

An unexpected new species of *Anachrysis* Krombein, 1986 (Hymenoptera, Chrysididae, Amiseginae) from the Arabian Peninsula

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Abstract

Anachrysis arabica **sp. nov.**, a new chrysidid species from Saudi Arabia and Yemen, is described and illustrated. The new species represents the first record of the subfamily Amiseginae in the Arabian Peninsula. A key to species of the genus is provided. The phylogenetic position of *Anachrysis* within the subfamily is briefly discussed.

Keywords

Afrotropics, description, key, Saudi Arabia, Yemen

Introduction

The Amiseginae are an unusual group of chrysidids with a pantropical distribution. Together with the related subfamily Loboscelidiinae, they are the only aculeate wasps known to parasitize phasmid eggs (Kimsey and Bohart 1991). Due to their parasitoid lifestyle, the distribution of Amiseginae is bound to that of their phasmid hosts. Krombein (1983) charted the zoogeography of the Amiseginae, as well as the distribution of the Phasmatodea. Notably, the Amiseginae are absent from the Mediterranean

subregion, as well as from the Arabian Peninsula (Rosa et al. 2020), although some species of Phasmatodea are recorded. Despite extensive collecting in these regions, no Amiseginae had been collected and their absence in the aforementioned regions seemed to be well established. Recent collecting carried out in Southwestern Saudi Arabia and Yemen revealed an undescribed species of *Anachrysis* Krombein. Despite the southern part of the Arabian Peninsula having strong ties to the Afrotropical fauna (e.g. Olmi and van Harten 2000; van Achterberg 2011; Fernández-Triana and van Achterberg 2017; Saure et al. 2017), the presence of *Anachrysis* is nonetheless unexpected considering the known distribution of the genus. The *Anachrysis* was described from a single species, *Anachrysis paradoxa* Krombein, one male from Transvaal, South Africa, and four females from Serowe, Botswana (Krombein 1986). A second species was recognized by Kimsey and Bohart (1991) from the same collecting event in Transvaal and later described by Krombein (1994) as *Anachrysis spanglerorum* which is known from the holotype male only. Both species were collected in open savannah. *Anachrysis* differs quite drastically from the other Afrotropical Amiseginae, in which both the female and male are apterous and possess a highly modified mesosoma. The fully winged state of both sexes and the short metanotum of *Anachrysis* are reminiscent of the morphology of the plesiomorphic New World Amiseginae, which include *Adelphé* Mocsáry, 1890, *Amisega* Cameron, 1888, *Anadelphé* Kimsey, 1987, and *Duckeia* Costa Lima, 1936.

Material and method

The present study is based on *Anachrysis* specimens collected from Jazan region (Southwestern Saudi Arabia) and Lahj and Sana'a governorates (Yemen), using Malaise traps. The specimens were examined using a MEIJI-EMZ-10 stereomicroscope (up to 180× magnification) fitted with an ocular micrometer for measurements and an Olympus SZ40 stereomicroscope.

Photographs, except that of male genitalia, were taken with a Canon EOS 70D camera attached to a LEICA MZ 125 stereomicroscope. Individual source images were then stacked using the extended depth-of-field software Helicon Focus (ver. 7.6). The male genitalia are imaged using an auto-montage software system (Syncroscopy, Cambridge, UK) attached to a phase contrast microscope (DM2500, Leica, Germany). Further image processing was completed with Adobe Photoshop CS5.1 (ver. 12.1.0.0) and Adobe Photoshop Lightroom 5.2 × 64 (ver. 5.2.0.10) software programs.

Morphological terminology largely follows Kimsey and Bohart (1991). The “scrobal sulcus” and “omalus” in Kimsey & Bohart are instead named oblique posterior sulcus following Mita (2022) for the former and prepectal carina for the latter in the present description. The terminology adopted for wing cells and veins follows Huber and Sharkey (1993). Body sculpture terminology follows Harris (1979).

The following abbreviations are used: **AOD**, anterior ocellus diameter; **F1**, **F2**, **F3**, **etc.**, first, second, third, etc. antennal flagellomeres; **IOL**, interocular distance at minimum width; **MT**, malaise trap; **OOL**, inner distance between posterior ocellus

and eye; **OPL**, minimal distance between posterior ocellus and occiput; **POL**, inner distance between posterior ocelli; **S1, S2, S3, etc.**, first, second, third, etc. metasomal sterna; **T1, T2, T3, etc.**, first, second, third, etc. metasomal terga. **Forewing cells and veins**: **2R1**, second radial 1 cell; **R**, radial cell; **1m-cu**, first median-cubital cross-vein; **Cu**, cubital vein; **cu-a**, cubital-anal cross-vein; **M**, median vein; **M+Cu**, median+cubital vein; **Rs+M**, radial sector+median vein.

