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On Sulawesi *Ceratina* (*Ceratinidia*)

(Hymenoptera, Apoidea, Anthophoridae)

With 12 figures

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Summary

Ceratina (*Ceratinidia*) *alexandrae* and *carinifrons*, spp. nov., are described from Indonesia, Sulawesi.

Zusammenfassung

Ceratina (*Ceratinidia*) *alexandrae* und *C. carinifrons*, spp. nov., werden von Sulawesi, Indonesien, beschrieben.

Keywords

taxonomy – biodiversity – agroecology – Indonesia

Introduction

Recent collections of Apoidea made in coffee plantations within the boundaries or in the vicinity of the Lore-Lindu National Park, Central Sulawesi, by A.-M. KLEIN, Georg-August-Universität, Göttingen, included, among other undescribed species, two species of *Ceratina* (*Ceratinidia*). These are described here in order to make names available for use in studies of the diversity and abundance of flower-visiting bees in two land-use gradients dominated by coffee and of pollination mechanisms in the two coffee species concerned. Lowland coffee, *Coffea canephora* PIERRE EX FRÖHNER [RUBIACEAE], which is not self-fertile, was dominant in the Palolo valley study area (1998-1999); highland coffee, *C. arabica* L., which is self-fertile, was dominant, but *C. canephora* was also present, in the Napu valley study area (2000-2001).

The geological history of Sulawesi is complex. It appears to be generally accepted that the northern and south-eastern arms and the western part of central Sulawesi are of Laurasian origin and the eastern and south-eastern arms of Gondwanic origin (see, e.g., AUDLEY-CHARLES, 1981, fig. 4.7). Western Sulawesi, now separated from Borneo by the deep waters (to 2000 m) of the Makassar Strait, may have been joined by land to that

island at periods during the Tertiary and the Quaternary. Eastern Sulawesi, originally the westernmost part of the Sula Peninsula (of Australian Gondwanaland) is thought to have collided with (present central) Celebes at 15 Ma (Miocene). The collision was submarine, an island chain between Sulawesi and Australia not becoming established until late Miocene/Pliocene. Eastern Sulawesi is now separated from the Moluccas by the deep waters (to 5000 m) of the Banda and Molucca Seas, narrowly broken however by the shallower seas of the Banggai-Sula Archipelago. The recent vertebrate fauna of Sulawesi is well known, the fossil less well known: both are distinctive with high endemism. Except in a few better-collected orders, the invertebrate fauna is much less well known, but it also exhibits certain peculiarities, some of which have long been recognized. Knowledge of the bee fauna is limited, most collecting done to date having been carried out either in the eastern extremity of the northern arm of the island or in the western central region, more especially in the Makassar and Palu districts; no adequately representative collecting appears to have been carried out in the eastern and south-eastern arms. On the basis of present knowledge, the bee fauna is inextensive and of Oriental origin, with a certain degree of endemism among those groups least likely to have been subject to accidental introduction by man and some suggestion of a closer link with the Philippine Islands than with Borneo.

Of four known Sulawesi species of *Ceratinidia*, three, apparently endemic and all, to some extent at least, sympatric within Sulawesi, are distinguished from other species of *Ceratinidia* in general by an abnormal inflation of the upper paraocular area. A similar development was noted by VAN DER VECHT (1952) only for *C. tropica* CRAWFORD, 1910 (Figures 7, 8), a species widely distributed in the Philippine Islands and differing from the Sulawesi species in having the lateral face marks divided into usually widely separated (♀) or only narrowly joined (♂) spots and in having the mesoscutum, if not entirely black, with discal vittae only. A fourth species known from Sulawesi is *C. cognata* SMITH, 1879, a common species found throughout continental SE Asia and the Greater Sunda Islands (but, as obtains with various species of bees of other families and genera, apparently not in Borneo) and possibly adventitious in Sulawesi.

