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New teratological cases in cuckoo wasps, with synonymization of *Oligogaster* Soliman & Kimsey (Hymenoptera, Chrysididae)

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Abstract

Aberrations involving the metasoma in Hymenoptera are well-documented, with one notable teratological case being the fusion of metasomal terga, named symphysomery. This aberration, characterized by the fusion of the second and third terga, has been observed in various species groups of *Hedychridium*, spanning from Southern Africa to Central Asia. Similar aberrations were noted in *Prochridium* Linsenmaier from Mongolia and *Anachrysis* Krombein from Southern Africa. The monotypic genus *Oligogaster* Soliman & Kimsey is distinguished by two visible metasomal terga. However, the sole specimen of *Oligogaster kimseyae* Soliman, the type species of the genus, is here considered an aberrant specimen affected by symphysomery, exhibiting the fusion of the second and third metasomal terga. Consequently, *Oligogaster* Soliman & Kimsey is here synonymized with *Hedychridium* Abeille de Perrin.

Key words: Cuckoo wasps, teratology, aberration, morphology, new synonym

Introduction

Teratologies are structural abnormalities named "monstruosités" by Balazuc (1948), who provided a complete classification and terminology for the malformations found in arthropods (Balazuc 1948, 1952, 1969), with a particular focus on Hymenoptera (Balazuc 1958). These "monsters" are specimens displaying one or more anatomical parts incompatible with the typical diagnosis of the taxon to which the species belongs (Savini & Furth 2004). Malformations may affect all body segments, spanning from the head to the abdomen, encompassing appendages and genitalia. Gynandromorphy is probably the best known of these phenomena, by which a single organism possesses differentiated tissues that are genotypically and phenotypically male and female (Narita *et al*. 2010; Rosa & Zettel 2018); this results in the specimen exhibiting characteristics of both sexes.

Among the aculeate Hymenoptera, a substantial number of malformations have been documented, particularly within Anthophila, both honeybees and wild bees (Balazuc 1958; Michez *et al*. 2009). Similar reports exist for ants (Formicidae), as compiled by Buschitoeb & Stoewesand (1971), with a summary of historical publications on this topic by Balazuc (1958). Notably, gynandromorphs constitute a significant portion of these reported malformations across various families. In the case of wild bees, for instance, records of gynandromorphs include over 110 species within 29 genera (Michez *et al*. 2009; Hinojosa-Díaz *et al*. 2012).

A number of teratological cases have been described and illustrated for cuckoo wasps, some of which are related to the metasoma: Negru (1955, 1958) described and illustrated the incomplete fusion of the first and second metasomal segment of *Holopyga chrysonota* (Förster, 1853) and *Holopyga amoenula* Dahlbom, 1845; Móczár (1963) described and illustrated two specimen of *Chrysis ignita* (Linnaeus, 1758), one without apical teeth on the last visible tergum and another one with a malformation on the apical margin of second tergum; finally, the holotype of *Chrysis gurkoi* Rosa, 2019 displays asymmetry of the second metasomal tergum (Rosa 2019, fig. 11).

In the framework of a comprehensive revision of Chrysididae genera initiated following the molecular phylogeny published by Pauli *et al*. (2019) and continued by Rosa *et al*. (2023), this contribution aims to highlight a specific abnormality that occasionally affects the chrysidid metasoma. Additionally, the intent is to propose a new synonymy for a genus that was initially described based on a single aberrant specimen.

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Materials and methods

Specimens photographed for this study are deposited in the collections of the following Institutes: Collection of Efflatoun Bey, Entomology Department, Faculty of Science, Cairo University (EFC, Egypt); Museum für Naturkunde, Berlin (ZMB, Germany); Zoological Institute, St. Petersburg (ZISP, Russia), the private collections of the author (PRC).

The terminology for chrysidids follows Kimsey & Bohart (1991); the terminology for morphological aberrations follows Balazuc (1948, 1958).

