



## The *inaequalis* species-group (Hymenoptera, Chrysididae, *Chrysis*) in China, with description of a new species

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### Abstract

The Chinese *Chrysis* of the *inaequalis* species-group are revised and *C. extraordinaria* sp. nov. is described. *Chrysis extraordinaria* sp. nov. is recognisable by the following characteristics: mesopleuron tridentate, apex of T3 with six teeth, and T3 metallic blue, contrasting with T1 and T2 golden to metallic red. A modification to the species-group key by Kimsey & Bohart (1991) is proposed.

**Key words:** *Chrysis*, new species, species-group, China

### Introduction

The genus *Chrysis* Linnaeus, 1761 is the largest genus of Chrysididae and includes more than 1,000 species (Kimsey & Bohart 1991). At present there are seventy-eight known Chinese *Chrysis*, of which seventy-six are listed in Rosa *et al.* (2014). The remaining two species, *C. alishana* Tsuneki, 1982 and *C. bishamon* Tsuneki, 1982, both described from Taiwan, are not listed in Kimsey & Bohart (1991) and Rosa *et al.* (2014) by negligence.

The Oriental *Chrysis* are poorly known and less than sixty species are listed for this zoogeographical region (Kimsey & Bohart 1991), excluding *Chrysis* described by Nurse (1902, 1903, 1904) from Deesa and Kashmir. There are at least two reasons that explain the scarcity of known species from this region: 1) Chrysidini are more abundant in temperate, xerothermic and semi-desert regions than in tropical and subtropical regions, reflecting the great quantity of their host (Hymenoptera Apoidea - both Spheciphormes and Anthophila – and Eumeninae) in these areas (Kimsey & Bohart 1991); 2) this apparent scarcity may be mainly due to limited and incomplete collecting. So far, only one monographic work on Indian Chrysididae was published (Bingham 1903), whereas occasional and scattered descriptions of *Chrysis* or local check-lists including *Chrysis* from Oriental fauna were published (Smith 1852, 1858, 1874; Mocsáry 1889, 1893, 1912, 1913a, b; Cameron 1897; du Buysson 1896, 1898, 1904, 1908; Bischoff 1910; Uchida 1927; Tsuneki 1950, 1963a, 1963b, 1970; Linsenmaier 1968).

Only twenty-three species of Oriental Chinese *Chrysis* have been listed by Rosa *et al.* (2014): *C. alishana* Tsuneki, 1982; *C. angolensis* Radoszkovsky, 1881; *C. bishamon* Tsuneki, 1982; *C. buddhae* Mocsáry, 1913; *C. cavaleriei* (du Buysson, 1908); *C. ceciliae* du Buysson, 1904; *C. durga* Bingham, 1903; *C. foochowia* Linsenmaier, 1968; *C. gracilentata* Mocsáry, 1889; *C. hoozana* Mocsáry, 1913; *C. ignifascia* Mocsáry, 1893; *C. ionophris* Mocsáry, 1893; *C. longissima* du Buysson, 1898; *C. nigropilosa* Tsuneki, 1970; *C. parallela* Brullé, 1846; *C. principalis* Smith, 1874; *C. taihorina* Mocsáry, 1913; *C. taiwana* Tsuneki, 1970; *C. takasago* Tsuneki, 1963; *C. takeuchii* Tsuneki, 1950; *C. talitha* Mocsáry, 1913; *C. varicolor* Smith, 1874; *C. vicaria* Mocsáry, 1913. Since many *Chrysis* species are widely distributed in the Oriental region from India to Vietnam and the Philippines (e.g. *C. bhavanae* Bingham, 1903; *C. chlorosoma* Dahlbom, 1854; *C. comottii* Gribodo, 1884; *C. orientalis* Guérin, 1842), we expect that the real number of *Chrysis* in the Oriental part of China is higher than we know from literature records.