Systematic

C. rugifrons SMITH, 1879

(Figs. 1, 2, 12)

Ceratina rugifrons SMITH, 1879: 93; ♂; Celebes, Macassar. Type ♂ BMNH, examined.

Ceratina (*Ceratinidia*) *rugifrons* SMITH, VAN DER VECHT, 1952: 64.

Diagnosis

C. rugifrons is distinguished from *C. carinifrons* and *C. alexandrae*, described below, by the dense and exceptionally coarse punctation of the face, by the absence of a median clypeal carina, by the punctation of the posterolateral areas of the mesoscutum, which bear at least a few scattered punctures and are more usually extensively punctate, and by the entirely dull, reticulately punctate mesepisterna.

Redescription

♀.

Structure. Clypeus with no indication of median carina; ocellar area defined posteriorly by an indistinct impressed line not extending laterad of posterior ocelli; vertex long, lateral ocelli separated from vertex by more than twice their diameter (1 : 2.5); paraocular area above level of antennal fossa moderately inflated, forming a conspicuous, nearly uniformly convex, callus, its lateral face, opposed to the inner orbit, impunctate; gena at mid-level of eye broader than eye (in lateral aspect of head, eye-width : genal width as 1 : 1.28)

Punctuation. Face anteriorly abnormally densely, coarsely punctate; vertex densely punctate. Mesoscutum anteriorly densely reticulately punctate, dull; posteriorly, between the parapsidal lines, largely impunctate; punctuation of posterolateral areas of mesoscutum variable, from having only a few scattered punctures (apart from series adjacent to lateral margin) to being nearly entirely, closely punctate and then a series of punctures inward of the parapsidal line anteriorly present; mesepisterna densely, uniformly, reticulately punctate, dull, the punctuation becoming finer on the ventral surface.

Maculation. Clypeal fascia narrow, irregularly linear, with weak median upward extension, the latter occasionally absent; frontal spots small, if linear their long axes convergent dorsad; paraocular marks not ascending to level of antennal fossae, their inward apical extension fine or absent. Dorsal fascia of pronotum divided, laterally usually not connected with pronotal spot; mesoscutum with small lateral vittae, these sometimes absent; scutellum with large subtriangular spot; mesepisternum with post-pronotal spot; axillary sclerites yellow-marked; all femora with small apicodorsal spots, that on I prolonged posteriorly and ventrally basad as a broad vitta; tibia I with dorsal yellow vitta, red below, II with small basidorsal yellow spot, otherwise largely red, III with larger basidorsal spot. Fascia of T1 narrow, interrupted medially, the two lateral elements slightly bent basad at either end; T2 – : see Figure 2.

♂. Similar.