Photographs of the specimens were taken with a Nikon D-3400 connected to the stereomicroscope Togal SCZ and stacked with the software Combine Z and a Canon EOS 70D camera attached to a LEICA MZ-125 stereomicroscope and stacked with the software Helicon Focus (ver. 7.6).

Results

Hedychridium Abeille de Perrin, 1878

Oligogaster Soliman & Kimsey, 2013: 198. Type species: *Oligogaster kimseyae* Soliman, 2013: 199, by original designation. **Syn. nov.**

Soliman & Kimsey (2013) described *Oligogaster* based on a single Elampini specimen collected in Egypt (Fig. 1) and characterised by two metasomal terga, four sterna and edentate tarsal claws. The discovery of a specimen with only two terga was deemed exceptional; however, the authors did not consider the possibility of an occasional aberration involving fusion of two metasomal segments, phenomenon documented in the literature under the term symphysomery (Balazuc 1948, 1958).

Thanks to the kind help of Ahmed Soliman, I examined the pictures of the holotype of *Oligogaster kimseyae* (Fig. 1). The specimen shows all the diagnostic characters of other members of *Hedychridium*, including the four visible sterna, which are visible in many species of the *ardens* group (Fig. 4D and line drawings in Linsenmaier (1959), figs 161, 167), whereas the simple tarsal claws may be an aberration of this teratological specimen or a specific character of this taxon, as in *Hedychridium minusculum* (du Buysson, 1898) (Rosa 2019) and in members of related genera with small species, such as *Prochridium* Linsenmaier, 1968 and *Kimseya* Antropov, 1995. Considering that the only known specimen of *Oligogaster kimseyae* is a teratological specimen, and the other diagnostic features attributed to the genus *Oligogaster* are present in several members of *Hedychridium*, I hereby propose the synonymy of *Oligogaster* Soliman & Kimsey, 2013, with *Hedychridium* Abeille de Perrin, 1878.

Hedychridium kimseyae (Soliman, 2013)
Fig. 1A–C

Oligogaster kimseyae Soliman, 2013: 199. Holotype ♀; Egypt: Wadi el Natrun, Beheira, Lower Nile Valley, 30°22’22”N 30°20’48”E, 18.vii.2003, leg. A.M. Soliman (EFC).

Given the aberrant nature of *Hedychridium kimseyae*, there are still opportunities for various analyses. This species shares similarities with the Central Asian *Hedychridium eupraxiae* Semenov-Tian-Shanskji, 1954, particularly for head profile, metasomal punctation, and metasomal apical margin. However, notable distinctions exist, such as the broadly cross-ridged scapal basin and body coloration. *H. kimseyae* displays a mesoscutellum-metanotum color congruence and non-metallic yellowish tibiae, whereas *H. eupraxiae* features a punctate scapal basin, green metanotum contrasting with the cupreous mesonotum, and metallic green tibiae. The tarsal claws in *H. eupraxiae* appear simple and enlarged in the basal half based on available images. However, it is necessary to double-check the type to verify this character. Considering these distinctive features and conducting a comparative analysis with other species documented in northern Africa (Linsenmaier 1999), I propose recognizing *H. kimseyae* as a valid species. However, further examination of additional specimens from both sexes is necessary to confirm this classification.