A single slash (/) represents a new line on the same label, whereas a double slash (//) represents the separation of labels. The material belongs to the following depositories: **KSMA**, King Saud University Museum of Arthropods, Riyadh, Saudi Arabia; **PRPC**, Paolo Rosa private collection, Bernareggio (Italy); **RMNH**, Naturalis Biodiversity Center, Leiden, the Netherlands.

Results

Genus *Anachrysis* Krombein, 1986

Type species. *Anachrysis paradoxa* Krombein, 1986 by original designation.

Diagnosis. Antennal flagellum fusiform (female) or filiform (male). Malar space with vertical sulcus. Male mandible broad basally and foliaceous (Γ -shaped in lateral view), edentate apically. Occipital carina absent. Pronotum flattened, with a furrow posteromedially. Metanotum short, without median enclosure. Propodeum posterolaterally rounded, not angulate. Mesopleuron with prepectal carina, without posterior oblique sulcus. Rs stub of forewing extended by more or less curved dark streak.

Anachrysis arabica van Loon & Soliman, sp. nov.

<https://zoobank.org/6FF256F7-9C68-4D21-A11B-4727D4AC4C55>

Figs 1–4

Type material. **Holotype** ♂: SAUDI ARABIA / Jazan / Ahad Almasarhah / Alkhoms [16°46'14.42"N, 42°46'15.94"E, alt. 20 m] // 21.v.2022, MT / Leg. Ahmed M. Soliman [KSAM]; **Paratypes**: 2♂ and 3♀ same data as holotype [KSAM]; 1♂ and 1♀ same data as holotype [PRPC]; 1♂, SAUDI ARABIA / Jazan / Farasan Island / site 2, 14.iv.2016, MT / Leg. H. Dawah [KSMA]; 1♂, YEMEN / Lahj, xi.2000, MT / no. 5202, Leg. A. v. Harten / & A. Sallam [RMNH]; 1♂ and 3♀, YEMEN (7585) / 12 km NW Manakhah / 15.v–23.vi.2003, MT / Leg. A. v. Harten [RMNH].

Diagnosis. Vertex with two large impunctate and polished swellings (Figs 1C, 2A, 3B). Gena narrowing gradually from mandibular base to upper limit of eye (Figs 1D, 3A). Scapal basin deep, transversally ridged (Figs 1C, 3C). Lateral lobe of male clypeus lamellate, acute at apex and translucent white in color (Fig. 1C). Pronotum and mesoscutum coarsely and densely setiferous foveate, interspaces polished (Figs 2A, B, 4A, B). Pronotum posteromedially with deep short groove (Figs 2A, 4A). Scutellum sparsely

setiferous punctate, interspaces polished (Figs 2A, 4A). Propodeum with longitudinal median fine carina (Figs 2A, 4A). T1–4 densely punctate (punctures on T4 minute), interspaces polished (Figs 2D, E, 3B, 4C). Body metallic blue, with reddish to reddish brown tint on mesepisternum, metasomal venter and legs (Figs 1A, B, 2F, 3A, B, 4E).

Description. Male (Figs 1–2): Body length 3–4 mm; forewing length 2.2–2.5 mm.

Head. In frontal view about as long as wide, distinctly narrowed ventrally, somewhat triangular (Fig. 1C). Vertex with two large polished swellings directly behind posterior ocelli, posteriorly moderately declivous and setiferous foveate-subreticulate, foveae about $0.3\times$ AOD (Figs 1D, 2A). Ocellar triangle equilateral (Fig. 1C). OOL $1.5\times$ AOD; POL $2\times$ AOD; OPL about $5\times$ AOD (Figs 1C, 2A). Occiput without occipital carina (Fig. 2A). Temple evenly rounded behind eye, about $1.5\times$ AOD (Fig. 1D). Frons setiferous foveate-subreticulate (foveae about $0.5\times$ AOD), bulging on either side of scapal basin; scapal basin relatively small but deeply depressed and transversally ridged, with longitudinal median ridge (Fig. 1C). IOL $0.4\times$ as long as head width (Fig. 1C). Eyes distinctly diverging ventrally, bare, about $1.25\times$ as high as wide (Fig. 1C, D). Subantennal distance relatively long, $2.8\text{--}3.0\times$ AOD (Fig. 1C). Clypeus broad, about $2\times$ as wide as long, slightly convex and punctulate on disc, depressed and polished along subapical rim, trilobate apically; median lobe acutely rounded apically; lateral lobe moderately large and thin (lamellate), broadly triangular and pointed towards apical end (Fig. 1C). Malar space long, $4.5\text{--}5.0\times$ AOD, sparsely punctate, with well-developed vertical sulcus (Fig. 1D). Gena gradually narrowed towards the temple, its width about $1.5\times$ AOD at its mid-length, densely foveate (Fig. 1D). Flagellum long, filiform, flagellomeres cylindrical and gradually decreasing in length distally; F1 longest, $5.0\text{--}5.2\times$ as long as wide; F2 $3.5\text{--}3.8\times$ as long as wide; F3 about $3.5\times$ as long as wide; F11 about $4.5\times$ as long as wide (Fig. 1E). Mandible flattened, broad and incised near base, tapering and edentate apically (Fig. 1C, D). Palpal formula $3/4$.

