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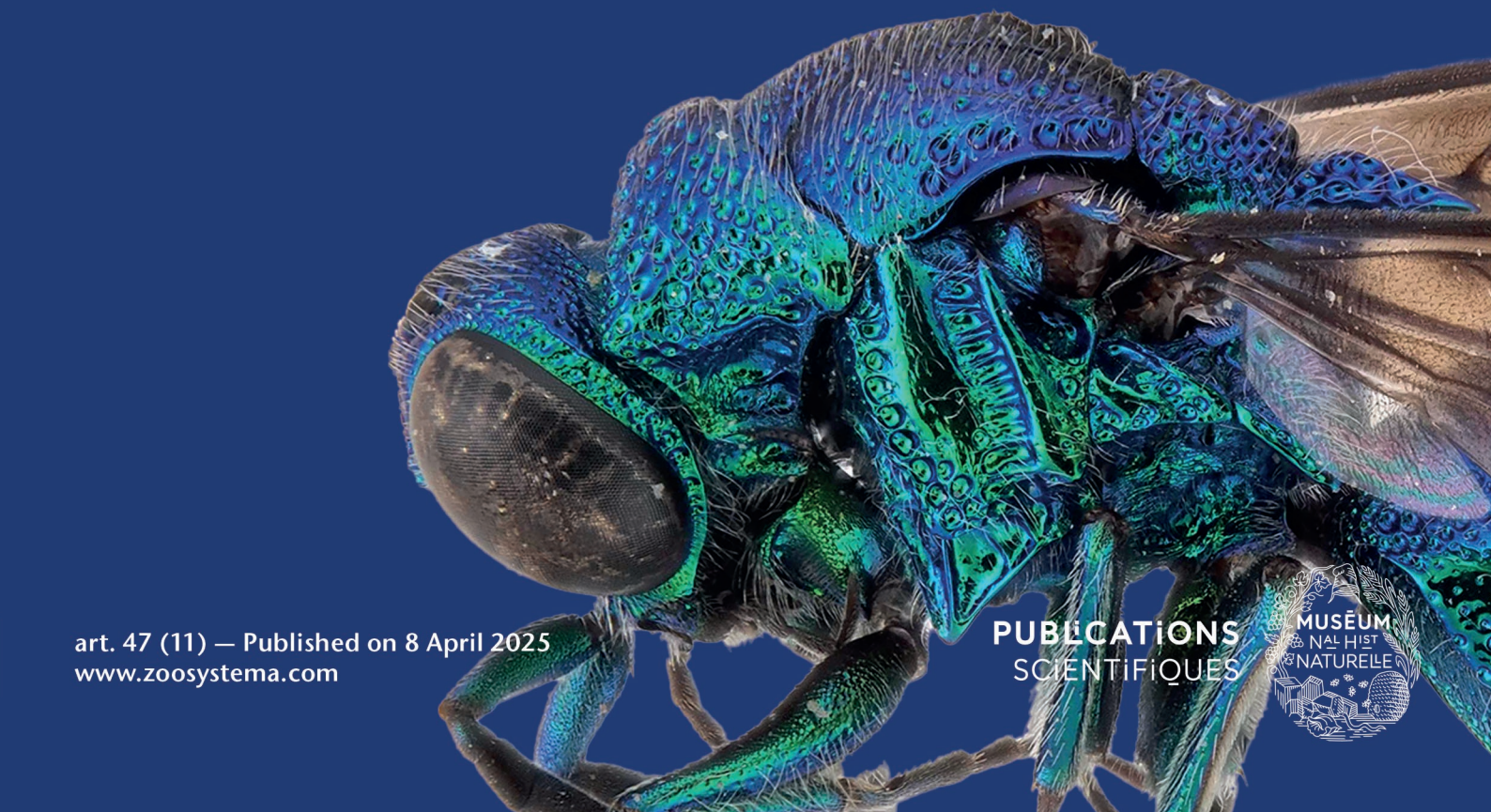
Paolo ROSA, Neveen S. GADALLAH & Yusuf A. EDMARDASH



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Couverture / *Cover* :
Chrysis canaliculata Brullé, 1846, lectotype, female (above) and *Chrysis lyncea* Fabricius, 1775 female (below).

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New findings of cuckoo wasps for Yemen with nomenclatural changes and review of the Arabian hexadentate species of the genus *Chrysis* Linnaeus, 1761 (Hymenoptera, Chrysididae)

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ABSTRACT
Three species of the genus *Chrysis* Linnaeus, 1761 (Chrysididae Latreille, 1802) new for Yemen were discovered, namely *C. lyncea* Fabricius, 1775, *C. oxyacantha* Mocsáry, 1913 and *C. smithii* Gribodo, 1879, the latter two so far known for the Afrotropical region only. The finding of *C. smithii* allows us to discuss some previously proposed synonymies in four hexadentate groups of Afrotropical and Arabian species in the *heymonsi*, *lyncea*, *oculata* and *smaragdula* species-groups. We hereby propose two new synonymies for *C. canaliculata* (Brullé, 1846) **n. syn.** of *C. stilboides* Spinola, 1838 (*oculata* group) and *C. gabonensis* Mocsáry, 1889 **n. syn.** of *C. heymonsi* Bischoff, 1910 (*heymonsi* group). During the present study, the type of *C. simillima* (Gribodo, 1879) stat. resurr. was found to be preserved in the Natural History Museum in London and it is here reinstated as valid species in the *oculata* group. We also resurrect *Chrysis smithii* Gribodo, 1879 stat. resurr. (synonym of *C. simillima sensu auctorum*) within the *lyncea* group, as well as *C. caroli* du Buysson, 1907 stat. resurr. and *C. rubroviolacea* Mocsáry, 1913 stat. resurr. both previously synonymised with *C. jousseaumei* du Buysson, 1898 in the *smaragdula* group. As a result of these changes, we propose a new key for the hexadentate species of the genus *Chrysis* Linnaeus, 1761 of the Arabian Peninsula.

KEY WORDS
Cuckoo wasps, Chrysidini, dichotomic key, species group, new synonymy, status resurrectus.

RÉSUMÉ
Nouvelles découvertes de guêpes coucous pour le Yémen avec changements de nomenclature et révision des espèces arabes hexadentées du genre Chrysis *Linnaeus, 1761 (Hymenoptera, Chrysididae).*
Trois espèces du genre *Chrysis* Linnaeus, 1761 (Chrysididae Latreille, 1802) nouvelles pour le Yémen ont été découvertes, à savoir *C. lyncea* Fabricius, 1775, *C. oxyacantha* Mocsáry, 1913 et *C. smithii* Gribodo, 1879, ces deux dernières n'étant jusqu'à présent connues que de la région afrotropicale. La découverte de *C. smithii* nous permet de discuter de certaines synonymies précédemment proposées chez quatre groupes d'espèces afrotropicales et arabes hexadentées dans les groupes d'espèces *heymonsi*, *lyncea*, *oculata* et *smaragdula*. Nous proposons ici deux nouvelles synonymies pour *C. canaliculata* (Brullé, 1846) **n. syn.** de *C. stilboides* Spinola, 1838 (groupe *oculata*) et *C. gabonensis* Mocsáry, 1889 **n. syn.** de *C. heymonsi* Bischoff, 1910 (groupe *heymonsi*). Au cours de la présente étude, le type de *C. simillima* (Gribodo, 1879) stat. resurr. a été trouvé au Natural History Museum de Londres et l'espèce est ici considérée comme valide dans le groupe *oculata*. Nous rétablissons également *Chrysis smithii* Gribodo, 1879 stat. resurr. (synonyme de *C. simillima sensu auctorum*) dans le groupe *lyncea*, ainsi que *C. caroli* du Buysson, 1907 stat. resurr. et *C. rubroviolacea* Mocsáry, 1913 stat. resurr., tous deux précédemment synonymes de *C. jousseaumei* du Buysson, 1898 dans le groupe *smaragdula*. À la suite de ces changements, nous proposons une nouvelle clé d'identification pour les espèces hexadentées du genre *Chrysis* Linnaeus, 1761 de la péninsule arabique.

MOTS CLÉS
Guêpes coucou,
Chrysidini,
clé dichotomique,
groupe d'espèces,
synonymie nouvelle,
statut restauré.

INTRODUCTION

The Chrysididae Latreille, 1802 fauna of Yemen, with only 32 species recorded, is scarcely known compared to the 126 species identified from the Arabian Peninsula (Rosa *et al.* 2020a; Soliman *et al.* 2022; Van Loon & Soliman 2023). Generally speaking, the hymenopteran fauna of Yemen is often considered Afrotropical (e.g., the Mutillidae Latreille, 1802, Lelej & Van Harten 2006) and some of the herein newly recorded Chrysididae might endorse this opinion. However, based on the poor distributional data available at the moment, only 17% of the Yemeni fauna is typical of the Afrotropical region, whereas 40% is considered endemic to the Arabian Peninsula.

The discovery of *Chrysis smithii* in Yemen, gave us the opportunity to clarify and emend some historical misidentifications by du Buysson (1898) and Linsenmaier (1994, 1999), as well as some erroneous synonymies proposed by Kimsey & Bohart (1991). Such corrections follow the examination, by the first author, of all available type material. Based on this study, *C. canaliculata* (Brullé, 1846), cited in Kimsey & Bohart (1991), is synonymised with *C. stilboides* Spinola, 1838, in the *oculata* group. Two of the three species previously synonymised with *C. canaliculata* are reinstated: *C. simillima* (Gribodo, 1879) in the *oculata* group, and *C. smithii* Gribodo, 1879 in the *smaragdula* group, while the third one, *C. gabonensis* Mocsáry, 1913 is here synonymised with *C. heymonsi* Bischoff, 1910 in the *heymonsi* group. Following type comparison, the first author also ascertained that *C. caroli* du Buysson, 1907 and *C. rubroviolacea* Mocsáry, 1913, which were synonymised with *C. jousseaumei* du Buysson, 1898 (Kimsey & Bohart 1991; Linsenmaier 1994, 1999), are actually valid species easily distinguishable from each other, and are therefore revalidated.

In the Arabian fauna, the six-toothed species of *Chrysis* generically indicated as "hexadentate" (a term without taxonomic value), belong to three species-groups: *C. lyncea* group (*C. lyncea* Fabricius, 1775, and *C. smithii* Gribodo, 1879), *C. oculata* group (*C. oxyacantha* Mocsáry, 1913, and *C. stilboides* Spinola, 1838), and *C. smaragdula* group (*C. diehli* Linsenmaier, 1968, and *C. jousseaumei* du Buysson, 1898). Species in the *lyncea* and *oculata* groups were historically included in the genus *Pyria* Lepeletier & Serville, 1825 (Brullé 1846; Gribodo 1879), which was sometimes considered as a subgenus of *Chrysis* Linnaeus, 1761 characterized by the shortened first flagellomere (Linsenmaier 1959, 1994).

MATERIAL AND METHODS

The present study is based on specimens collected during Tewfik's expedition to Yemen in 1936. In "Material examined" we listed only specimens collected in the Arabian Peninsula.

