

## Miscellaneous notes on European and African *Cheiracanthium* species (Araneae: Miturgidae)

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**Abstract.** The African species *Cheiracanthium furculatum* Karsch, 1879 was recognised as being introduced to Germany and is re-described and illustrated in the present study. *C. tenuipes* Roewer, 1961 is recognised as a junior synonym of *C. africanum* Lessert, 1921 (**new synonymy**); both subspecies of *C. strasseni* Strand, 1915, namely *C. strasseni strasseni* Strand, 1915 and *C. strasseni aharonii* Strand, 1915, are recognised as junior synonyms of *C. mildei* L. Koch, 1864 (**new synonymies**). Photographic images of the copulatory organs of the types of *C. cretense* Roewer, 1928, recently synonymised with *C. mildei*, are provided and discussed in the course of intraspecific variation in *C. mildei*. The female holotype of *C. rehobothense* Strand, 1915 is re-described and illustrated. Relations of *C. rehobothense* to other *Cheiracanthium* species are discussed.

**Keywords:** Africa, copulatory organs, Europe, intraspecific variation, introduction, new synonymies, taxonomy

**Zusammenfassung. Verschiedene Anmerkungen über afrikanische und europäische *Cheiracanthium*-Arten (Araneae: Miturgidae).** Die afrikanische Dornfingerspinnenart *Cheiracanthium furculatum* Karsch, 1879 wurde erstmals nach Deutschland eingeschleppt. In der vorliegenden Studie wird sie wiederbeschrieben und dargestellt. *C. tenuipes* Roewer, 1961 wird mit *C. africanum* Lessert, 1921 synonymisiert (**neue Synonymie**); beide Unterarten von *C. strasseni* Strand, 1915, und zwar *C. strasseni strasseni* Strand, 1915 und *C. strasseni aharonii* Strand, 1915, werden mit *C. mildei* L. Koch, 1864 synonymisiert (**neue Synonymien**). Fotografische Abbildungen der Kopulationsorgane der Typus-Exemplare von *C. cretense* Roewer, 1928, welche vor kurzem mit *C. mildei* synonymisiert wurde, werden im Rahmen der Untersuchung der intraspezifischen Variabilität von *C. mildei* diskutiert. Das Holotypus-Weibchen von *C. rehobothense* Strand, 1915 wird wiederbeschrieben und dargestellt. Beziehungen dieser Art zu anderen *Cheiracanthium*-Arten werden diskutiert.

In July 2012 a *Cheiracanthium* female was found (by chance) within a box of light green grapes from a supermarket in Spesbach, near Kaiserslautern in south-western Germany. The grapes were imported from the Meknès region, Morocco. The female specimen was kept and fed until it laid an egg-sac. Afterwards it was identified as *Cheiracanthium furculatum* Karsch, 1879. In the course of identification, all relevant African and Mediterranean *Cheiracanthium* species were considered. In addition, some species, which were deposited in the arachnid collection of the Senckenberg Research Institute, Frankfurt am Main, Germany, and were not assessed since their first description 50 or more years ago, were examined. One of them, *C. tenuipes*, was described by Roewer (1961) and three others by Strand (1915), namely *C. rehobothense* Strand, 1915, and the two subspecies *C. strasseni strasseni* Strand, 1915 and *C. strasseni aharonii* Strand, 1915. The present study re-describes *C.*

*furculatum* and evaluates the status of the three above-mentioned species. Interestingly, the introduction of *C. furculatum* to Belgium was recently recognised and documented by Bosselaers (2013), who also reported on a possible introduction to Ireland.

### Material and methods

The spiders examined in the present study derive from natural history museum or private collections, which are listed below. Examinations and drawings were carried out with a Leica M 165 C stereomicroscope with a drawing mirror. Photos of preserved spiders and copulatory organs were taken with a Sony DSC W70 compact camera via the ocular of the stereomicroscope. Female copulatory organs were cleared from surrounding hairs and dissected. The (opaque) tissue surrounding the vulva was removed mechanically in order to have the best possible view on the different vulva-structures. In the illustrations of the present paper all epigynes are shown in ventral view and all vulvae are shown in dorsal view, except where otherwise noted.

All measurements (and all numbers listed next to the scale bars) are in millimetres (mm). In the

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present study the “opisthosoma length” is regarded as length of the main part of opisthosoma only, thus without spinnerets and petiolus. Palp and leg lengths are listed as: total (femur, patella, tibia, metatarsus, tarsus). Leg formula (from longest to shortest leg) and leg spination pattern follow those in Bayer & Jäger (2010) and Bayer (2012). In leg/palp spination the limbs femur, patella, tibia and metatarsus (tarsus in palp) are listed in exactly this sequence. First, all spines on the prolateral surface of the respective limb are counted and listed, then those on the dorsal, then retrolateral and finally the ventral surfaces. Thus the resulting number is generally 4-digits. If a spination pattern of a certain limb article differs between the left and right sides, the pattern for the right article follows in curved brackets.

Abbreviations used in the text: ALE - Anterior lateral eye(s). AME - Anterior median eye(s). Juv. - Juvenile. PLE - Posterior lateral eye(s). PME - Posterior median eye(s). RTA - Retrolateral tibial apophysis. S.a. - Subadult.

Terminology of structures belonging to the copulatory organs is given as follows: The internal parts of the female copulatory organ (vulva) comprise a duct system, which can be divided into different sections. An initial duct (copulatory duct) leads from the copulatory opening to the spermatheca. It may be long, with several windings around the spermatheca (e.g. in species like *Cheiracanthium campestre* Lohmander, 1944, see Tullgren 1946, pl. VII, fig. 78, Almquist 2006, fig. 304e). From the spermatheca a narrow fertilisation duct leads to the uterus externus. The latter and parts of the fertilisation duct are inevitably removed along with the dissection and clearing of the copulatory organ. The receptaculum seminis (spermatheca) may be one single voluminous, often pear-shaped to elongated kidney bean-shaped chamber (Figs 8b, 9b) or there are two chambers connected with each other by a narrow duct (Figs 2b,d, 3c, 4b,d, 6b, 7c), which may build up a “compound spermatheca”. In the latter case the initial (anterior) chamber contains an area with numerous pores, which permit connection to accessory glands. Apart from structures that are well known in arachnology, e.g. conductor, sperm duct and embolus, the palps of *Cheiracanthium* bear particular structures, e.g. a tegular apophysis (in some species with special structures), a (long) cymbial

spur, etc. The terminology of these structures follows Lotz (2007a).

Symbols/styles used in the illustrations: Regular solid lines indicate surface edges/margins/rims of structures as recognised in the respective view; weak solid lines indicate edges of fine structures, e.g., membranous structures, or wrinkles in the area of the epigyne; dashed lines indicate inner walls of chambers, ducts (and/or slits); dotted lines (rough) indicate structures visible through cuticula (e.g., parts of vulva visible through epigynal cuticula); dotted lines (fine) indicate clear colour differences (e.g., border of epigynal field). In schematic illustrations showing the course of the internal duct system the area containing numerous pores is marked with a “T”-symbol, the copulatory opening with a circle and the end of the fertilisation duct in direction of the uterus externus with an arrow (Figs 2c, 6c, 8c). Arising points and/or directions of tegular appendages in males are described as clock-positions of the left palp in ventral view.