The Palaearctic Chinese *Chrysis* are also poorly known, with fifty-five species (Rosa *et al.* 2014). In this

zoogeographical region of China, we also expect a considerably higher number of species, because the northern and north-western parts of the country offer suitable places for Chrysidinae and their hosts (Wei *et al.* 2013, 2014; Rosa *et al.* 2015). In fact, various data on Chrysididae collected on the Tian-Shan mountains and central Asian countries bordering China show a great diversity and abundance of *Chrysis* and related genera in similar environments (Semenov-Tian-Shanskij & Nikol'skaya 1954; Semenov-Tian-Shanskij 1967; Tarbinsky 2000, 2002a, b, c).

In the last twenty years, new field researches have been conducted in different Chinese provinces and autonomous regions and resulted in inspiring findings. We here initiate reporting the most relevant findings on the genus *Chrysis* of *inaequalis* species-group.

## Materials and methods

Studied specimens were examined and described using a Leica MZ125 stereomicroscope. Photographs were taken with a digital camera (CoolSNAP) attached to a Zeiss Stemi 2000-CS stereomicroscope. Images were processed using Image-Pro Plus software.

Abbreviations used in the descriptions are as follows: **F1, F2, F3**, etc. = flagellomeres 1, 2, 3, etc., respectively; **l/w**=length/width; **MOD** = midocellus diameter; **MS** = malar space, the shortest distance between base of mandible and lower margin of compound eye; **OOL** = the shortest distance between posterior ocellus and compound eye; **P** = pedicel; **POL** = the shortest distance between posterior ocelli; **S2** = metasomal sternite 2; **T1, T2, T3** = metasomal tergites 1, 2, 3; **TFC** = transverse frontal carina.

Types and other specimens have been examined from the following institutions:

NMLS NaturMuseum, Luzern, Switzerland.

SCAU Hymenopteran Collection, South China Agricultural University, Guangzhou, China.

ZIN Zoological Institute, St. Petersburg, Russia.

## *Chrysis* of *inaequalis* species-group

*Chrysis* (*Pentachrysis*) *inaequalis* species-group: Linsenmaier 1959: 165 (diagnosis).

*Chrysis inaequalis* species-group: Kimsey & Bohart 1991: 320 (key), 349 (diagnosis), 329 (Fig. 107p), 331 (Fig. 108b), 335 (Fig. 109g), 336 (Fig. 110g).

**Diagnosis.** The *Chrysis* of *inaequalis* species-group is diagnosed by the following combination of characters: F1 slender, scapal basin deep, TFC strong and sharply projecting, mesopleuron bidentate or tridentate, T2 and T3 with sharp median carina, apex of T3 with four or six sharp teeth, and punctures on body large and deep.

**Description.** F1 l/w=3.0–4.0. Scapal basin deep, usually transversely ridged. TFC sharply projecting. MS 1.2–2.0 MOD. Mesopleuron bidentate or tridentate, and somewhat bulging. Propodeal angle large, sharp and curved behind. T2 and T3 with sharp median carina. T3 with four or six sharp teeth and deep pit row. T3 transversely bulging before pit row. Black spots on S2 indistinct, fused or nearly so.

**Biology.** Parasitoids of Eumeninae (Hymenoptera, Vespidae): *Odynerus* sp. (Berland & Bernard 1938) and *Eumenes coarctatus* (Linnaeus, 1758) (Kunz 1994).

**Species included.** *Chrysis inaequalis* Dahlbom, 1845, *C. mysticalis* Linsenmaier, 1959, *C. placida* Mocsáry, 1879, and *C. extraordinaria* Rosa, Wei & Xu, **sp. nov.**

