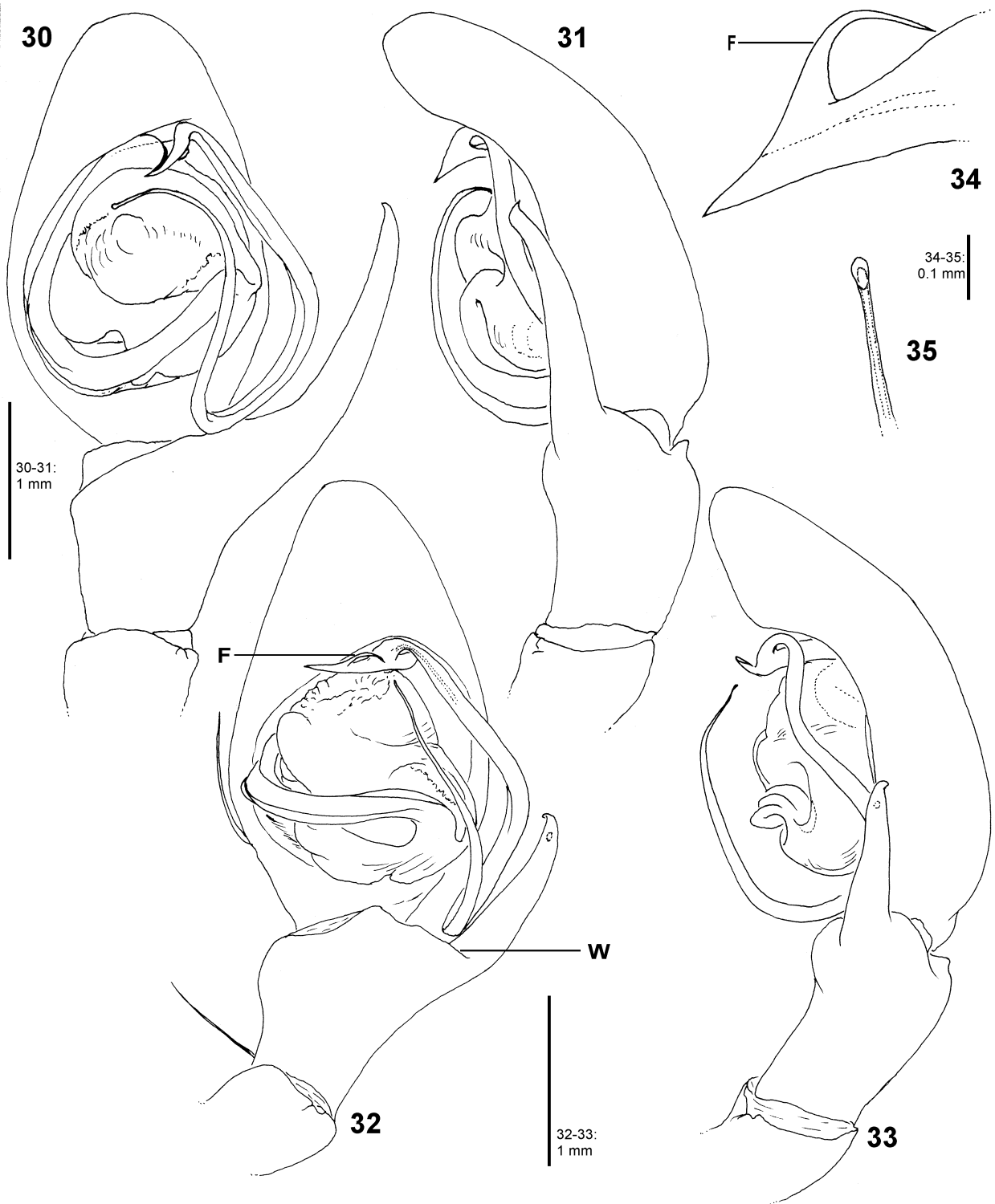
**Distribution.** Only known from the type locality (Fig. 173).

### ***villosus* group**

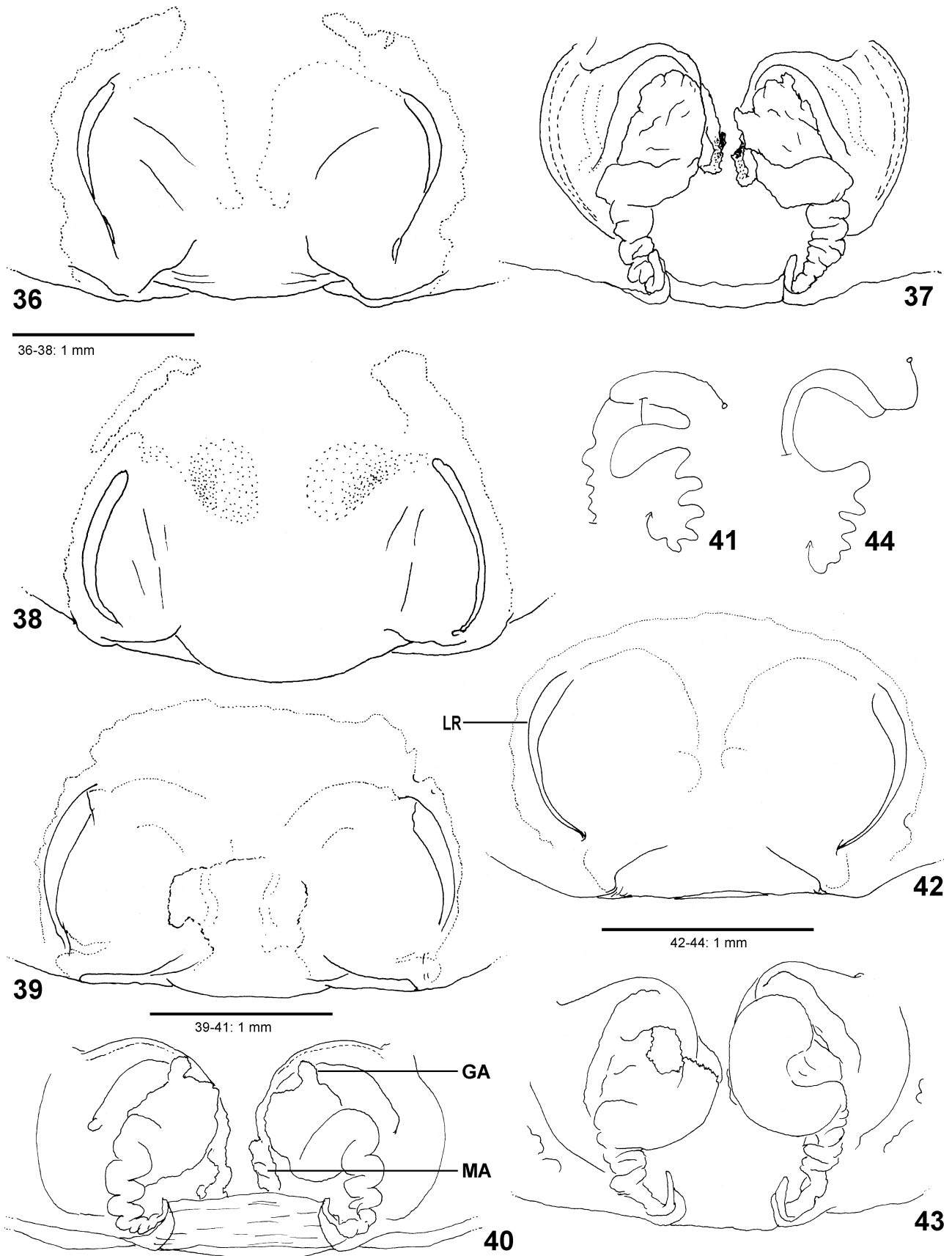
**Diagnosis.** See Jäger (2000).

**Species included.** *C. intermedius*, *C. laurae spec. nov.*, *C. concolor*, *C. rechenbergi spec. nov.*, *C. villosus*.

**Distribution.** Northern Africa (Canary Islands, Morocco, Algeria, Tunisia, Egypt), Asia (Saudi Arabia) (Fig. 173).

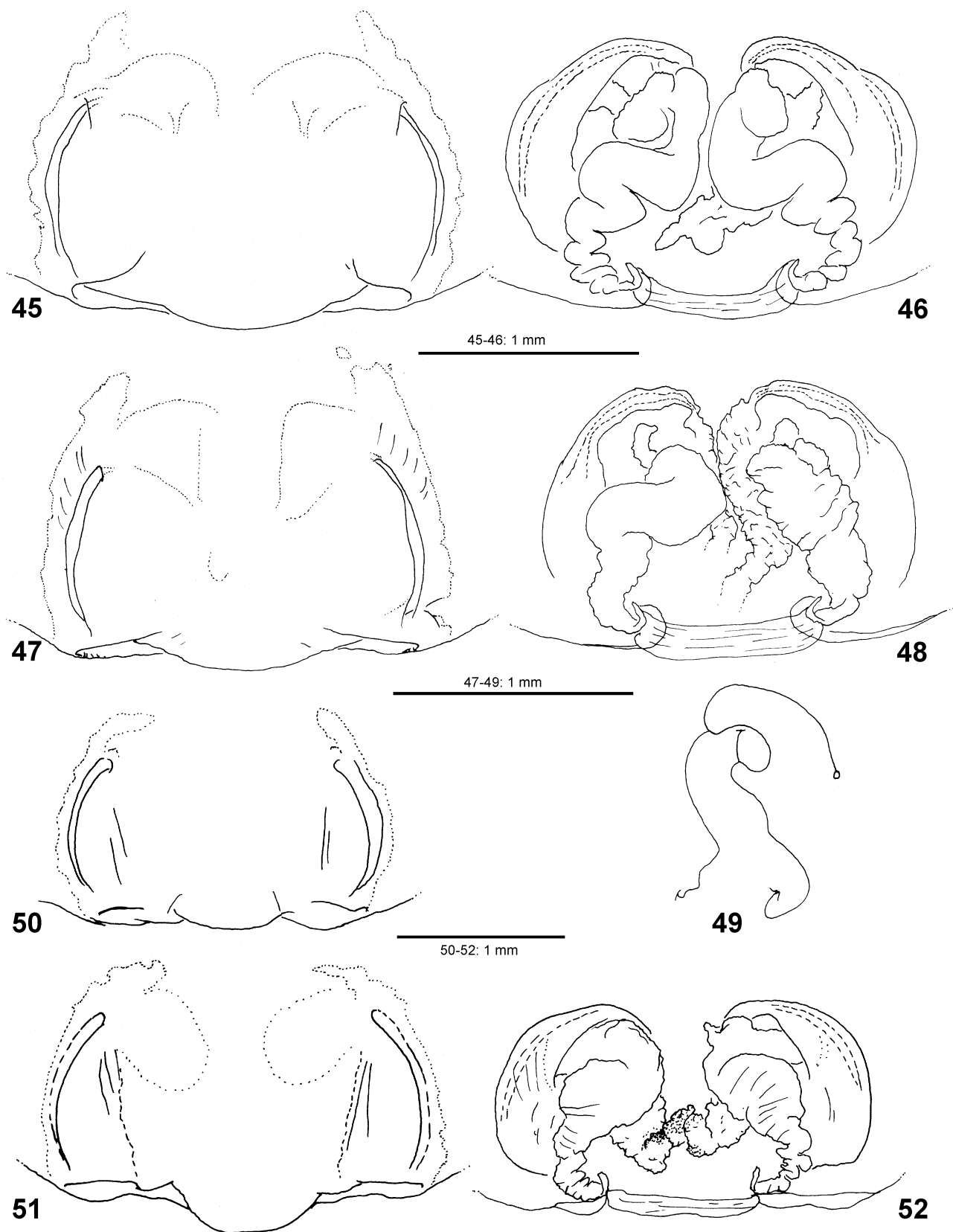


**FIGURES 30–35.** 30–31 *Cebrennus aethiopicus* Simon, 1880, male from Sudan; 32–35 *Cebrennus flagellatus* *spec. nov.*, holotype male from Nangarhar Province, E Afghanistan. 30–33 Left male palp (30, 32 ventral, 31, 33 retrolateral); 34 Embolic kink showing flagellum, proximal; 35 Embolus tip, ventral. F—flagellum at embolus kink.