Mesosoma. About $2.5\times$ as long as maximum width at the level of mesopleuron (Fig. 2A), relatively flat in lateral view (Fig. 2B). Pronotum wider than long, about $1.2\times$ (Fig. 2A), with anterior shelf longitudinally ridged, dorsal face setiferous foveate-reticulate to subreticulate (foveae about $0.7\times$ AOD), humeral angles evenly rounded (Fig. 2A) and lateral lobe not reaching tegula (Fig. 2B), posteromedially with deep short groove (Fig. 2A). Mesoscutum shorter than pronotum, about $0.7\times$, setiferous foveate-subreticulate (Fig. 2A); notauli complete, anteriorly strongly diverging towards pronotal lobes (Fig. 2A); parapsides reaching anterior fourth of mesoscutum (Fig. 2B). Tegula oval and polished (Fig. 2A). Scutellum about $0.7\times$ as long as mesoscutum, setiferous sparsely punctate (Fig. 2A); interspaces between foveae and punctures on pronotum, scutum and scutellum polished (Fig. 2A, B); metanotum about $0.3\times$ as long as scutellum, longitudinally ridged (Fig. 2A). Propodeum areolate, posterolaterally evenly rounded (without lateral angle), with longitudinal median fine carina extended on both faces (Fig. 2A, D), propodeal dorsal face about $0.9\times$ as long as scutellum and metanotum combined (Fig. 2A), posterior face in lateral view rather abruptly declivitous (Fig. 2B). Mesopleuron gradually differs from being foveate on dorsal face to sparsely punctate on ventral face (Fig. 2B, F), with prepectal carina (Fig. 2B).