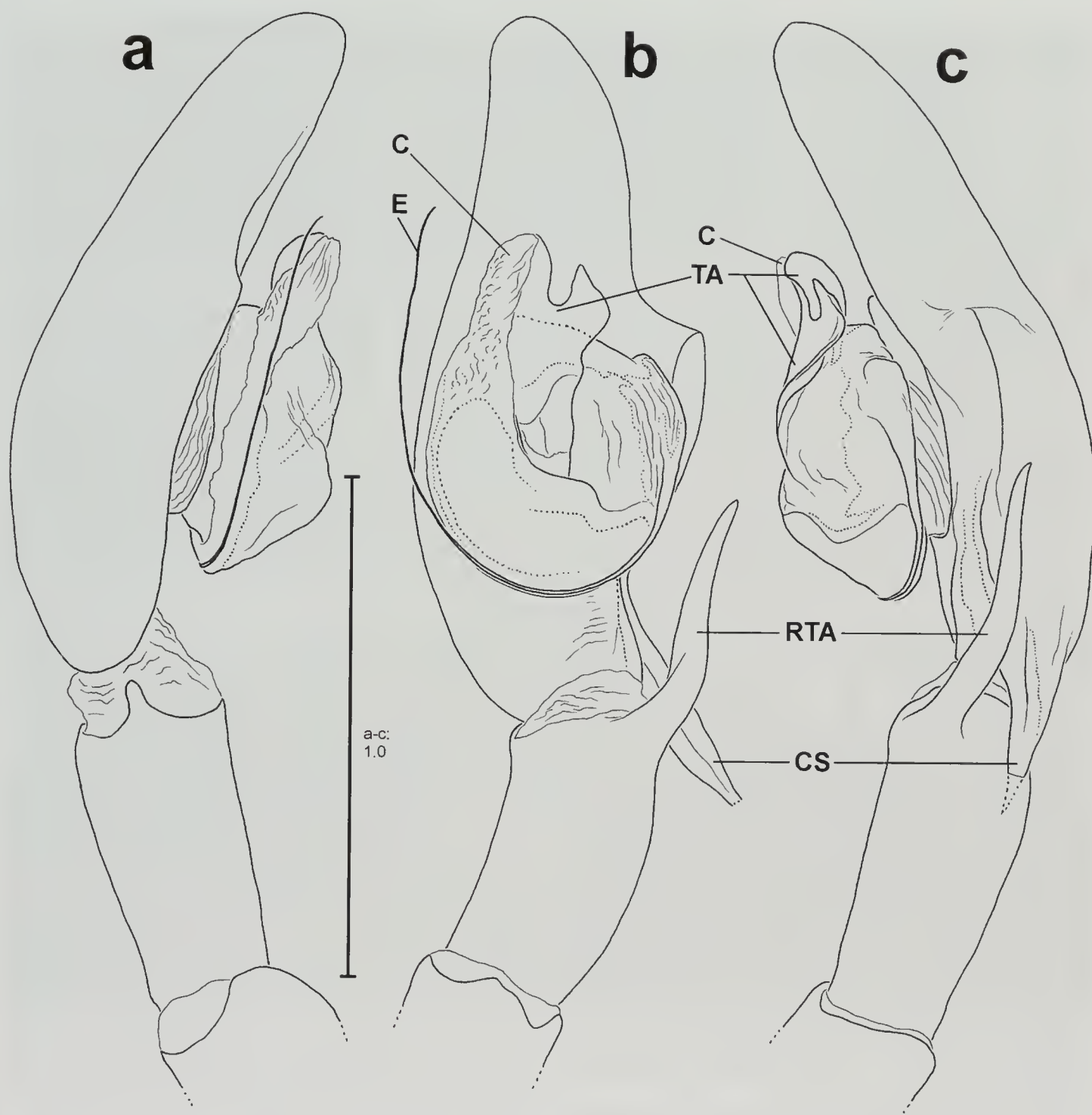
Museum collections (with curators) & private collections: BPC - Steffen Bayer, private Collection, Frankfurt am Main, Germany. MHNG - Muséum d'histoire naturelle, Geneva, Switzerland (P. Schwenninger). NHM - Natural History Museum, London, United Kingdom (J. Beccaloni). NHMNB - Naturhistorisches Museum, Nürnberg (Nuremberg), Germany (D. Cordes). NHMW - Naturhistorisches Museum Wien, Vienna, Austria (C. Hörweg). OUMNH - Oxford University Museum of Natural History, United Kingdom (Z. Simmons). SMF - Senckenberg Museum, Frankfurt am Main, Germany (P. Jäger). ZMB - Zoologisches Museum (Museum für Naturkunde), Berlin, Germany (J. Dunlop)

## Taxonomy

*Cheiracanthium furculatum* Karsch, 1879 (Figs 1–4)  
For the synonymic list see Platnick (2013)

**Material examined** (2♂, 4♀, 1 s.a. ♀). Holotype ♂: GABON: Estuaire: Chinchou (today: Chinchoua), S 00°02', E 09°47'; Dr Julius Falkenstein leg. 1873–1876 (‘Loango-Expedition der Deutsch-Afrikanischen Gesellschaft’), ZMB 2962. GERMANY: Rhineland-Palatinate: Landkreis Kaiserslautern: Spesbach, supermarket, N 49°25'51", E 07°30'46" (within a box of white grapes imported from Morocco [origin: Morocco: Meknès-Tafilalet: Surroundings of Meknès, approximately N 33°51'–33°57', W 05°23'–05°39',





**Fig. 1a-c:** *Cheiracanthium furculatum*, male holotype from Gabon, Estuary. **a-c** Left palp. **a** – prolateral, **b** – ventral, **c** – retrolateral view. C: conductor, CS: cymbial spur, E: embolus, RTA: retrolateral tibial apophysis, TA: tegular apophysis.

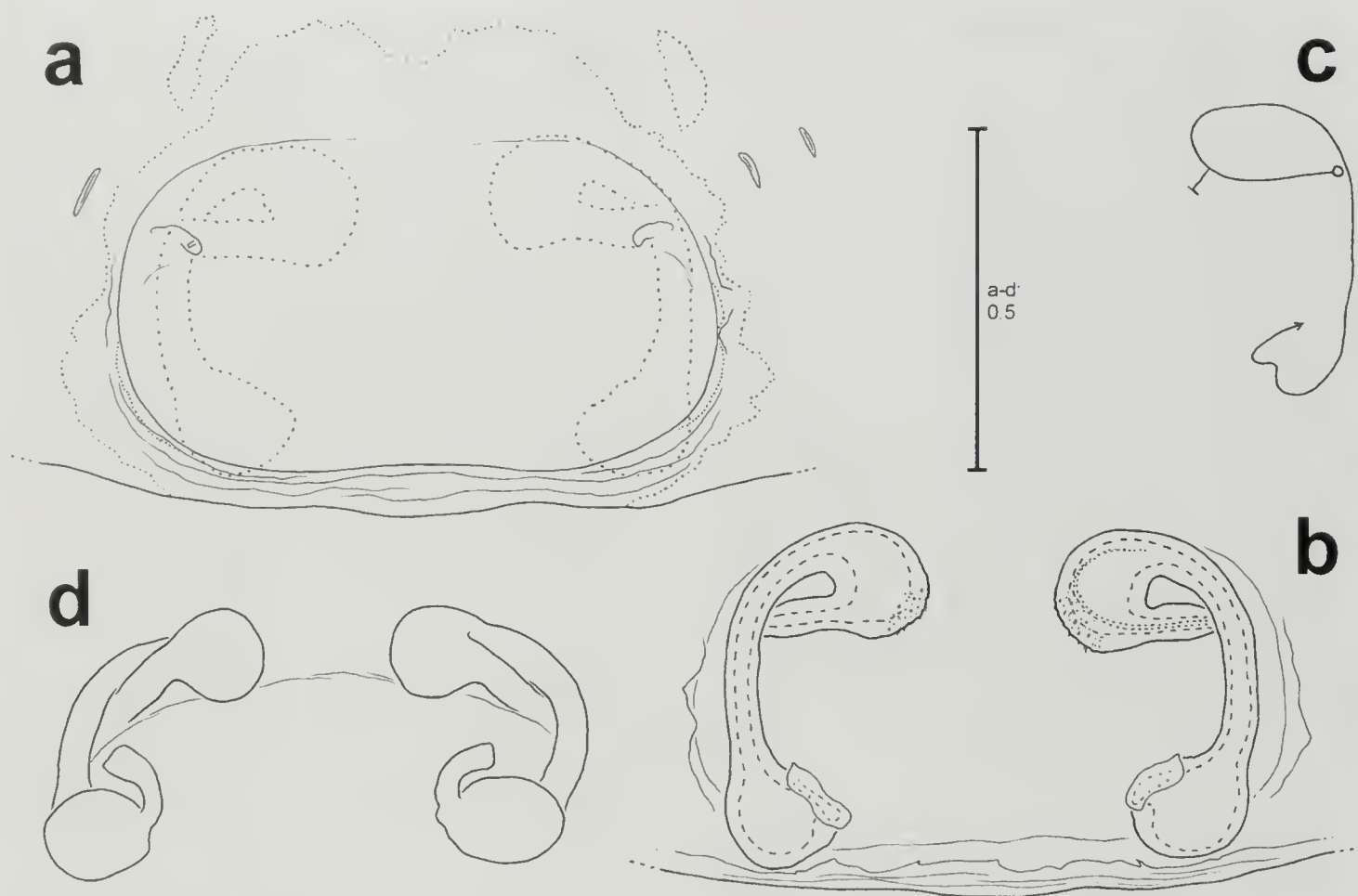
Remark: (Pointed) tip of cymbial spur was found broken; in **c** it is indicated with a dotted line, inferred from the situation in the right palpus.

500–700 m]); R. Bayer & G. Bayer leg. 04.VII.2012, 1 ♀, SMF, 1 s.a. ♀ (raised from egg cocoon produced by female listed directly before), BPC. CAP VERDE ISLANDS: Boavista; G. Schmidt leg.; 1 ♀ (only vulva as microslide), SMF 58248. Maio; G. Schmidt leg. 01.III.1995; 1 ♀, SMF 38567, 1 ♂ SMF 38566. Brava; G. Schmidt leg.; 1 ♀ (only vulva as microslide), SMF 58289.

**Diagnosis and Description.** Lotz (2007a) treated this species in detail. However, he did not give the

measurements of the male holotype, hence, these are added herein. Furthermore, the measurements of the female from Morocco are listed, as this record represents the northernmost record of this species.

**Male** (holotype): Body and eye measurements. Total length 7.8, carapace length 3.4, carapace width 2.5, anterior width of carapace 1.6, opisthosoma length 3.6, opisthosoma width 2.0, sternum length 1.4,



**Fig. 2a-d:** *Cheiracanthium furculatum*, copulatory organ of female from Germany, Rheinland-Pfalz (introduced from Morocco, Meknès-Tafilalet). **a** – Epigyne. **b** – Vulva. **c** – Schematic course of internal duct system. **d** – Vulva, postero-dorsal view. Dotted line (fine) in right vulva-half indicates a broken embolus stuck therein.

sternum width 1.5, ratio carapace length/carapace width 1.36, ratio total length of leg I/carapace length 6.29. Eyes: AME 0.19, ALE 0.16, PME 0.16, PLE 0.16, AME-AME 0.24, AME-ALE 0.17, PME-PME 0.31, PME-PL 0.28, AME-PME 0.17, ALE-PL 0.07, clypeus height at AME 0.06, clypeus height at ALE 0.10.