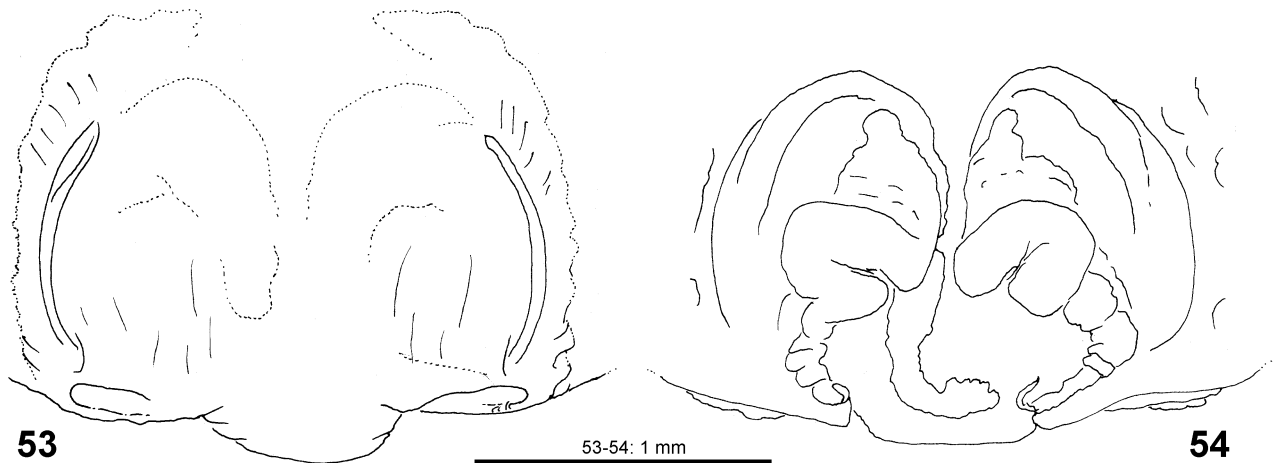


**FIGURES 36–43.** 36–38 *Cebrennus castaneitarsis* Simon, 1880, females from Wahran, Algeria or Casablanca, N Morocco (see note in text); 39–41 *Cebrennus* spec. B, female from Aouinet Torkoz, S Morocco; 42–44 *Cebrennus wagaе* (Simon, 1874), female from Algier, Algeria. 36, 38–39, 42 Epigyne, ventral; 37, 40, 43 Vulva, dorsal; 41, 44 Schematic course of internal duct system, dorsal. GA—glandular appendages, LR—lateral ridge, MA—membranous atrium.





**FIGURES 45–52.** *Cebrennus wagaе* (Simon, 1874), females (45–46 Malta, 47–49 Chott, Algeria, 50–52 Biskra, Algeria). 45, 47, 50–51 Epigyne, ventral; 46, 48, 52 Vulva, dorsal; 49 Schematic course of internal duct system, dorsal.



FIGURES 53–54. *Cebrennus wagae* (Simon, 1874), female from Tunisia. 53 Epigyne, ventral; 54 Vulva, dorsal.

***Cebrennus laurae* spec. nov.**

Figs 101–108, 173

**Type material.** CANARY ISLANDS. Holotype male (PJ 3404), labelled “71.I.d” (MNHN). Paratype: 1 male (PJ 3405), labelled “71.1a, T71-1” (SMF).

**Diagnosis.** Medium-sized Sparassinae, body length of female: 12.8. Copulatory organ similar to those of *C. villosus* and *C. concolor* in having the distal part of the embolus coiled in a circle, but distinguished by 1. distal coil of embolus situated at distal tegulum (retrolaterally in *C. villosus* and *C. concolor*), 2. RTA distinctly longer than in *C. villosus* and *C. concolor* (shorter or almost absent in *C. villosus* and *C. concolor*), 3. embolus arising in a 6-o’clock-position (8- to 9-o’clock-position in *C. villosus* and *C. concolor*) (Figs. 105–106).

**Etymology.** The species is dedicated to my beloved daughter Laura Schwalbach; noun (name) in genitive case.

**Description.** Female (holotype): PL 6.4, PW 5.3, AW 4.0, OL 6.5, OW 4.5. AME 0.39, ALE 0.31, PME 0.25, PLE 0.28, AME–AME 0.31, AME–ALE 0.35, PME–PME 0.48, PME–PLE 1.04, AME–PME 0.43, ALE–PLE 0.82, clypeus AME 0.27, clypeus ALE 0.23 (Fig. 108). Spination: Palp: 020, 000, 1000; legs: femur I 223(324), II 3(4)23, III 322(1), IV 321; patella 000; tibia 2024; metatarsus I–III 2024, IV 3036. Ventral metatarsi I–IV with sparse scopula in distal half, without spines or bristles distally. Leg formula: 2143. Measurements of palp and legs: Palp 7.0 (2.4, 0.9, 1.1, -, 2.6), leg I 24.0 (6.7, 2.6, 6.2, 6.6, 1.9), leg II 26.6 (7.4, 2.7, 7.1, 7.3, 2.1), leg III 19.2 (5.8, 2.3, 4.9, 4.7, 1.7), leg IV 23.2 (7.1, 2.4, 5.8, 6.2, 1.7). Cheliceral furrow with 2 anterior and 6 adnate posterior teeth, without denticles (Fig. 107). Margin of chelicerae close to fang base with 2 bristles.

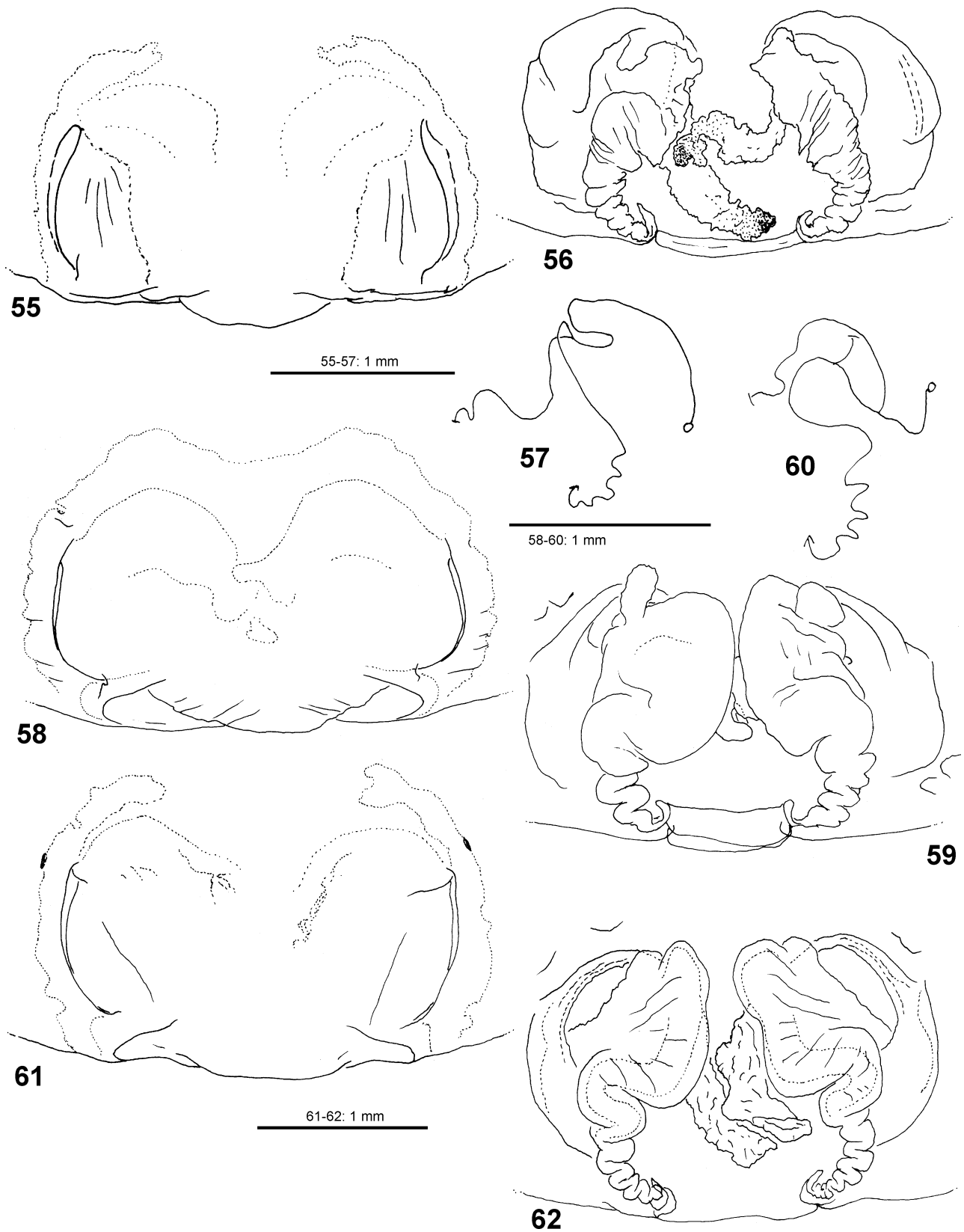
Palp as in diagnosis (Figs 105–106). RTA similarly long as in *C. intermedius*, but disto-retrolaterad (distad in *C. intermedius*). Distal cymbium with intermediate shape between *C. villosus* (blunt) and *C. concolor* (pointed). Distal half of cymbium with dorsal scopula. Distal coil of embolus partly hidden behind bulging tegulum.