Specimens were examined using an Olympus SZ40 and Leica WILD M3Z stereomicroscopes. Photographs of types deposited at HMNH, MNHN, MSNG, ZMB were taken with Nikon D3400 and D80 photo cameras attached to a Carton Togal microscope, and processed with Adobe Photoshop CS6 software program.

Personal comments are enclosed in square brackets [ ].

Abbreviations

Morphology

F1, F2	first flagellomere, second flagellomere;
l/w	length vs width;
MOD	mid ocellus diameter.

Institutions

EFC	Efflatoun Bey Collection, Entomology Department, Faculty of Science, Cairo University, Giza;
HMNH	Magyar Természettudományi Múzeum, Budapest;
ISEA-PAS	Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, Kraków;

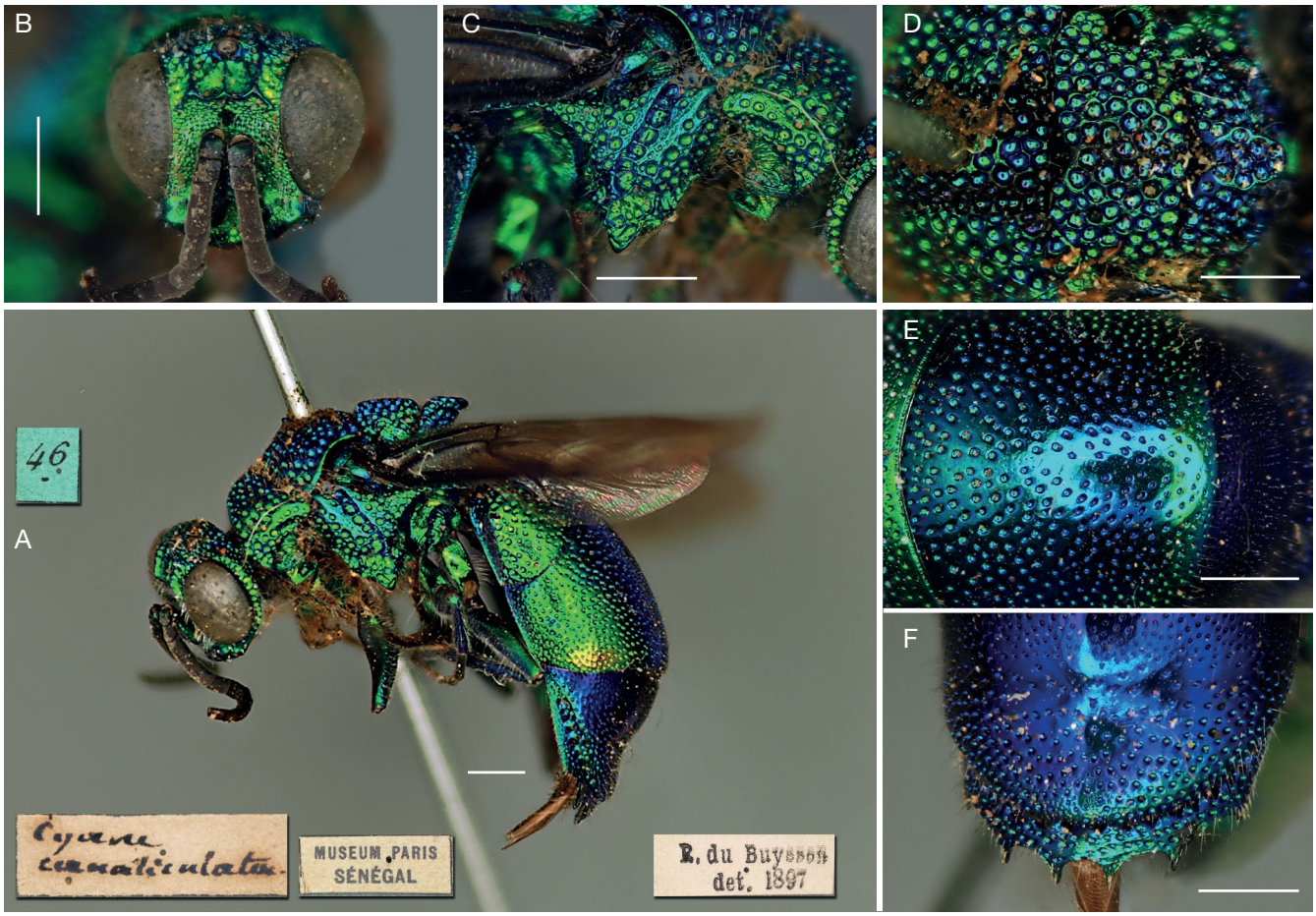

Fig. 1. — *Chrysis canaliculata* (Brullé, 1846), lectotype (MNHN), female; **A**, habitus, lateral view; **B**, head, frontal view; **C**, mesosoma, lateral view; **D**, mesosoma, dorsal view; **E**, second tergum, dorsal view; **F**, third tergum, dorsal view. Scale bars: 1 mm.

MNHN	Muséum national d'Histoire naturelle, Paris;
MRSN	Museo Regionale di Scienze Naturali, Torino;
MSNG	Museo di Storia Naturale "G. Doria", Genova;
NHMUK	Natural History Museum, London;
NMLU	NaturMuseum, Luzern;
RMNH	Naturalis Biodiversity Center, Leiden;
ZMB	Museum für Naturkunden, Berlin.

Private collection

coll. MHC	private collection of Marek Halada (České Budějovice, Czeck Republic).

TAXONOMIC RESULTS

Kimsey & Bohart (1991: 393) synonymised *Chrysis simillima* (Gribodo, 1879), *C. smithii* Gribodo, 1879 and *C. gabonensis* Mocsáry, 1889 with *C. canaliculata* (Brullé, 1846). However, Linsenmaier (1994, 1999) disregarded these synonymies and continued to use *C. simillima* as a valid name. The first author studied all available types, as well as related specimens, and discovered that the synonymic list proposed by Kimsey & Bohart (1991) includes species belonging to three different species-groups (*oculata, lyncea* and *heymonsi* groups). The history of these names, is rather complex and is summarised as follows:

Chrysis canaliculata (Brullé, 1846)

Brullé (1846) provided the descriptions of three species in the genus *Pyria* Lepeletier & Serville, 1825: *P. oculata* Fabricius, 1775 (from Eastern India), *P. smaragdula* Lepeletier & Serville, 1825, *nec* Fabricius, 1775 [currently *C. stilboides* Spinola, 1838] (from Africa) and *P. canaliculata* Brullé, 1846 (from Africa).

In Kimsey & Bohart's monograph (1991), the holotype of *P. canaliculata* was reported as being deposited at MRSN. However, as observed by Rosa & Xu (2015) and Rosa (2024), no specimens from Brullé's collection were found in the Spinola collection, currently housed at MRSN. In fact, the species was described on two syntypes originating respectively from the collections of Serville and from the MNHN ("Hab. le Sénégal. C.M. [= Collection du Muséum] et Collect. de M. Serville"). The syntype of *P. canaliculata* from the Paris Muséum (Fig. 1) is still preserved in the collection of MNHN, while the whereabouts of the second syntype remain unknown. Actually, the examined syntype of *P. canaliculata* at MNHN turned out to be a specimen of *C. stilboides*.

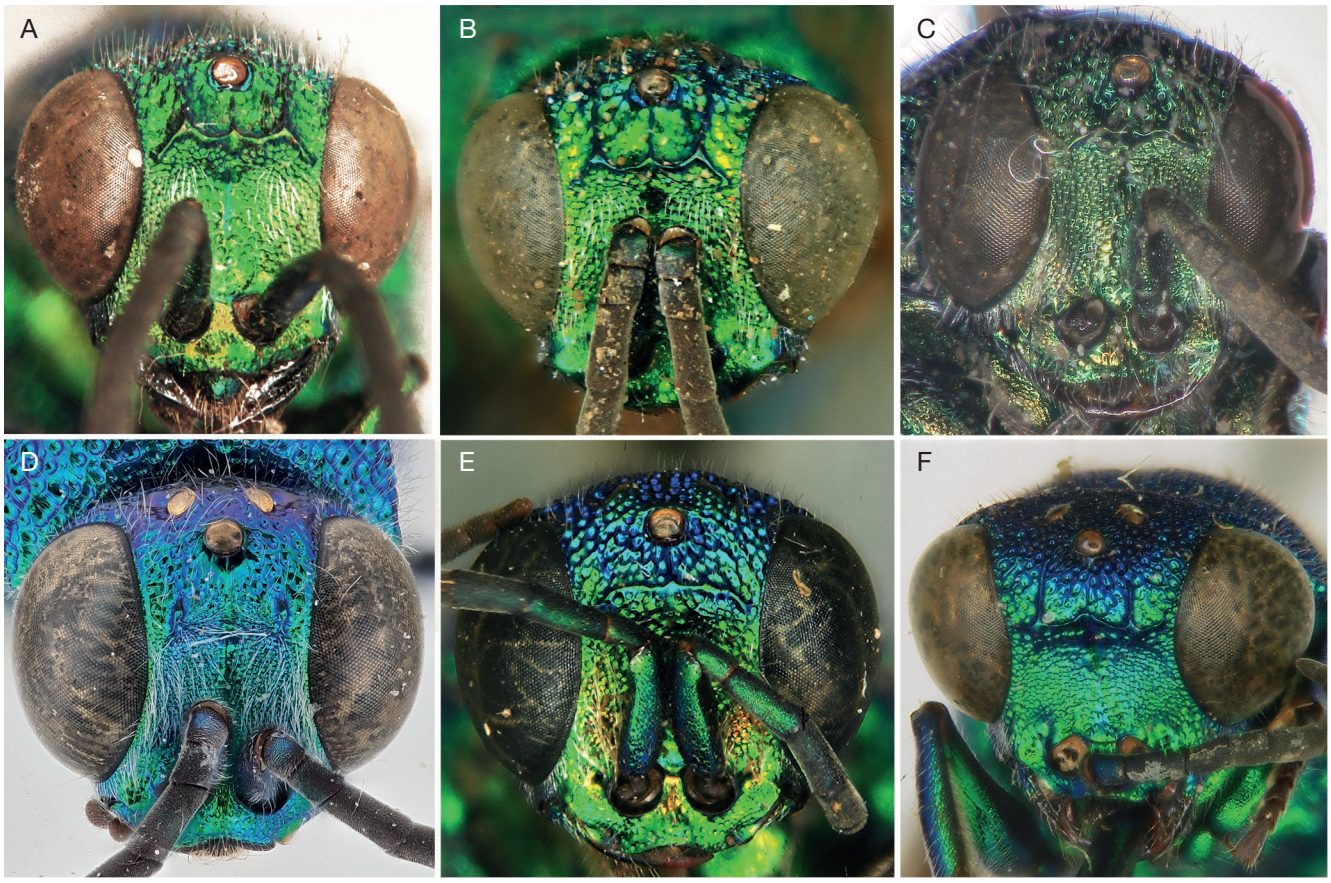

FIG. 2. — Head, frontal view: **A**, *Chrysis stilboides* Spinola, 1838, holotype (MRSN), female from Egypt; **B**, *Chrysis canaliculata* (Brullé, 1846), lectotype (MNHN), female from Senegal; **C**, *Chrysis simillima* (Gribodo, 1879), holotype (MSNG), female from Western Africa; **D**, *Chrysis lyncea* Fabricius, 1775 from Cyprus (NMLU); **E**, *Chrysis smithii* Gribodo, 1879, female (MNHN) from Sudan; **F**, *Chrysis heymonsi* Bischoff, 1910, holotype (ZMB), female from Guinea. Not to scale.