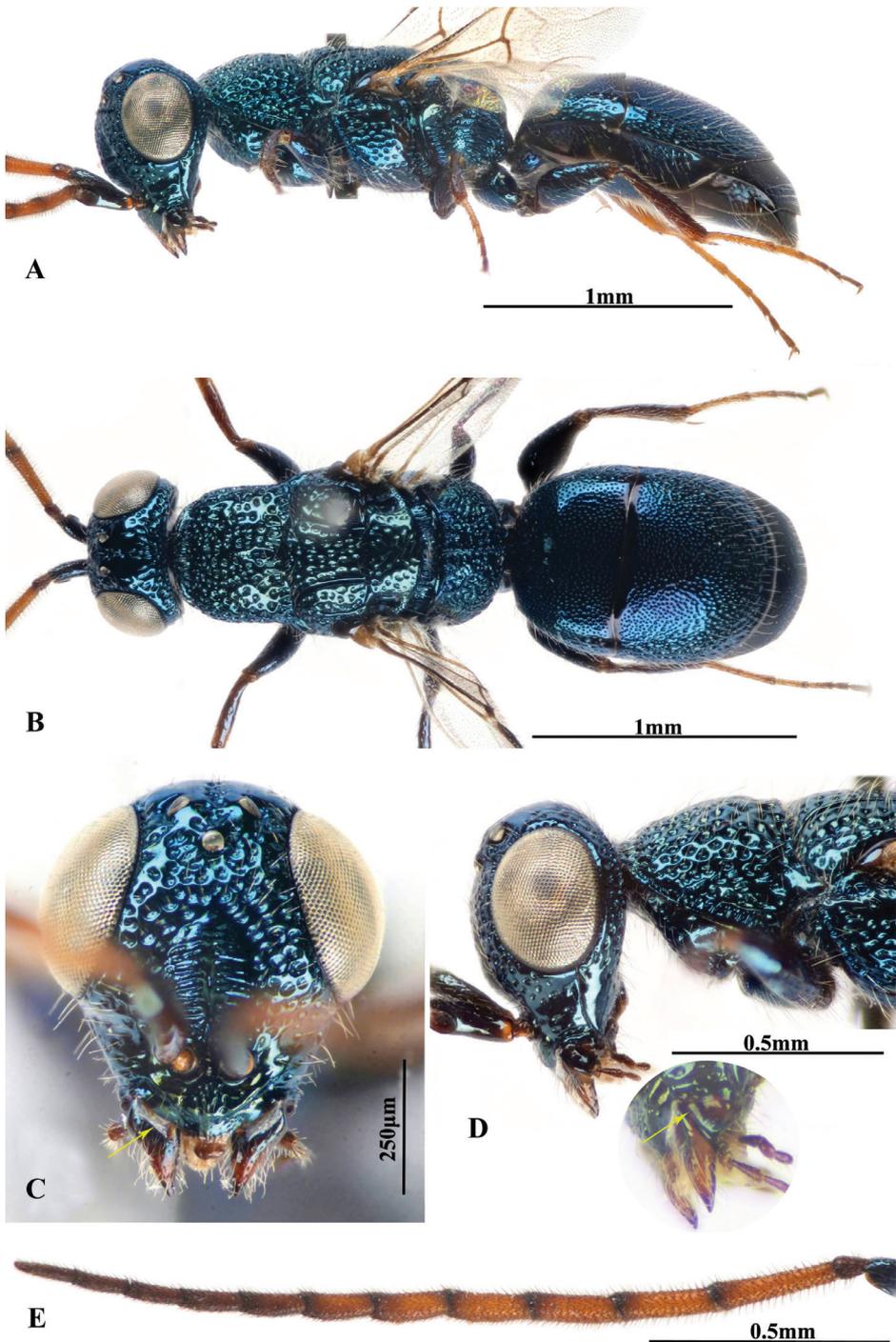


Figure 1. *Anachrysis arabica* van Loon & Soliman, sp. nov., holotype ♂ **A** habitus, lateral view **B** habitus, dorsal view **C** head, frontal view (clypeal lateral lamella indicated) **D** head and pronotum, lateral view (mandible is magnified, mandibular subbasal incision indicated) **E** antenna (part of scape).