**Distribution.** Palaearctic and Oriental Regions.

**Remarks.** Linsenmaier (1959) included *inaequalis* species-group into the subgenus *Chrysis* (*Pentachrysis*) due to the following combination of characters: elongated F1, sharp TFC, dentate mesopleuron, transverse bulge before pit row and body punctuation. Kimsey & Bohart (1991) placed this species-group in the genus *Chrysis* and not *Pentachrysis* (raised to genus rank) due to the four teeth on the apex of T3 and differences in male terminalia. Nevertheless, all males from the genus *Pentachrysis* (*P. admiranda* (Mocsáry, 1889), *P. amoena* (Eversmann, 1857), *P. arrogans* (Mocsáry, 1889), *P. goliath* (Abeille de Perrin, 1878), *P. seminigra* (Walker, 1871), *P. zharptitza*

(Semenov, 1912)) have four sharp teeth and a very small median denticle, and similar genitalia to species from the *C. inaequalis* group (Linsenmaier 1959: Figs. 405–408). The small differences in the apical margin of T3 observed by Kimsey & Bohart (1991) do not clarify whether the *C. inaequalis* species-group could be more related to the genus *Pentachrysis* rather than to *Chrysis* s. str. and only molecular analysis will clarify the real systematic position of this species-group.

### Key to Chinese species of the *inaequalis* species-group

1. Metasoma metallic golden to metallic red (Fig. 1A, 1E, 1F); mesopleuron bidentate (Fig. 1A); apex of T3 with four teeth (Fig. 1F) ..... *C. inaequalis* Dahlbom
- Metasoma bicoloured, T1 and T2 metallic red, T3 metallic blue (Fig. 2A, 2E, 2F); mesopleuron tridentate (Fig. 2A); apex of T3 with six teeth (Fig. 2F) ..... *C. extraordinaria* sp. nov.

### *Chrysis inaequalis* Dahlbom, 1845

(Fig. 1A–1F)

*Chrysis inaequalis* Dahlbom, 1845: 8. Neotype, ♂, designated by Rosa & Vårdal 2015: 124: Switzerland, Roveredo (NMLS) (examined).

*Chrysis (Tetrachrysis) inaequalis*: Tsuneki 1947: 56 (China: Beijing); Tsuneki 1948: 126 (China: Shanxi: Kiutauyüan, Hengshuichen, Hengshuichen-Henglingkuan), 128 (Beijing distr., Shanxi); Tsuneki 1953: 59 (Manchuria: Kaiyüan, Lushan).

*Chrysis (Pentachrysis) inaequalis*: Linsenmaier 1959: 165 (North China, Manchuria); Linsenmaier 1997b: 126 (China, Manchuria).

*Chrysis inaequalis*: Banaszak 1980: 28 (China, Manchuria); Rosa *et al.* 2014: 52 (China: Liaoning, Inner Mongolia, Beijing, Shanxi).

**Material examined.** CHINA: 1♀, Hebei, Xiaowutaishan National Nature Reserve, 20–23.VIII.2005, leg. Jing-xian Liu & Li-qiong Weng (SCAU); 1♀, Guizhou, Mayanghe National Nature Reserve, 2.X.2007, leg. Cui-hong Xie (SCAU); 1♀, Beijing, Russian Mission, 5.IX.1906, leg. Y. Vasiliev (ZIN); 1♀, Alashan (Inner Mongolia), Dinyuan-in, 5–6.VI.1908, leg. P. Kozlov (ZIN).

**Diagnosis.** *Chrysis inaequalis* Dahlbom is easily recognisable by the following characteristics: mesopleuron bidentate (Fig. 1D), apex of T3 with four sharp teeth (Fig. 1F), metasoma with deep and round punctures (Fig. 1E), pre-pit row area transversely bulged (Figs 1E, 1F).