Regarding *P. canaliculata*, the description provided by Brullé (1846) closely resembles that of *C. stilboides*, with the only distinction being the shape of the metanotal mucron, indicated as non-canaliculate (*haud canaliculato*). In fact, Brullé did not mention other important diagnostic characters, such as wing venation (including an additional vein extending from the radial sector in *C. simillima sensu auctorum*), or the shape of the head, with a simple transversal frontal carina in *C. simillima* (strong, with three branches in *C. stilboides*), or even differences in the length ratio of first and second flagellomeres, which vary among *Pyria* species; for instance, in *C. stilboides* female (Fig. 2B) F1 l/w = 1.0; F2 = 2.0 × F1 length; in *C. simillima* female (Fig. 2C) F1 l/w = 1.6; F2 = 1.3 × F1 length; in *C. smithii* female (Fig. 2E) F1 l/w = 2.5; F2 = 1.1 × F1 length. Also, although Brullé detailed the coloration of the antennal segments (identical in both descriptions of *stilboides* and *canaliculata*, with the scape and part of pedicel green, and with metallic green colour extending until the second flagellomere in *smithii* or *simillima sensu auctorum*), he did not observe these morphological and color differences.

In the diagnosis of the genus *Pyria*, Brullé (1846) stated that the genus is distinguished from *Chrysis* by having a short pedicel and first flagellomere of equal length, with the second flagellomere being significantly longer than the first and longer than the pedicel and first flagellomere taken together ("On distinguera ensuite les *Pyria* des *Chrysis* par les deuxième et troisième articles des antennes égaux en longueur et par le quatrième, beaucoup plus long que le troisième et le plus long de tous, si l'on en excepte le premier"). This definition excludes *C. simillima sensu auctorum* from the synonymy with *C. canaliculata* for its elongate first flagellomere.

Due to indefiniteness regarding the description of Brullé of a non-canaliculate mucron, a character shared with other African species, we designate the syntype of *C. canaliculata* at MNHN as the lectotype (Fig. 1), and considering Brullé's diagnosis of *Pyria*, and the syntype housed at MNHN, we synonymize *C. canaliculata* Brullé, 1846 with *C. stilboides* Spinola, 1838. The lectotype bears the following labels: Sénégal / 46 / *Chrysis canaliculata* [handwritten by Brullé] / Museum Paris Sénégal / R. du Buysson det. 1897. Du Buysson (1898) had already synonymised *C. canaliculata* (as *canalicuta*) with *C. orientalis* Guérin-Méneville, 1842, an Oriental species closely related to *C. stilboides*. The new synonymy does not significantly impact the current classification of the group, because *C. canaliculata* was listed only by Mocsáry (1889), who reported the original description, and consequently by Kimsey & Bohart (1991) and Madl & Rosa (2012) in their catalogues. Conversely, the name *C. simillima* was used in

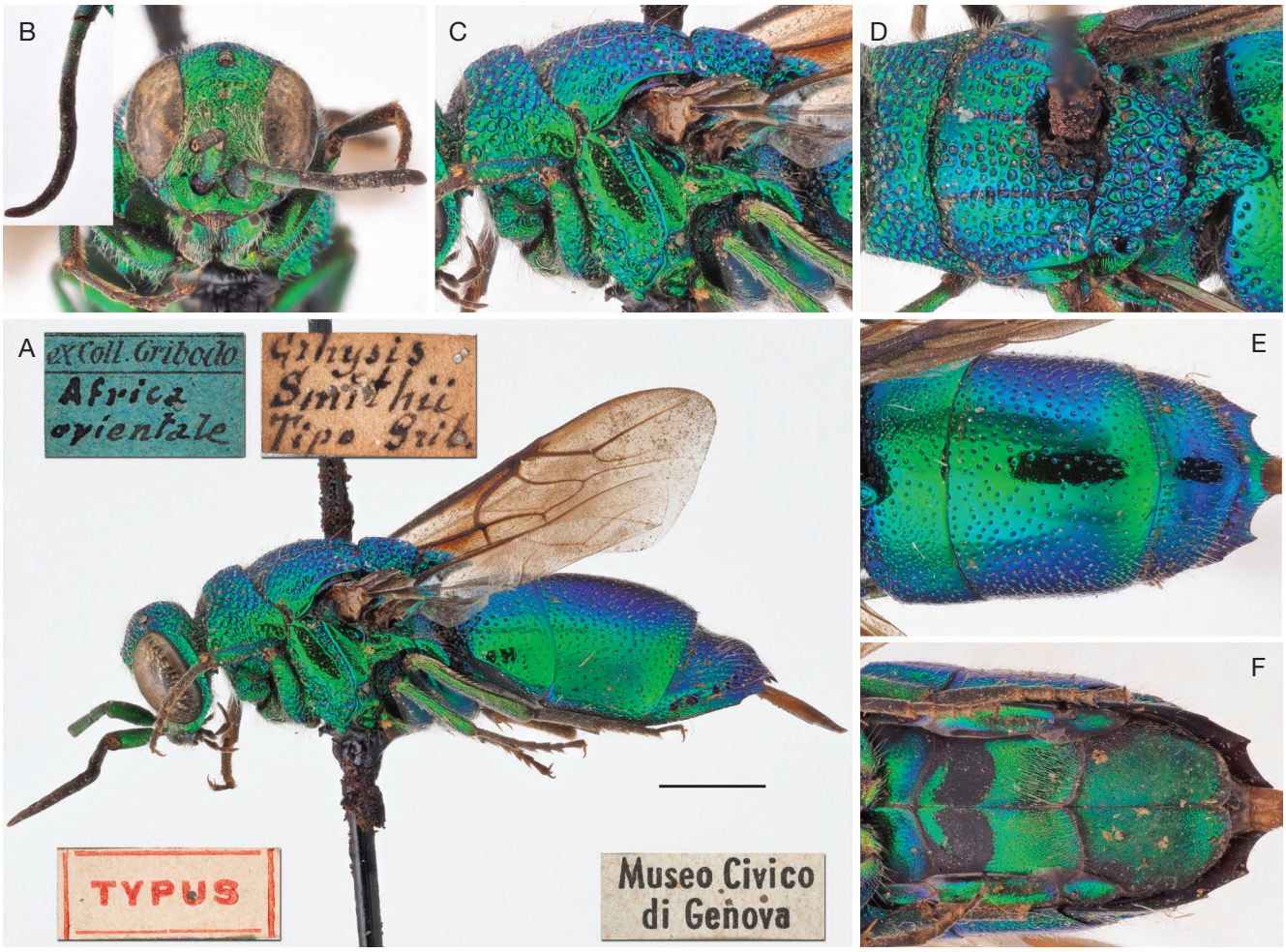

Fig. 3. — *Chrysis smithii* Gribodo, 1879, lectotype (MSNG), female: **A**, habitus, lateral view; **B**, head, frontal view and antenna, lateral view; **C**, mesosoma, lateral view; **D**, mesosoma, dorsal view; **E**, metasoma, dorsal view; **F**, metasoma, ventral view. Scale bar: 2 mm.

European collection (first author pers. note), and in Linsenmaier's publications and keys (Linsenmaier 1994, 1999). However, Linsenmaier's identification corresponds to specimens identified as *C. simillima* by du Buysson (1898) and deposited at MNHN, but not syntype specimens (see below), and not to the real type of *C. simillima* found at the NHMUK.

Chrysis smithii Gribodo, 1879

The holotype of *C. smithii* (Fig. 3), listed by Kimsey & Bohart (1991) at MSNG, was examined by Rosa (2009). However, a second syntype was subsequently found at NHMUK (B.M. Type Hym. 13.151) (box 76). Based on the assumption given in Kimsey & Bohart (1991), we consider the specimen housed at MSNG as the lectotype by inference of the term holotype (ICZN 1999). Furthermore, Kimsey & Bohart (1991) synonymised *C. smithii* and *P. simillima*, despite being both described by Gribodo (1879) on the same page and in different genera. Considering that Gribodo was an expert chrysidid taxonomist, it is at least unlikely that he described the same species in two different genera. In fact, the types of these two species are distinct. The type of *P. simillima* has short first flagellomere and resemble *C. stilboides*, whereas *C. smithii* has an elongate first flagellomere and was not included in the genus *Pyria*. *Chrysis smithii* (see the description below) is therefore clearly distinct from *C. simillima* and *C. stilboides*, and it is here resurrected to species rank.

Based on the study of material identified at MNHN and NMLU, we can state that *C. smithii* is the correct name for the species misidentified by du Buysson (1898) and Linsenmaier (1994, 1999) as *C. simillima*. According to Linsenmaier (1994), this species belongs to the *lyncea* group due to the shape of the head, pronotum and mesopleuron which align with the diagnostic criteria of the *lyncea* group. However, other diagnostic features, such as the metasomal apical margin and the shape of black spots on second sternum, do not match the diagnosis of the *lyncea* group (see below).

Chrysis simillima (Gribodo, 1879)

According to Kimsey & Bohart (1991), the holotype of *C. simillima* was deposited at MSNG. However, we found out that this type had never been deposited either in Gribodo's or Invrea's collections (Rosa 2009). Instead, the holotype was found in the collection of the NHMUK (box 79), along with a syntype of *C. smithii* (box 76). In fact, both types were sent back to