Cheliceral furrow with 2 very small promarginal and 3 retromarginal teeth.

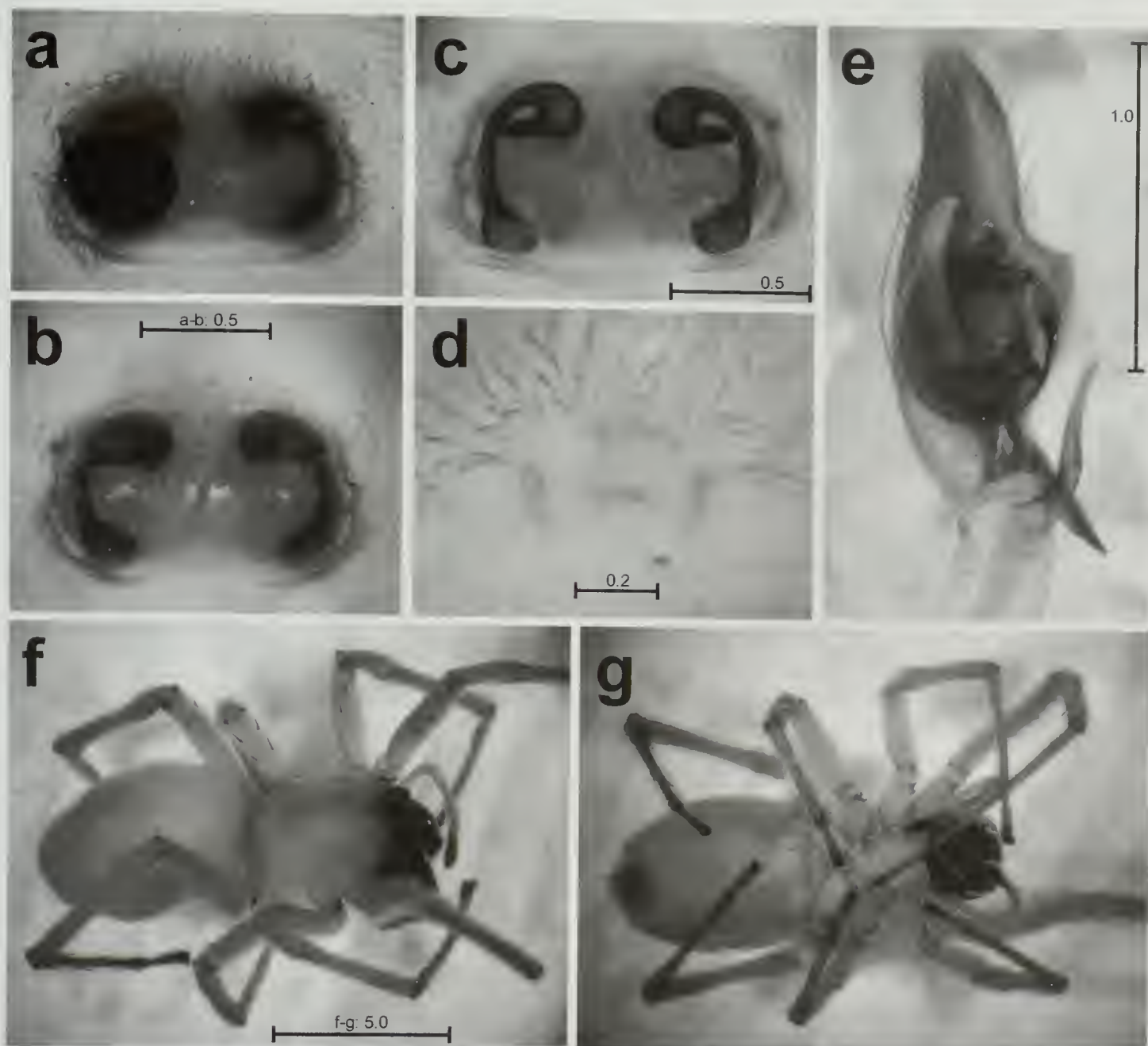
Measurements of palp and legs. Leg formula: 1423. Palp 4.4 [1.7, 0.5, 0.7, 1.5 (without cymbial spur) 1.7 (with cymbial spur)], I 20.4 [5.0, 1.8, 5.5, 5.8, 2.3], II 14.1 [3.7, 1.5, 3.7, 4.0, 1.2], III 10.5 [2.8, 1.1, 2.3, 3.2, 1.1], IV 16.3 [4.0, 1.5, 3.6, 5.0, 1.2].

Spination. Palp: 0200, 0000, 0000, 0000; legs: femur I 2020, II 2010, III 4020{5030}, IV 3020; patella I-IV 0000; tibia I 00011, II 2005{2009}, III 2023, IV 2022{2023}; metatarsus I 0004, II 2004, III 3035{3036}, IV 30317{30319}.

Copulatory organ. Cymbium quite elongated (ca. 2.4x longer than broad), with pedestal-like extension

retrolaterally (Figs 1b, 3e, 4e), retrolatero-proximal cymbium spur (which is a typical character for males of this genus) moderately long (slightly longer than half the length of palpal tibia without RTA) and pointed (Figs 1c, 3e, 4e); embolus very long and filiform (2-3x tegulum width), arising at 2-3 o'clock position on tegulum, running in a semi-circular course prolatero-distally (Figs 1b, 3e, 4e); conductor ca. 4x as long as broad, fleshy and arising centrally in prolateral half of tegulum; tegular apophysis with characteristic shape: relatively broad, arising centrally on tegulum, distally divided into two, relatively broad lobe-like extensions, with the prolateral slightly longer than the retrolateral one (Fig. 1b); sperm duct course hardly recognisable; palpal tibia (without RTA) ca. 2.5 times longer than broad (Figs 1a, 1c), RTA slightly longer than diameter of tegulum and slim, distally almost pointed (Figs 1b-c).

**Female** (adult specimen from Morocco): Body and eye measurements. Total length 10.4, carapace length 4.5, carapace width 3.2, anterior width of



**Fig. 3a-g:** *Cheiracanthium furculatum*, photographic images of adult and primary copulatory organs and female habitus. **a-b** epigyne (**a** still with mating plug), **c** vulva, **f-g** habitus, all of female, **d** Pre-epigyne, of subadult female, both from Germany, Rheinland-Pfalz (introduced from Morocco, Meknès-Tafilet). **e** Left palp, of male holotype from Gabon, Estuary.

carapace 2.2, opisthosoma length 5.8, opisthosoma width 4.0, sternum length 2.1, sternum width 1.7, ratio carapace length/carapace width 1.41, ratio total length of leg I/carapace length 3.87. Eyes: AME 0.25, ALE 0.26, PME 0.20, PLE 0.20, AME-AME 0.29, AME-ALE 0.31, PME-PME 0.41, PME-PLE 0.48, AME-PME 0.25, ALE-PLE 0.13, clypeus height at AME 0.13, clypeus height at ALE 0.12.

Cheliceral furrow with three promarginal (both very small) and two retromarginal teeth.