**Description.** Body length 6.0–10.0 mm.

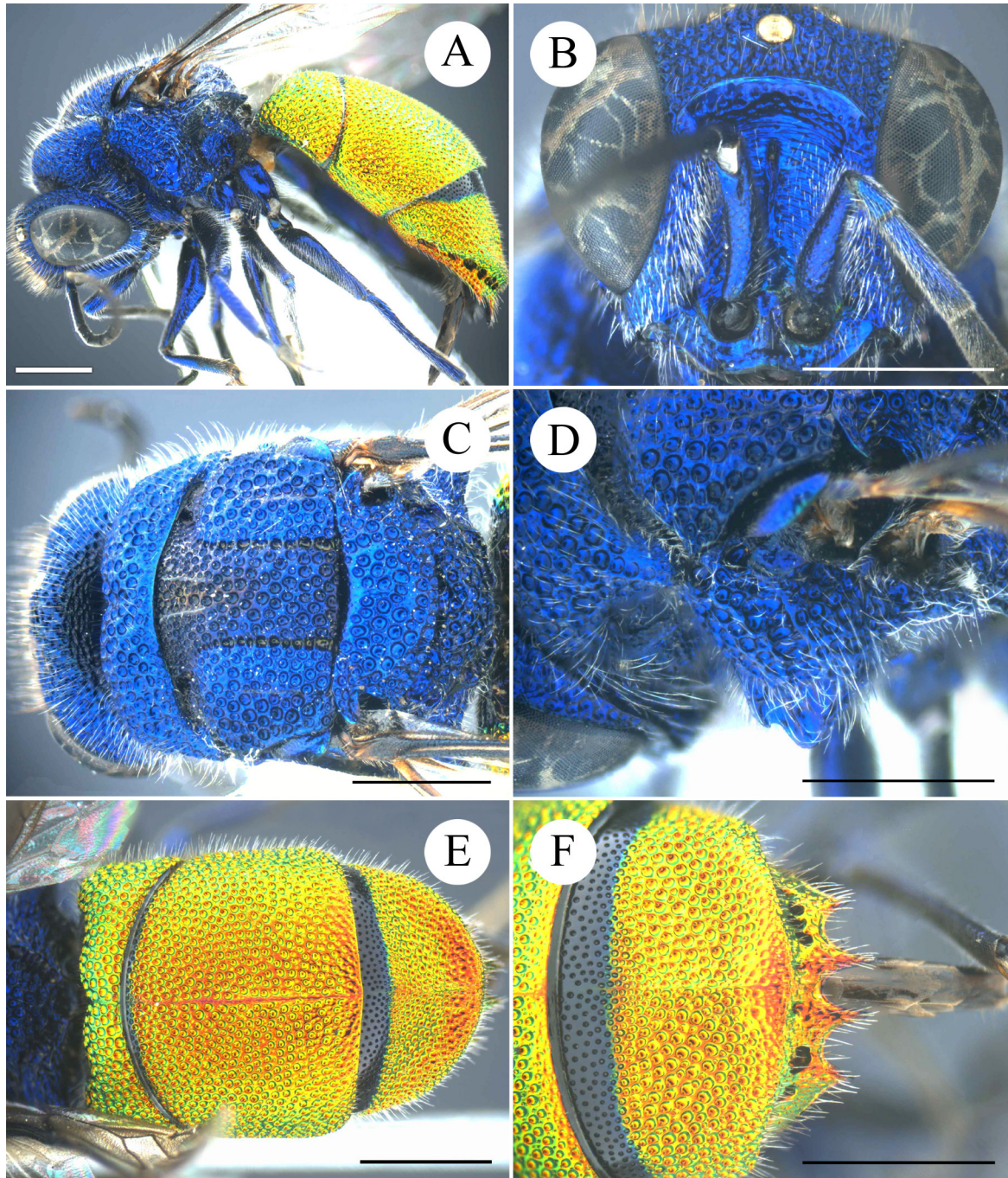
**Head.** Scapal basin striated with or without distinct small punctures within striae and laterally setose in females (Fig. 1B), more setose in males. TFC distinctly sharp and arched in females, medially straight in males. Relative length of P:F1:F2:F3 = 1.0:2.2–2.4:1.2:1.0 (females), 1.0:2.5–2.7:1.4:1.0 (males); OOL = 1.7 MOD (females) 2.0 MOD (males); POL = 2.0 MOD; MS = 1.4 MOD; subantennal space 0.7–0.8 MOD. Genal carina sharply developed from temple to mandible.