Colouration in ethanol (Figs 101–104): Yellowish- to reddish-brown. Dorsal prosoma yellowish-brown with antero-lateral margin darker. Sternum, ventral coxae and femora pale yellowish-brown. Gnathocoxae and labium reddish-brown with light yellowish-brown distal lip. Chelicerae deep reddish-brown with distal margins black. Palp and legs yellowish-brown with distal segments darker. Opisthosoma uniformly yellowish-brown.

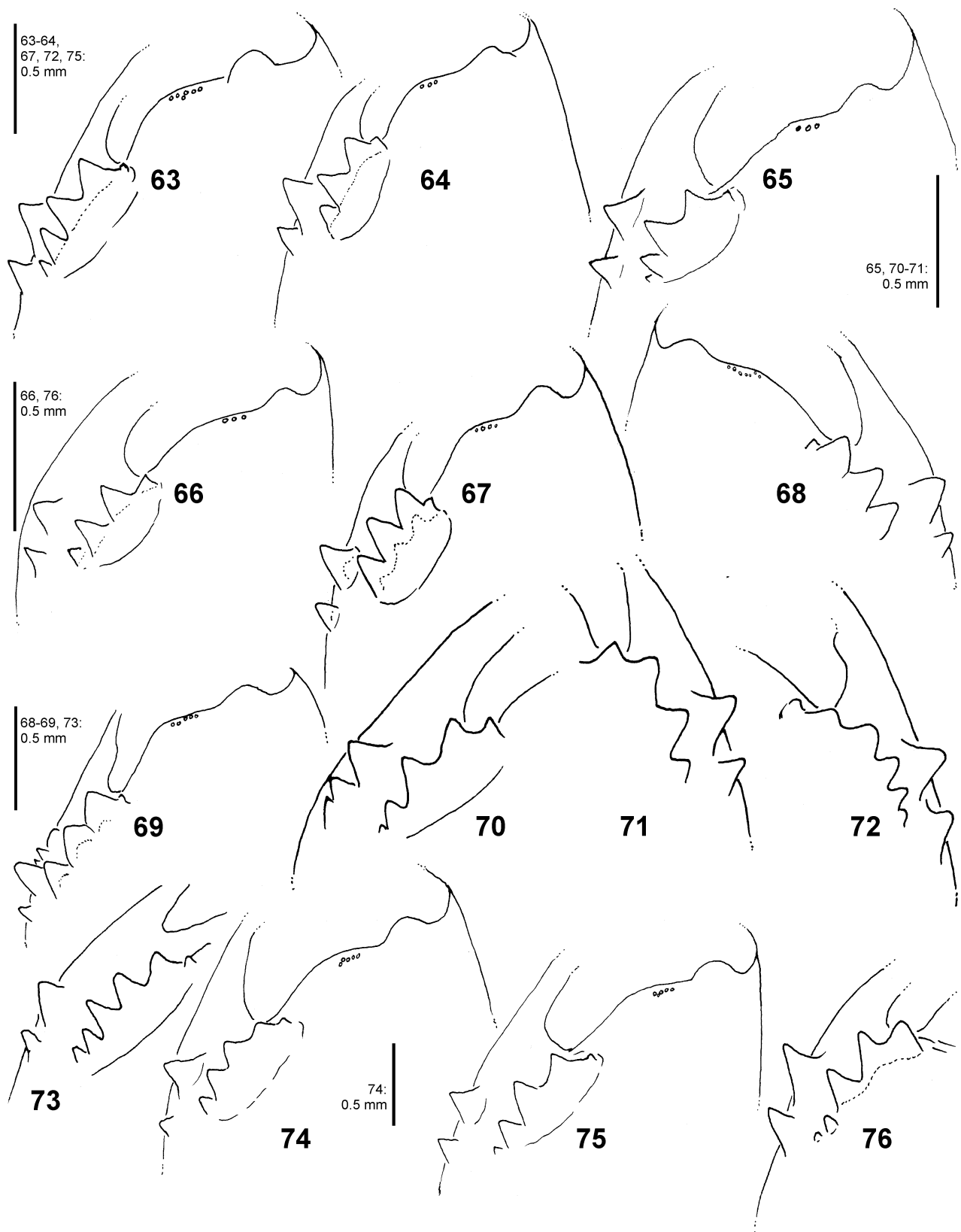
Female: unknown.

**Variation.** Paratype with PL 5.8, PW 5.0, AW 3.6, OL 5.7, OW 5.0. Dorsal opisthosoma with median row of indistinct patches.

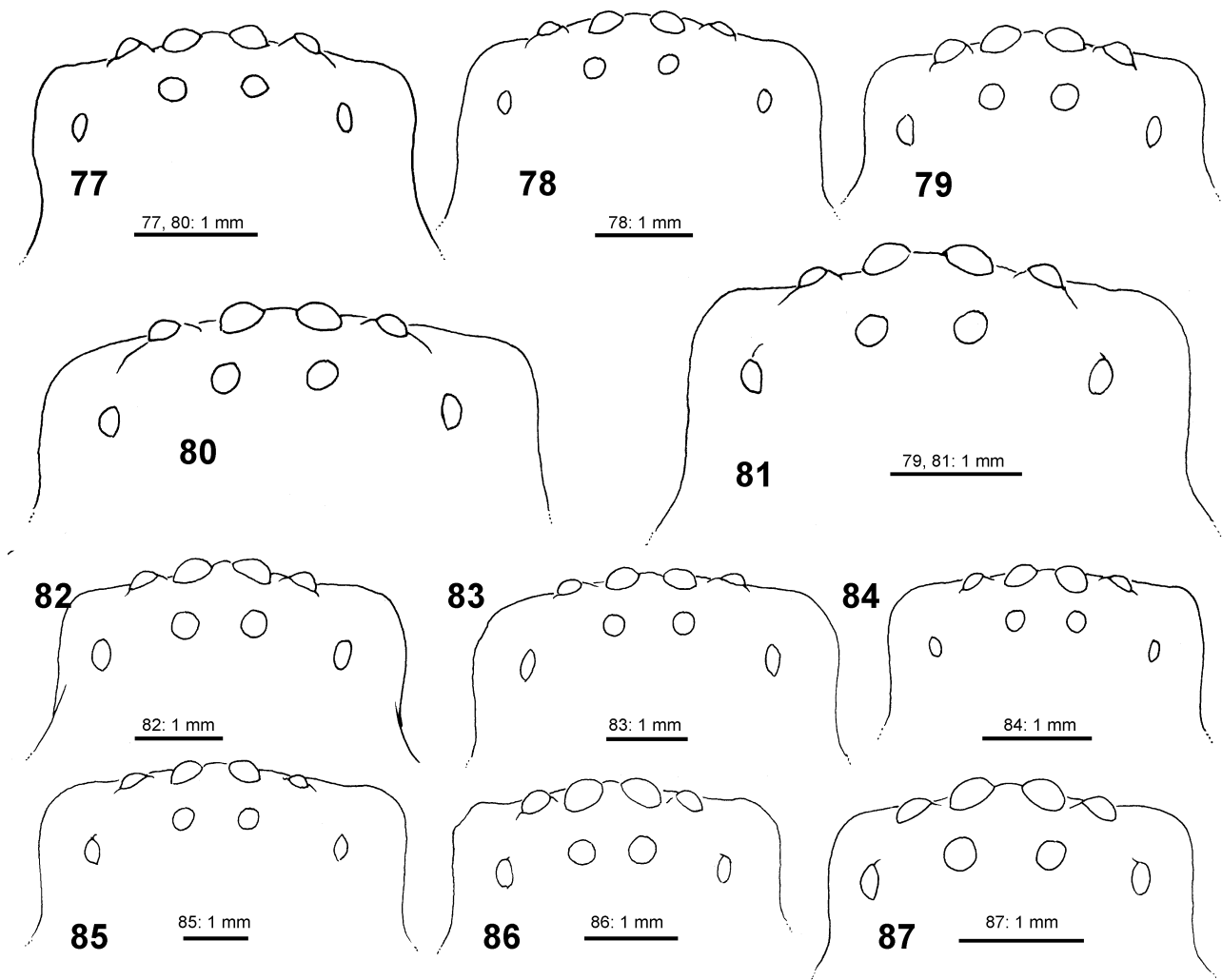
**Distribution.** Only known from the type locality (Fig. 173).



**FIGURES 55–62.** *Cebrennus aethiopicus* Simon, 1880, females (55–57 “A Sefza”, 58–60 Gheleb, Eritrea, 61–62 Eritrea). 55, 58, 61 Epigyne, ventral; 56, 59, 62 Vulva, dorsal; 57, 60 Schematic course of internal duct system, dorsal.



**FIGURES 63–76.** *Cebrennus* spp., cheliceral dentition, ventral. 63 *Cebrennus* spec. B, female, S Morocco; 64–69 *Cebrennus waga* (Simon, 1874) (64 female from Algeria, 65 male from Libya, 66 male from Tunisia, 67 female from Malta, 68–69 female from Tunisia); 70–75 *Cebrennus aethiopicus* Simon, 1880 (70–71 female from “A Sefza”, 72 female from Eritrea, 73 holotype male from Eritrea, 74 female from Eritrea, 75 male from Sudan); 76 *Cebrennus flagellatus* spec. nov., holotype male from Afghanistan.



**FIGURES 77–87.** *Cebrennus* spp., eye arrangement, dorsal. 77–81 *Cebrennus wagaе* (Simon, 1874) (77 female from Algeria, 78 female from Malta, 79 male from Tunisia, 80 female from Tunisia, 81 male from Libya); 82–86 *Cebrennus aethiopicus* Simon, 1880 (82 male from “A Sefza”, 83 female from Eritrea, 84 female from A Sefza?, 85 female from Eritrea, 86 male from Sudan); 87 *Cebrennus flagellatus* **spec. nov.**, holotype male from Afghanistan.