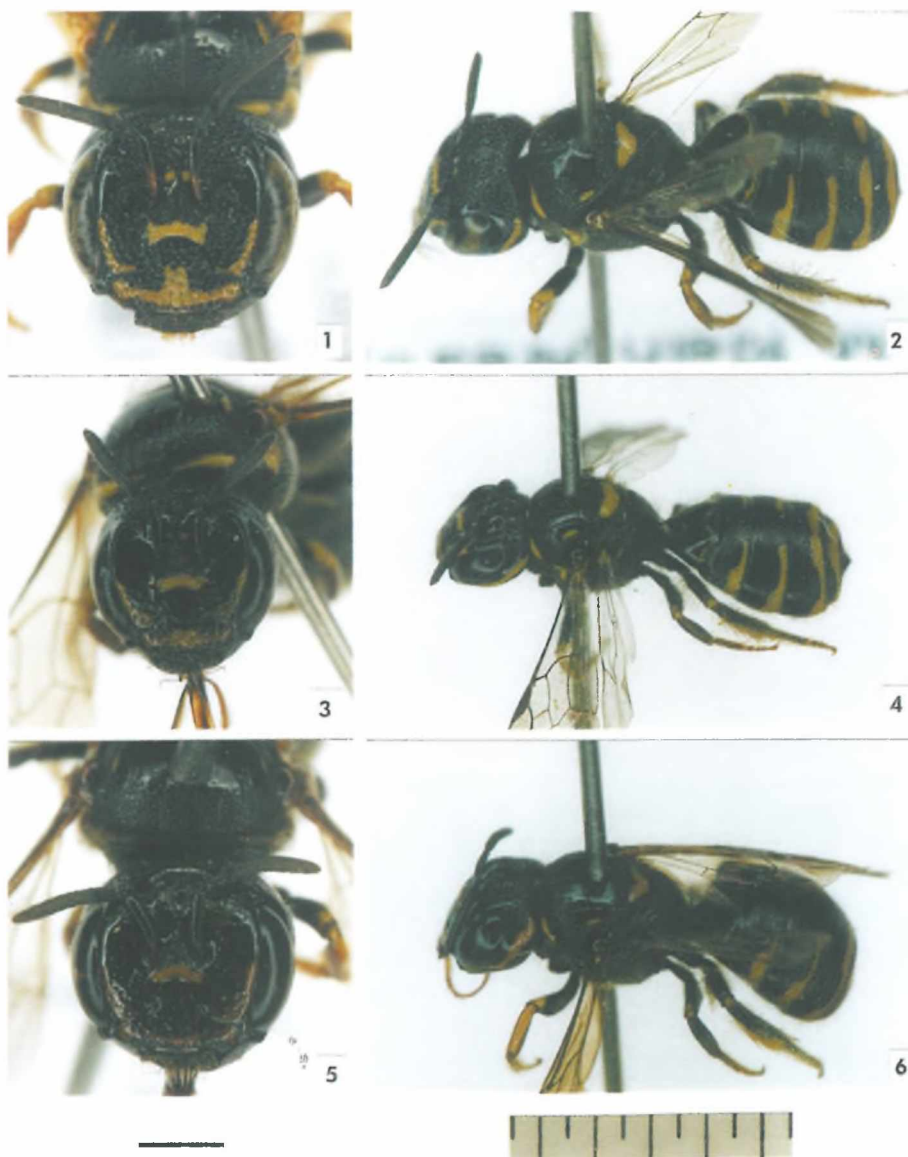
Structure. Frontal excrescences stronger than in ♀, laterally only narrowly impunctate. T7 bluntly angular.

Punctuation. Posterolateral areas of mesoscutum usually densely punctate; disc less extensively impunctate.

Maculation. Median upward extension of clypeal fascia more strongly developed, dorsally incised; labrum with central yellow macula; frontal spots absent; tibiae yellow; metasoma: see Figure 12.