**Mesosoma.** Pronotum short, about 0.66–0.7 × as long as mesoscutellum (Fig. 1C); pronotal groove wide and extended almost to posterior margin or 3/4 length of pronotum; lateral margins depressed medially. Pronotum and mesoscutum with coarse punctuation; notauli complete, becoming wider and deeper posteriorly, with foveae partially fused; mesoscutellum with similar punctuation to mesoscutum; metanotum with larger punctures. Lower mesopleuron with two pointed teeth ventrally, well visible in lateral view at 35°–45°; episternal sulcus with large scrobiculate punctures; scrobal sulcus with large foveate punctures (Fig. 1D).

**Metasoma.** Metasoma with coarse and even punctuation, with tiny punctures among main punctures; T3 transversely bulging before pit row; pit row well developed with deep and large pits; T2 and T3 with sharp carina; apex of T3 with four sharp teeth (Fig. 1A); T3 baso-laterally with convexity; S2 black spots vanishing, sometimes as blue shadows.

**Colouration.** Head and mesosoma metallic blue, with darkened blue area medially on mesoscutum; usually in male with green or greenish reflections contrasting with blue area medially on mesoscutum; T1–T3 golden to metallic red; in male variable, from flame red to green or bluish-green. Scape, P, F1 and F2 metallic blue to green, rest of flagellum black. Tegula metallic blue. Sternites metallic blue.





**FIGURE 1.** *Chrysis inaequalis* Dahlbom, 1845, ♀ from Hebei. **A.** Habitus, lateral view; **B.** Head, frontal view; **C.** Mesosoma, dorsal view; **D.** Mesopleuron, lateral view; **E.** Metasoma, dorsal view; **F.** T3, posterior view. Scale bar 1 mm.

**Distribution.** Both Palaearctic and Oriental parts of China (Liaoning, Inner Mongolia, Beijing, Hebei, Shanxi, Guizhou). Trans-Palaearctic, from Europe to Siberia (Linsenmaier 1959; Kimsey & Bohart 1991; Tarbinsky 2002b; Kurzenko & Lelej 2007; Rosa *et al.* 2014).

**Remarks.** We provide a general description based on more specimens from West to East Palaearctic region to facilitate species identification. *C. inaequalis* is a very common species, well known and documented in literature; morphological descriptions have already been published in several languages, but not in English (e.g. Berland & Bernard 1938, Balthasar 1954; Linsenmaier 1959, 1997b; Mingo 1994; Tarbinsky 2002; Rosa 2006); images of specimens, male genitalia and other morphological details have been already published (Linsenmaier 1959, 1997b; Kimsey & Bohart 1991; Kunz 1994; Mingo 1994; Tarbinsky 2002b; Rosa 2006). The male colouration is variable. Specimens from Greece to Central Asia show green to bluish metasoma, sometimes greenish on T1 and T2 and

gradually flame red towards the apical margin of T3. Nevertheless, some taxa described as colour variations and currently considered as synonym of *C. inaequalis* (e.g. *C. sapphirina* Semenov, 1912) are supposed to be valid species.

***Chrysis extraordinaria* Rosa, Wei & Xu, sp. nov.**

(Fig. 2A–2F)

**Material examined.** Holotype, ♀, CHINA: Yunnan, Chenggong, Luoyang Town, 8–19.VIII.2006, leg. Qiang Li (SCAU).

**Diagnosis.** *Chrysis extraordinaria* sp. nov. is recognisable by the following characteristics: mesopleuron tridentate (Fig. 2D); T3 metallic blue, apex with six teeth (Figs 2E, 2F); T1 and T2 golden to metallic red (Fig. 2A, 2E).