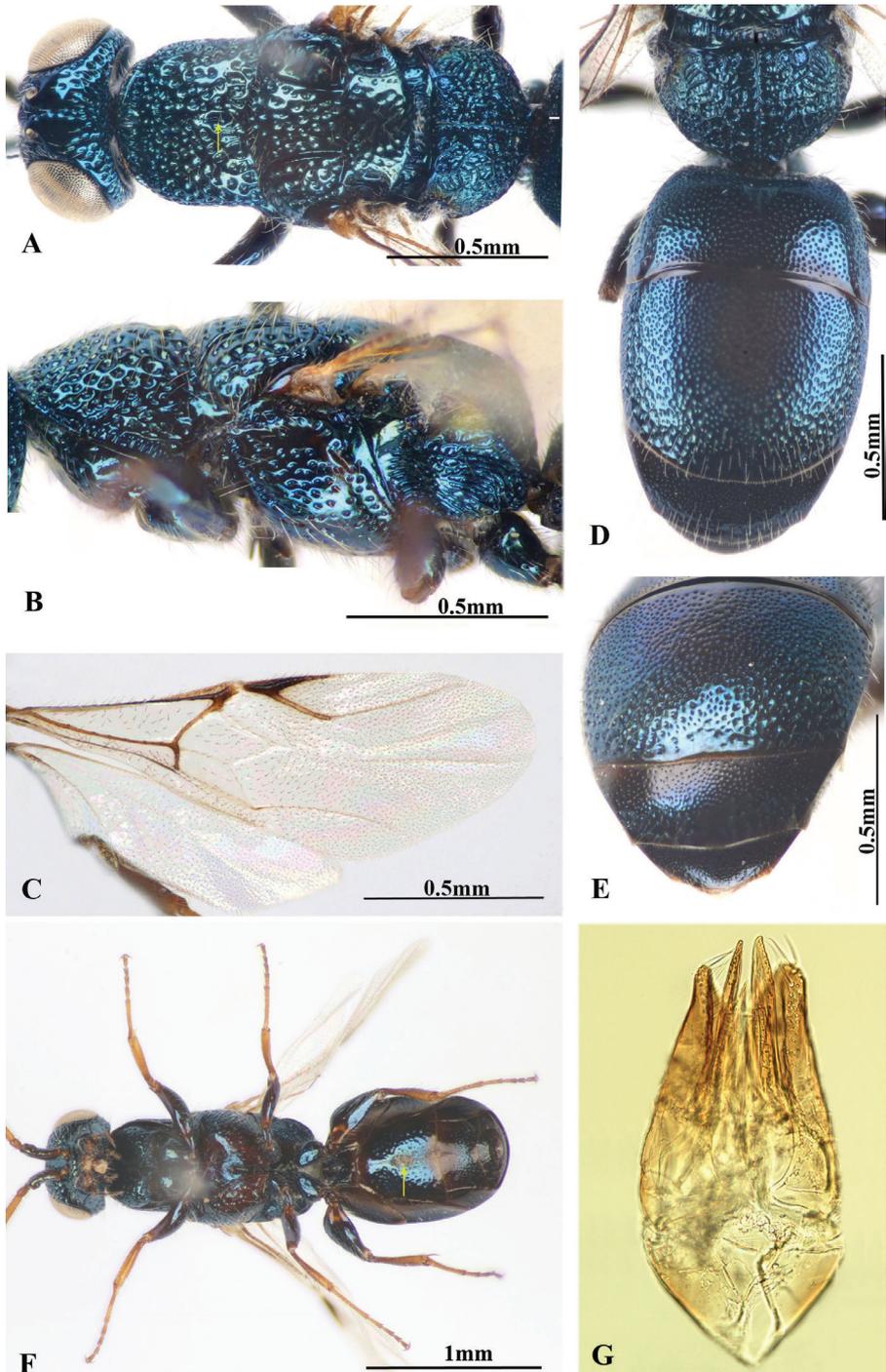


Figure 2. *Anachrysis arabica* van Loon & Soliman, sp. nov., holotype ♂ **A** head and mesosoma, dorsal view (pronotal posteromedian groove indicated) **B** mesosoma, lateral view **C** wings **D** propodeum and metasoma, dorsal view **E** metasomal T2–5, dorsal view **F** habitus, ventral view **G** genitalia, ventral view.