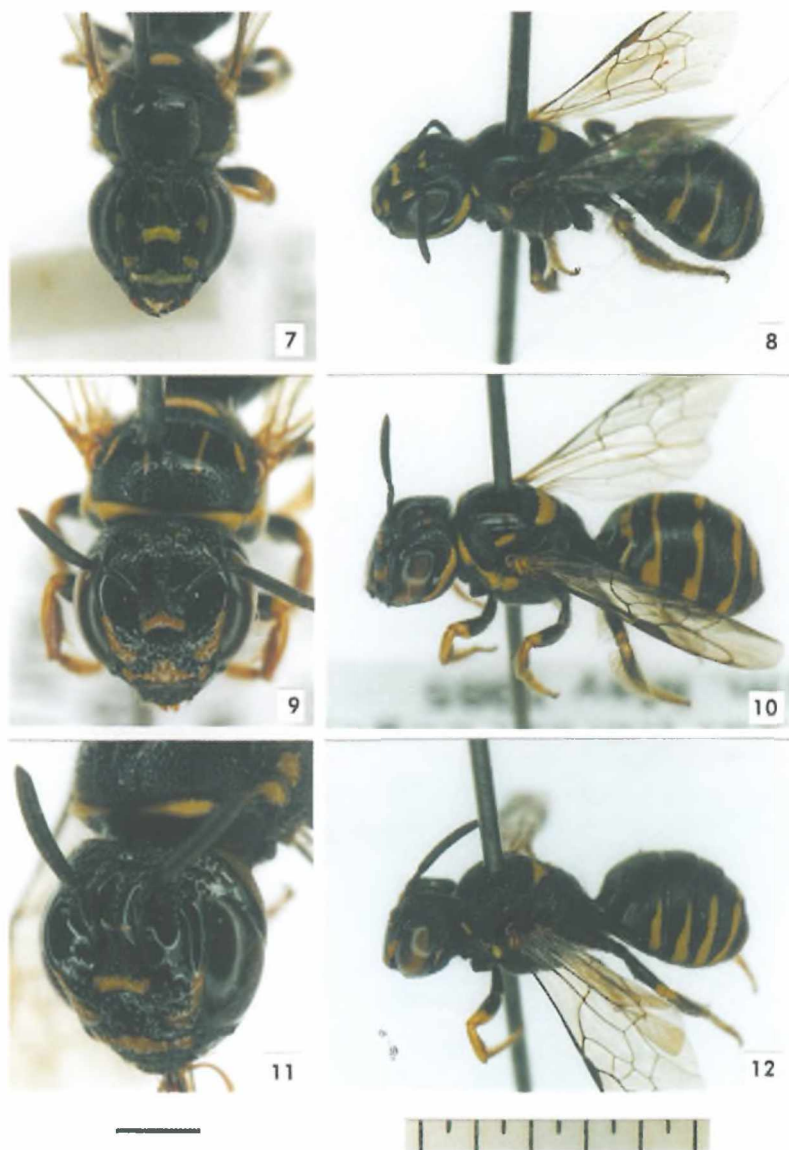
Material examined.

INDONESIA: Sulawesi (NE), 47km WSW Kotamobagu, Dumoga-Bone National Park, Toraut (forest edge), 211 m [sic], iv-vi 1985 (G.R. ELSE), 32 ♂♂ 17 ♀♀ [BMNH, DBB]; Sulawesi (Central), ca. 100 km SE Palu, Napu valley, ca. 1100 m, xii 2000 – i 2001 (A.-M. KLEIN), 8 ♀♀ 2 ♂♂ [GAUG, DBB].



Figures 1-6, *Ceratina* (*Ceratinidia*) spp., head in frontal aspect (Figures 1, 3, 5) and whole insect in dorso-lateral aspect (Figures 2, 4, 6). **Figures 1, 2, *C. rugifrons* SMITH, 1879: (1), ♀, SULAWESI (central): Napu valley, ca. 100 km SE Palu, Wuasa, ca. 1100 m, 14 xii 2000 (A.-M. KLEIN) [Negative 163.4]; (2), ♀, SULAWESI (central): Napu valley, ca. 100 km SE Palu, Wuasa, ca. 1100 m, 8 i 2001 (A.-M. KLEIN) [Negative 164.16]. **Figures 3, 4, *C. carinifrons* sp. nov.:** (3), holotype ♀, SULAWESI (central): Napu valley, ca. 100 km SE Palu, Alitupu, ca. 1100 m, 15 xii 2000 (A.-M. KLEIN) [Negative 163.6]; (4), paratype ♀, SULAWESI (central): Napu valley, ca. 100 km SE Palu, Wuasa, ca. 1100 m, 7 i 2001 (A.-M. KLEIN) [Negative 164.18]. **Figures 5, 6, *C. alexandrae* sp. nov.:** (5), paratype ♀, SULAWESI (central): Napu valley, ca. 100 km SE Palu, nr Alitupu, ca. 1100 m, 14 i 2001 (A.-M. KLEIN) [Negative 163.8]; (6), paratype ♀, SULAWESI (central): Napu valley, ca. 100 km SE Palu, Wuasa, ca. 1100 m, 7 i 2001 (A.-M. KLEIN) [Negative 164.20].**

Scale bar for figures 1-9 (odd numbers) represents 1 mm; scale for figures 2-12 (even numbers) represents 5 mm.