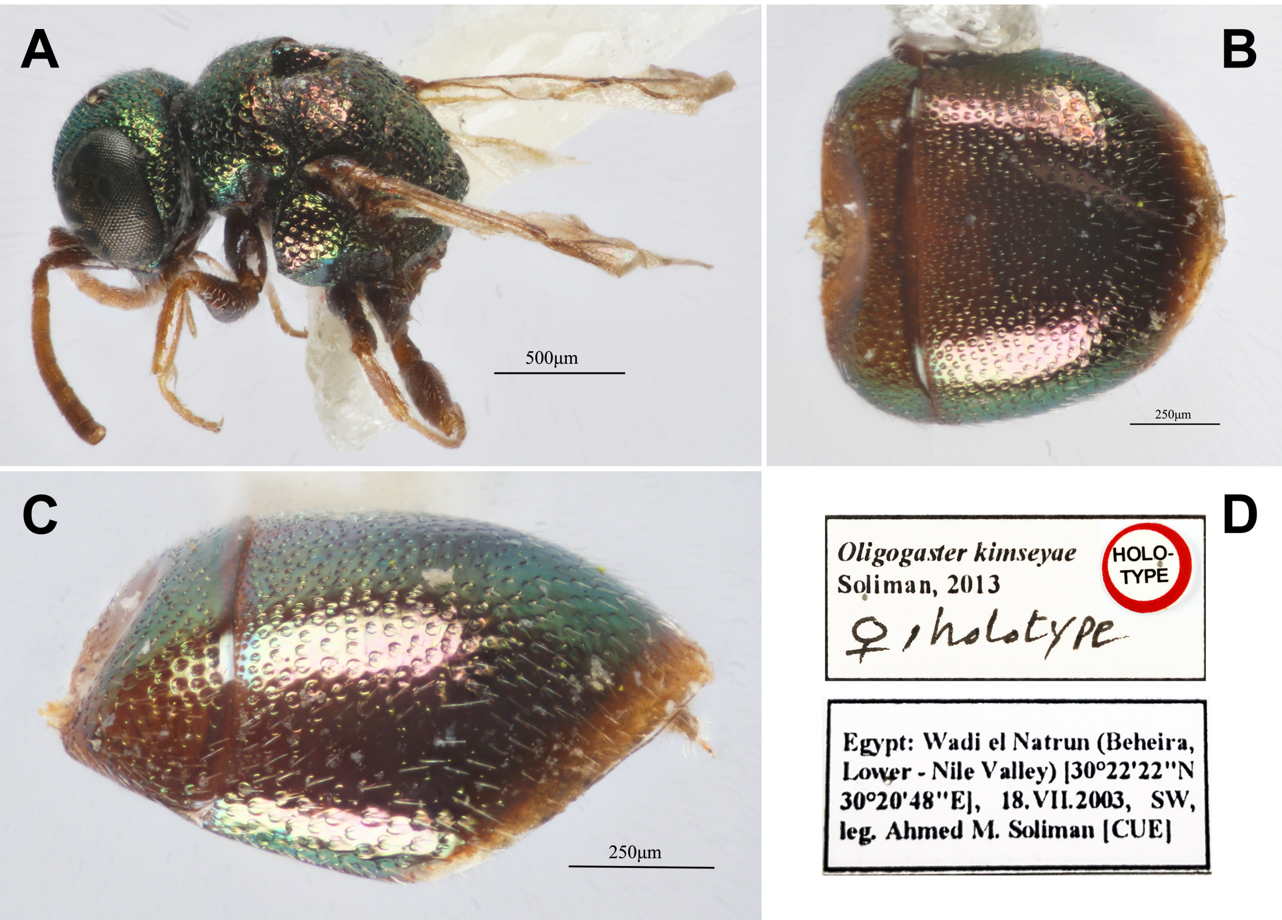

FIGURE 1. *Oligogaster kimseyae* Soliman, 2013, female, holotype. A) Head and mesosoma, dorsal view. B–C) Metasoma: B) dorsal view, C) lateral view. D) Labels. Images © by A. Soliman.

Discussion

Chrysididae stand out easily among other Hymenoptera due to the reduced number of visible metasomal terga and sterna (Kimsey & Bohart 1991). Their metasoma comprises two distinct functional parts: the external part, which includes the visible segments, and the internal part with the remaining segments that are invaginated, forming either the telescopic female ovipositor or the male genital tube (Kimsey & Bohart 1991). Chrysidinae (Chrysidini and Elampini) exhibit three visible metasomal terga and sterna in both sexes, with few exceptions displaying four sterna, as observed in some South American Chrysidini, and with the fourth sternum partially visible in certain Elampini, including some species of *Hedychridium* and *Hedychrum* (Linsenmaier 1959). Parnopini are sexually dimorphic having four visible terga in the male and three in the female, whereas both sexes of Allocoelini possess two visible terga and three sterna (Kimsey & Bohart 1991). Cleptinae, Amiseginae, and Loboscelidiinae showcase sexual dimorphism with five external metasomal segments in males and four in females.