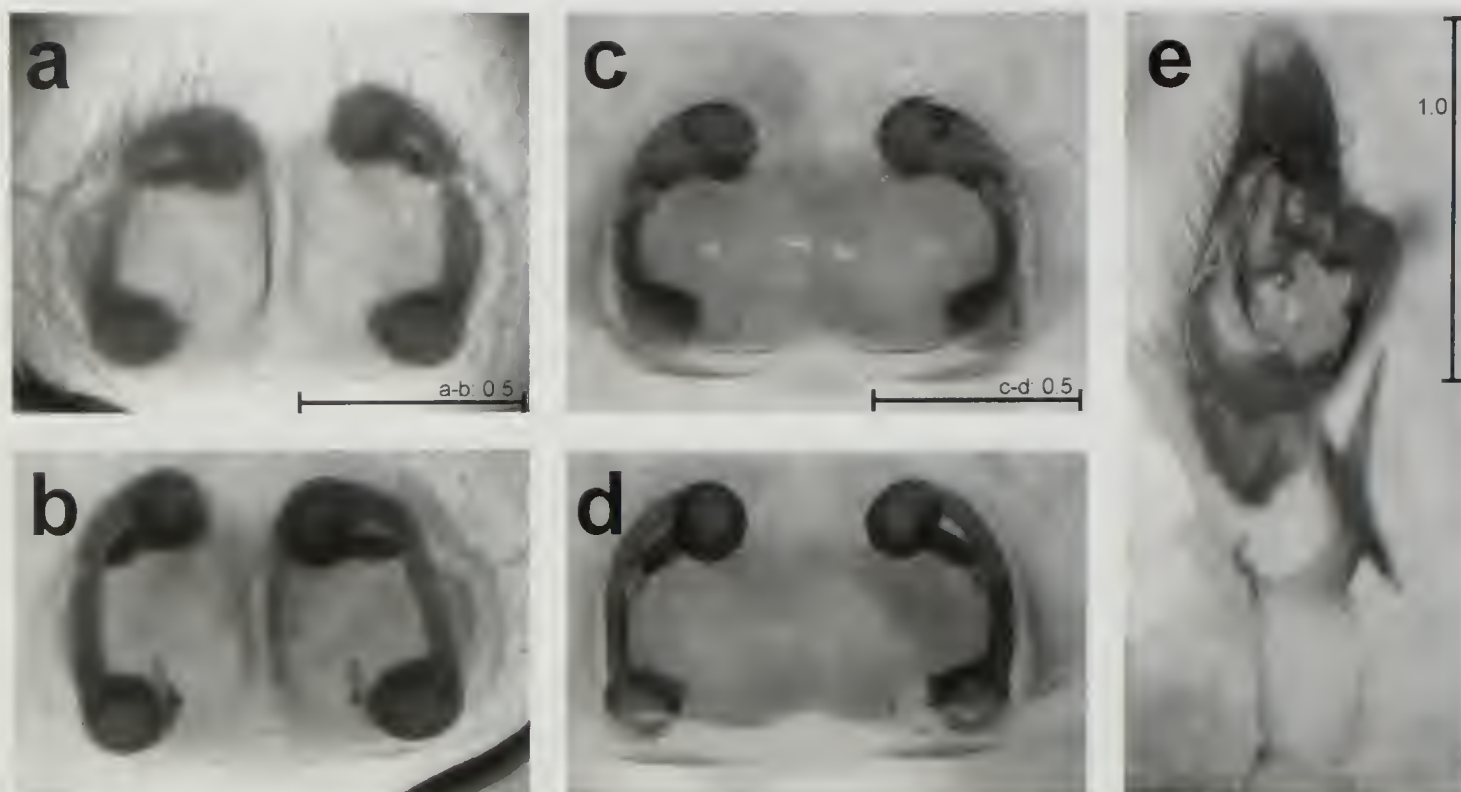
Measurements of palp and legs. Leg formula: 1423. Palp 4.9 [1.6, 0.6, 1.2, 1.5], I 17.4 [4.6, 1.9, 4.3,

4.8, 1.8], II 12.7 [3.5, 1.6, 3.0, 3.5, 1.1], III 9.7 [2.7, 1.3, 2.1, 2.7, 0.9], IV 14.6 [4.0, 1.6, 3.4, 4.5, 1.1].

Spination. Palp: 0500, 1200, 3100, 0000 (spines on all limbs of palp very small, less than 1/3 the length and width of those on the limbs of legs); legs: femur I 2000, II 2000, III 2020{3020}, IV 1010{2010}; patella I-IV 0000; tibia I 0002, II 0000, III 1010, IV 1010; metatarsus I 0003, II 0003, III 4044, IV 4045.

Copulatory organ. Epigyne with large-area, cross-oval (occasionally roughly kidney bean-shaped), very flat depression (Figs 2a, 3a-b, 4c), the margin of which posteriorly and laterally more distinctly developed





**Fig. 4a-e:** *Cheiracanthium furculatum*, photographic images of copulatory organs showing intraspecific variation. **a** Epigyne, **b** Vulva, both of female (SB 1278), **c-d** same of female (SB 1280). **e** Left palp, ventral view of male (SB 1281). All material from Cap Verde Isl.

than anteriorly (Fig. 2a); copulatory openings located antero-laterally within that depression (Fig. 2a); epigynal field broader than long, anterior muscle sigilla elongated and located close to epigynal field (Fig. 2a). Vulva with short, transverse copulatory duct running from antero-laterally to antero-medial, leading into a first chamber with connection to associated glands (see area with pores medio-posteriorly on that chamber [Fig. 2b] which may be homologous to the spermathecal head in other groups of spiders); a long duct running posteriorly connects the first with another, posterior chamber (Figs 2b, 3c, 4b, d). In the female from Morocco in the right half of the vulva a broken embolus of a male reaches through the copulatory duct far into the first chamber (Figs 2b, 3c). An indistinct fertilisation duct arises medially on the second chamber of the receptaculum (Fig. 2b). Posterior view of the vulva (Fig. 2d) shows that the copulatory duct runs ventro-dorsally, with its initial section ventral to the connective duct between the two chambers. Fig. 2c shows the course of the rather simple internal duct system. In Fig. 3a the epigyne of this specimen is shown before preparation, still with a mating plug, which is almost round and covers a large area of the epigynal depression. The pre-epigyne of the subadult

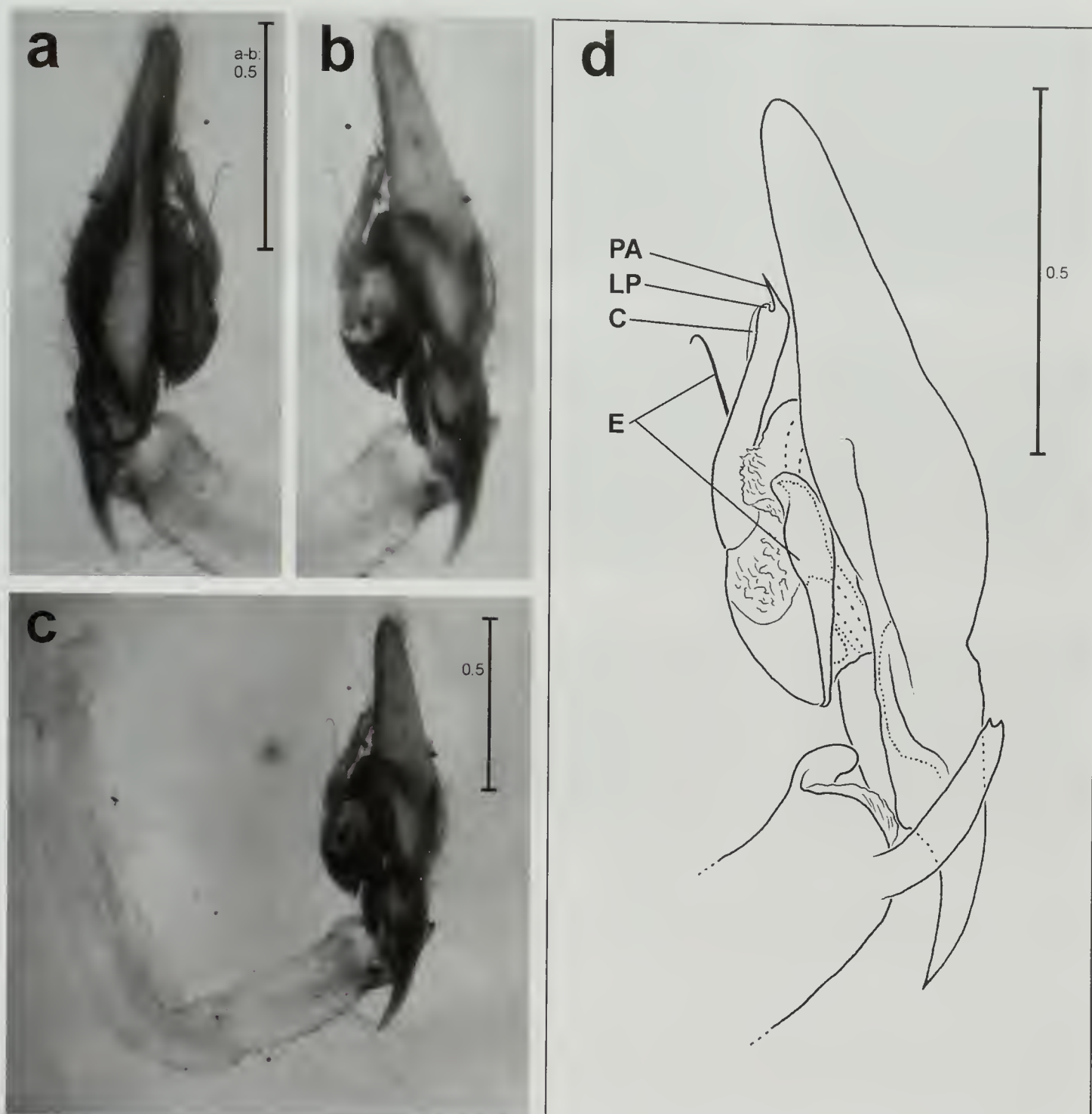
female (Fig. 3d) shows an inverted trapezoid, slightly sclerotised structure with two small, flat and indistinct depressions in the centre.

**Colouration.** See Lotz (2007a) for the male, colouration of female see Figs 3f-g.

**Variation of male and female copulatory organs.** Males: Shape of the tegular apophysis may differ slightly (Figs 1b, 3e cf. Fig. 4e cf. Lotz 2007a, fig. 39). In the holotype male (Figs 1b, 3e) the RTA (in relation to the cymbium length) is slightly shorter than in other specimens (Fig. 4e, Lotz 2007a, figs 39-40).

Females: Epigyne may consist of a very flat cross oval depression (Figs 2a, 3a-b, 4c), either without longitudinal ridge or with very indistinct one, or the depression is divided into two more or less round depressions by a distinct longitudinal ridge (Fig. 4a, Lotz 2007a, fig. 35). Length and orientation of copulatory ducts show differences (Fig. 3c cf. Fig. 4b cf. Fig. 4d), or partly distinct differences (Lotz 2007a, fig. 36, right half of vulva).