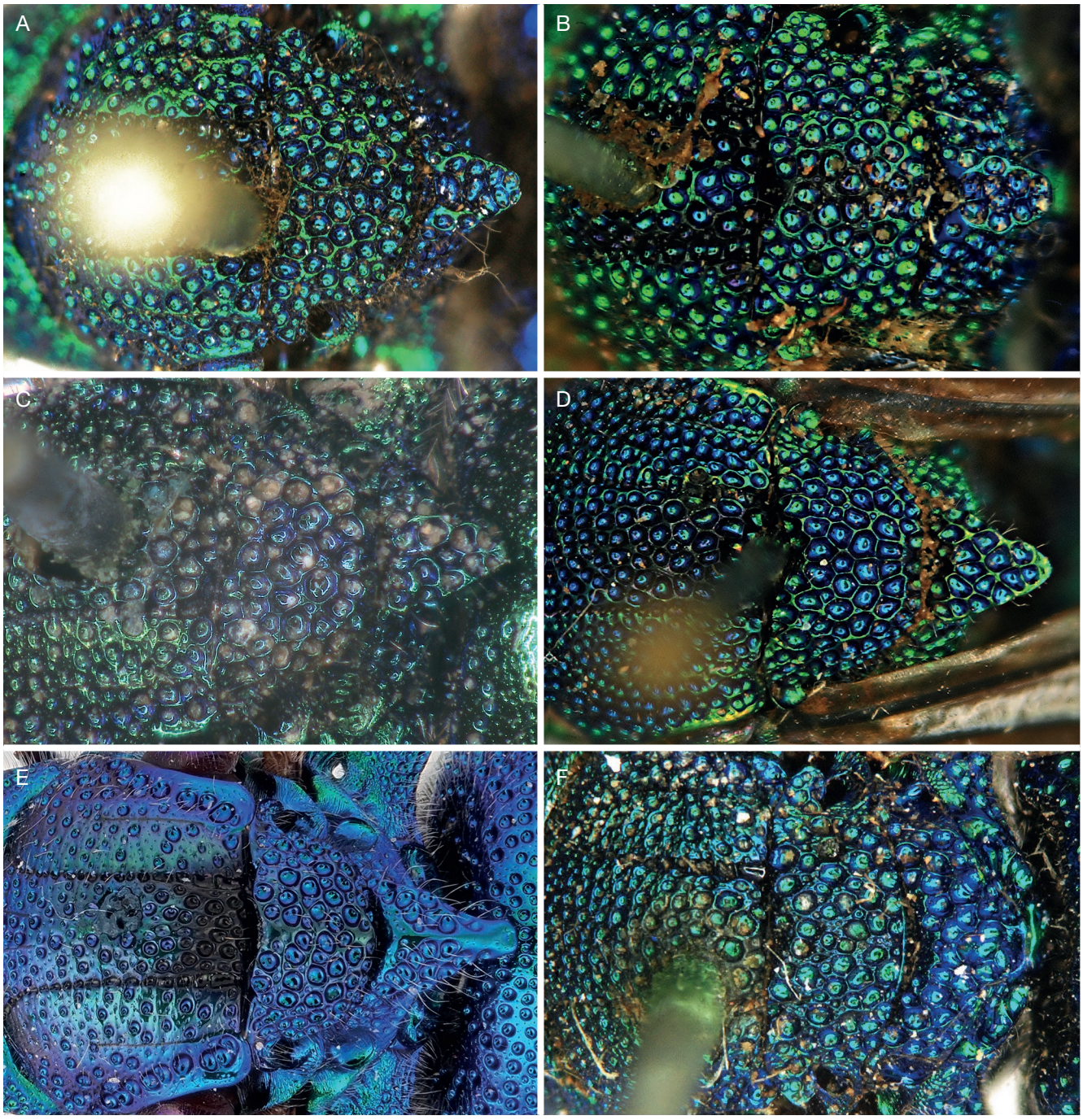

Fig. 4. — Mesosoma with metanotal mucron: **A**, *Chrysis stilboides* Spinola, 1838, holotype (MRSN), female from Egypt; **B**, *Chrysis canaliculata* (Brullé, 1846), lectotype (MNHN), female from Senegal; **C**, *Chrysis simillima* (Gribodo, 1879), holotype (MSNG), female from Western Africa; **D**, *Chrysis smithii* Gribodo, 1879, female (MNHN), from Sudan; **E**, *Chrysis lyncea*, female from Cyprus (NMLU); **F**, *Chrysis heymonsi* Bischoff, 1910, holotype (ZMB), female from Guinea. Not to scale.

Smith by Gribodo who only retained a syntype of *C. smithii* for his collection (Fig. 3). *Chrysis simillima* (Figs 2C; 4C) is similar to *C. stilboides*, albeit with a simple, sharp transverse frontal carina lacking three branches, a longer ratio of length of the first flagellomere (l/w = 1.6 vs 1.0), a shorter second flagellomere (1.3 × F1 length vs 2.3) and a larger, triangular and flat metasomal mucron (smaller and medially concave in *C. stilboides*). This species has not yet been found in the Arabian Peninsula and previous records reported by Linsenmaier (1994) refer to *C. smithii* Gribodo.

Chrysis gabonensis Mocsáry, 1913

The holotype of *C. gabonensis* is deposited at ISEA-PAS (Rosa *et al.* 2015). After the publication of types deposited at ISEA-PAS (Rosa *et al.* 2015), the first author examined the Afrotropical types deposited at ZMB, including the type of

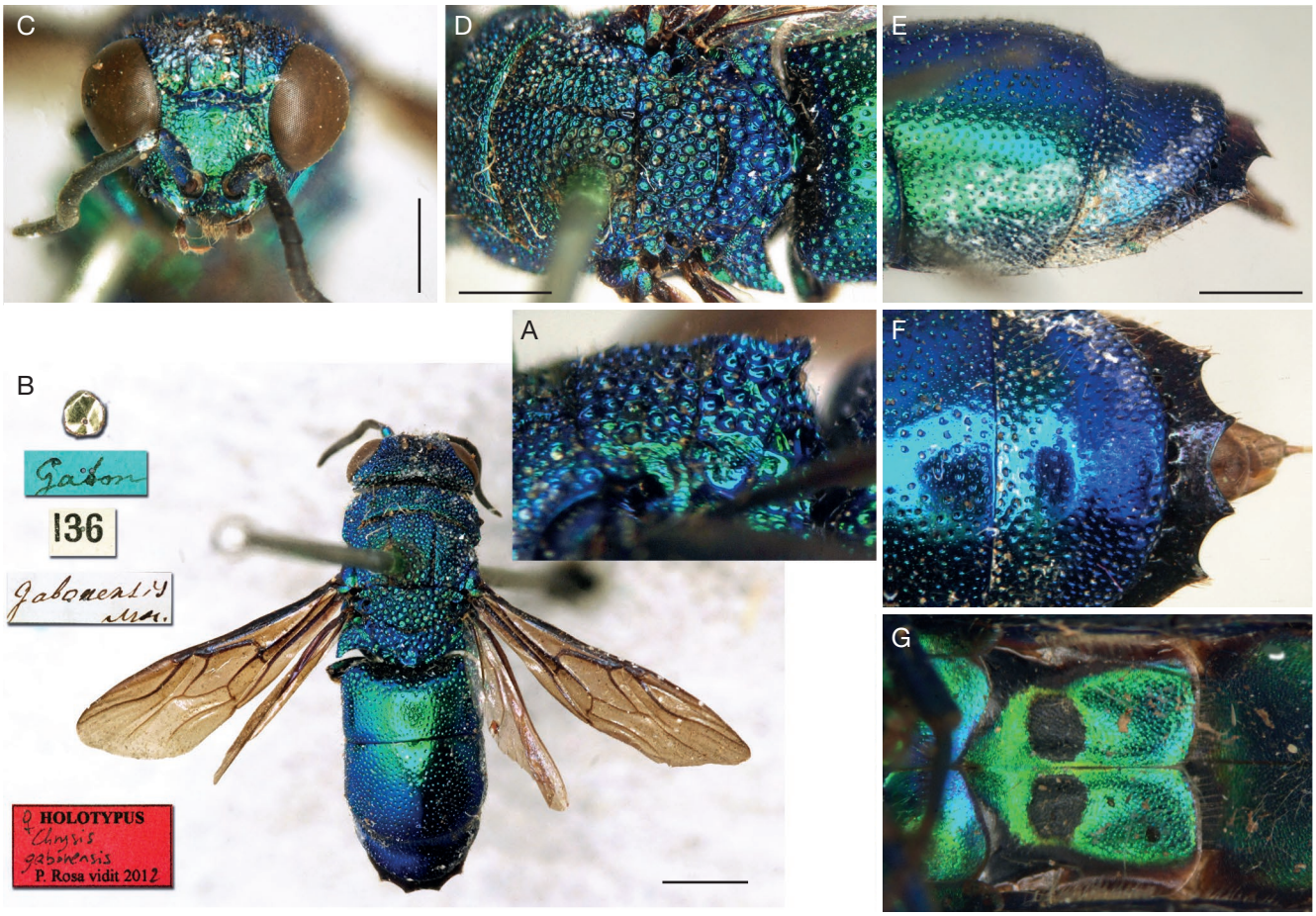

FIG. 5. — *Chrysis gabonensis* Mocsáry, 1913, holotype (ISEA-PAS), female: **A**, scutellum and metanotal mucron, lateral view; **B**, habitus, dorsal view; **C**, head, frontal view; **D**, mesosoma, dorsal view; **E**, second and third metasomal tergum, lateral view; **F**, third tergum, dorsal view; **G**, second metasomal sternum, ventral view. Scale bars: A, C-G 1 mm; B, 2 mm.

Chrysis heymonsi Bischoff, 1910 (Fig. 6). Following the results of a morphological type comparison, we here synonymise *Chrysis gabonensis* Mocsáry, 1913 **n. syn.** with *Chrysis heymonsi* Bischoff, 1910.

CHRYSIS RUBROVIOLACEA MOCSÁRY, 1913

Kimsey & Bohart (1991: 427) synonymised *C. rubroviolacea* Mocsáry, 1913, described from South Africa, with *C. jousseaumei*, described from Djibouti. *Chrysis jousseaumei* is characterised by toothed mesopleuron (Fig. 7C), violet to purplish body colour, large punctures with polished interspaces covering the whole body (Fig. 7E). *Chrysis rubroviolacea*, as correctly given in the original description, has a simple, unmodified mesopleuron, without any evident tooth (Fig. 7D); in addition, the shape of the head is different (Fig. 7B), being clearly transverse (l/w = 0.7) (measure taken from the transverse frontal carina to clypeal margin) and the shortest distance between inner eye margin instead of triangular, and short (l/w = 0.8) as in *C. rubroviolacea* (Fig. 7A); the episternal sulcus is formed by larger foveae (Fig. 7D); the black spots on second sternum are narrower, almost half as wide as long. For these notable differences in diagnostic characters, we consider *C. rubroviolacea* Mocsáry, 1913 as a valid species.

CHRYSIS CAROLI DU BUYSSON, 1907

Linsenmaier (1994: 199, 1999: 250) synonymised *C. caroli*, described from Tunisia with *C. jousseaumei* because the two species share the dentate lower mesopleuron. However, the body sculpture and colour pattern of *C. caroli* are clearly different. In *C. caroli* the first tergum is densely micropunctate on interspaces among large punctures (Fig. 7F) (vs large, even punctures with polish interspaces in *C. jousseaumei*, Fig. 7E); the second tergum has even, medium-sized punctures and densely micropunctate interspaces (vs large punctures with polished interspaces in *C. jousseaumei*); the body color pattern in *C. caroli* is green with blue areas on mesosoma, and blue basal and lateral bands on metasomal segments, while it is entirely dark blue to purplish in *C. jousseaumei*. For these notable differences in diagnostic characters, we consider *C. caroli* du Buysson, 1907 as a valid species.