Metasomal anomalies involving terga in Hymenoptera are well-known (Balazuc 1948, 1958). Among the most striking cases there are spiral alignment of segment halves (helicomery) (Fig. 2A), incomplete median fusion between two hemi-terga (epigatroschisis) (Fig. 2B), partial or total fusion of two segments (symphysomery) (Figs 3–5), omission of a segment half (hemimery), partially reduction of sclerites (hemiatrophy), metasomal asymmetry, development of ancestral characters, and multiple monstrosities, including metasomas with two or three apical margins. All these abnormalities have been observed in a large number of Chrysididae (unpublished data) belonging to all subfamilies and will be discussed in a series of forthcoming articles including other aberrations observed in all body parts of the cuckoo wasps, such as anarthrogenesis, aplasia, atrophy, dysplasies, ectromely, heteromorphosis, hypertrophy, microcephaly, nanism, polymery, schistomely, somatomely, symphysocery, and tumors.

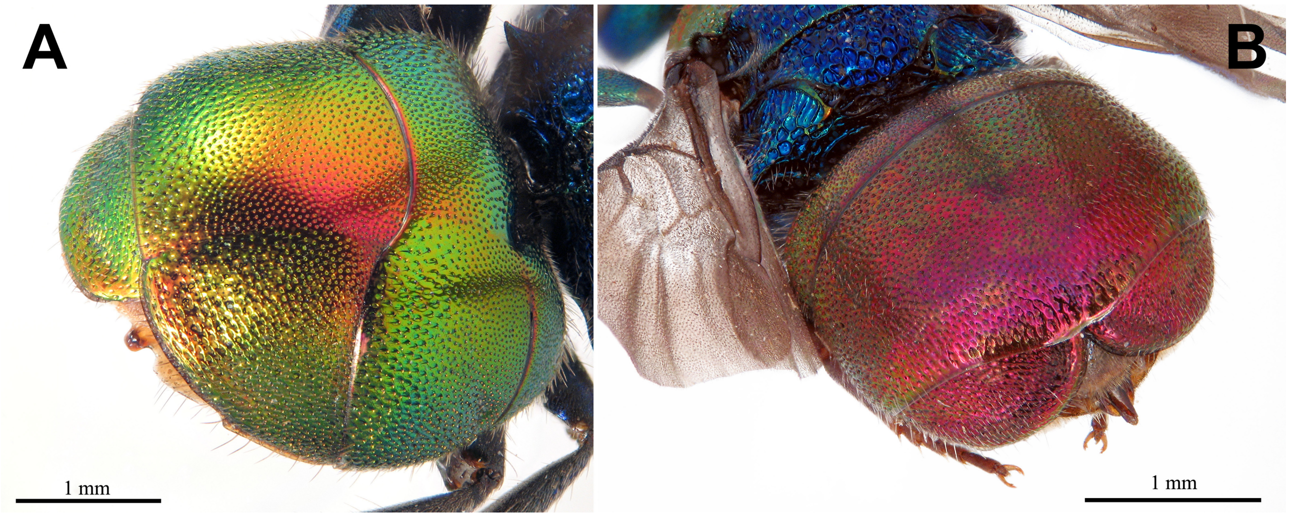

FIGURE 2. A) *Hedychrum nobile* (Scopoli, 1763) metasoma with helicomery. B) *Hedychrum niemelai* Linsenmaier, 1959, metasoma with epigatroschisis. Images © by M. Zilioli.