***Cebrennus rechenbergi* spec. nov.**

Figs 109–127, 135–146, 149–161, 173

*Cebrennus villosus* (Jézéquel and Junqua). King 2013: 7 ff., figs 2.1–2.8, 4.1 (illustration of flic-flac behaviour; misidentification)

**Type material. MOROCCO: Meknès-Tafilelet:** Holotype male (PJ 3187), Er Rachidia, 30 km SE Erfoud, near Tisserdmine, northern Erg Chebbi, 31° 16.212' N 3° 59.475' W, 760 m elev., sand dunes, I. Rechenberg leg. 15 July 2009, SD 622 (SMF 59794). **Paratypes:** 1 male (PJ 3395), leg. 2008 (SMF); 1 male (PJ 3407), leg. 14 August 2010, SD 392 (SMF); 1 male (PJ 3189) leg. 27 July 2009 (SMF 59796); 1 female (PJ 3186) leg. 14 July 2009 (SMF 59793); 1 female (PJ 3188) leg. 25 July 2009 (SMF 59795), 1 male (PJ 3477, SD 435), 1 female (PJ 3478, SD 439), leg. 1 September 2013 (ZMB); 1 male (PJ 3479, SD 463), 1 female (PJ 3480), leg. 1 September 2013 (SMF); 1 male (PJ 3481, SD 479), 1 female (PJ 3482, SD 480), leg. 1 September 2013 (SMF), all other data as for holotype.

**Additional material examined.** 3 juveniles, as for holotype except for: leg. 5. July 2009 (SMF 59797).

**Diagnosis.** Medium-sized Sparassinae, body length of males: 13.8–19.0, females: 19.0–19.5. Similar to *C. villosus* and *C. concolor* in having the distal embolus coiled, the RTA reduced (Figs 109–114) and epigyne with a simple and long median septum (Figs 118, 123). It is distinguished from *C. concolor* (only males known) by the

blunt distal tip of cymbium, the absence of a gap between the strong rounded part of embolus and the tegulum and the slightly smaller RTA, that is not reaching the distal tibial margin in retrolateral view. Males of the new species can be distinguished from those of *C. villosus* by the presence of a small RTA. Females are hard to distinguish from those of the very similar *C. villosus*. Both species exhibits small pits at the lateral epigyne originated from deeply invaginated muscular attachment points. These are slightly deeper and more pronounced in *C. rechenbergi* **spec. nov.** Females exhibit a small, but distinct transversal ridge close to the posterior end of the medium septum (it may be functionally connected with anchoring the male RTA considering functional morphology of other Sparassidae; Jäger unpubl. data). The rounded median structures of the internal duct system (glandular appendages) are relatively larger than in *C. villosus* (Figs 119, 124), i.e. their largest diameter as large or larger than the distance from these structure to the anterior end of the internal duct system (generally smaller in *C. villosus*), and by the septum relatively longer to the length of the internal duct system (septum length/length internal duct system = 0.69–0.72; *C. villosus*: 0.57–0.66). Moreover, the two posterior teeth are in both sexes more distinctly fused (Figs 116, 121, 126) than in *C. villosus*, i.e. the apices are relatively shorter than those in *C. villosus*. The flic-flac (escape) behaviour of *C. rechenbergi* **spec. nov.** (Figs 152–161) seems also to be unique and was not observed in *C. villosus* so far.

**Etymology.** The specific name is honouring Prof. Dr. Ingo Rechenberg, who collected the type material. Moreover, he spent many months in the Saharan desert observing and filming the unusual behaviour of this new species and triggered research in the field of bionics and bio-robotics; noun (name) in genitive case.

**Description.** Male (holotype first with paratypes in parentheses if differing). PL 8.2 (7.2–8.5), PW 6.5 (5.8–6.7), AW 3.9 (3.3–3.8), OL 8.7 (6.6–10.5), OW 7.0 (4.9–6.3). AME 0.62 (0.57–0.70), ALE 0.39 (0.35–0.38), PME 0.35 (0.36–0.40), PLE 0.37 (0.31–0.41), AME–AME 0.10 (0.15), AME–ALE 0.06 (0.08–0.10), PME–PME 0.54 (0.56–0.61), PME–PLE 0.61 (0.55–0.66), AME–PME 0.41 (0.45–0.48), ALE–PLE 0.46 (0.52–0.53), clypeus AME 0.17 (0.20), clypeus ALE 0.32 (0.28–0.30) (Fig. 117). Spination: Palp: 120 (020), 000, 000, 000; legs: femur I–III 323, IV 322(3); patella 000; tibia I–IV 2024; metatarsus I–III 2024, IV 3036 (3035/4024). Ventral metatarsi I–IV with sparse scopula in distal half, without spines or bristles distally. Leg formula: 2413. Measurements of palp and legs: Palp 10.8 (3.8, 1.6, 1.7, -, 3.7), leg I 37.8 (11.5, 3.6, 9.8, 10.3, 2.6), leg II 40.9 (12.2, 4.0, 10.6, 11.5, 2.6), leg III 32.6 (10.3, 3.5, 8.0, 8.6, 2.2), leg IV 37.9 (12.1, 3.7, 9.3, 10.3, 2.5). Cheliceral furrow with 2 anterior and 2 adnate posterior teeth, without denticles (Fig. 116). Margin of chelicerae close to fang base with 6/9 (7–9) bristles.

Palp as in diagnosis (Figs 109–114). Tibia distinctly shorter than cymbium, short RTA with concave distal margin, disto-retrolaterad. Embolus arising in a 9-o'clock-position, distal coil situated in a 1- to 3-o'clock-position; embolus tip reaching into retrolateral half of that coil. Subtegulum visible at distal and prolateral margin of alveolus.

Colouration in ethanol: Pale yellowish-brown without distinct pattern. Dorsal prosoma with distinct longitudinal fovea and slight radial pattern. Ventral side lighter; distal segments of appendages slightly darker; spinnerets appearing in ventral view dark by dark setae, otherwise body and legs with white setae; tips of chelicerae, fangs, and distal leg claw tufts dark. Live specimens exhibiting yellow areas on dorsal opisthosoma and femora, otherwise the spider appears white shimmering with ventral leg scopulae in black (Figs 141–144).

Female (2 paratypes, PJ 3186, 3188): PL 7.3–8.2, PW 5.8–6.3, AW 4.0–4.4, OL 9.0–11.3, OW 6.5–8.6. AME 0.62–0.67, ALE 0.38–0.40, PME 0.38–0.40, PLE 0.35–0.41, AME–AME 0.16–0.20, AME–ALE 0.06–0.09, PME–PME 0.65, PME–PLE 0.57–0.72, AME–PME 0.47, ALE–PLE 0.51–0.59, clypeus AME 0.26–0.27, clypeus ALE 0.31–0.33 (Fig. 122, 127). Spination: Palp: 120, 000, 0000, 1000; legs: femur I–II 323, III 32(1)3, IV 322; patella 000; tibia I–III 2024, IV 2024(3); metatarsus I–II 2024, III 2024 (2014, 1024), IV 3035. Ventral metatarsi I–IV with sparse scopula in distal half, without spines or bristles distally. Leg formula: 2413(4213). Measurements of palp and legs: Palp 10.4–11.0 (3.5–3.6, 1.5–1.6, 1.9–2.2, -, 3.5–3.6), leg I 30.2–32.2 (9.1–9.7, 3.5–3.7, 7.2–7.8, 8.1–8.5, 2.3–2.5), leg II 31.7–33.08 (9.7–10.2, 3.6–3.7, 7.7–8.4, 8.3–9.0, 2.4–2.5), leg III 25.7–26.6 (8.0–8.5, 3.2–3.3, 5.8–5.9, 6.5–6.8, 2.1–2.2), leg IV 31.9–32.7 (10.1–10.6, 3.5, 7.2–7.9, 7.9–8.3, 2.2–2.4). Cheliceral furrow with 2 anterior and 2 adnate posterior teeth, without denticles (Fig. 121, 126). Margin of chelicerae close to fang base with 4–12 bristles. Palpal claw with ca. 7–9 teeth.

Copulatory organ as in diagnosis (Figs 118–120, 123–125). Epigynal field only well distinguishable in the posterior half, with one slit sensillum on each side. Internal duct system with anteriorly situated membranous sacs (atria) of diverse shapes; medially with slightly sclerotized oval structures originated from a membranous zone. Fertilisation ducts flattened, their tips bent at a right angle.

Colouration in ethanol: As in male. For live colouration see Figs 135–139, 141–144.

**Distribution.** Only known from the type locality (Fig. 173).

**Biology and behaviour.** The following data are compiled mainly from field observations and shots by Ingo Rechenberg in Morocco. Parts of these observations have been used and published by King (2013).

*C. rechenbergi* **spec. nov.** lives in sandy deserts in the Erg Chebbi (Fig. 173) and builds similar vertical burrows (Figs 149–151) like *C. villosus* (compare “Biology” paragraph under *C. villosus*). Although no direct observations were made the same array of long bristles at palps and chelicerae let assume that spiders carry the loose sand in the same way as *C. villosus* (Fig. 131). Some of the tubes sticking out of the sand in the morning exhibited an elongation part (Figs. 149, 150 right). It is not clear yet how the spiders construct this part, but it is considerably narrower than the rest. Probably it can be interpreted as energy saving issue in a habitat with limited prey items. Further it was observed that the spider returns after its nocturnal trip to its burrow and “dives” through a slit of the lid (Figs 135–140) starting with leg II and III of one side (here right side, Fig. 136), then first disappearing with one side of the body and continuing with the rest.

Copulatory posture is the same as in other Sparassidae (*Micrommata virescens*, *Heteropoda venatoria*, *Heteropoda tetrica*, *Holconia insignis*; Jäger unpubl.): the male is sitting on the back of the female in a reverse position, i.e. with his head at her opisthosoma, no matter whether the female is sitting on the desert ground or hanging at grass leaves (Figs 141–144). Palps are inserted alternatively: left palp at the left side of the female and right palp accordingly. From a close-up (Fig. 144) it is clear that the RTA comes close to the epigynal pits as well as to the transversal ridge of the medium septum during the copulation process, theoretically supporting the hypothesis that these structure build a functional unit.

The most striking behaviour is the so-called flic-flac behaviour: when disturbed a spider will usually show first the threatening behaviour like *C. villosus* (Fig. 145; compare for *C. villosus* Jäger 2000 and Fig. 130). When further provoked the spider starts running and in about 50% of all cases observed running transforms to flic-flac behaviour. Usually it is performed forwards (Figs. 152–161), but can also be done backwards. It can be performed on even ground but also down- or up-hill (Fig. 161). It could be interpreted as last-resort escaping behaviour. Speed is two times higher than running speed (according to high speed camera shots and subsequent analysis by I. Rechenberg) and might be the trigger to select for this costly behaviour. However, I. Rechenberg observed that males and females perform this behaviour and that the spider will approach the person who provoked it. Spiders got to the hand, the knee or to other body parts of that person, in one case a spider choose the torch lying in the sand beside the person. Such behaviour is not known from any of the other *Cebrennus* species, but in the Kalahari(?) desert photo evidence exists from a Sparassidae (*Leucorchestris?* sp.) jumping on the back from a suricate (Henschel, personal communication). Mock attacks were also observed in Namibia by Henschel on a dune lark (which fled after the attack) and by Norgaard on himself on several occasions (both unpublished observations). It may be interpreted as best option to defend, since running away is useless in a habitat without any possibilities to hide and with temperatures making a spider exhausted after several metres running (Norgaard, personal communication).