**Distribution.** Africa including Cape Verde- and Comoro-Islands (almost all records south of the Sahara, except one in Morocco), introduced into Belgium, Germany and probably Ireland.



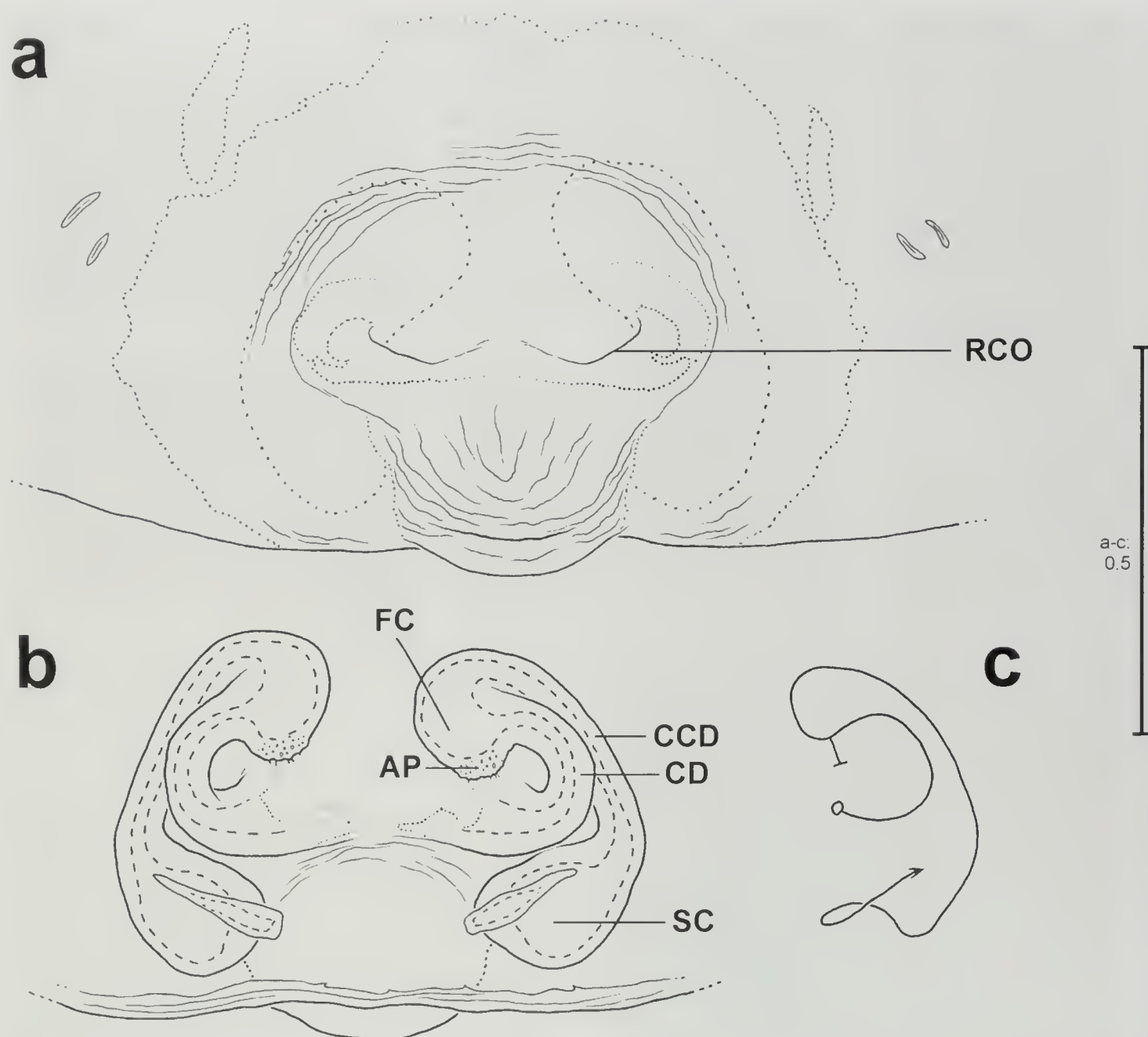
**Fig. 5a-d:** *Cheiracanthium africanum*, left palp (male holotype of *Cheiracanthium tenuipes* from Senegal, Niokolo-Koba-Park). **a** prolateral view. **b-d** retrolateral view (**b-c** different planes of focus). C: conductor, E: embolus, LP: lobus-like part of distal tegular apophysis, PA: pointed apex of distal tegular apophysis.

***Cheiracanthium africanum*** Lessert, 1921 (Fig. 5)  
*Cheiracanthium africanum* Lessert 1921: 411, figs 41-44 (descr. & illustr. ♂ & ♀). [Lectotype ♀ and one of the five paralectotypes, namely the only ♂, TANZANIA: Kibonoto: Kilimanjaro, S 03°12', E 37°07'; Bror Yngve Sjöstedt leg. 1905-1906 ('Kilimanjaro-Mission'); MHNG C1 20, examined by Lotz 2007a (remaining four ♀ paralectotypes could not be traced by P. Schwendinger and also not by L. Lotz)]. For the complete synonymic list see Platnick (2013).

*Cheiracanthium tenuipes* Roewer 1961: 64, figs 21a-c (descr. & illustr. ♂). [Holotype ♂ left palpus as microslide; type locality: SENEGAL: Niokolo-Koba-Parc, Siminti, ex 'IFAN-Dakar'; collection Roewer; SMF 13255, examined].  
**New synonymy**

**Diagnosis and description.** See Lotz (2007a) and Lessert (1921).

**Additional descriptive remarks on the male copulatory organ.** Cymbium quite elongated (at least 2.5x



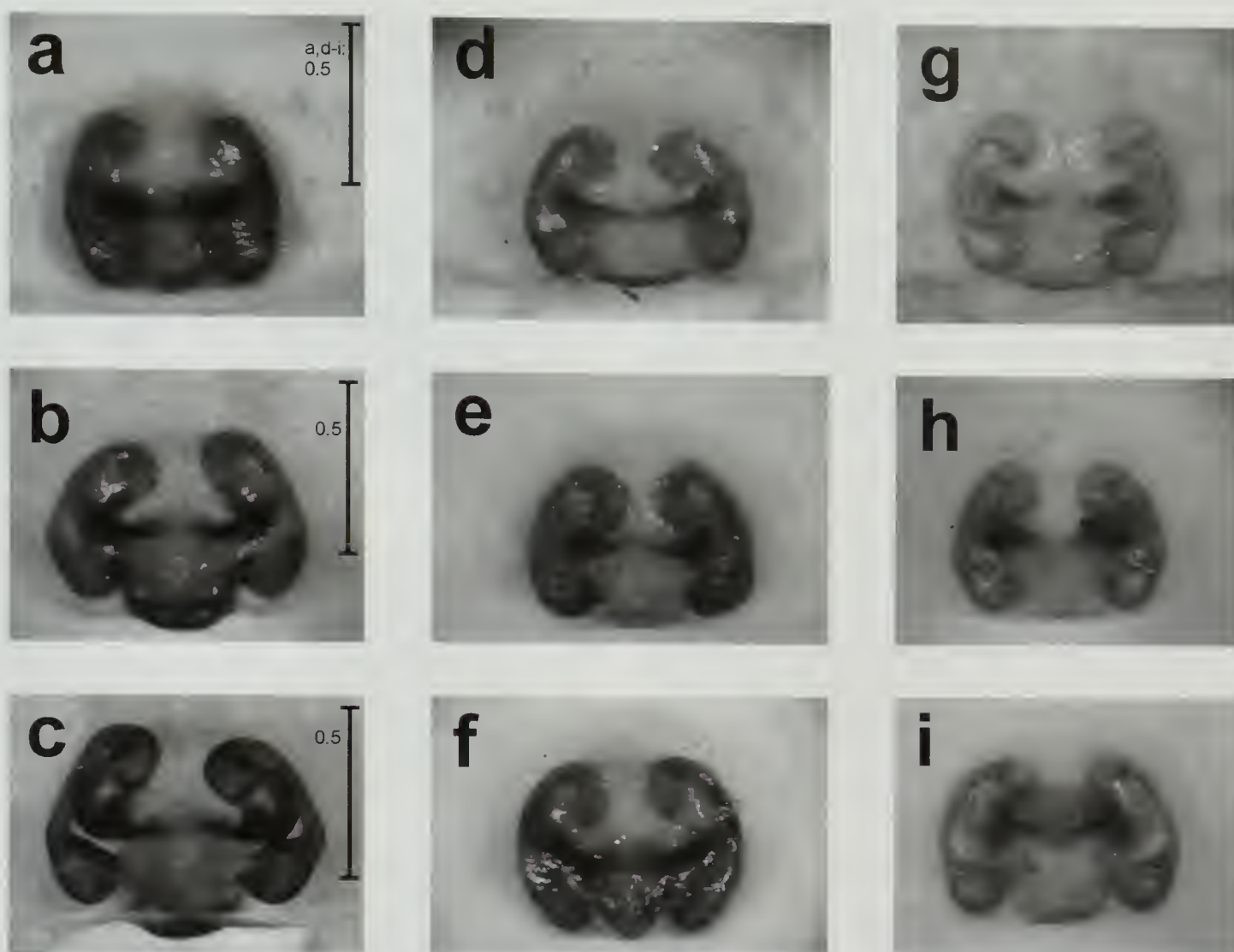
**Fig. 6a-c:** *Cheiracanthium mildei*, female from Germany, Rhineland-Palatinate. **a** Epigyne. **b** Vulva. **c** Schematic course of internal duct system. AP: area with many pores giving connection to accessory glands, CCD: Connective duct between the two chambers, CD: copulatory duct, FC: first chamber, RCO: rims of copulatory openings, SC: second chamber.