Figures 7-10, *Ceratina* (*Ceratinidia*) spp., head in frontal aspect (Figures 7, 9) and whole insect in dorso-lateral aspect (Figures 8, 10). **Figures 7, 8**, *C. tropica* CRAWFORD, 1910: (7), ♀, PHILIPPINE IS.: Luzon, La Union, Bacnotan, Sapilang, 25 v 1989 (*G. & E. MANALANG*) [Negative 163.10]; (8), ♀, PHILIPPINE IS., Luzon, Los Baños (*C.F. BAKER*) [Negative 164.22]; **Figures 9, 10**, *C. sp.*: (9), ♀, (SULAWESI (NE): 47 km WSW Kotamobagu, Dumoga-Bone Natl Pk, Toraut (forest edge), 211 m, v 1985 (*G.R. ELSE*) [Negative 163: 12]; (10), *idem* [Negative 164.24]. **Figure 11**, *C. carinifrons* sp. nov., head: same specimen as Figure 2 (holotype ♀, SULAWESI (central): Napu valley, ca. 100 km SE Palu, Alitupu, ca. 1100 m, 15 xii 2000 (*A.-M. KLEIN*) [Negative 163.28]) but further enlarged and shown in oblique aspect to illustrate paraocular carinae and impunctate depressions [Negative 163.26]. **Figure 12**, *C. rugifrons* SMITH, 1879, whole insect in dorso-lateral aspect: ♂, SULAWESI (central): Napu valley, ca. 100 km SE Palu, Wuasa, ca. 1100 m, 8 i 2001 (*A.-M. KLEIN*) [Negative 164.14].

***C. carinifrons* sp. nov.**

(Figs. 3, 4, 11)

Diagnosis

Distinguished from *rugifrons* by the more prominent and differently formed frontal excrescences, by the weaker and less dense, more ordinary nature, of the facial punctation, by the carinate clypeus, by the impunctate posterolateral areas of the mesoscutum and by the graduated punctation of the mesepisterna; from *alexandrae* by the longer vertex, the strong, laterally displaced, excrescences of the supraclypeal area, the short supra-ocellar sulcus; the longer vertex, and the broader genae.

Description

♀.

Structure. Clypeus with weak, impunctate, median carina; ocellar area defined posteriorly by a weakly impressed transverse sulcus, this not extending laterad of centres of lateral ocelli and lying about half an ocellar diameter above them; vertex long, lateral ocelli separated from vertex by more than twice their diameter (1 : 2.5); paraocular area laterally, from below level of antennal fossa to level of summit of eye, strongly inflated (particularly noticeable when the head is seen in dorsal aspect), forming a conspicuous narrow, narrowly rounded, longitudinal ridge; both the convex outer face of the ridge and the broadly concave surface of the frontal area inward of the ridge impunctate (Figure 11); gena at mid-level of eye broader than eye (in lateral aspect of head, eye-width : genal width as 1 : 1.7).

Punctation. Face with much weaker punctation than in *rugifrons*, the clypeal punctures shallow, ill-defined, separated by about half puncture diameter, those of the paraocular areas anteriorly more widely separated; vertex moderately densely, irregularly punctate. Mesoscutum anteriorly densely punctate, the punctures tending, especially laterad, to become slightly elongated and subconfluent; posterolateral areas impunctate except for the usual lateral series; mesepisternum dorsally densely, reticulately punctate but from about midway between episternal scrobe and subpleural signum becoming much less dense with evident glossy interspaces of about half puncture diameter, below subpleural signum abruptly finer and denser.