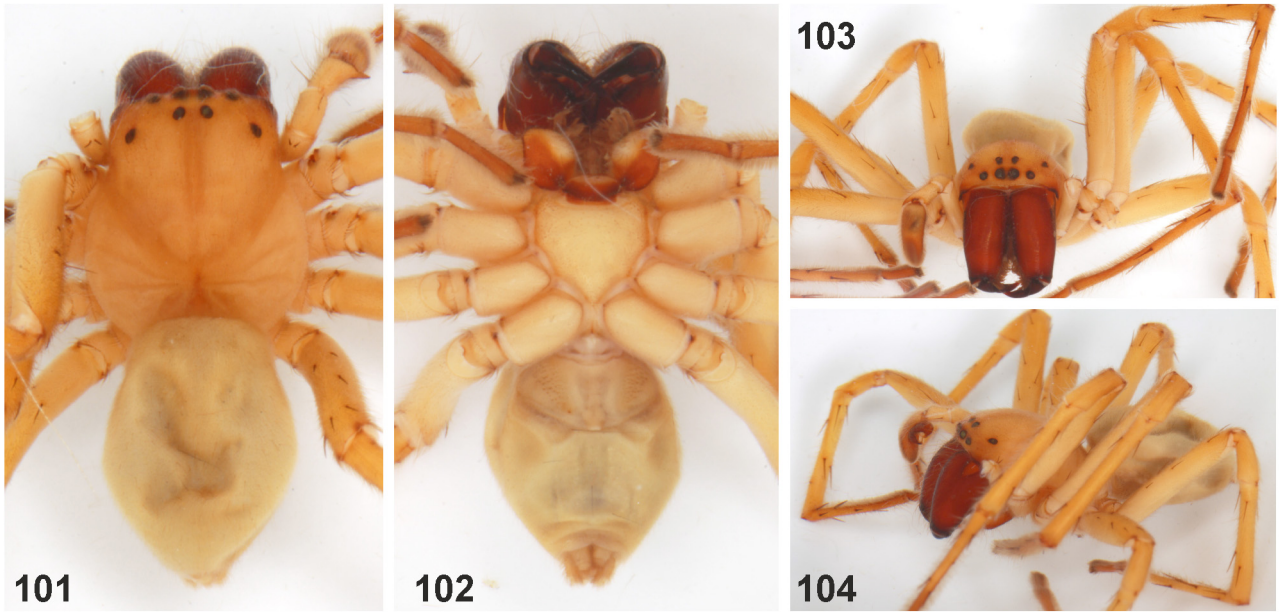
The movement itself is induced mainly by legs I, II and IV and their quick and powerful stretching. The spider will jump, tumble and land on the dorsal tarsi and metatarsi IV (Fig. 156). Subsequently, tarsi II are in contact with the ground. In this stage legs I and III are held above the body (Fig. 157). After that, dorsal tarsi and metatarsi I touch the sand (Fig. 158). At least tarsi II and IV dive slightly into the sand, when oriented in a right angle to the sand’s surface (Fig. 158). The flic-flac behaviour is not known from *C. villosus* (Algeria, Tunisia) or *C. concolor* (Egypt), two closely related species according to their palpal morphology.

Similar behaviours are known from the huntsman spiders *Carparachne aureoflava* Lawrence, 1966 and *C. alba* Lawrence, 1962 (gravity-driven wheeling in Namib dunes; Henschel 1990). Another wheeling behaviour is known from larvae of the tiger beetle *Cicindela dorsalis media* (LeConte, 1856) (wind-powered somersaults in Namib; Harvey & Zukoff 2011) and from an unidentified Salticidae (wind-powered wheeling in Namib; Henschel 1990). Caterpillars of two species (Brackenbury 1997, 1999) as well as a mantis shrimp (Full et al. 1993) perform active backward somersault and subsequent wheeling. Gravity-driven rolling is known from Glomeridae, Sphaerotheriida (pill millipedes, giant pill millipedes; Myriapoda) and Armadillidiidae (pill bugs; Crustacea). In all cases it is reported that speed is increased when the particular behaviour is applied. In two examples it seems to be an evolutionary response to parasitic wasps that hunt the tiger beetle larvae or the golden wheel spider, in others it is when animals are provoked, disturbed or threatened. In *C. rechenbergi* **spec. nov.** the natural triggering factor is yet unknown. In contrast to the wheeling behaviour in *Carparachne aureoflava* it is an active energy-consuming movement, which can lead to the death of the individual when performed some times in succession (Rechenberg, personal communication). The unique flic-flac behaviour of *C. rechenbergi* **spec. nov.** inspired King (2013) to investigate this form of locomotion structurally and to invent a robot with similar motional elements.

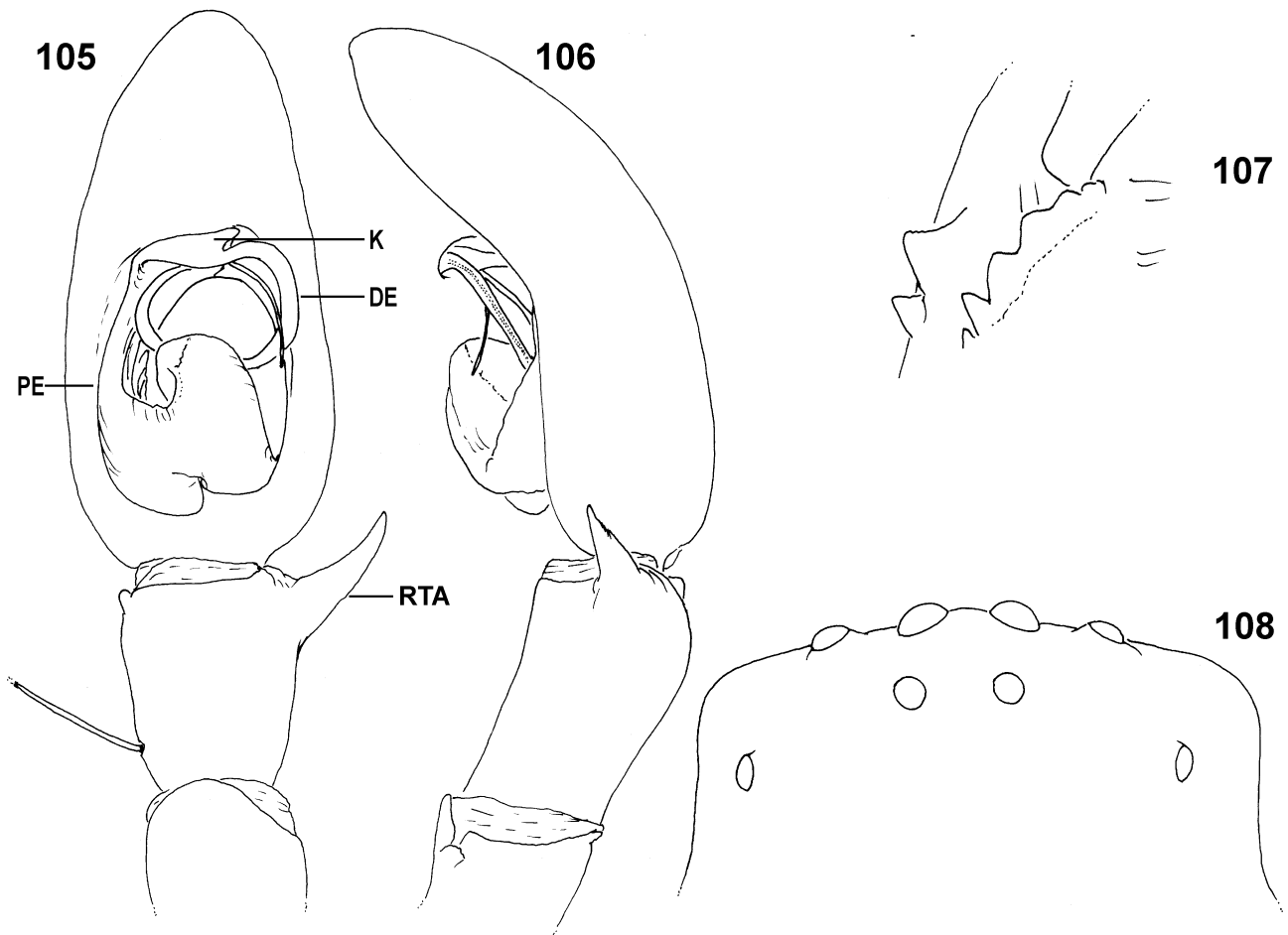


**FIGURES 88–100.** *Cebrennus* spp., habitus (photos in ethanol; 88, 92, 95, 97 dorsal, 89, 98 ventral, 91, 94, 100 frontal, 90, 93, 96, 99 lateral). 88–91 *Cebrennus kochi* (O. Pickard-Cambridge, 1872), female from Sede Boquer, Israel; 92–93 *Cebrennus rungsi* Jäger, 2000, male from Anti-Atlas, Morocco; 94–96 *Cebrennus atlas* **spec. nov.**, holotype female from Atlas, Morocco; 97–100 *Cebrennus flagellatus* **spec. nov.**, holotype male from Afghanistan.