longer than broad) (Figs 5a-d), retrolatero-proximal cymbial spur (Figs 5c-d) moderately long (ca. half the length of palpal tibia without RTA) and pointed (Fig. 5c-d); embolus (Fig. 5a, d) quite long and filiform (ca. 2x tegulum width), arising in a 3 o'clock position on tegulum, running in a semicircular course prolatero-anteriorly; conductor ca. 3x as long as broad, fleshy and arising centrally in prolateral half of tegulum; tegular apophysis relatively slim, arising centrally on tegulum, distally bifurcated, one extension lobe-like, the other very narrow and pointed ("pointed apex" following Lotz 2007a) (Figs 5b-d); sperm duct course hardly re-

cognisable; palpal tibia (without RTA) slightly more than 2 x longer than broad (Fig. 5c), RTA as long as the diameter of the palpal tibia, slim and distally with slight indentation (Fig. 5c-d).

**Remarks.** *Cheiracanthium tenuipes* was considered a nomen dubium by Lotz (2007a) with the supposition that it might be a synonym of *C. africanum*. In the present study it is explicitly recognised as junior synonym of *C. africanum* because the microslide with the fixed left male palp of the holotype clearly shows the diagnostic characters of *C. africanum* after Lotz (2007a). Especially the bipunctated distal tip





**Fig. 7a-i:** *Cheiracanthium mildei*, photographic images of female copulatory organs showing intraspecific variation. **a** Female (SB from Switzerland, Lago Maggiore. **b-c** Female from Germany, Rhineland-Palatinate. **d-e** Female holo- and paratype of *C. cretense* from Greece, Crete; unfortunately unknown which is which (see remarks in synonymic list of *C. mildei* under *C. cretense*). **f** Female from Germany, Bavaria. **g** Female holotype of *C. strasseni strasseni* from Israel, Rehovot-Tel-Aviv. **h-i** Female syntypes of *C. strasseni aharonii* from Israel, Tel-Aviv-Rehovot. **a-b, d-i** Epigyne. **c** Vulva.

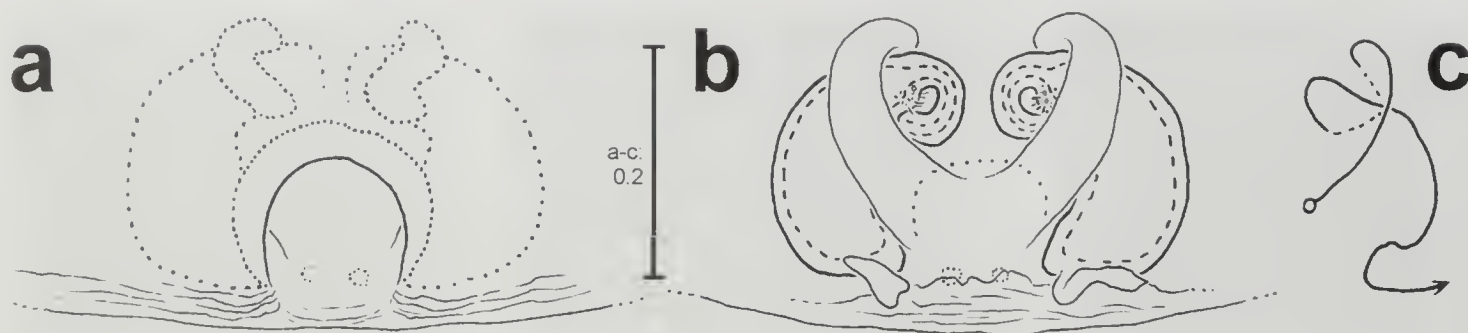
of the RTA (accordingly the tip shows a small, flat and rather indistinct indentation, Fig. 5c-d) and the bilobed tegular apophysis with the prolateral pointed apex (Figs 5a-b, d) are clearly recognisable.

*Cheiracanthium africanum* is very similar to *C. inclusum* (Hentz, 1847). A synonymy of these two species was proposed by Ledoux (2004) but subsequently rejected by Lotz (2007a). Especially the males are extremely hard to discriminate from those of *C. inclusum*. The distinction of the males of these two species as given in Lotz (2007a) is based on the fact that the males of *C. inclusum* do not possess a bilobed tegular apophysis (with a long, slim and pointed prolateral part [pointed apex] and a broad, rounded retrolateral lobe-like part, as can be seen in

*C. africanum*). However, at least in the illustrations of male palps of *C. inclusum* from America in Bonaldo & Brescovit (1992, figs 1-2) and Edwards (1958, figs 10-11) the tegular apophysis is bilobed and a pointed prolateral apex is present.

**Distribution.** Africa (south of the Sahara), Madagascar, Réunion.

***Cheiracanthium mildei*** L. Koch, 1864 (Figs 6-7)  
*Cheiracanthium mildei* Koch 1864: 342 (descr. ♂ & ♀) [Syn-types, 1 ♂, 1 ♀ ITALY: South Tyrol, Meran; Dr J. Milde leg.; originally in NHMNB, but no longer there (Cordes pers. comm.), later transferred to NHMW, acquisition date 1882, no. I.335 (Hörweg pers. comm.); further syntype material with unknown number of specimens from Croatia: Dalmatia, deposition unknown, possibly NHM (response of curator



**Fig. 8a-c:** *Cheiracanthium rehobothense*, female holotype from Israel, Tel-Aviv-Rehovot. **a** Epigyne. **b** Vulva. **c** Schematic course of internal duct system.

J. Beccaloni to date missing) but definitely not OUMNH (Simmons pers. comm.); type material not examined, species identity is clear]. For the complete synonymy list see Platnick (2013).

*Cheiracanthium strasseni strasseni* Strand 1915: 156 (descr. ♀). [holotype ♀ ISRAEL: Rehoboth - Jaffa (between Rehovot and Tel Aviv); J. Aharoni leg. 26.IV.1913; SMF 4493, examined]. **New synonymy**

*Cheiracanthium strasseni aharonii* Strand 1915: 157 (descr. ♀). [2 ♀ syntypes (one of which with mating plug) ISRAEL: Jaffa - Rehoboth (between Tel Aviv and Rehovot); J. Aharoni leg. 1913; SMF 4494, examined]. **New synonymy**

*Cheiracanthium cretense* Roewer 1928: 116, pl. 1, fig. 22 (descr. & illustr. ♀). [holotype ♀ (sub 'Typus') and paratype ♀ (sub 'Co-Typus') GREECE: Crete: Chania: Environments of Chania, ca. N 35°30', E 24°00' (holotype), Akrotiri: Governeto monastery, ca. N 35°35', E 24°05' (paratype); unfortunately both specimens were put in the same vial, so it is impossible to tell which is which; C.-F. Roewer leg. 1926, collection Roewer RII/740/33, R. Bosmans det. *C. mildei*; SMF 9900740, examined]. Bosmans et al. 2013: 8 (synonymy).

**Additional material examined (3 ♀).** GERMANY: Rhineland-Palatinate: Landkreis Mainz-Bingen: Heidesheim, on a house wall, N 49°59'34", E 08°06'47", 105 m; S. Bayer leg. 01.V.2012, 1 ♀, BPC. Bavaria: Lindau, harbour facility, at handrail, N 47°32'34", E 09°40'59", 396 m; S. Bayer leg. 07.VI.2013, 1 ♀, BPC. SWITZERLAND: Ticino: Ascona, Lago Maggiore; collection Roewer RII/13395; 1 ♀, SMF 60687.

**Diagnosis and description.** See Koch (1864), Simon (1932), Sterghiu (1985), Dondale & Redner (1982).

**Variation of female copulatory organ.** Comparing Figs 7a, b, f with Figs 7d, g-i the colour of the postero-median section of the epigyne partly differs clearly, but this may be due to preservation differences as several examples examined here are old museum specimens. The posteriormost median section of the epigyne may be narrow (Figs 7a, f) or rather broad with a relatively even posterior margin (Figs 7d, g, i).