Maculation. Clypeal fascia linear, not or weakly expanded medially; frontal spots small, subcircular; paraocular marks widened apicad to fill epistomal suture below anterior tentorial pit. Pronotal fascia divided medially and separated from spots on lateral lobes; four mesoscutal vittae present; scutellum nearly entirely yellow; postscutellum black (in one example with small median spot); mesepisternum with postpronotal spot; tegula dark (in one example weakly yellow-marked); axillary sclerites dark (in one example weakly yellow-marked); femora with small apicodorsal spots, on I prolonged posteriorly and ventrally basad as a broad vitta; tibia I dorsally largely yellow, II with short dorsal vitta, III with small basidorsal spot. Fascia of T1 as in *rugifrons*; T2 – : see Figure 4.

♂. Not known.

Etymology. *L. carina* + *frons*, referring to the frontal excrescences.

Type material

Holotype ♀, labelled 'Indonesia. Sulawesi / II / P4 / Area: 3 / Date: 15.12.00 / leg. A.-M. Klein' [ink and print], deposited in OUM. [The data indicate: Central Sulawesi, Napu valley, ca. 100 km SE Palu, Alitupu, ca. 1100 m, 15 xii 2000, on ASTERACEAE sp.]

Paratypes [original labelling not transcribed]: 1 ♀ data as holotype; 2 ♀ ♀ data as holotype but locality Wuasa, not Alitupu, and dates 15 xii 2000, 7 i 2001 [GAUG, DBB].

The type locality was a three-year-old agroforestry system, with *Gliricidia sepium* STEUD. [Madre, LEGUMINOSAE] and *Theobroma cacao* L. [Cacao, STERCULIACEAE] as shade trees, in the vicinity of the Lore-Lindu National Park, about 1400 m from the forest edge.

C. alexandrae sp. nov.

(Figures 5, 6)

Diagnosis

Distinguished from *rugifrons* by the simply convex upper paraocular area, the weaker and less dense, more ordinary nature, of the facial punctation, by the carinate clypeus, by the impunctate posterolateral areas of the mesoscutum and by the graduated punctation of the mesepisterna; from *carinifrons* by the simply convex upper paraocular area, the nature of the posterior delimitation of the ocellar area, the relatively shorter vertex and narrower gena, and the reduced maculation, notably the absence of frontal maculae, the dark pronotal lobes and the absence of a mesepisternal post-pronotal macula.

Description

♀.

Structure. Clypeus with weak median carina; ocellar area defined posteriorly by a narrow, depressed, impunctate, glossy arc, produced forward on either side to enfold lateral ocelli; vertex shorter than in *rugifrons* or *carinifrons*, the lateral ocelli separated from occipital ridge by less than twice their diameter (1 : 1,7); paraocular area above level of antennal fossa weakly convex, sparsely, finely punctate; gena at mid-level of eye narrower than in *rugifrons* or *carinifrons* (in lateral aspect of head, eye-width : genal width as 1 : 1).

Punctation. Face anteriorly rather uniformly, shallowly, punctate, glossy, the punctures ill-defined, separated by one puncture diameter or more; vertex more strongly and, behind the ocellar area, more densely punctate. Mesoscutum anteriorly densely punctate but with evident, narrow, glossy interspaces, the punctures becoming coarser and more widely spaced posterad but the interspaces not attaining puncture diameter; posterolateral areas impunctate except for the usual marginal tract; mesepisternum dorsally densely, subreticulately punctate, matt, the punctation becoming less dense ventrad with evident though narrow interspaces, here glossy, denser again towards level of epipleural signum and on pseudosternum.

Maculation. Yellow markings less extensive than in *rugifrons* or *carinifrons*. Clypeal fascia linear, without median upward extension; frontal spots absent; paraocular markings widened and gently curved inward anteriorly. Dorsal pronotal fascia reduced to small lateral spots; pronotal lobes dark; mesoscutum with distinct but short outer vittae and a faint indication of longer inner vittae; scutellum with triquetrous macula, incised anteriorly,

or the macula dissolved into three spots; mesepisternal spot absent; axillary sclerites dark; femur I with small dorsoapical spot, II and III immaculate; tibia I with dorsal yellow vitta, anteriorly and posteriorly more or less red, ventrally black; tibiae II and III entirely black. T1 immaculate or with small, indistinct spots representing lateral extremities of the usual fascia; T2 – : see Figure 6.