**Description.** Holotype: *Female*. Body length 7.2 mm.

**Head.** Scapal basin striated and laterally setose (Fig. 2B). TFC almost straight medially, with two ends laterally bending downwards before compound eyes. Relative length of P:F1:F2:F3 = 1.0:2.3:1.3:1.0; OOL = 2.0 MOD; POL = 1.8 MOD; MS = 1.2 MOD; subantennal space 1.0 MOD. Genal carina sharply developed from temple to mandible.

**Mesosoma.** Pronotum short,  $0.75 \times$  as long as mesoscutellum; pronotal groove wide and extended almost to posterior margin; pronotum with lateral margins depressed medially. Pronotum and mesoscutum with coarse punctuation; notauli complete, becoming wider and deeper posteriorly, with foveae partially fused; mesoscutellum with similar punctuation to mesoscutum; metanotum with larger punctures (Fig. 2C). Lower mesopleuron with three pointed teeth on episternal and scrobal sulcus ventrally; episternal sulcus with large scrobiculate punctures; scrobal sulcus with large foveate punctures (Fig. 2D).

**Metasoma.** Metasoma with coarse and even punctuation, with minute punctures among the main punctures; T3 transversely bulging before pit row; pit row well developed with deep and large pits; T2 and T3 with sharp median carina; apex of T3 with six teeth, four sharp teeth medially and two short but pointed teeth laterally; lateral teeth aligned to median teeth, not placed on basal 1/4 or 1/3 of lateral edge, as abrupt swelling in *C. inaequalis* (Fig. 1A); lateral margins of T3 straight, without abrupt swelling; S2 black spots suboval, oblique directed and fused to lateral margin, medially separated by 1 MOD.

**Colouration.** Body metallic cobalt blue, with darkened blue areas medially on mesoscutum; T1 and T2 golden to metallic red, medially violet; T3 metallic blue. Scape, P, F1 and F2 metallic blue, rest of flagellum black. Tegula metallic blue. Sternites metallic blue.

**Male.** Unknown.

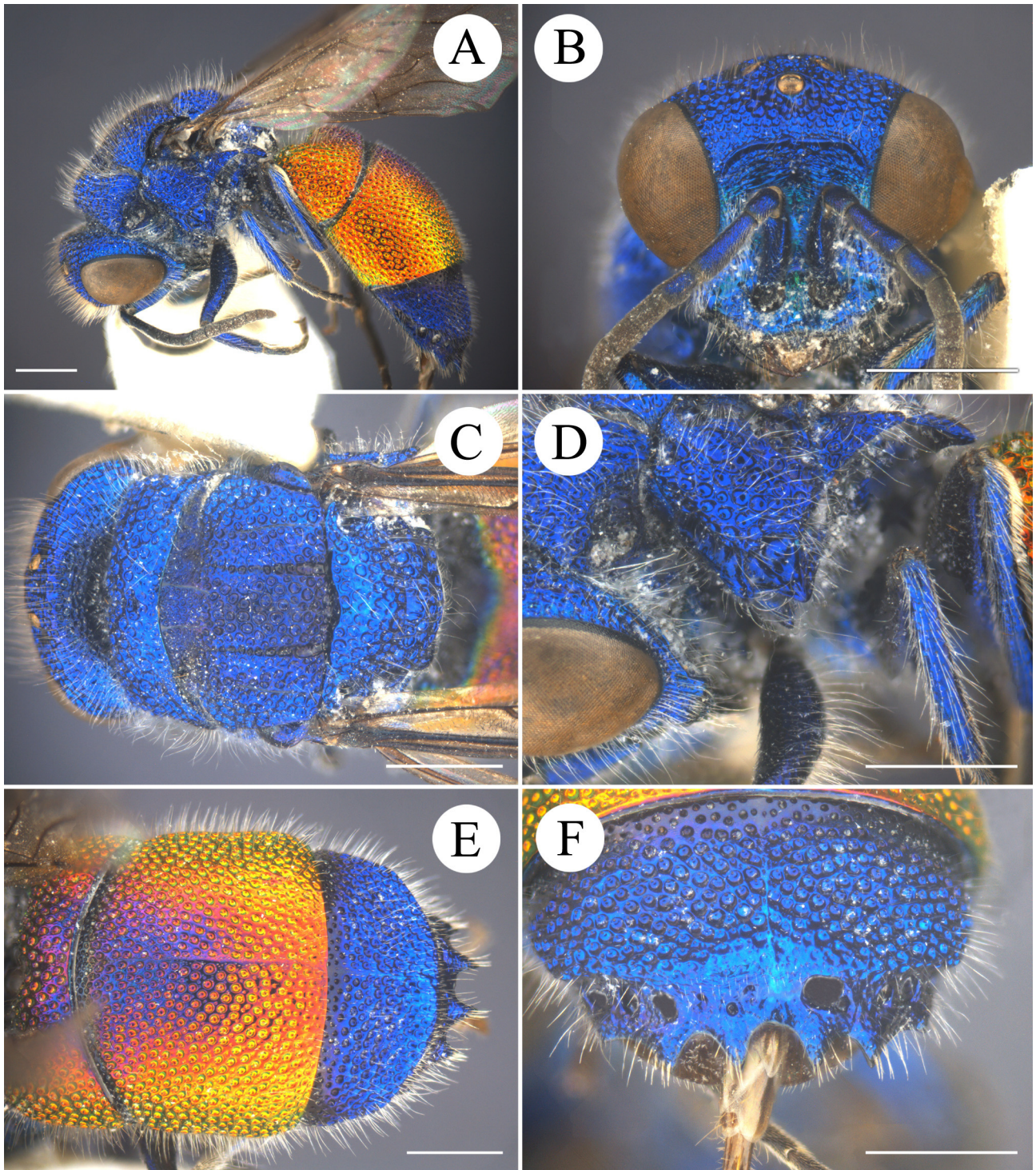
**Distribution.** Oriental part of China (Yunnan).