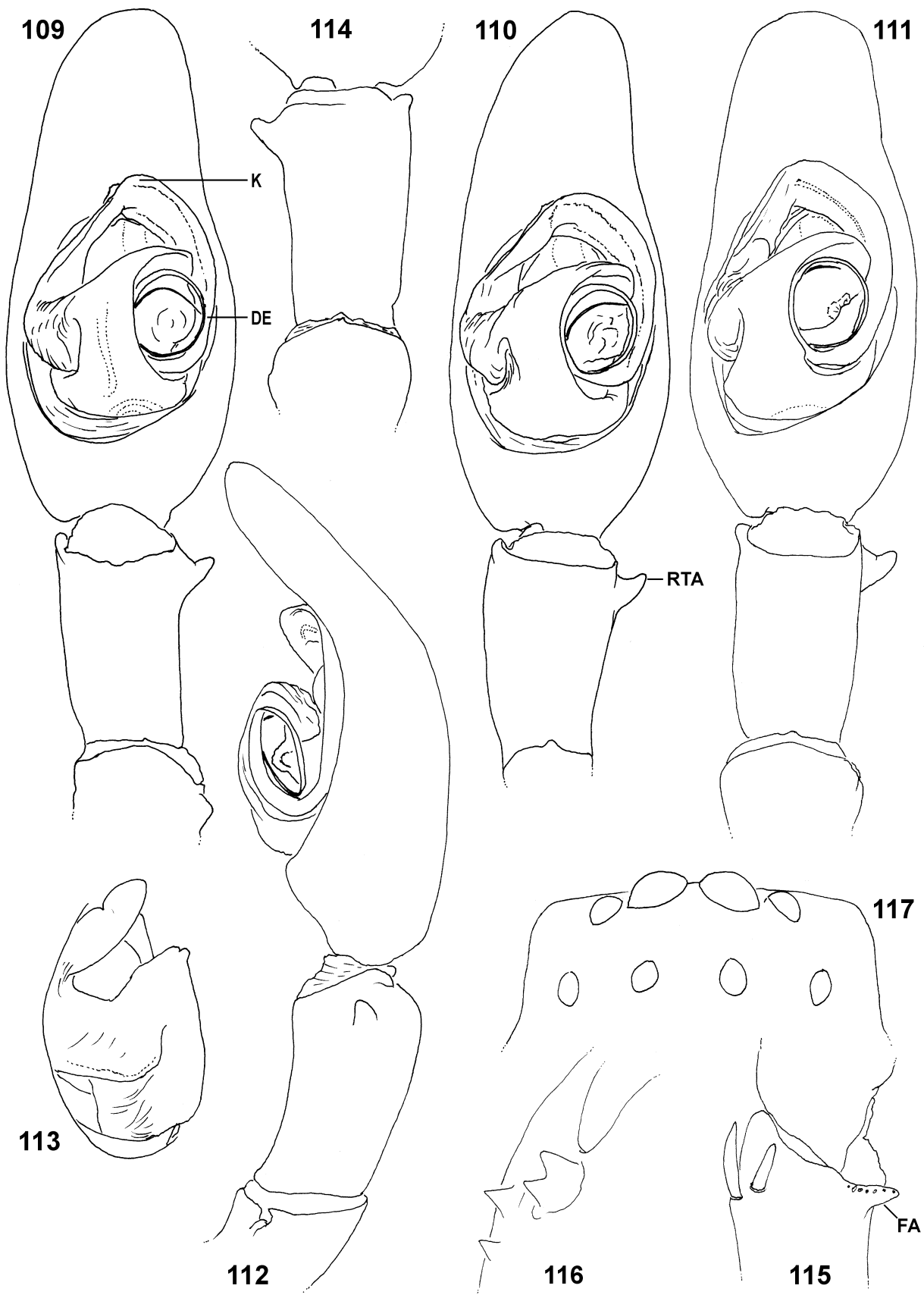




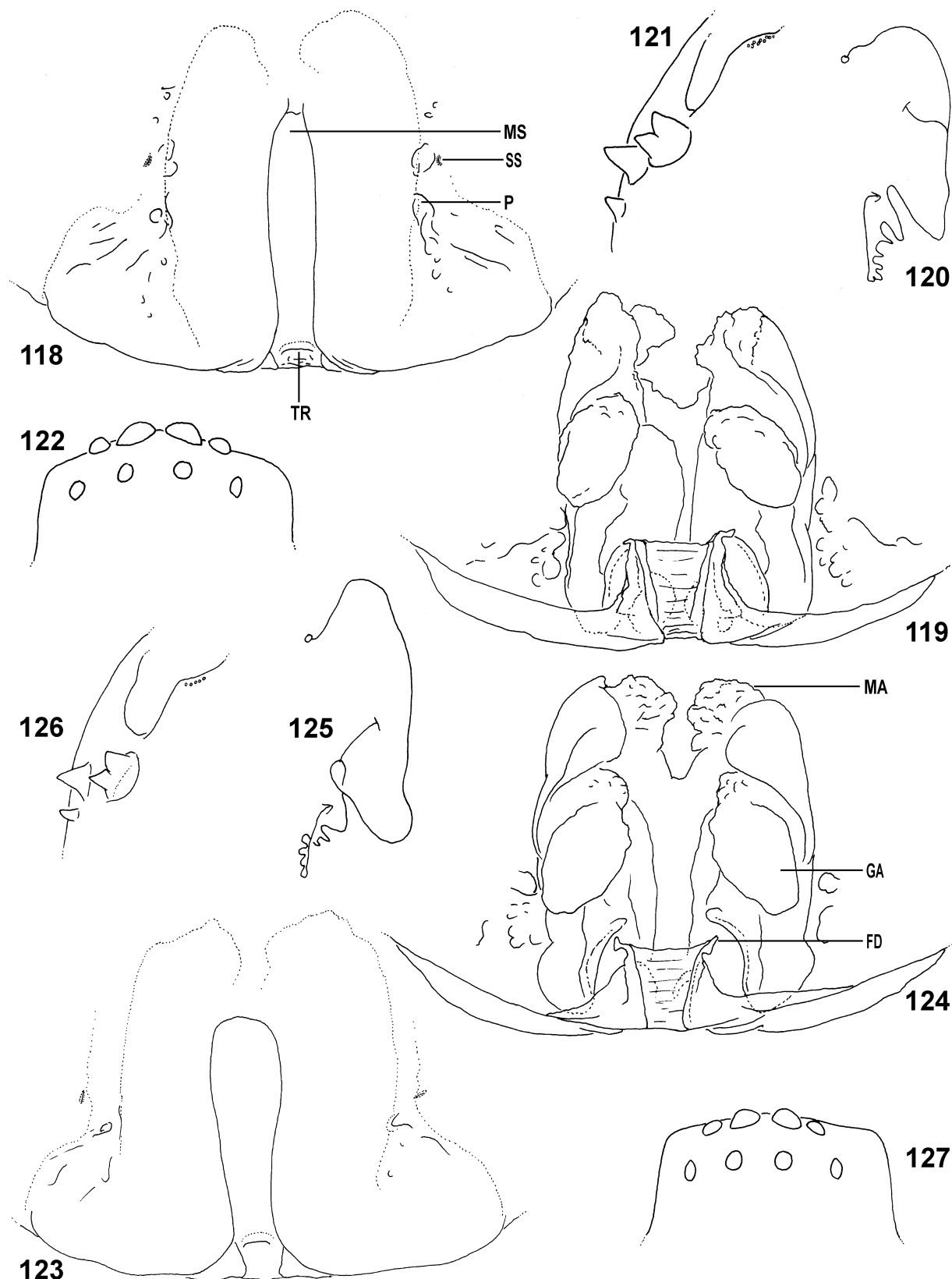
**FIGURES 101–104.** *Cebrennus laurae* *spec. nov.*, holotype male from Canary Islands, habitus (photos in ethanol; 101 dorsal, 102 ventral, 103 frontal, 104 lateral).



**FIGURES 105–108.** *Cebrennus laurae* *spec. nov.*, holotype male from Canary Islands. 105–106 Left male palp (105 ventral, 106 retrolateral); 107 Cheliceral dentition, ventral; 108 Eye arrangement, dorsal. DE—distal part of embolus, here developed as coil, K—embolic kink, PE—proximal part of embolus, RTA—retrolateral tibial apophysis.



**FIGURES 109–117.** *Cebrennus rechenbergi* **spec. nov.**, males from Erg Chebbi, Morocco (109 holotype, 110 PJ 3395, 111–117 PJ 3407). 109–115 Left male palp (109–111 ventral, 112 retrolateral, 113 bulb, prolateral, 114 tibia, dorsal, 115 distal femur, retrolatero-dorsal); 116 Cheliceral dentition, ventral; 117 Eye arrangement, dorsal. DE—distal part of embolus, here developed as coil, FA—femoral apophysis, K—embolic kink, RTA—retrolateral tibial apophysis.



**FIGURES 118–127.** *Cebrennus rechenbergi* **spec. nov.**, females from Erg Chebbi, Morocco (118–122 PJ 3188, 123–127 PJ 3186). 118, 123 Epigyne, ventral; 119, 124 Vulva, dorsal; 120, 125 Schematic course of internal duct system, dorsal; 121, 126 Cheliceral dentition, ventral; 122, 127 Eye arrangement, dorsal. FD—fertilisation duct, GA—glandular appendages, MA—membranous atrium, MS—median septum, P—lateral pit, SS—slit sense organ, TR—transversal ridge of median septum.



**FIGURES 128–134.** *Cebrennus villosus* (Jézéquel & Junqua, 1966), females from Tunisia, photos of live spiders. 128–129 Habitus showing specialised hairs on palps and chelicerae; 130 Threatening behaviour; 131 Carrying sand with specialised hairs; 132 Adding silk strands to the tube wall when descending to the bottom; 133 Closing the tube opening with a silken lid; 134 Pattern of leg movements around the closed opening.



**FIGURES 135–140.** *Cebrennus rechenbergi* **spec. nov.**, female from Erg Chebbi, Morocco, entering the tube through a semi-circular slit in the silken lid. Photos: I. Rechenberg.

***Cebrennus villosus* (Jézéquel & Junqua, 1966)**

Figs 128–134, 147–148, 173

*Cerbalopsis villosa* Jézéquel and Junqua, 1966: 970, figs 4–8 (description of male and female; 3 males, 10 females, juveniles, syntypes from Grand Erg Occidental [for notes on the type locality see below], MNHN, not found).