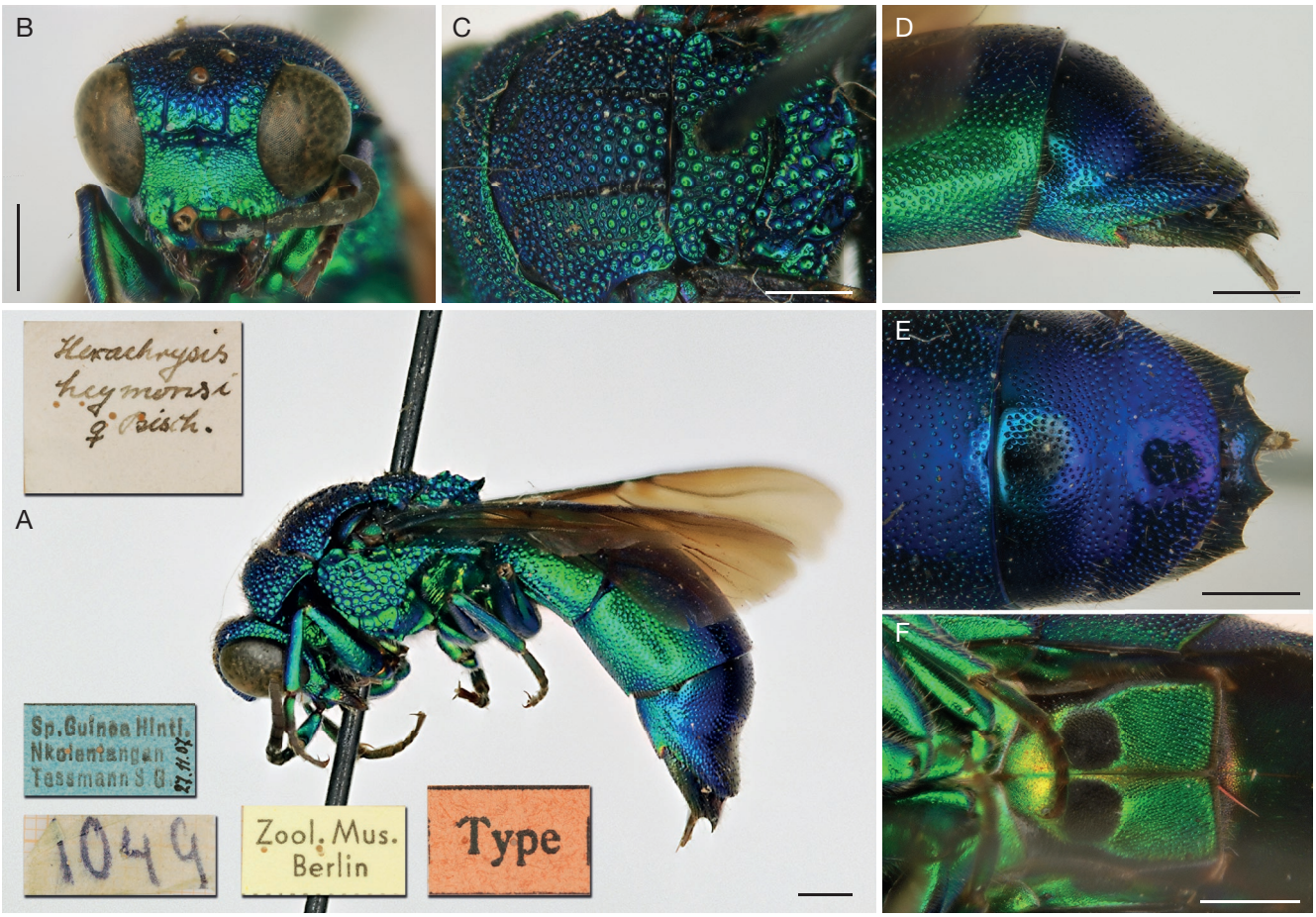

Fig. 6. — *Chrysis heymonsi* Bischoff, 1910, holotype (ZMB), female (images to compare with Fig. 5); **A**, habitus, lateral view; **B**, head, frontal view; **C**, mesosoma, dorsal view; **D**, second and third metasomal tergum, lateral view; **E**, third tergum, dorsal view; **F**, second metasomal sternum, ventral view. Scale bars: 1 mm.

SYSTEMATIC

Family Chrysididae Latreille, 1802
Subfamily Chrysidinae Latreille, 1802
Tribe Chrysidini Latreille, 1802
Genus *Chrysis* Linnaeus, 1761

Chrysis lyncea species-group

Diagnosis. — Species of the *lyncea* group are recognised by the combination of following characters: first flagellomere short in both male and female (l/w = 1), with the exception of *C. smithii* female (l/w = 2.5); malar space short (0.5-0.75 MOD) in both sexes; subantennal space about 1 MOD; strong, raised, transverse frontal carina, not branched; pronotum medially much shorter than mesoscutellum; pronotum with acute humeral angle; mesopleuron medially, longitudinally flattened and polished, with a large acute tooth below the scrobal area; metanotal plate large, triangular, with or without median carina; posterior propodeal projections strong; third metasomal tergum saddled; margin of third tergum with four triangular apical teeth and two lateral angles, placed at the base of tergum (in *C. lyncea*) or close to lateral teeth (in *C. smithii*).

Hosts. — Species of this group are recorded to parasitize the mud dauber wasps of the genus *Sceliphron* Klug, 1801 (Sphecidae Latreille, 1802) (Kimsey & Bohart 1991).

Remarks
The present diagnosis of the group differs from that of Kimsey & Bohart's (1991) for the inclusion of *C. smithii* and *C. seyrigi* Zimmermann, 1961 (resurrected by Rosa *et al.* 2020b). The real placement of these two species is somewhat uncertain, and they may represent at least a separated subgroup with the shape of the head, pronotum and mesopleuron corresponding to the diagnosis of the *lyncea* group. Moreover, they share common characters with the *smaragdula* group: elongate first flagellomere (l/w = 2.5) in the female, the shape of the apical margin with six aligned teeth and the large black spots on the second metasomal sternum. A unique character of these two species is found in the forewing, with the ancillary vein extending from the Radial sector (Fig. 9D). This vein is barely visible in the species closely allied to *C. lyncea.*

Chrysis lyncea Fabricius, 1775
(Fig. 8)

Chrysis lincea Fabricius, 1775: 357.

Chrysis lyncea – Fabricius 1781: 455 (emendation of *lincea* Fabricius, 1775).

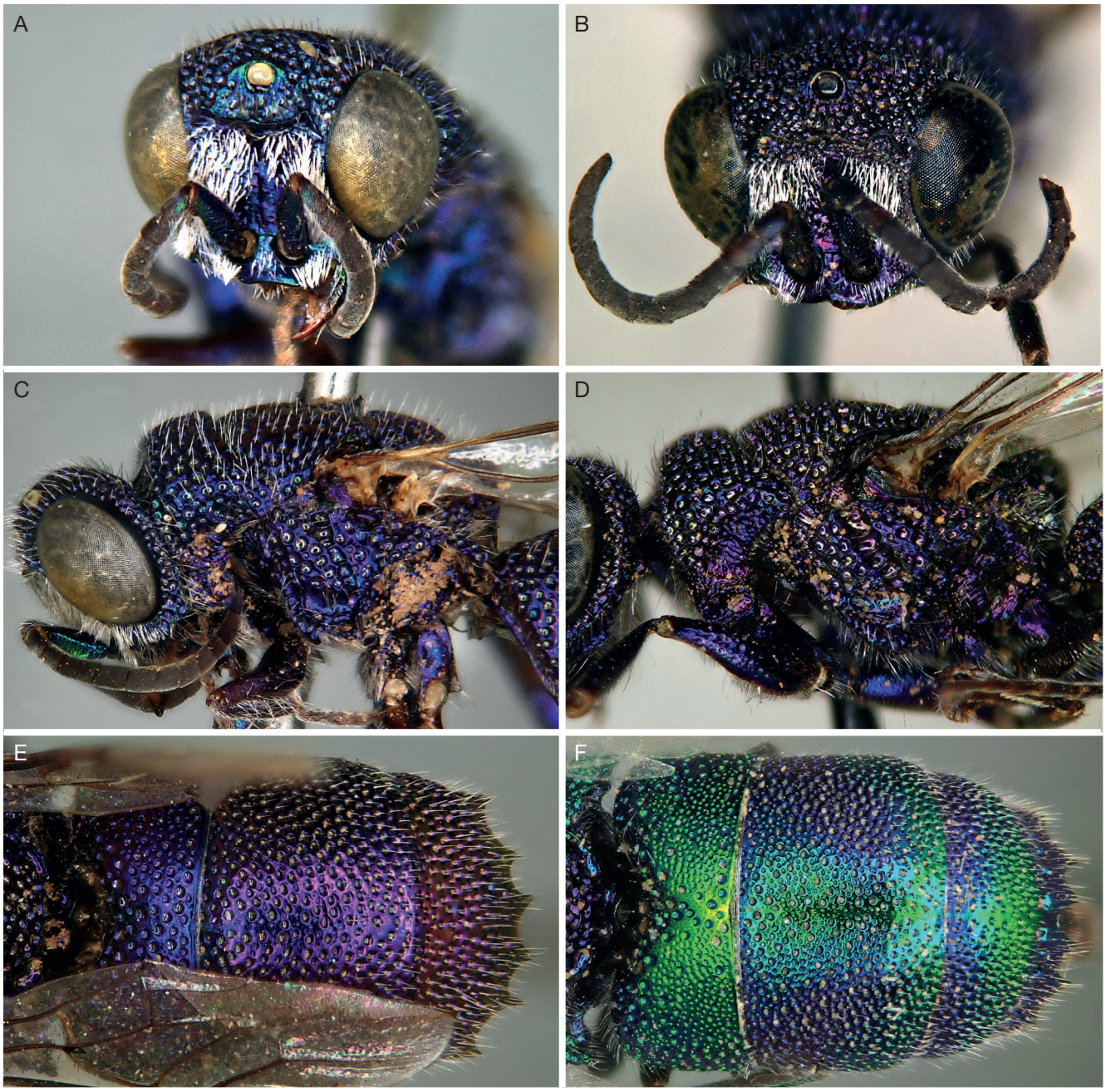

FIG. 7. — **A**, **C**, **E**, *Chrysis jousseaumei* du Buysson, 1898, holotype (MNHN), female; **A**, head, frontal view; **C**, head and mesosoma, lateral view; **E**, metasoma, dorsal view; **B**, **D**, *Chrysis rubroviolacea* Mocsáry, 1913, paralectotype (HMNH), male; **B**, head, frontal view; **E**, mesosoma, lateral view; **F**, *Chrysis caroli* du Buysson, 1907, holotype (MNHN), female, metasoma, dorsal view. Not to scale.

TYPE MATERIAL. — **Holotype** • sex unknown; Sierra Leone, type possibly lost.

MATERIAL EXAMINED. — **Yemen** • 2 ♀; Wadi Higgan; 7.VIII.1936; M.T. leg.; EFC.

DIAGNOSIS. — Body length: 8.0-12 mm. Body colour varying from entirely green to blue, with or without darker or purple reflections; legs including basitarsi metallic green; scapal basin punctate-rugose; first flagellomere reduced in both sexes (l/w = 1); pronotal humeral angle strongly produced, acute; metanotal mucron elongate, triangular, medially carinate and apically blunt and impunctate (Fig. 8B); mesopleuron largely smooth, polished medially (Fig. 8C), with two distinct ventral teeth, the lower of which conspicuously large, pointed and sharply carinate; lateral tooth on third tergum small, placed basally (Fig. 8E); wings darkened; metasomal sterna metallic green, with two small, oval black spots widely separated from lateral margin and between each other (Fig. 8F).