In Chrysididae, the reduction of the number of terga normally involves the fusion of the second and the third terga, producing a single segment. This phenomenon is apparently more frequent in members of *Hedychridium* and in a closely related genus, *Prochridium*. In particular, I observed this teratology in specimens collected from Southern Africa to Central Asia (Rosa *et al*. 2017) and Mongolia, including species belonging to different species groups, such as *Hedychridium braunsii* (Mócsary, 1902) from Namibia (Wlotzkasbaken, ZMB) (Fig. 3); *Hedychridium longigena* Rosa in Rosa *et al*., 2017 from Siberia (Russia: Irkutsk Prov.), and *Hedychridium belokobylskiji* Rosa, 2017 from Siberia (Russia: Tuva Rep., Rosa private coll.) (Fig. 4). This teratology was observed also in members of an undescribed species of the genus *Prochridium* from Mongolia (Dornod Prov.: Choilbalsan, Marek Halada private coll., České Budějovice, Czech Republic). Interestingly, in the Siberian series of *Hedychridium*, where more material was available for study, this aberration was observed in several specimens of the same population, thus suggesting a genetic origin.

The symphysomery observed in *Hedychridium braunsii* from Namibia (Fig. 3) provides a significant insight into this aberration, unambiguously revealing the complete fusion of the second and third terga. In fact, *H. braunsii* is the type species of the (sub)genus *Acrotoma* Mócsary, 1902, *nec* Boettger, 1881 [(used as a valid subgenus name by Linsenmaier (1959, 1999)], in which the main diagnostic feature is the bidentate apical margin of the third tergite. In the specimen examined with symphysomery (Fig. 3), the second and third terga are fused together and the two small, median apical teeth, typical of this species, are positioned on the apical margin the second tergite, lacking the third apparent one (Figs 3B, C). Interestingly, the number of apparent sterna remains unaltered (Fig. 3C). This aberration, involving the fusion of the second and third terga, is similarly observed in other species of *Hedychridium*. In these cases, the translucent apical margin of the third tergum is observed on the apical margin of the second, without the presence of the apparent third one (Figs 4B, C). Although the fusion of the two terga may be less obvious than in the case of *H. braunsii*, it remains indicative of symphysomery.

It is important to note that all examined specimens with two terga do not belong to *Oligogaster*, but instead represent different genera, for instance *Hedychridium* and *Prochridium* and different species groups such as *Hedychridium ardens* group and *braunsii* group, and their modified metasoma is a result of symphysomery.