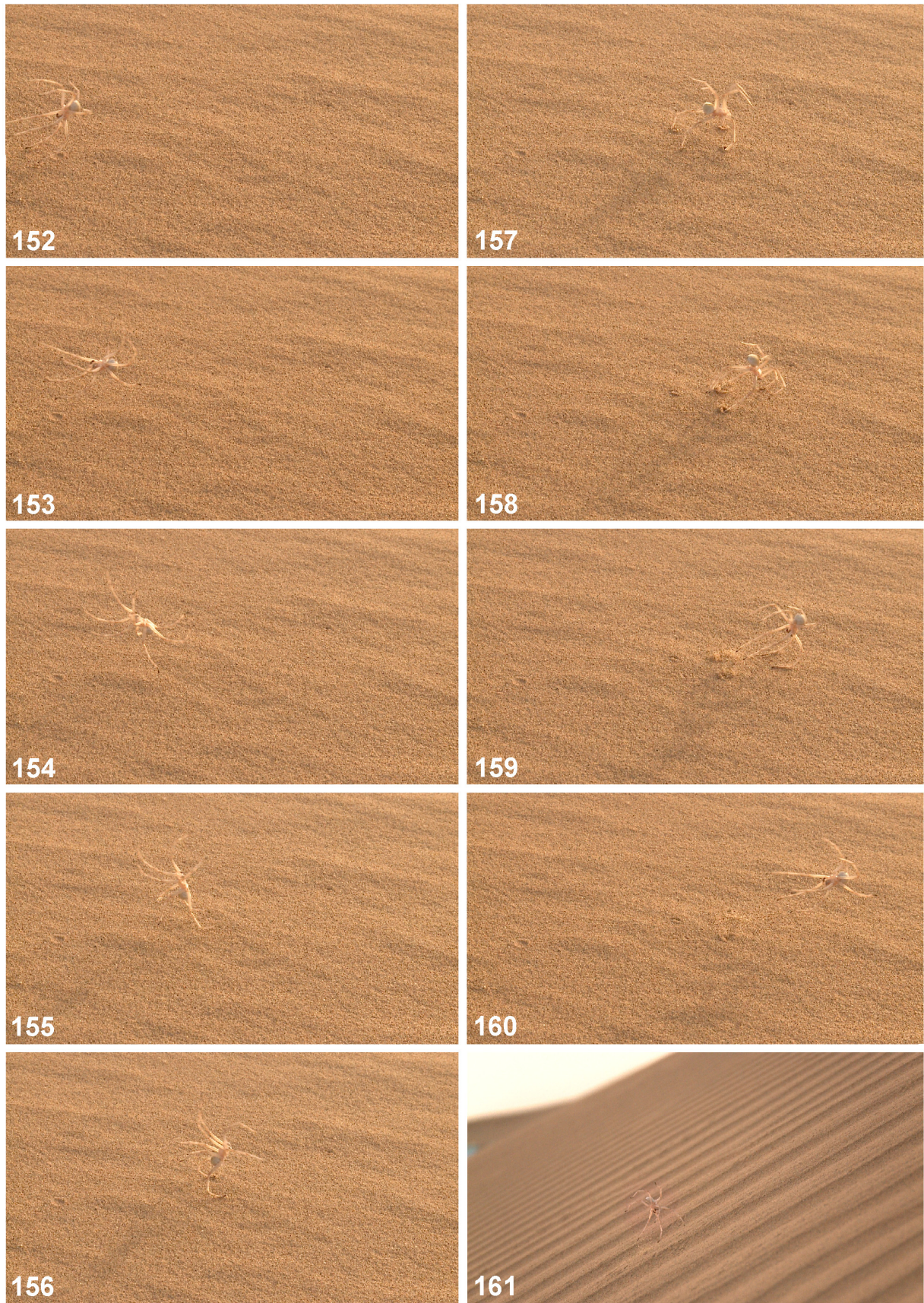
*Cebrennus villosus* (Jézéquel & Junqua). Jäger 2000e: 181, figs 73–85 (illustration of male and female from Tunisia).



**FIGURES 141–146.** *Cebrennus rechenbergi* **spec. nov.** from Erg Chebbi, Morocco. 141–144 Copulation (141–142 on sand, 143–144 in grass); 145 Threatening behaviour; 146 Habitat with mobile research station of Ingo Rechenberg. Photos: I. Rechenberg.



**FIGURES 147–151.** Silken burrows (149, 150 [right] showing distal extensions). 147–148 *Cebrennus villosus* (Jézéquel & Junqua, 1966) from Tunisia; 149–151 *Cebrennus rechenbergi* **spec. nov.** from Erg Chebbi, Morocco. Photos: 147–148 Beudels; 149–151 I. Rechenberg.



**FIGURES 152–161.** *Cebrennus rechenbergi* **spec. nov.** from Erg Chebbi, Morocco, flic-flac behaviour (152–160 even surface, 161 uphill; see text for detailed description). Photos: I. Rechenberg.



**Note.** In the original publication no exact type locality is mentioned. Grand Erg Occidental is a huge area with an extent of ca. 500 km (West-East) by 300 km (North-South). Jézéquel and Junqua (1966) mention a Solifugae (*Othoes saharae*) as potential competitor or predator of *C. villosus*. In the cited work on this species (Junqua 1966) it is mentioned that studies were performed with the Centre de Recherches Sahariennes de Béni-Abbès as base for collecting and rearing. Therefore, in Fig. 173 the type locality was set close to this Centre.

**Material examined. TUNISIA: Kebili:** 1 female (PJ 2466, SD 522), 2 juveniles, Jbil National Park, N 33.14°, E 9.26° [137 m elev.], U. Moldrzyk leg. October 2005, female died 5 May 2006 (SMF); 1 female (PJ 3328, SD 712), 2 juveniles, Grand Erg Oriental, small area of dunes, N 32°59.45', E 9°1.512' [137 m elev.], U. Moldrzyk leg. October 2010, female died 14 April 2011 (SMF).

**Description.** See Jäger (2000).

**Variation.** One female from Tunisia: PL 7.2, PW 6.1, AW 4.1, OL 8.1, OW 6.4; chelicerae with 2 anterior and 2 adnate posterior teeth.

**Distribution.** Algeria (Grand Erg Occidental), Tunisia (Grand Erg Oriental).

**Biology.** *Cebrennus villosus* builds vertical burrows as described in Jézéquel and Junqua (1966) as well as in Jäger (2000) according to observations in the lab. Figs 131–134 show different stages of this behaviour: the female carries sand from the ground of the burrow with their palps and chelicerae and specialised elongated bristles respectively, which latter build a basket to hold as much of the small-grained desert sand (Fig. 131). The sand is deposited around the opening of the burrow in a distance of ca. one to three centimetres. When the spider goes again down to the burrow bottom it moves in a circle and strengthens the silken wall with new layers of silk (Fig. 132). The special shape of opisthosoma fits into the circular cross section of the tube and the minimised cross-section dimension in order to save energy in these harsh environments. When closing the burrow with the silken lid sand is taken with the fourth leg to cover the silk by sand grains (Fig. 133). The fourth leg is also the last one that pokes out of the burrow before it is definitely closed. Around the closed burrow characteristic radial marks of the leg movements are left behind (Fig. 134). When the sand is blown away by the wind the top part of the tube is visible in the morning (Fig. 147). When a tube is dug out the layered structure is recognisable (Fig. 148).

The threatening behaviour was described in Jäger (2000). Fig. 130 shows a female from Tunisia in the lab, standing at its tiptoes raising the first pair of leg after it was tantalised in its cage. It never showed the flic-flac behaviour, described above for *C. rechenbergi* **spec. nov.**, neither in the field (Moldrzyk, personal communication) nor in the lab.

## Unassigned species

### *Cebrennus tunetanus* Simon, 1885

Figs 162–171, 173

*Cebrennus tunetanus* Simon, 1885: 14 (Description of male; holotype male, Tunisia, Enfida or El Kef, MNHN 1613-6491, examined). Fage 1921: 163, figs 2d–f (illustration of male, description of female); Jäger 2000: 185, figs 86–88 (illustration of male and female).

**Note.** Jäger (2000) considered the two specimens from MNHN syntypes. This cannot be true, since Simon described only the male sex (Simon 1885). Most likely the female was added from Fage when he described the female (Fage 1921). Simon (1885) mentioned "quelque femelles jeunes" (several female juveniles) which are not present in this series.

**Additional material examined.** 1 female, no data given by Fage (1921) (MNHN 1613-6491; see note above).

**Extended diagnosis.** Males can be recognised by their proximal tegular hump (i.e. proximal tegulum in lateral view distinctly wider than cymbium) in combination with the short and simple tapering embolus (Figs 162–164). Females with median field triangular similar to that in *C. mayri* Jäger 2000, but distinguished by the two light "windows" at the anterior end (Fig. 167), and uniquely anteriorly situated glandular appendages covering atria in dorsal view (Fig. 169).

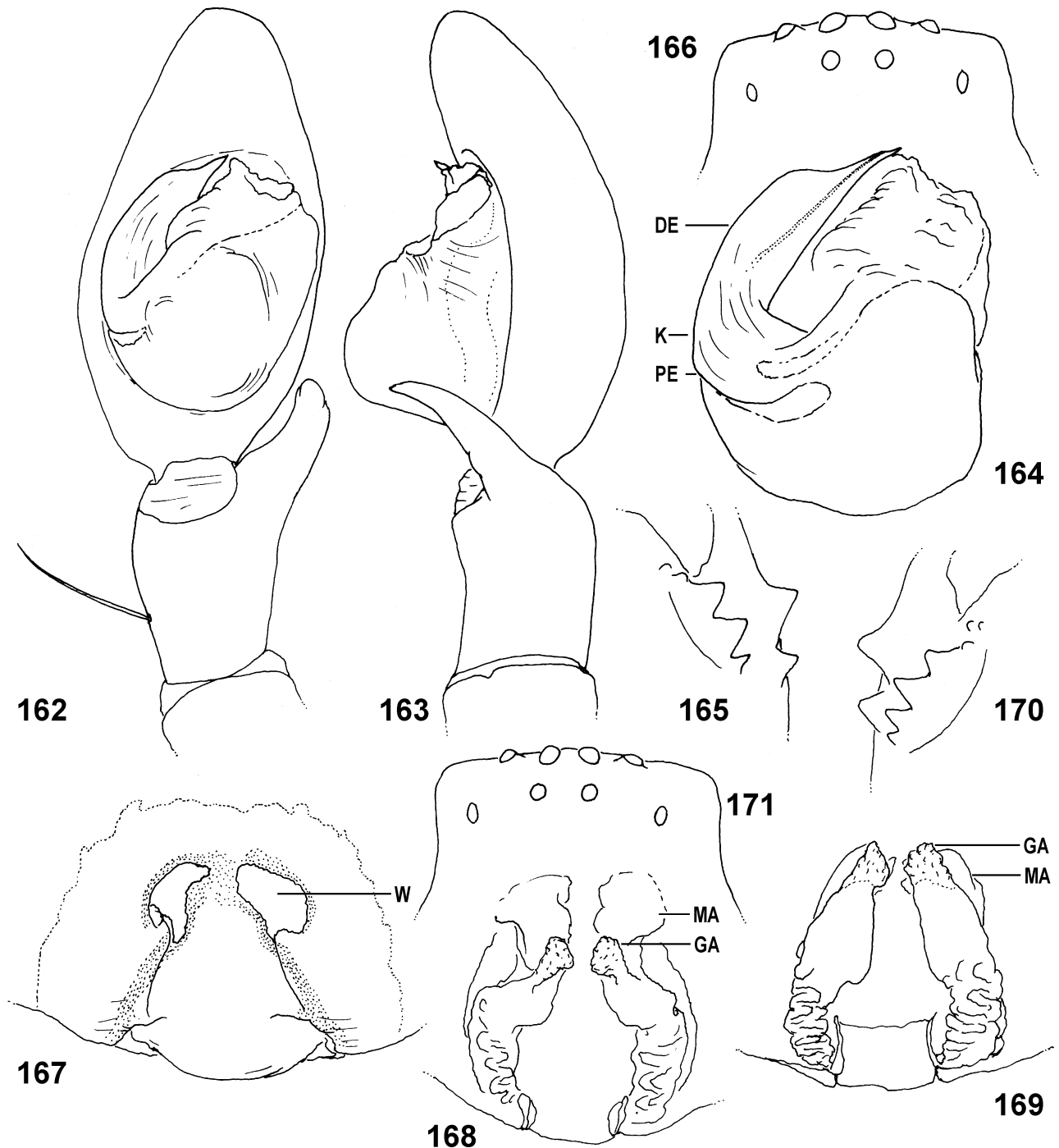
**Description.** See Simon (1885) and Fage (1921). Here, some additional data are given.