DISTRIBUTION IN THE ARABIAN PENINSULA. — Oman, United Arab Emirates (Linsenmaier 1994 as *C.* (*Pyria*) *lyncea*; Howarth & Gillett 2008; Strumia 2008), Yemen (new record).

EXTRALIMITAL DISTRIBUTION. — Cyprus (Linsenmaier 1959, 1994, 1999), Sub-Saharan Africa (Linsenmaier 1959, 1994, 1999), Northern Africa.

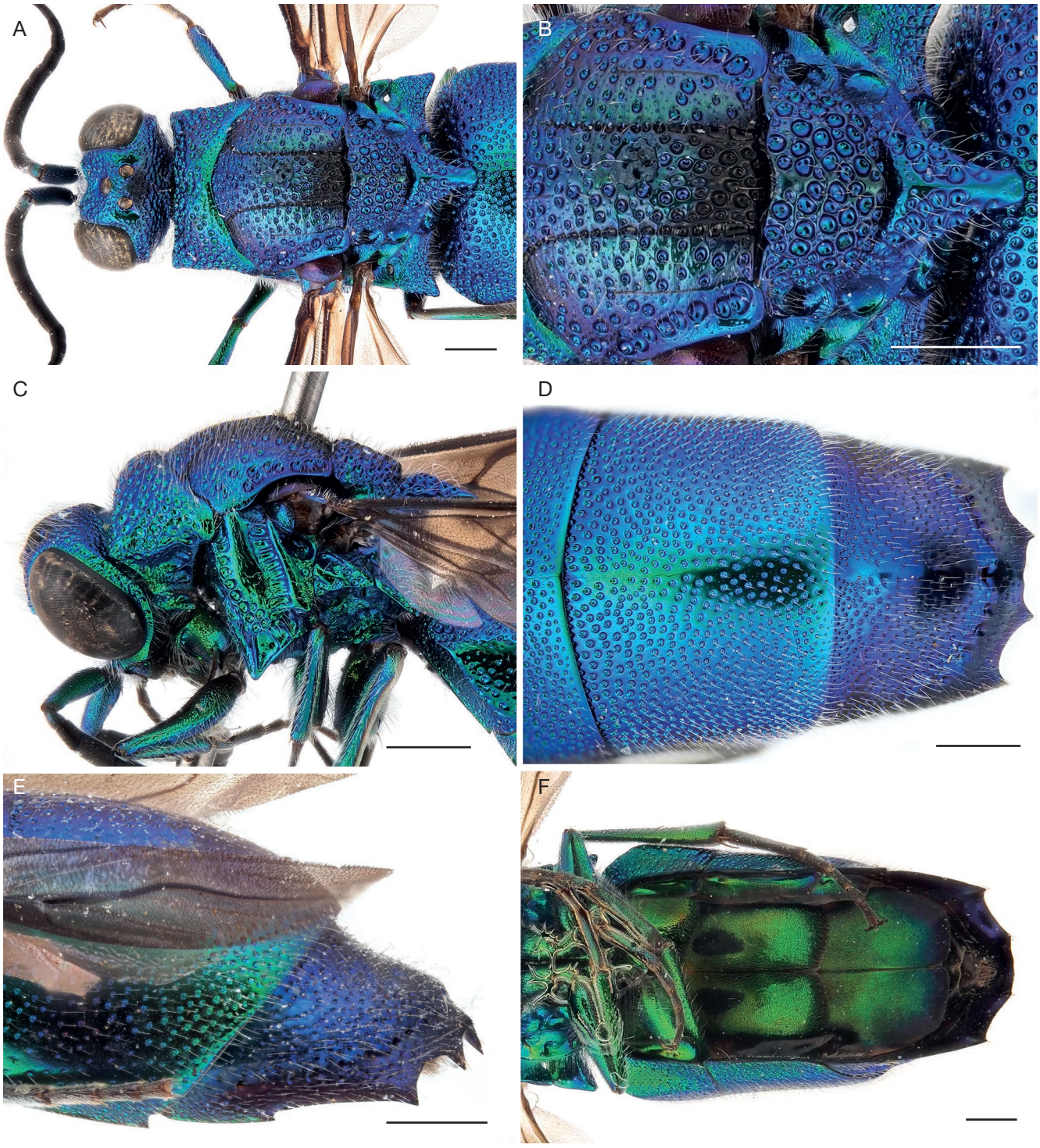

FIG. 8. — *Chrysis lyncea* Fabricius, 1775, females from Limassol, Cyprus (NMLU): **A**, head and mesosoma, dorsal view; **B**, mesosoma, dorsal view; **C**, head and mesosoma, lateral view; **D**, metasoma, dorsal view; **E**, second and third metasomal tergum, lateral view; **F**, metasoma, ventral view. Scale bars: 1 mm.

REMARK

Other taxa described as variations of *C. lyncea* from Oriental and Australian regions are currently under revision and will be elevated to species rank.

Chrysis smithii Gribodo, 1879
(Fig. 3; 9)

Chrysis smithii Gribodo, 1879: 326.

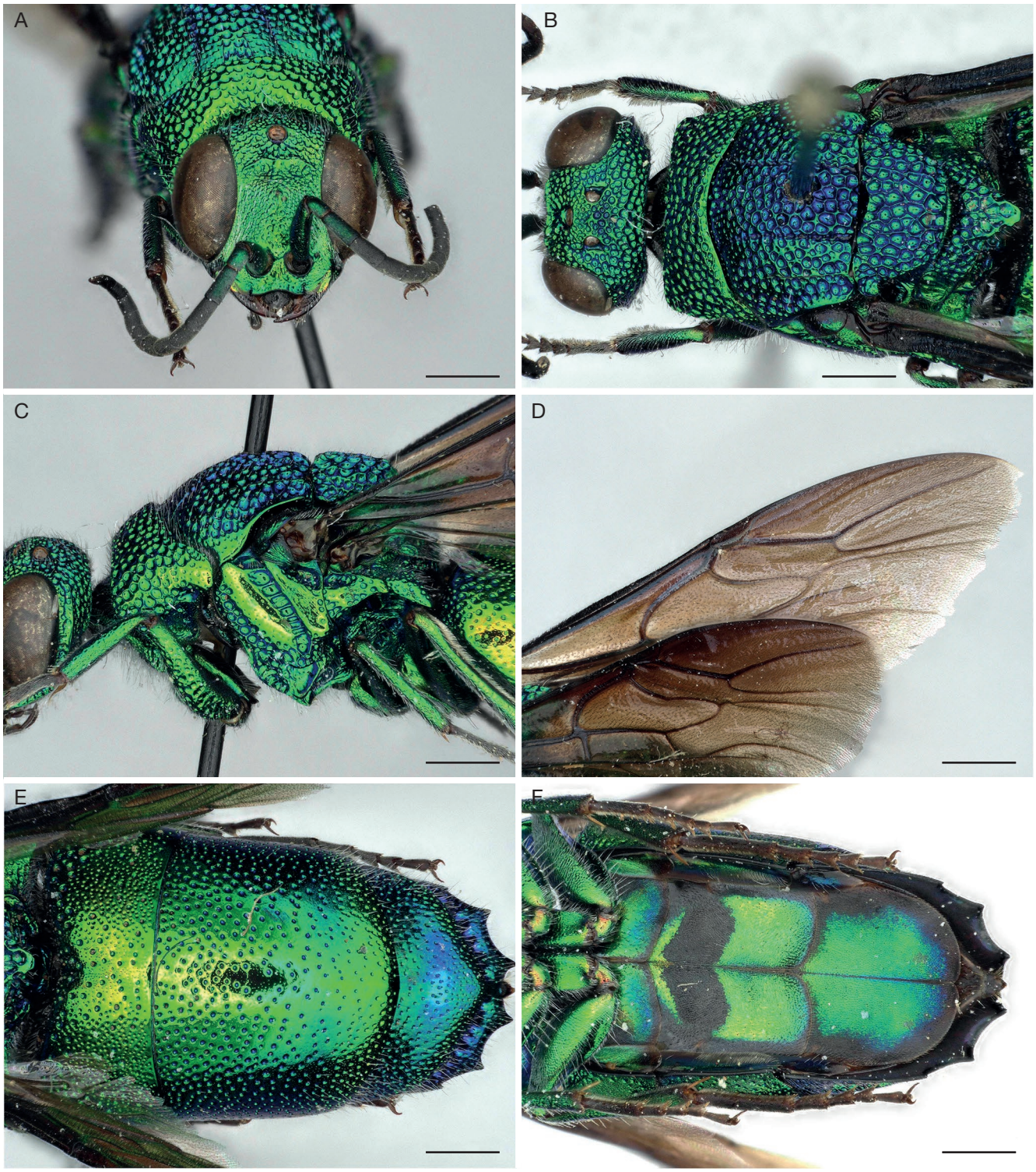

FIG. 9. — *Chrysis smithii* Gribodo, 1879, female, Zimbabwe (MHC): **A**, head, frontal view; **B**, head and mesosoma, dorsal view; **C**, head and mesosoma, lateral view; **D**, forewing; **E**, metasoma, dorsal view; **F**, metasoma, ventral view. Scale bars: 1 mm.

Chrysis simillima sensu auctorum.

TYPE MATERIAL. — **Lectotype**. **Eastern Africa** • ♀ (designated by Kimsey & Bohart, 1991: 393 by inference of the term "holotype"); "Affrica [sic] orientale"= Eastern Africa; MSNG (examined).

MATERIAL EXAMINED. — **Yemen** • 1 ♀; Hajjah Governorate, Hirran; 28.IV.1936; M.T. leg.; EFC.

DIAGNOSIS. — Body length: 9.0-12 mm. Body metallic green, metasomal tergum bluish medially; antenna with scape, pedicel, first and sometimes base of the second flagellomeres metallic

green; wings dark brown with ancillary vein extending from radial sector (Fig. 9D); first flagellomere elongate (l/w = 2.5-3.0), slightly longer than second one; metanotal mucron triangular, densely and coarsely punctate throughout (Fig. 9B); genal carina sharp; occipital hook prominent and spiny; clypeus medially emarginated and bulging; transverse frontal carina U-shaped, sharp (Fig. 9A); mesopleuron smooth and shiny medially on mesepimeron and on mesepisternum (Fig. 9C); ventrally with two teeth; third tergum with four triangular teeth and lateral tooth as a blunt angle; black spots on second sternum large, transversal, with curved margins, laterally connected to sternum margins and medially fused (Fig. 9F).

DISTRIBUTION IN THE ARABIAN PENINSULA. — Saudi Arabia (Linsenmaier 1994 as *C.* (*Pyria*) *simillima*), Yemen (new record).

EXTRALIMITAL DISTRIBUTION. — West Africa and East Africa, from Mali to Sudan.