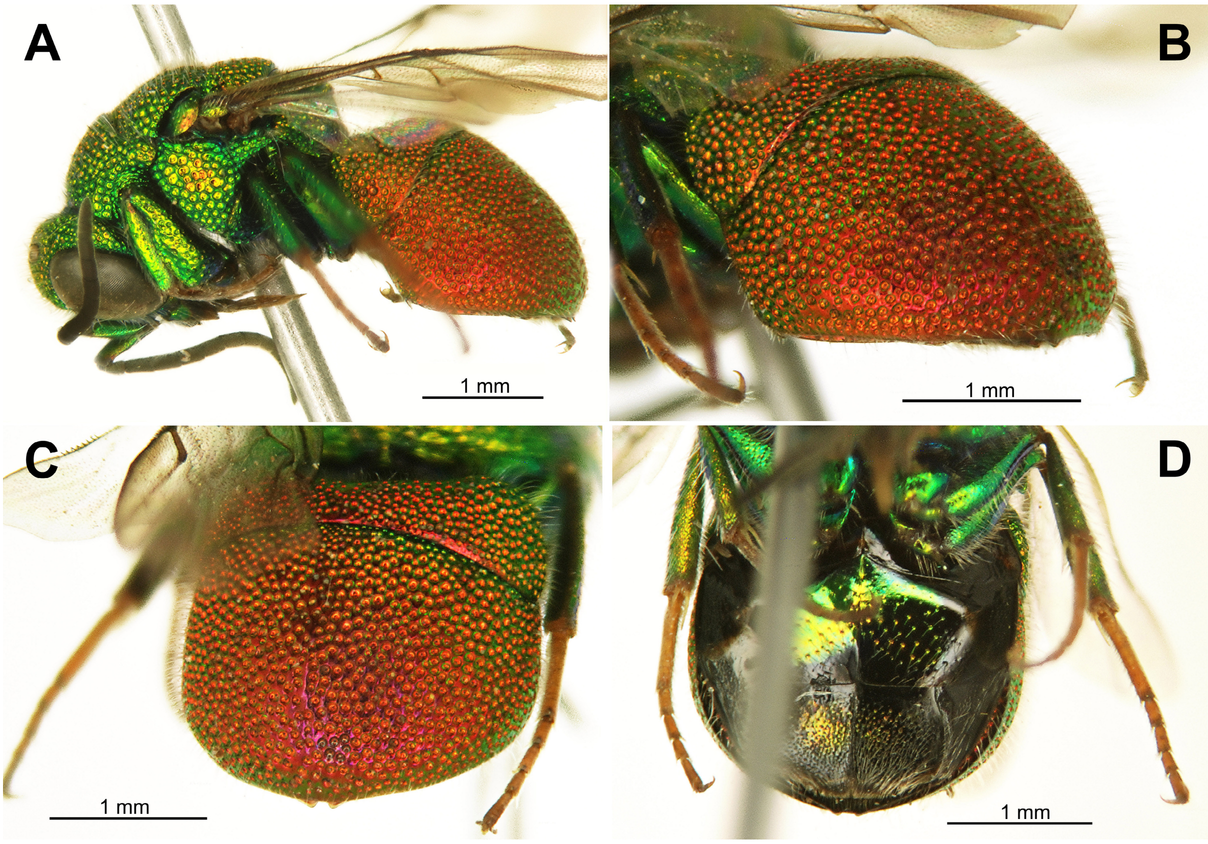

FIGURE 3. *Hedychridium braunsii* (Mócsary, 1902), aberrant male from South Africa. A) Habitus, lateral view. B–D) Metasoma: B) postero-lateral view, C) posterior view, D) ventral view.