Male (holotype): PL 7.5, PW 6.2, AW 4.0, OL 6.7, OW 5.4. Anterior eye row straight, posterior eye row recurved, AME largest (Fig. 166). Spination: Palp: 130, 000, 1000; legs: femur I 323, II 324, III 323(4), IV 322; patella 000; tibia 2024; metatarsus I–II 2024, III 3024, IV 3036(7). Cheliceral furrow with 2 anterior, 4 adnate

posterior teeth and 1 small single tooth distally, without denticles (Fig. 165). For further description see Simon (1885).

Palp as in diagnosis (Figs 162–164). Tibia distinctly shorter than cymbium, RTA ventrad. Embolus arising in an 8- to 9-o'clock-position, distal tip situated in a 12-o'clock-position, retrolatero-distad.

Female: PL 8.0, PW 6.5, AW 5.1, OL 8.0, OW 7.5. Anterior eye row straight, posterior eye row recurved, AME largest (Fig. 171). Spination: Palp: 130, 000, 1000, 1000; legs: femur I–III 323, IV 321; patella 000; tibia 2024; metatarsus I–III 2024, IV 3036. Cheliceral furrow with 2 anterior, 5 adnate posterior teeth and 2 small single teeth distally, without denticles (Fig. 170).

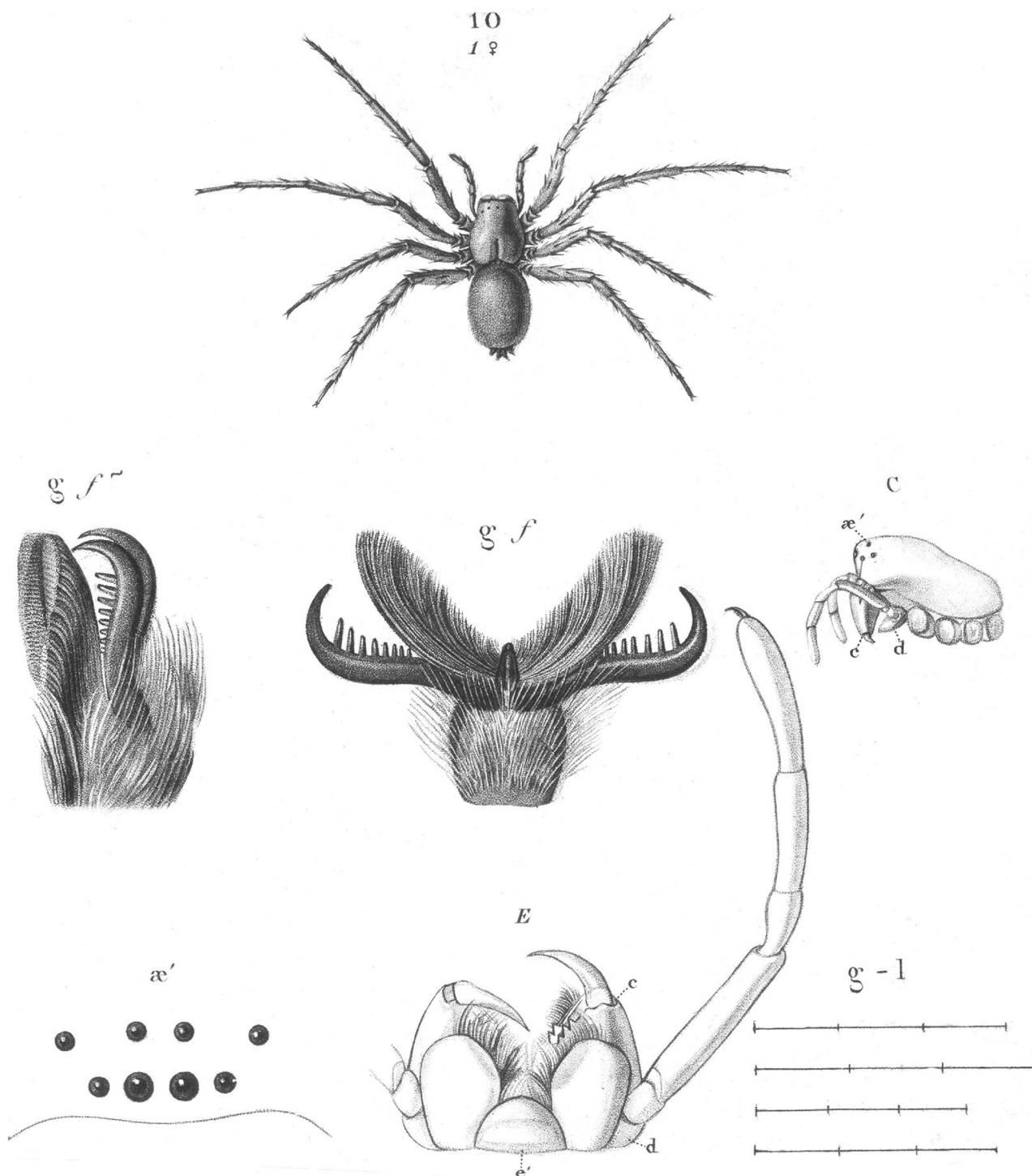


**FIGURES 162–171.** *Cebrennus tunetanus* Simon, 1885 from Tunisia (162–166 holotype male, 167–171 female). 162–164 Left male palp (162 ventral, 163 retrolateral, 164 bulb, slightly prolateral); 165, 170 Cheliceral dentition, ventral; 166, 171 Eye arrangement, dorsal; 167 Epigyne, ventral; 168–169 Vulva (168 antero-ventral, 169 dorsal). DE—distal part of embolus, GA—glandular appendages, K—embolic kink, MA—membranous atrium, PE—proximal part of embolus, W—light “windows” close to copulatory openings.

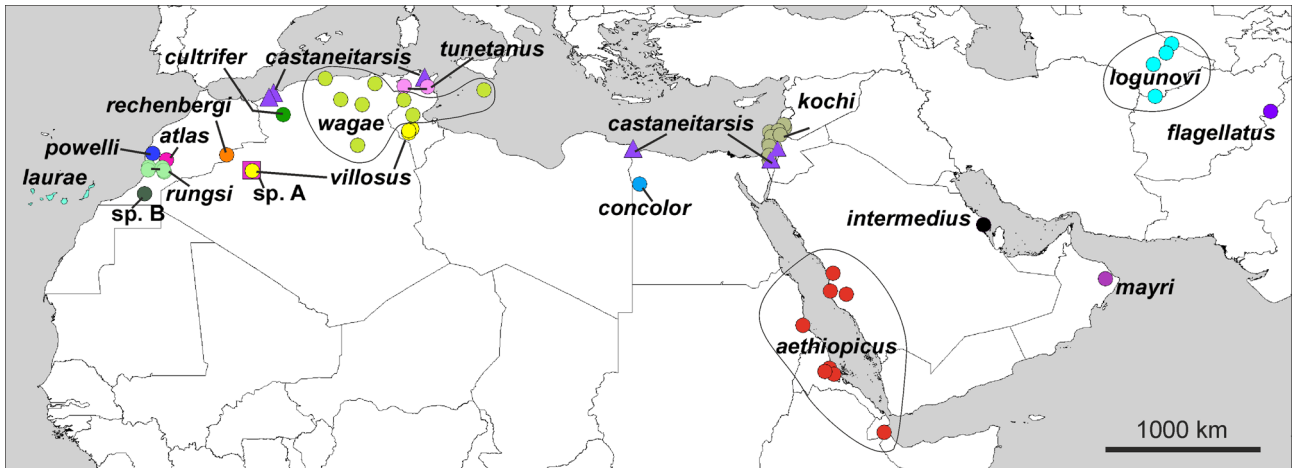
Copulatory organ as in diagnosis (Figs 167–169). Epigynal field wider than long. Epigyne with narrow ridge between anterior “windows” and with posterior margin of median part convex and slightly extending beyond epigastric furrow. Posterior part of internal duct system with several windings. Fertilisation ducts narrow, antieriad.

**Distribution.** Only known from the type locality (Fig. 173).

**Biology.** According to Simon (1885) spiders of this species build their burrows in plain sandy or slightly clayey habitats. The burrows may be five to eight centimetres deep and three to four centimetres wide. They fix this cavity with a strong and dense tissue of silk and close the entrance completely with a drumhead-like lid. For hunting they leave the tube via a semi-circular slit in the lid (cf. *C. rechenbergi* **spec. nov.** and Figs 135–140).



**FIGURE 172.** *Cebrennus clerckii* (Audouin, 1826) from Egypt or Israel, holotype (female?) (from Audouin 1826: habitus, leg claws, prosoma, eye arrangement, and mouthparts).



**FIGURE 173.** Distribution records of *Cebrennus* spp. (according to Jäger 2000 and references therein, this paper and Reimoser 1919). Note that the exact locality for *C. laurae* *spec. nov.* is unknown.

***Cebrennus clercki* (Audouin, 1826) comb. nov. nomen dubium**

Fig. 172

*Philodromus clerckii* Audouin, 1826: 159 (Description of female, Fig. 172). Roewer 1955: 1623 [„nicht zu deuten“; sub „*Philodromus clerckii* Audouin 1827“]

*Sparassus clercki* (Audouin). Bonnet 1958: 4102 [Transfer to Sparassidae; sub “*Sparassus clercki* (Sav. & Aud. 1825), Egypte”]

*Philodromus clercki* (Audouin). Platnick 2000–2014 (Transfer to Philodromidae; nomen dubium, Egypt)

**Type material.** The original type material (most likely a female holotype; Audouin 1826: “individu femelle de grandeur naturelle”) is supposed to be lost. Since the type locality is not fixed and several *Cebrennus* species occur in Egypt and Israel (El-Hennawy 2002, Jäger 2000, Levy 1989), no neotype is designated here.

**Systematic position.** The affiliation to the family Sparassidae was once recognised by Bonnet (1958), but not followed by Platnick (2000–2014), who used Roewer’s (1955) catalogue as base for the online version. The placement of the species in the genus *Cebrennus* is supported by the clear concordance of somatic characters shown in Savigny’s plate (Audouin 1826; Fig. 172) with other *Cebrennus* species (see Jäger 2000). Species identity can only be clarified by copulatory organs. Since these are in this case not available as drawings or as from the original type material, *C. clercki* **comb. nov.** is considered a nomen dubium.

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