Chrysis oculata species-group

DIAGNOSIS. — Species of the *oculata* group are recognised by the combination of the following characters: F1 short (l/w = 0.5-1) in both sexes; transverse frontal carina M-shaped, with or without upward branches; anterior ocellus lidded; malar space long (1 MOD); pronotum medially shortened, less than half scutellar length; mesopleuron without polished, shining areas, with large ventral tooth and associated denticles; metanotal plate large, triangular to spoon-like, flat or medially concave; wing venation unmodified, without ancillary vein on forewing; apex of third tergum with six teeth more or less equally spaced and sharp; black spots on second sternum large, normally transversally elongate.

HOSTS. — Unknown.

Chrysis oxyacantha Mocsáry, 1913
(Fig. 10)

Chrysis (*Heptachrysis*) *oxyacantha* Mocsáry, 1913: 41.

TYPE MATERIAL. — **Holotype**. **Eritrea** • ♀; Keren; HMNH (examined).

MATERIAL EXAMINED. — **Yemen** • 1 ♀; Hajjah Governorate, Hiran; 28.IV.1936; M.T. leg.; EFC • 1 ♂; Sana'a University Campus, 2300m; 3.XI.2005; J. Halada leg.; coll. MHC • 1 ♂; Wadi Sudd, 10 km W Marib, 1120 m; 8.X.2005; [15°24'N, 45°16'E]; J. Halada leg.; MHC.
Oman • 1 ♂; 17 km W of Súr; 15.III.2015; M. Snižek leg.; coll. MHC • 1 ♂; E of Súr, S of Shiya; 15.III.2015; [22°30'31"N, 59°25'15"E]; L. Černý leg.; MHC.

DIAGNOSIS. — Body length: 11.5-13.0 mm. Metallic green to blue, face golden-green; scape metallic green, rest of antenna dark brown; wings brown with dark veins. First flagellomere short (l/w = 0.8); second flagellomere 3× as long as the first; transverse frontal carina strong, sharp, M-shaped with upwards branches (Fig. 10A); pronotal humeral angles acute, pointing upwards; propodeal antero-median line very deep; notauli exceptionally wide and deep (Fig. 10C), width decreasing towards anterior margin; notauli width basally larger than largest punctures on mesoscutum (Fig. 10D); metanotal plate triangular, basally concave; mesopleuron densely, coarsely punctate, with scrobal area forming a ventral, pointed tooth; first tergum densely dotted between larger punctures, second and third tergum with polished intervals between punctures; apical margin of third tergum with six triangular, pointed teeth (Fig. 10E); black spots of second sternum large, sub-quadrate, with apical margin arcuate, distinctly separated medially and from lateral sternal margins (Fig. 10F).

DISTRIBUTION IN THE ARABIAN PENINSULA. — Oman (new record), Yemen (new record).

EXTRALIMITAL DISTRIBUTION. — Eritrea (Mocsáry 1913), Mali (new record).

REMARK
The type has a very small denticle between apico-median teeth of third tergum, and for this reason the species was described in the subgenus *Heptachrysis* Mocsáry, 1889.

Chrysis stilboides Spinola, 1838
(Figs 2A; 4A)

Chrysis stilboides Spinola, 1838: 446.

TYPE MATERIAL. — **Holotype**. **Egypt** • ♀; MRSN (examined).

MATERIAL EXAMINED. — **Saudi Arabia** • 1 ♀; El Riyadh; 10.VIII.1959; Dr Diehl leg.; NMLU • 2 ♂, 1 ♀; idem; 1.IX.1958; NMLU • 1 ♂, 1 ♀; idem; 3.VI.1959; NMLU • 1 ♂; idem; 5.VI.1959; NMLU • 3 ♂; idem; 17.VI.1959; NMLU • 5 ♂, 2 ♀; idem; 25.VI.1959; NMLU • 3 ♂, 1 ♀, idem; 1.VII.1959; NMLU • 4 ♂, 3 ♀; idem; 6.VII.1959; NMLU • 6 ♂; idem; 29.VII.1959; NMLU • 3 ♂, 2 ♀; idem; 1.VIII.1959; NMLU • 5 ♂; idem; 5.VIII.1959; NMLU • 1 ♂; idem; 15.VIII.1959; NMLU • 1 ♀; Medaen Salin; 1948-18; [26.45 N, 38.15 E]; G.V. Popov B.M. leg.
Yemen • 1 ♀; Gabal El Mogash. s.w. Sana'a; 31.V.1936; M.T. leg.; EFC • 1 ♂; Wadi Sharis; 1936; M.T. leg.; EFC • 3 ♀; Wadi Higgan, Manahla-Hajila; 7.VIII.1936; M.T. leg.; EFC.

DISTRIBUTION IN THE ARABIAN PENINSULA. — Kuwait (Al-Houty 1989 as *Stilbum splendidum*), Oman, Saudi Arabia (Linsenmaier 1994 as *Chrysis* (*Pyria*) *stilboides*), United Arab Emirates (Strumia 2014), Yemen (Madl, 2018).

EXTRALIMITAL DISTRIBUTION. — Widespread from sub-Saharan Africa to South Asia (Kimsey & Bohart 1991; Linsenmaier 1994; Madl 2018).

DIAGNOSIS. — Body length: 7-13 mm. Body entirely metallic green to blue, with or without golden hue on different body parts; legs including basitarsi green; scape and pedicel metallic green; wings dark, lighter on distal margin. First flagellomere short (l/w = 1.1-1.2); second flagellomere 1.6-1.7× longer than the first; transverse frontal carina strong, sharp, M-shaped, with three upwards branches; propodeal humeral angles acute pointing upwards; mesopleuron densely and coarsely punctate, with two sharp teeth; third tergum with small, shallow and round pits of the pit row; apical margin with six pointed teeth; black spots on second sternum transversal, rounded laterally, and almost touching each other along midline.

Chrysis smaragdula species-group

DIAGNOSIS. — Species of the *smaragdula* group *sensu* Kimsey & Bohart (1991) are recognised by the combination of following characters: first flagellomere l/w = 1-3 (male), 2-3.5 (female, most often 2.5 or more); face densely punctate, striato-punctate medially, yet not

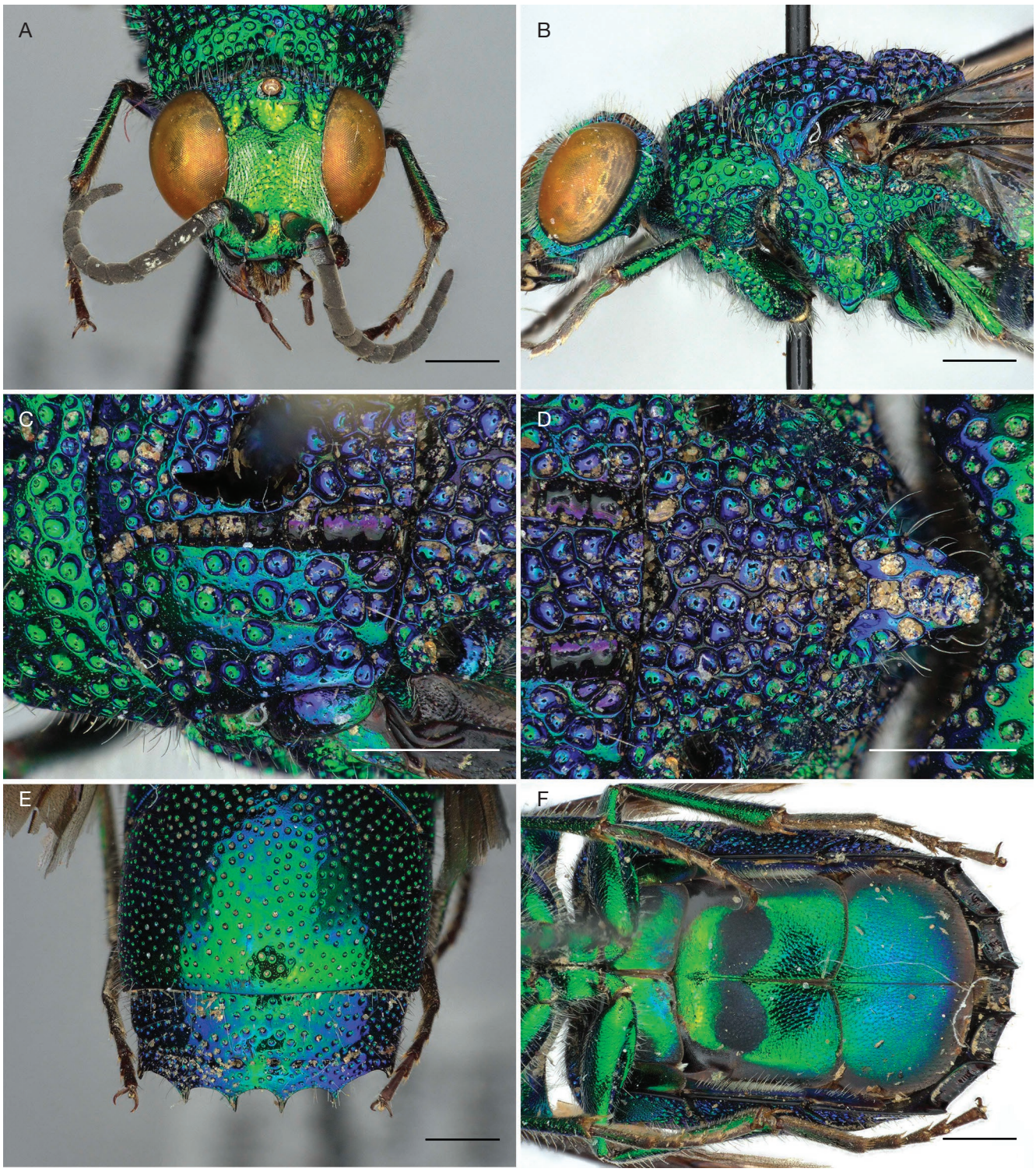

FIG. 10. — *Chrysis oxyacantha* Mocsáry, 1913, male (MHC), from Yemen: **A**, head, frontal view; **B**, head and mesosoma, lateral view; **C**, mesoscutum, detail on notauli, dorsal view; **D**, mesosoma, detail on metanotal mucron; **E**, metasomal second and third terga, posterior view; **F**, metasoma, ventral view. Scale bars: 1 mm.

microridged; transverse frontal carina well visible, normally M-like or inverted U-like, with or without posterior branches; anterior ocellus lidded; malar space long (1 MOD) to very long (2-3 MOD); pronotum shorter than scutellum, rarely carinate laterally, and humeral angle not acute; mesopleuron dentate in some species; metanotum sometimes slightly produced; apical margin of third tergum with six teeth or angles, rarely seven for a small median denticle; black spots on second sternum transverse, fused or nearly so, rarely small or medium. Body colour with various shades of green, blue, and bluish purple (in *C. jousseaumei* all reddish purple).