♂. Not known.

Etymology. Named for A.-M. KLEIN, Göttingen, who collected the species in central Sulawesi.

Type material.

Holotype ♀ labelled 'Indonesia. Sulawesi / IV / P6 / Area: 10 / Date: 07.01.01 / leg. A.-M. Klein' [ink and print], deposited in OUM. [The data indicate: Central Sulawesi, Napu valley, ca. 100 km SE Palu, Wuasa, ca. 1100 m, 7 i 2001.]

The type locality was an unshaded, after slash and burn, coffee plantation immediately adjacent to the forest edge of the Lore-Lindu National Park.

Other material examined, not paratypes: A series of 8 ♀ ♀ from NE Sulawesi (47km WSW Kotamobagu, Dumoga-Bone National Park, Toraut (forest edge), 211 m [sic], v 1985 (*G.R. ELSE*) [BMNH, DBB]: Figures 9, 10), agreeing structurally and in punctuation with *alexandrae* appears to represent a form of that species with much more extensive yellow maculation. The well developed dorsal pronotal fascia is narrowly united with the maculae of the pronotal lobes, the four vittae of the mesoscutum are well developed, the scutellum is largely yellow, a post-pronotal spot is present on the mesepisternum, the axillary sclerites are yellow-marked, and the tergal fasciae are entire or nearly so; the clypeal fascia is however dissociated into a more or less triangular median macula and small lateral spots. Three ♂ ♂ associated with these ♀ ♀ and almost certainly conspecific with them should serve to confirm identity when the ♂ of *alexandrae* becomes known.

Abbreviations

Terminology

The terminology of this paper is essentially that of MICHENER (1944). Femur, tibia I, II, III refer to the anterior, intermediate and posterior legs; T1, T2 etc refer to the metasomal terga.

Acronyms for collections.

BMNH	Natural History Museum, London (formerly British Museum (Natural History)).
DBB	D.B. BAKER, personal reference collection.
GAUG	Fachgebiet Agrarökologie, Georg-August-Universität, Göttingen.
OUM	Oxford University Museum of Natural History, Oxford.

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NOTE

¹ Two large, widely distributed SE Asian megachilids, *Creightonella frontalis* (F., 1804) and *Chalicodoma* (*Eumegachilana*) *tuberculatum* (SMITH, 1857), are distinctive in that both have yellow-winged western forms [*frontalis atrata* SMITH, 1853, *tuberculatum tuberculatum* (SMITH, 1857)] and black or dark grey-winged eastern forms [*frontalis frontalis* (F.), *tuberculatum clotbo* (SMITH, 1860)], the dividing line being Huxley's line (1868) (BAKER, 1993: 20-22, pl. II). In both species, the Sulawesi form is the dark-winged eastern form (except for one record of yellow-winged *frontalis* from the extreme southern end of the south-western arm of the islands). The *Chalicodoma* has as a cleptoparasite a species of *Torridapis*, the large *T. ducalis* (SMITH, 1854). The species also exists in two strikingly different colour forms, but here the western form (continental SE Asia, Malaysia, Philippines) is the dark-winged nominotypical form while the Sulawesi form, *flavipennis* (FRIESE, 1908), described from Toli-Toli in N Celebes, is yellow-winged. There seems no obvious explanation of this reversal. Unfortunately, available material of *T. ducalis* is inadequate to demonstrate where the dividing line between the two forms runs. *T. ducalis flavipennis*, apparently common in NE Sulawesi, is represented also in the Göttingen material from the Wuasa valley (near Alitupu, 28 xii 2000, collected at *Coffea canephora*).

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