**Remarks.** *Chrysis extraordinaria* sp. nov. is considered an outstanding species because bears unique features so that it cannot be included in any species-groups following the keys proposed by Kimsey & Bohart (1991) and Linsenmaier (1959). In particular, the combination of following characters is unusual: mesopleuron tridentate; T3 without basal abrupt swelling on lateral margins, and bearing six sharp teeth on apex; T3 metallic blue, contrasting with T1 and T2 metallic red, an unusual colour pattern for *inaequalis* species-group, which is typical for Palaearctic *C. splendidula* and *C. viridula* species-groups. Thus we suggest to modify couplets 6 and 7 of the key in Kimsey & Bohart (1991) as follows:

- 6. Pit row practically absent; male F1 and F2 short and, taken together, shorter than F3 ..... *somaliae* group
- Pit row distinct; male F1 sometimes reduced, but not F2 ..... 7
- 7a. F1 in both sexes about as broad as long or shorter ..... *oculata* group
- F1 in both sexes longer than broad ..... 7b
- 7b. Scapal basin transversely striate; female F1 l/w = 3/4; mesopleuron tridentate; mesoscutellum simple, without any plastic modification or depression; T2 and T3 with sharp median longitudinal ridge ..... *inaequalis* group (part.)
- Scapal basin punctate; female F1 l/w = 2; mesopleuron without teeth, if dentate then mesoscutellum with mucron, convexity or median depression; T2 and T3 without median longitudinal ridge, at most impunctate ..... *smaragdula* group

**Etymology.** The specific epithet *extraordinaria* is derived from the Latin adjective *extraordinarius* (extraordinary) referring to the unique morphological characteristics and colour of this species.





**FIGURE 2.** *Chrysis extraordinaria* Rosa, Wei & Xu, **sp. nov.**, holotype, ♀. **A.** Habitus, lateral view; **B.** Head, frontal view; **C.** Mesosoma, dorsal view; **D.** Mesopleuron, lateral view; **E.** Metasoma, dorsal view; **F.** T3, posterior view. Scale bar 1 mm.

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