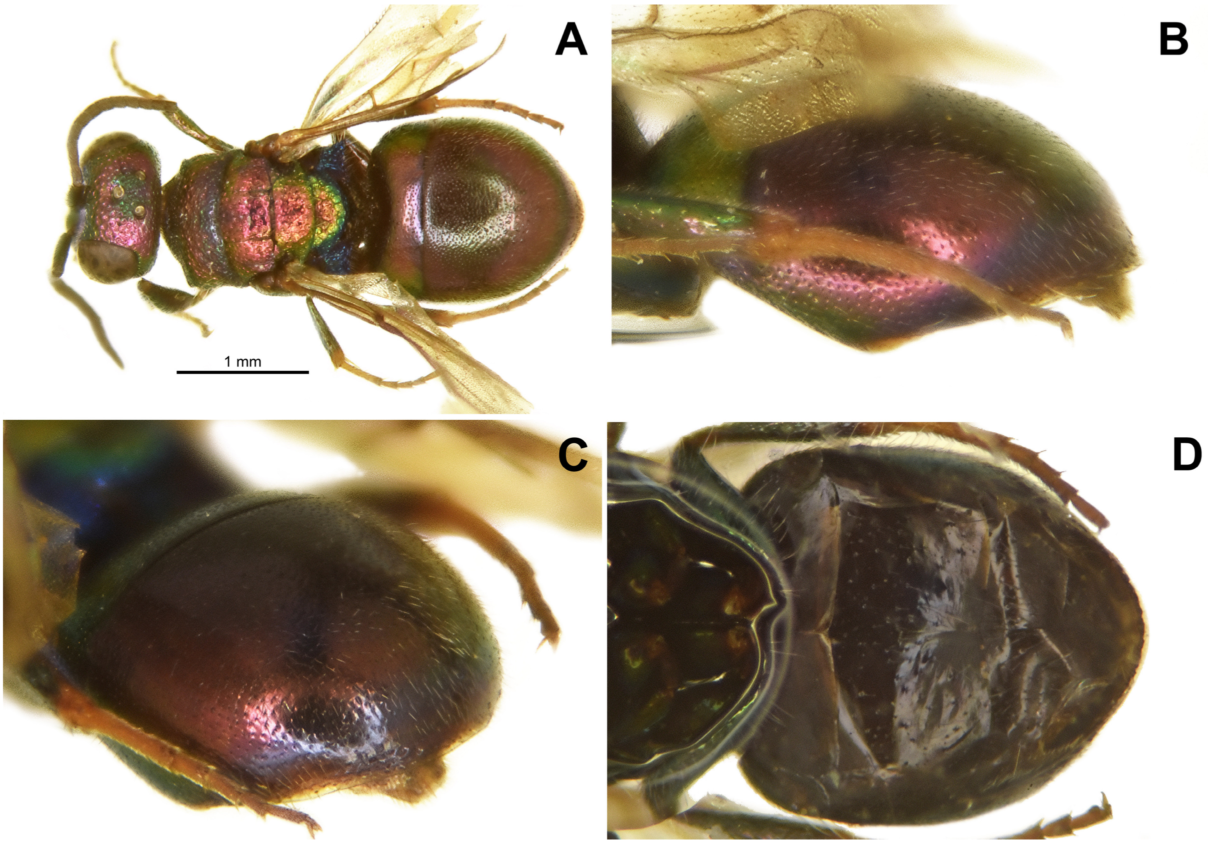

FIGURE 4. *Hedychridium belokobylskiji* Rosa, 2017, female from Siberia. A) Habitus, dorsal view. B–D) Metasoma: B) lateral view, C) postero-lateral view, D) ventral view.

Another intriguing case of symphysomery has been noted in a female of *Anachrysis* Krombein, 1986 from Namibia (Bushmanland, ZMB) within the subfamily Amiseginae. Typically, females of Amiseginae exhibit four visible metasomal terga, but in this particular case, the female displays only two visible terga (Fig. 5).