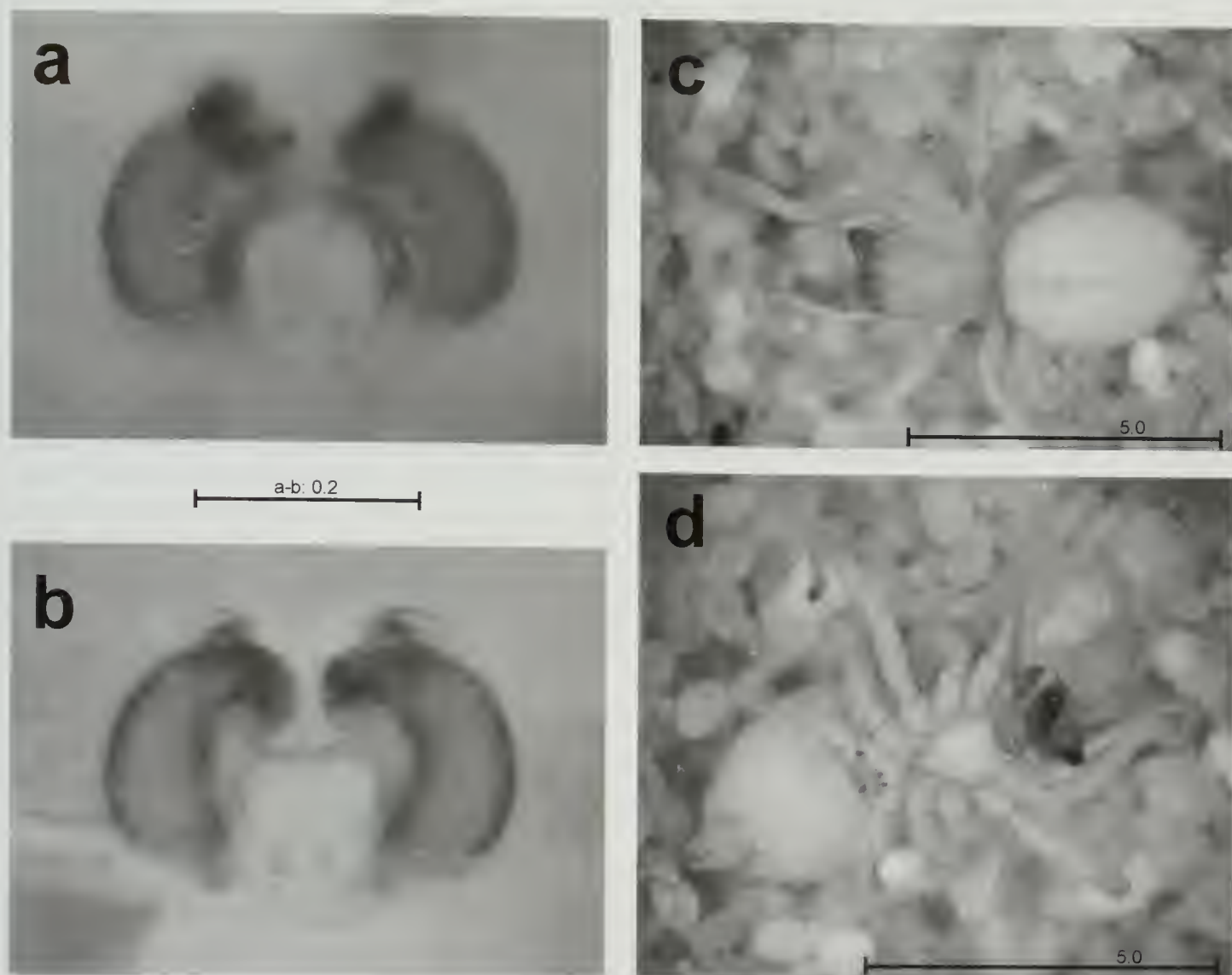
The roughly transversely orientated rims of the copulatory openings may be almost in contact with each other so that a long transverse edge is visible in the epigyne (Figs 7b, d, f) or they are clearly apart from each other (Figs 7a, g). The orientation of the lateral sections of the copulatory ducts may differ clearly (Figs 6a-c & 7b-e, h cf. Figs 7a, f, g).

**Remarks.** The two subspecies of *Cheiracanthium strasseni*, namely *C. strasseni strasseni* Strand, 1915 (nominotypical taxon) and *C. strasseni aharonii* Strand, 1915 are both synonymised with *C. mildei* because the copulatory organs of the female type specimens clearly show specific conformity with those of *C. mildei* (Figs 7g-i cf. Figs 6a-b, 7a-f). Strand (1915) delimited *C. strasseni* (both subspecies) from *C. mildei* by a septum that divides the epigynal pit. It is difficult to deduce what Strand meant with "septum". In fact the two roughly transversely orientated rims of the copulatory openings may be almost connected with each other or there is some space between them (which Strand possibly regarded as elongated septum). However, this is a matter of intraspecific variation (see above).

*Cheiracanthium cretense* was synonymised with *C. mildei* by Bosmans et al. (2013). Photographic images of the types of *C. cretense* are here shown (Figs 7d, e).

**Distribution.** This species has expanded its distribution area from Southern to Central Europe within the last decades/century (Muster et al. 2008, Wunderlich 2012). While formerly only known from the Mediterranean Palaearctic and Southern European region and not Central Europe (Simon 1932, Reimoser 1937) it is now known from most countries in Central Europe (Nentwig et al. 2013). Helsdingen (1979) did not list this species for the Netherlands, but as it was recorded in Belgium (Van Keer et al. 2007), Germany (e.g. Jäger 2000) and Austria (e.g. Thaler 2005) it is not unlikely that it will be found





**Fig. 9a-d:** *Cheiracanthium rehobothense*, female holotype from Israel, Tel-Aviv-Rehovot, photographic images of copulatory organ and habitus. **a** Epigyne. **b** Vulva. **c-d** Female, habitus, **c** dorsal, **d** ventral view.

in the Netherlands too. Even though in Central Europe it is mostly found synanthropically, it cannot be excluded that, in the course of climate change, it may be found far away from human settlements too. *C. mildei* was introduced into North and South America and is now established there (Edwards 1958, Bonaldo & Brescovit 1992, Dondale & Redner 1982, Paquin & Dupérré 2003).

#### *Cheiracanthium rehobothense* Strand, 1915

(Figs 8-9)

*Cheiracanthium rehobothense* Strand 1915: 158 (descr. ♀). [Holotype ♀ ISRAEL: Jaffa - Rehoboth (between Tel Aviv and Rehovot); J. Aharoni leg. 14.VII.1913; SMF 4490, examined].

**Additional material examined** (1 s.a. ♂). ISRAEL. Jaffa - Rehoboth; J. Aharoni leg. 14.VII.1913, E. Strand det.

with denotation “likely belonging to this species”; 1 s.a. ♂, SMF 4491.

**Remark.** Strand (1915) also examined an adult male that he also found likely to belong to this species (SMF 4492). This specimen must have become lost, as in the SMF collection only the empty vial exists with a label saying “type” and a corresponding index card saying “vial was found empty, checked 1967”. However, neither this male nor the subadult male listed above can be considered types of *C. rehobothense*, as Strand (1915) expressed some doubts about their species affiliation in saying “[these two specimens] likely belong to this species” [ICZN § 72.4.1].

**Diagnosis.** Females of *Cheiracanthium rehobothense* are distinguished from those of all other *Cheiracanthium* species by the following characters in combination:



Small species (body length female: 5.5 mm) with small epigyne (width ca. 0.4 mm); central epigynal pit consistently semicircular (Figs 8a, 9a); initial section of copulatory duct with steep (latero-) anterior course (Figs 8b-c); copulatory duct with less than one winding around anterior section of elongated kidney bean-shaped receptaculum, and medially with a semicircular curve until reaching the latter (Fig. 8b).

Presently, it is impossible to give a diagnosis for males. Strand (1915) examined a male, which is now lost (see above) and which he did not unambiguously assign to this species. Based only on the description in Strand (1915) it is not possible to clearly characterise and distinguish the male from those of similar species.

## Description

**Female** (holotype): Body and eye measurements. Total length 5.5, carapace length 2.2, carapace width 1.6, anterior width of carapace 1.3, opisthosoma length 3.1, opisthosoma width 2.4, sternum length 1.1, sternum width 1.0, ratio carapace length/carapace width 1.375, ratio total length of leg I/carapace length 4.00. Eyes: AME 0.12, ALE 0.12, PME 0.115, PLE 0.115, AME-AME 0.15, AME-ALE 0.14, PME-PME 0.21, PME-PLE 0.22, AME-PME 0.125, ALE-PLE 0.06, clypeus height at AME 0.08, clypeus height at ALE 0.07.

Cheliceral furrow with six promarginal (both very small) and six retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp 2.5 [0.8, 0.35 0.5, 0.85], I 8.8 [2.3, 0.9, 2.1, 2.3, 1.2], II 5.5 [1.5, 0.7, 1.3, 1.35, 0.65], III 4.4 [1.3, 0.6, 0.8, 1.1, 0.65], IV 6.3 [1.8, 0.65, 1.5, 1.7, 0.65].

Spination. Palp: 0000, 0000, 0000, 0000; legs: femur I 1000, II-IV 0000; patella I-IV 0000; tibia I 0002, II 0000, III 1010, IV 1010; metatarsus I 0003, II 0003, III 2025{4034}, IV 4034.