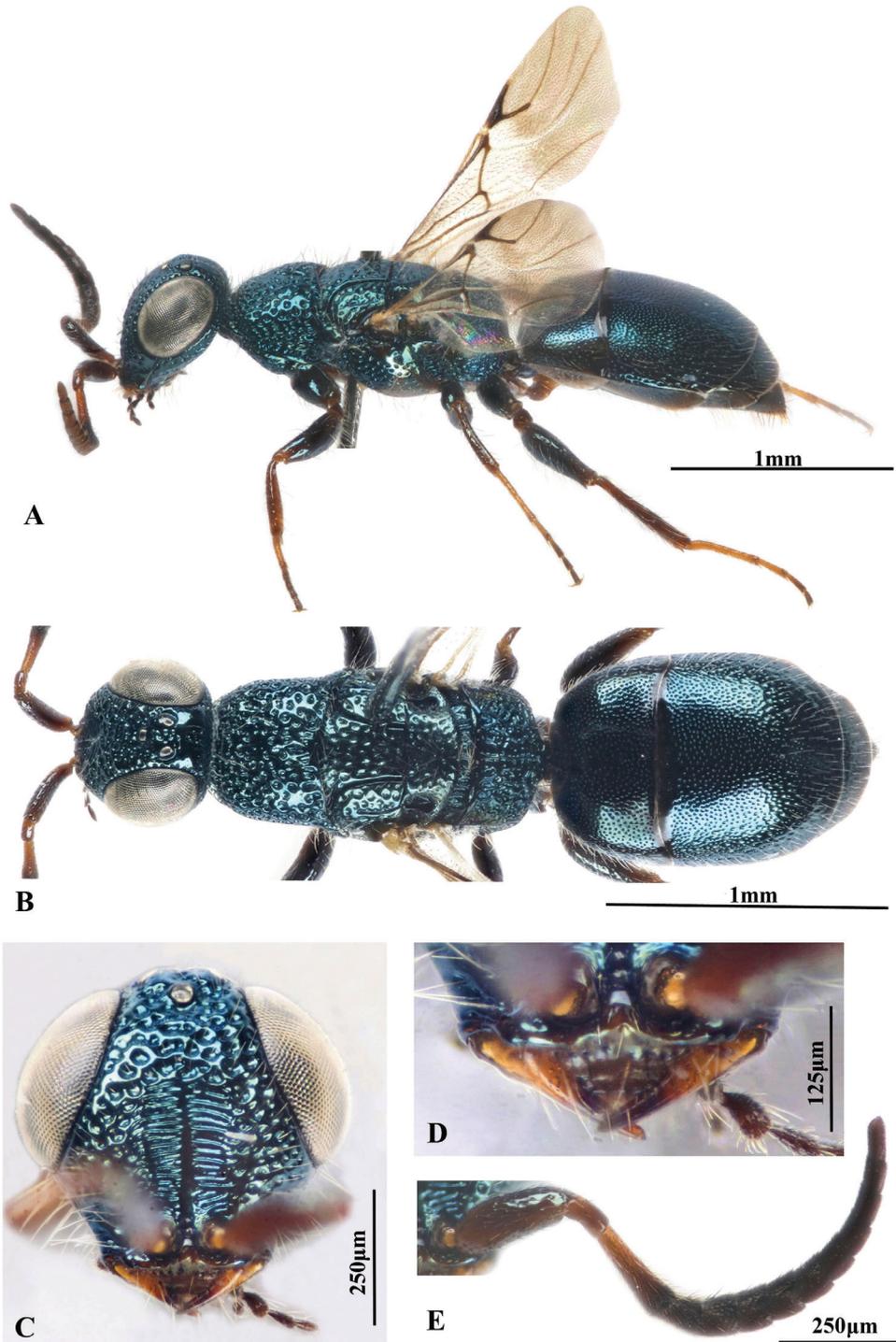


Figure 3. *Anachrysis arabica* van Loon & Soliman, sp. nov., paratype ♀ from Saudi Arabia **A** habitus, lateral view **B** habitus, dorsal view **C** head, frontal view **D** mandibles and clypeus **E** antenna.