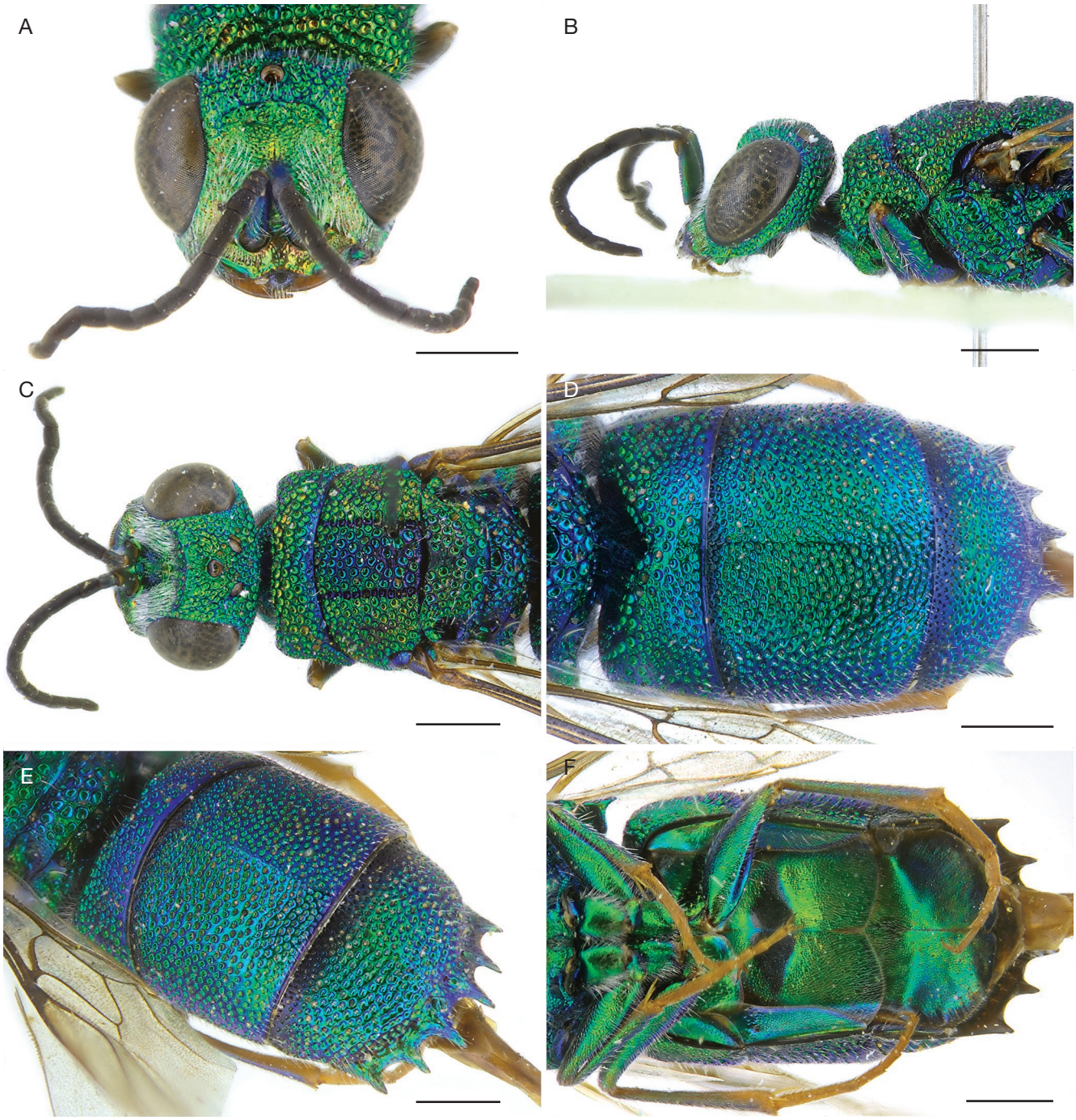

Fig. 11. — *Chrysis diehli* Linsenmaier, 1968, holotype (NMLU), female: **A**, head, frontal view; **B**, head and mesosoma, lateral view; **C**, head and mesosoma, dorsal view; **D**, metasoma, dorsal view; **E**, metasoma, postero-lateral view; **F**, metasoma, ventral view. Scale bars: 1 mm.

Hosts. — Eumenine hosts are known for several species (Kimsey & Bohart 1991).

Remarks

The *smaragdula* group is the most speciose after the *ignita* group and has a worldwide distribution. This group is anyway heterogeneous in the definition given by Kimsey & Bohart (1991). Linsenmaier (1959, 1994, 1999) split it in several groups, e.g. *diehli* group, *fasciata* group, *sexdentata* group, and the *decemdentata* group, which was recently confirmed as a distinct group by Rosa & Halada (2021). According to Linsenmaier's (1994) classification, the Arabian species should be included as follows: *C. jousseaumei* in the *sexdentata* group, with the ancillary vein originating from the Radial sector; *C. diehli* in the *diehli* group, which is characterized by specimens with *sexdendata* habitus and first flagellomere shorter than the second in both male and female.

Chrysis jousseaumei du Buysson, 1898
(Fig. 7A, C, E)

Chrysis jousseaumei du Buysson, 1898: 538.

TYPE MATERIAL. — **Holotype**. **Somalia** ♂; MNHN (examined).

MATERIAL EXAMINED. — **Yemen** • 3 ♂, 1 ♀; Lahj; III-V.2002; Malaise trap; A. van Harten & A. Sallum leg.; RMNH • 1 ♀; Seyun; light trap; 12-14.VII.2002; A. van Harten leg.; RMNH.

DISTRIBUTION IN THE ARABIAN PENINSULA. — United Arab Emirates (Linsenmaier 1994 as *Chrysis* (*Hexachrysis*) *jousseaumei*; Howarth & Gillett 2008; Strumia 2008; Madl 2018); Yemen (Linsenmaier 1994 as *Chrysis* (*Hexachrysis*) *jousseaumei*).

EXTRALIMITAL DISTRIBUTION. — Somalia to Saudi Arabia (see Remark).

DIAGNOSIS. — Body length: 8.0-11.0 mm. Body entirely metallic dark blue and violet to dark purple (Fig. 7A, C, E), including legs; scape and pedicel metallic green; wings slightly ambrate, with ancillary vein originating from the Radial sector. First flagellomere l/w = 1.5; second flagellomere 1.7 × longer than the first; transverse frontal carina strong, sharp, M-shaped, with two upwards branches encircling anterior ocellus (Fig. 7A); apical margin of clypeus sharp, metallic blue and protruding; body sculpture with very large punctures (0.8 MOD) separated by polished interspaces (Fig. 7E), weakly wrinkled on mesoscutum; mesopleuron with large tooth on antero-ventral margin (Fig. 7C); apical margin with six elongate and pointed teeth; black spots on second sternum transverse, connected to lateral margin, fused medially, with straight apical margin.

REMARK

Chrysis jousseaumei is known from the Afrotropical (Djibouti, Eritrea, Ethiopia, Somalia, Sudan, Yemen) and Palaearctic (Algeria, Egypt, Tunisia, United Arab Emirates) regions.

Chrysis diehli Linsenmaier, 1968
(Fig. 11)

Chrysis (*Hexachrysis*) *diehli* Linsenmaier, 1968: 123.

TYPE MATERIAL. — **Holotype**. **Saudi-Arabia** • ♀; El Riyadh; NMLU (examined).

MATERIAL EXAMINED. — **Saudi Arabia** • 1 ♀, El Riyadh; 3.IV.1959; Dr Diehl leg.; coll. Linsenmaier; ♀ Type *Hexachrysis* L. *diehli* Lins. det. Linsenmaier 1968 / 295 / NML_ENT GBIF_Chr0044200; coll. NMLU.

DISTRIBUTION IN THE ARABIAN PENINSULA. — Saudi Arabia (Linsenmaier 1968, 1994).

EXTRALIMITAL DISTRIBUTION. — None.

DIAGNOSIS. — Body length: 9.0 mm. Body entirely metallic green, including legs, with golden hues on face, pronotum anteriorly, lateral fields of mesoscutum and scutellum; scape and pedicel metallic green; wings hyaline with light brown veins, without ancillary vein originating from the Radial sector; femora and tibiae yellowish on inner side. First flagellomere l/w = 1.8; second flagellomere 1.6 × longer than the first; transverse frontal carina inverted U-shaped, without branches (Fig. 11A); humeral angles blunt, convergent (Fig. 11C); mesosoma with large punctures, up to 0.8 MOD postero-medially on median area of mesoscutum, separated by narrow polished interspaces; posterior propodeal angles spiny and projected posteriorly; mesopleuron simple, without teeth; metasoma with dense, small punctures (Fig. 11D), as large as half of mesosomal punctures; pits of the pit row small, deep, slightly larger than punctures on the tergum; apical margin with six elongate and pointed teeth (Fig. 11E); black spots on second sternum with unique shape, triangular, almost fused medially and separated from lateral margin (Fig. 11F).

KEY TO THE ARABIAN HEXADENTATE SPECIES OF *CHRYSIS* LINNAEUS, 1761

1. Species with mucronate metanotum 2
— Species without mucronate metanotum 5

2. Apical margin of third tergum with four small, triangular, median teeth, the lateral ones located on baso-lateral edge of tergum (Fig. 8E); metanotal mucron elongate, medially carinate, apically blunt and impunctate (Fig. 8B); black spots on second sternum small, longitudinal, and suboval (Fig. 8F) ..... *C. lyncea* Fabricius, 1775
— Apical margin of third tergum with six aligned teeth; metanotal mucron triangular, fully punctate, flat or medially concave; black spots on second sternum large, transverse, fused to almost fused medially 3

3. Transverse frontal carina U-shaped, simple, without branches (Fig. 9A); first flagellomere elongate (l/w = 2.5-3) in female, slightly longer than second; mesopleuron smooth and shiny on two stripes on mesepimeron and on mesepisternum (Fig. 9C); forewing with ancillary vein originating from the Radial sector (Fig. 9D) .... *C. smithii* Gribodo, 1913
— Transverse frontal carina M-shaped, with two or three branches upwards or enclosing anterior ocellus if frontal carina U-shaped, then mesopleuron fully punctate;; first flagellomere short (l/w = 0.5-1) in both sexes, 2 to 3 times shorter than second; mesopleuron fully punctate; anterior wing without ancillary vein 4

4. Mesoscutum with very large punctures (up to 1 MOD), widely separated by polished interspaces; notauli exceptionally wide (Fig. 10C), larger than largest punctures on mesoscutum basally, notauli triangularly shaped, larger at base and narrower towards apex ..... *C. oxyacantha* Mocsáry, 1838
— Mesoscutum with medium to large punctures (max 0.7 MOD), dense with narrow interspaces, occasionally with small punctures; notauli not exceptionally wide, formed by subsquare large foveae, as large as largest punctures on mesoscutum, notauli larger at base, not distinctly triangularly shaped ..... *C. stilboides* (Spinola, 1838)

5. Transverse frontal carina M-shaped, with branches encircling anterior ocellus (Fig. 7A); mesopleuron with strong tooth on lower margin (Fig. 7C); body colour dark blue to violet; black spots on second sternum subrectangular, connected to lateral margins ..... *C. jousseaumei* du Buysson, 1898
— Transverse frontal carina inverted U-shaped (Fig. 11A); mesopleuron simple, without teeth (Fig. 11B); body colour green; black spots on second sternum triangular, separated from lateral margins (Fig. 11F) .... *C. diehli* Linsenmaier, 1968

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