Copulatory organ. Epigyne generally of the type of the common and well-known species *Cheiracanthium erraticum* (Walckenaer, 1802): a roughly semi-circular epigynal pit with more or less distinctly sclerotised margin; vulva: copulatory ducts at least slightly wound around receptacula and generally visible through cuticle. The vulva of *C. rebobothense* shows a copulatory duct with less than one winding around receptaculum; initial section of copulatory duct almost hyaline and its central part slightly

more than half as broad as central part of receptaculum (Fig. 9b); distance between the anterior-medial semi-circular sections of each copulatory duct (before meeting receptacula) slightly less than diameter of one duct (Figs 8b, 9b); fertilisation ducts indistinct, arising posterior to posterior-medial on receptacula (Fig. 8b); two yellowish-brown spots recognisable in the epigynal pit, clearly posterior to the copulatory openings (Figs 8a, 9a-b).

**Colouration.** Carapace light with light-brown to yellow colour; chelicerae brown; sternum and legs with the same colour as carapace but even lighter (Fig. 9d); opisthosoma very light with beige colour, dorsally with a very long and narrow yellowish medial lanceolate band which may be interrupted several times towards posterior end of opisthosoma (Fig. 9c). Even though the specimen is slightly faded in EtOH the detailed description by Strand (1915) is still applicable.

**Remarks.** According to the similarity of the copulatory organ of *Cheiracanthium rebobothense* to those of the following species it seems possible that these species are the closest relatives: *C. gratum* Kulczyński, 1897, *C. pelasgicum* (C. L. Koch, 1837), *C. montanum* L. Koch, 1877 and *C. pennatum* Simon, 1878. According to the structure of the female copulatory organ *C. gratum* is most similar. Merkens & Wunderlich (2000) removed *C. gratum* from the synonymy with *Cheiracanthium angulitarse* Simon, 1878 and first described and illustrated the female of *C. gratum*. The latter also has a copulatory duct with less than one complete winding around the distal part of the receptaculum. However, the curve of the distal-most section of the copulatory duct (before meeting the receptaculum) is orientated in the opposite direction. Based on Simon (1932) and Hansen (1991) the female copulatory organ of *C. angulitarse* is clearly different from *C. gratum* and *C. rebobothense* as well. According to Simon (1932) and Sterghiu (1985) the epigyne and the vulva of *C. pelasgicum* are quite similar to *C. rebobothense*, however, in *C. pelasgicum* the epigynal pit is not as evenly semicircular and its strongly sclerotised margin is distinctly broader than in *C. rebobothense*. The illustrations in Sterghiu (1985) and Dimitrov (1999) show the initial section of the copulatory duct of *C. pelasgicum* also running quite steep, but the distal section with a different course. According to the general appearance of the copulatory organ (Reimoser 1937, Fleimer & Nentwig 1991,

Roberts 1998) *C. montanum* is also similar to *C. rehobothense*, however there are clear differences in the course of the distal half of the copulatory duct (Fig. 8b cf. Reimoser 1937, fig. 51 [ventral view], Sterghiu 1985, fig. 35c and Roberts 1998, p. 142, fig. at lower left corner, all showing the vulva of *C. montanum*). Pesarini (1997) gave a detailed illustration of the male copulatory organ of *C. montanum* in retrolateral view. It seems highly likely that he mixed the figure numbers. Pesarini's (1997) fig. 3 actually shows *C. montanum*, his fig. 4 shows *C. elegans* Thorell, 1875. Since its first description, *C. pennatum* was only treated and illustrated three times (Simon 1932, Sterghiu 1985, Urones 1988). The illustrations of the male in Sterghiu (1985) and male and female in Urones (1988) are difficult to interpret and it is possible that they are based on misidentifications. They are reminiscent of *C. pennyi* O. Pickard-Cambridge, 1873. The illustration of the female epigyne of *C. pennatum* in Simon (1932) resembles that of *C. rehobothense*, but the anterior sections of the copulatory ducts that shine through the cuticle are not as compact and curved as in the latter species. Simon (1878, 1932) did not provide illustrations of the vulva, so it is now difficult to delimit *C. pennatum* from *C. rehobothense* according to the course of the copulatory duct. The epigyne of *C. erraticum* may somewhat resemble that of *C. rehobothense*, however, the course of the copulatory duct is clearly different and shows more than one winding around the receptaculum.

Even though colouration is a character with far less taxonomical priority it may be briefly discussed here too. *C. pennatum*, *C. montanum* and *C. erraticum* have colouration patterns different from that of *C. rehobothense*. They show a relatively broad and distinct red to red-brown median band, with its posterior section often in form of many stacked broad chevrons. *C. pelasgicum* resembles more *C. rehobothense* concerning the colouration as it is rather uniformly and relatively pale coloured, without a broad red to red-brown band dorsally on the opisthosoma, but instead just a narrow lanceolate band (Sterghiu 1985). *C. gratum* (Merkens & Wunderlich 2000, p. 43) resembles *C. rehobothense* mostly in having a similar colouration like *C. pelasgicum*, albeit in general even lighter.

**Distribution.** At the moment only known from the type locality (between Tel-Aviv and Rehovot) in Israel.

## Discussion

Some species mentioned and treated herein are concerned by taxonomical transactions from Wunderlich (2012), who resurrected the genus *Chiracanthops* Mello-Leitão, 1942. He justified his decision by proposing several diagnostic characters. In this context he transferred *Cheiracanthium mildei* and *C. inclusum* (Hentz, 1847) to *Chiracanthops*. Platnick (2013) did not follow this decision and still regarded *Chiracanthops* as a junior synonym of *Cheiracanthium* C. L. Koch, 1839. Wunderlich's (2012) concept seems comprehensible and indeed seems applicable to most of the African and European *Cheiracanthium* species. Following this concept, three of the focal species treated herein would belong to *Chiracanthops*, namely *C. furculatum*, *C. africanum* and *C. mildei*, while *C. rehobothense* would remain in *Cheiracanthium*. However, the genus *Cheiracanthium* is very diverse and up to now more than 180 valid species have been described. Before splitting such a genus, all current species should be considered, which certainly requires a large-scale study (i.e. a worldwide phylogenetic revision). At least a few African species show some diagnostic characters of *Cheiracanthium sensu stricto* and some of *Chiracanthops* (after Wunderlich 2012) which makes it impossible to assign them correctly (e.g. *C. leucophaeum* Simon, 1897 and *C. minshullae* Lotz, 2007). Consequently, the present study follows Platnick (2013) in regarding *Chiracanthops* as a junior synonym of *Cheiracanthium*.

A comprehensive revision of the Afrotropical *Cheiracanthium* species was presented by Lotz (2007a, 2007b). The present study is partly based on the findings of this publication. Following Lotz (2007a), *C. furculatum* is widely distributed and common in Africa and often appears synanthropic. This may explain the introductions to Central Europe with fruit imports from Africa. It is unlikely that this species, which is adapted to tropical and subtropical climates, will establish stable populations in Central Europe; at least not outside of human buildings. It remains to be seen if in the future further introduction events of *C. furculatum* in Central Europe will be revealed.

Up to now no revisions *sensu stricto* have been published for the *Cheiracanthium* species of Europe, Mediterranean Africa and the Near East. Several studies introducing the *Cheiracanthium* fauna of certain regions or countries of Europe have been presented, e.g. Simon (1932), Sterghiu (1985), Heimer & Nentwig (1991), Roberts (1998), Almquist (2006).



For the countries bordering the Mediterranean Sea from the East and the South and for several countries of South-Eastern Europe knowledge of the genus *Cheiracanthium* is markedly poor. Currently, 41 *Cheiracanthium* species have been described from Europe, Mediterranean Africa and the Near East with several groups of very similar species. At least 10 of these 41 species (*C. abbreviatum* Simon, 1878, *C. annulipes* O. Pickard-Cambridge, 1872, *C. auenati* Caporiacco, 1936, *C. barbarum* (Lucas, 1846), *C. cuniculum* Herman, 1879, *C. exilipes* (Lucas, 1846), *C. festae* Pavesi, 1895, *C. fulvotestaceum* Simon, 1878, *C. jovium* Denis, 1947, *C. macedonicum* Drensky, 1921) are currently poorly characterised and thus difficult to identify. According to their type localities it is possible that the following species are related to *C. rehobothense* (or even conspecific?): In *C. auenati* and *C. cuniculum* the illustrations of the copulatory organs in Caporiacco (1936) and Herman (1879) are small and simplified and thus difficult to interpret. Lucas (1846) and Pavesi (1895) did not even provide illustrations of copulatory organs for *C. barbarum*, *C. exilipes* and *C. festae*, respectively. For the following species it is unlikely or even impossible that they are related to *C. rehobothense*: *C. jovium* as illustrated in Denis (1947) appears very likely to be a synonym of *C. furculatum* and *C. macedonicum* might be a synonym of *C. mildei*, based on the illustration in Drensky (1921) and the fact, that the latter is widely distributed and common in the Balkan region. The illustration of the epigyne of the Israeli species *C. annulipes* in Pickard-Cambridge (1872) looks clearly different from that of *C. rehobothense*. By checking the type material of the species mentioned above and ideally a lot of material from each species it would be possible to learn (more) about intraspecific variation and thus to give a clear characterisation of these species.

Hence, a revision of *Cheiracanthium* for Europe, Mediterranean Africa and the Near East including a thorough examination and re-description of the type material of all described species (valid species and synonyms) is urgently necessary.

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