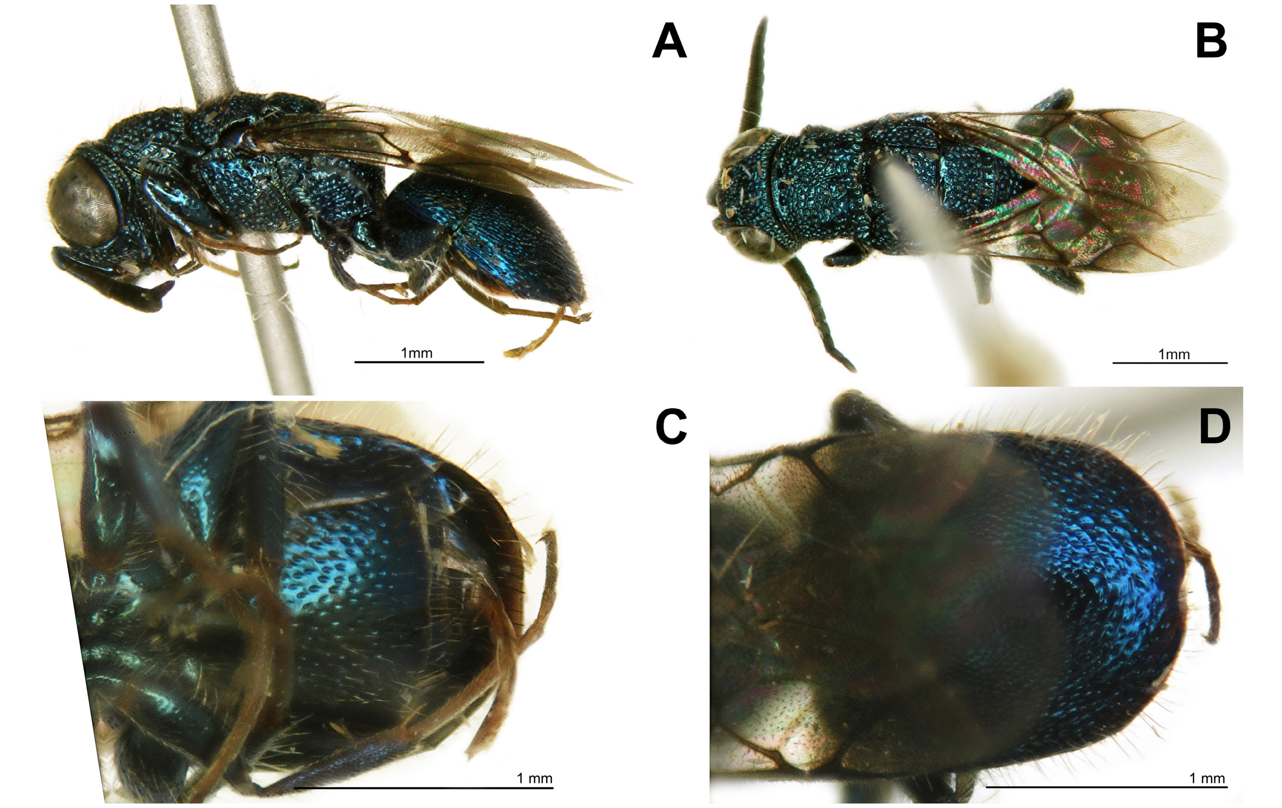

FIGURE 5. *Anachrysis* sp. Krombein, 1986 from South Africa. A–B) Habitus: A) lateral view, B) dorsal view. C–D) Metasoma: ventral view, D) dorsal view.

Despite the scarcity of described records, aberrations are frequently observed in cuckoo wasps, in particular on head and metasoma (unpublished data). They were probably neglected by former entomologists for several reasons. For example, because of the small size of the majority of the species, or because aberrations are hard to discover due to poor preparation of the specimens. Indeed, chrysidids are usually badly pinned through the mesosoma with the body almost rolled up, with the head facing downwards toward the bottom of the drawer, with the antennae placed under the specimen, with the wings obscuring the metasoma, and with the legs hidden under the ventral side of the body. It is also conceivable that authors have thought that no significant conclusions could be obtained from isolated aberrant individuals.

It is well-documented that malformations and aberrations in Hymenoptera have led to the description of new genera and species, subsequently resulting in their synonymization (De Beaumont 1959; De Rond 1994; Popovici *et al.* 2014). This phenomenon extends beyond metasomal aberrations, encompassing abnormal antennae, wing venation, and aberrant mesosomal parts, which have caused misidentifications and proven to be sources of taxonomic challenges (Bouček & Graham 1978; Masner & Huggert 1989). The synonymization of *Oligogaster* with *Hedychridium* aligns with this historical trend. Stylopized specimens can potentially generate aberrations and taxonomic confusion, similar to the impact observed with gynandromorphs (Salt & Bequaert 1929; de Beaumont 1953, 1957; Portman & Griswold 2017), among other cases. Apparently, stylops do not attack cuckoo wasps, likely due to the thicker cuticle structure they possess (pers. obs.).

The precise origins of aberrations are often challenging to pinpoint. They may stem from genetic mutations or morphological alterations during various developmental stages, influenced by physiological irregularities in the hormonal regulation of molting processes. Additionally, factors like malnutrition, environmental elements, and chemical agents, including temperature variations, humidity, radiation, and chemicals (Safavi 1968; Berndt & Wisniewski 1984; Wcislo *et al*. 2004), or even mechanical damage to nests, such as crushing, can lead to damage or deformation of the adult cuticle (Balazuc 1958). Other potential causes may be associated with viruses and parasitism by Nematoda (Laciny 2021). However, it is noteworthy that all observed cuckoo wasps to date with Nematoda do not exhibit any morphological aberrations (pers. obs.).

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