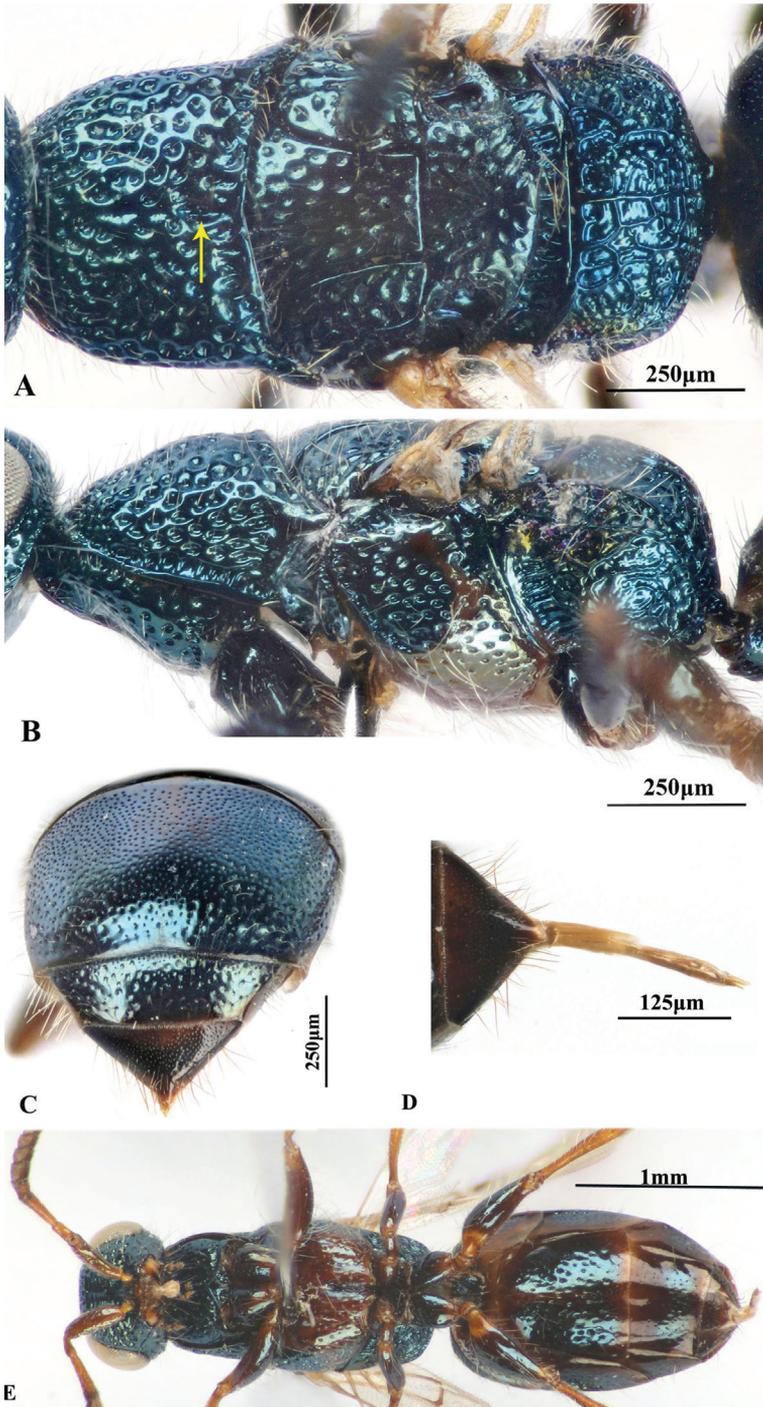


Figure 4. *Anachrysis arabica* van Loon & Soliman, sp. nov., paratype ♀ from Saudi Arabia **A** mesosoma, dorsal view (pronotal posteromedian groove indicated) **B** mesosoma, lateral view **C** metasomal T2–5, dorsal view **D** T4 and ovipositor **E** habitus, ventral view.

Forewing (Fig. 2C). R and 1Cu cells fully sclerotized. M1 cell delimited with faint veins except proximal M well sclerotized. Stub of Rs particularly well sclerotized (thick), about 0.7× as long as pterostigma and R1 combined. M vein slightly curved, meets M+Cu before cu-a.

Hind leg (Figs 1A, 2F). Femur 2.3–2.5× as long as its maximum width, with dorsal margin basally strongly swollen then gradually narrowing towards apical end.

Metasoma. T1 about 0.5× and 1.5× as long as T2 and T3 respectively, anterolaterally gently rounded (Fig. 2D). T1–4 punctulate (punctures on anterior half of T3 and T4 minute), interspaces polished (Fig. 2D, E). T2 with posterior margin strongly convex (Fig. 2D). T5 extremely small, greatly concealed (Fig. 2E). S2 punctulate on disc, polished on edges, with posterior margin slightly emarginate medially (Fig. 2F). S3–4 minutely punctate, S3 polished on anterior half (Fig. 2F).

Genital capsule. As in Fig. 2G.

Pilosity. Body rather sparsely setose throughout, with erect to suberect white fine setae (about 1.5–2× AOD in length) (Figs 1A, C, D, 2B, D), except male antennal flagellomeres particularly with dense short reddish setae (Fig. 1E) and male S2 with circular central area of dense recumbent setae (Fig. 2F). Setae longest on fore coxa and femur and hind femur. Wings with brown macrotrichiae on both sides, denser on distal half than elsewhere (Fig. 2C).

Color. Body metallic blue (Figs 1A, B, 2F), except following parts: apical half of mandible (Fig. 1C), labial and maxillary palps (Fig. 1D), F7–11 (Fig. 1E), small to large marking on mesepisternum and metasomal sternal borders reddish to reddish brown (Fig. 2F); ventral aspect of tibiae, entire tarsi and F1–6 orange (Figs 1A, E, 2F); lateral lamella of clypeus whitish and largely translucent (Fig. 1C); anterior rim of T2, anterior half of T3 and T4 with black tint (Fig. 2D, E). Wings hyaline, veins and pterostigma brown to dark brown (Fig. 2C).

Female (Figs 3, 4): Body length 3–3.5 mm; forewing length about 2.3 mm.

Similar to male, but differs as follows: Subantennal distance distinctly shorter, 0.9–1.0× AOD (Fig. 3C); clypeus without lateral lamella (apically not trilobate), with free margin truncate (Fig. 3D); mandible simple, rather slender and subbasally entire (without incision) (Fig. 3D); flagellum fusiform and distinctly shorter (F2–8 widened, at least as long as wide), ventral surface of F3–11 flattened, pedicel and F1 reddish brown, F2–11 dark brown to blackish (Fig. 3E); frons in lateral view more strongly bulging (Fig. 3A); reddish marking on mesepisternum extensive and lighter (Fig. 4E); forewing slightly infumate, brown, on distal half (Fig. 3A); distal veins, Cu, Rs+M and 1 m-cu of M1 cell extremely faint (nearly absent) (Fig. 3A); S2 sparsely setose throughout (without central area of dense recumbent setae) (Fig. 4E); metasoma with slender ovipositor (Fig. 4D).

Distribution. Southwestern Saudi Arabia and Yemen.

Etymology. The specific name *arabica* is a Latin adjective derived from Arabian Peninsula, referring to the subregion where the species has been found.

The following key can be used for differentiation between *Anachrysis* species: the new species *A. arabica* (Saudi Arabia and Yemen), *A. paradoxa* Krombein, 1986 (Botswana and South Africa) and *A. spanglerorum* Krombein, 1994 (South Africa).

Key to the species of *Anachrysis* Krombein

Males

- 1 Vertex with impunctate and polished swellings behind posterior ocelli. Punctuation of body sparse to subreticulate, not reticulate. Pronotum posteriorly without transverse carina..... *Anachrysis arabica* **sp. nov.**
- Vertex entirely foveate-reticulate, without such swellings. Punctuation of body dense and reticulate, especially on head. Pronotum posteriorly with a transverse carina on each side of posteromedian groove **2**
- 2 Clypeus without lateral reflexed lamella, with median lobe gently arched. Mesepisternum largely reddish to reddish brown. T2 with a narrow polished longitudinal median streak on anterior two-thirds.....
..... *Anachrysis spanglerorum* **Krombein**
- Clypeus with distinct lateral reflexed lamella and median lobe sharply arched. Mesepisternum uniformly metallic blue. T2 evenly punctate, without polished longitudinal median streak..... *Anachrysis paradoxa* **Krombein**

Females (female of *A. spanglerorum* Krombein unknown)

- 1 Vertex with impunctate and polished swellings behind posterior ocelli. Clypeal apical margin truncate. Gena evenly curved behind eye, not angulate. Pronotum posteriorly without transverse carina. Mesoscutum and scutellum in lateral view flattened, the latter sparsely punctate. Mesepisternum ventrally and laterally partially reddish to reddish-brown *Anachrysis arabica* **sp. nov.**
- Vertex entirely foveate-reticulate, without such swellings. Clypeal apical margin evenly rounded. Gena abruptly widened, with obtuse angulation, behind lower third of eye height. Pronotum posteriorly with transverse carina on each side of posteromedian groove. Mesoscutum and scutellum in lateral view convex, the latter foveate-reticulate. Mesepisternum uniformly metallic blue *Anachrysis paradoxa* **Krombein**

Discussion

All specimens of *Anachrysis arabica* sp. nov. were collected in southwestern Saudi Arabia (Jazan and Farasan Island) and western Yemen (Lahj and Sana'a). The position of the Arabian Peninsula in relation to the faunal regions of the world is rather unique, as it is situated at the junction of three different biogeographical realms with the southern part of the Peninsula having Afrotropical affinities (Gadallah and Brothers 2020). Conditions in west Yemen superficially resemble those of the African savanna, with the average annual rainfall in the western highlands ranging between 200 to 500 mm (Hadden 2012), which is about the same as the annual rainfall in the southern Afrotropical open savanna where *Anachrysis paradoxa* Krombein was collected. Hosts of any species of *Anachrysis* are un-

known, but since all female Amiseginae have narrow and pointed mandibles, presumably used to pierce the tough outer layer of phasmid eggs, it is likely that *Anachrysis* also parasitizes phasmid eggs. *Anachrysis* shares the lateral lamellate process of the clypeus and the foliaceous mandibles of the male with *Adelphæ* Mocsáry and possibly *Anadelphæ* Kimsey. These features are not seen in any other Amiseginae and are likely synapomorphic traits. The alleged lack of a lateral lamellate process of the male clypeus in *Anachrysis spanglerorum* is notable. Nevertheless, since it is present in both the closely related *A. paradoxa* and the relatively more distantly related *A. arabica*, its absence is very likely not plesiomorphic. This new discovery reaffirms the notion by Krombein (1986) that *Anachrysis* is a relict genus lacking synapomorphies with the more derived Afrotropical Amiseginae and instead shares synapomorphies (e.g. the derived mandible shape of the males and the short metanotum) with the New World Amiseginae. The discovery of a species of *Anachrysis* in the Arabian Peninsula and its previous known presence in southern Africa indicate that the distribution of *Anachrysis* is much broader than previously thought. The Amiseginae very likely had a northern origin (Kimsey 1990) and fossil evidence, of which primitive species have been exclusively found in the Northern Hemisphere, seems to support this hypothesis (Krombein 1986; Martynova and Perkovsky 2017). The presence of *Anachrysis* in the Northern Hemisphere might provide us with a better understanding of how those basal lineages spread to the Southern Hemisphere. Further sampling with malaise traps in the Arabian Peninsula as well as southern and particularly eastern Africa is recommended and will almost certainly lead to the discovery of more species of *Anachrysis*.

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