A PRELIMINARY REVISION OF THE ORIENTAL SPECIES OF THE GENUS CERATINA (HYMENOPTERA, APIDAE)

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The Oriental bees of the genus *Ceratina* Latr. are difficult to identify. Until now our knowledge of these insects consisted mainly of a considerable number (about 90) of isolated descriptions, scattered through several scientific journals. Most of these descriptions are based on colour characters and although these are certainly not without taxonomic value, they must be used with great care on account of their intra-specific variability. The structural and sculptural characters which are much more reliable for distinguishing the species have thus far not received sufficient attention.

There exist a few keys, dealing with the species occurring in certain parts of the region, but none of these contains more than 11 species and the characters used are often of doubtful taxonomic value.

An attempt to identify a large number of species collected in Indonesia, mainly in Java, by Dr. and Mrs. Lieftinck, my wife and myself, soon demonstrated the necessity of a revision of the *Ceratina* species described from this and other parts of the Oriental region.

It would have been completely impossible to recognize the majority of these species with sufficient certainty from their descriptions. Fortunately I had an opportunity to study much authentic material. In September 1951 I examined the types of several species described by Smith, Cameron, and Cockerell in the collections of the British Museum (Natural History) and the Oxford University Museum; some additional types, preserved in the Rothney collection in the latter Museum, were kindly sent to me for study at a later date.

The U.S. National Museum sent me a very interesting collection of oriental *Ceratina,* containing several species identified by Cockerell as well as some "cotypes" (paratypes) of species described by this author.

The Museum Zoologicum at Bogor (Buitenzorg), Java, the Museum of Natural History at Leiden, and the Zoological Museum at Amsterdam supplied further material as a basis for these studies.

I am very much indebted to the authorities of all these institutions for their valuable assistance and cooperation. In particular I wish to thank Mr. Karl V. Krombein, Division of Insect Identification of the Bureau of Entomology and Plant Quarantine, U.S. Dept. of Agriculture, for sending me detailed notes on some unique types in the collections of the U.S. National Museum. Furthermore Mr. Krombein kindly reviewed the manuscript of this paper and sent me various corrections and valuable suggestions.

The present revision is preliminary and incomplete. In very few areas has enough collecting been done to obtain an adequate idea of the *Ceratina* species occurring there, and even in the best explored localities, such as West Java and certain parts of the Philippine Islands, there remain problems to be solved, because certain species are as yet too poorly represented in collections. I have purposely omitted from this revision a number of species which have been found only at the northern or western margins of the oriental region and which appear to belong to the palaearctic fauna (compare the list on p. 7).

HISTORICAL.

Two oriental species of *Ceratina* had been described by the end of the eighteenth century, viz., *C. smaragdula* (Fabr.), 1787, and *C. aenea* (Fabr.), 1798; both were described under the generic name *Apis*. The first species was recorded from Tranquebar, the second from "India orientali".

In 1854, F. Smith added a few more species from the Oriental region in his catalogue of bees in the British Museum of Natural History. The original material of one of these, *C. hieroglyphica,* undoubtedly consisted of two or three species and this has been the cause of a good deal of confusion. Some authors have used the name *hieroglyphica* for any black and yellow oriental *Ceratina,* and consequently one often finds several species together under this name in museum collections. Another of Smith's species, *C. maculata,* has proved to be identical with *C. smaragdula* (F.), and I have recently discovered that a third species, described in this catalogue from Java (*C. smaragdina*) is based on an incorrectly labelled specimen probably originating from America.

The collections made by A. R. Wallace in the East Indies yielded some further species which were described by Smith in 1858 and 1861, and finally a revision of the material in the British Museum induced this author to recognize another five species from different parts of the oriental region as new to science. The descriptions were published posthumously in 1879.

Since then, some further species have been added by Bingham, Cameron, Nurse, Friese, and others. After about 1910 the subject was almost monop-

olized by the prolific T. D. A. Cockerell, who in the period 1908-1937 published the descriptions of approximately 30 new species in more than a dozen different papers. Unfortunately this author bothered very little about the previously published species and never redescribed any of them. Moreover the descriptions of his new species are often inadequate.

SUBGENERA.

Several subgenera of *Ceratina* have been described, but the study of the oriental material has shown that some species cannot be placed satisfactorily into the existing subgenera.

In the present revision the oriental species have been tentatively arranged in seven subgenera. For three of them names were available, viz., *Pithitis* Klug, *Chloroceratina* Ckll., and *Ceratinidia* Ckll. For three others new names have been proposed. One subgenus has been left unnamed, because not enough material was available to permit an adequate study of this group. Perhaps the name *Neoceratina* Perk. 1912 will prove to be applicable to this subgenus.

The type of the genus *Ceratina* is a palaearctic species, *C. cucurbitina* (Rossi). I am not aware that the subgeneric group to which it belongs has ever been clearly defined, but I have not seen any species from the oriental region which could be considered as closely related to *C. cucurbitina,* at least not if certain palaearctic species penetrating into border areas of the oriental region are excluded (compare p. 7).

Other subgenera of *Ceratina* apparently not occurring in the region under consideration are *Zadontomerus* Ashm. 1899, *Calloceratina* Ckll. 1924, and *Crewella* Ckll. 1903.

MORPHOLOGICAL NOTES.

It is not intended to discuss here the external morphology of these bees in detail, but a few remarks on some features which thus far have often been overlooked in descriptions appear necessary at this point.

Head. — In most species the vertex and upper part of the temples merge gradually into the occiput, but in *Pithitis* and in *Catoceratina* these parts are sharply separated. The apex of the mandibles is tridentate in the female, the middle tooth usually slightly longer than the others; in the male the upper (basal) tooth is often obsolete or absent. The clypeus has the shape of a reversed T, the median portion is about rectangular, the lateral areas are generally rounded at the sides. The sculpture of the clypeus is of taxonomic importance, although some species show considerable variation in this respect. The median portion of the clypeus is separated from the eyes by the lower

part of the paraocular areas; the degree of puncturation of the latter varies but is fairly constant in the species. The antennae are placed in subcircular depressions, the antennal fossae, which are separated by a sharp median carina. The upper part of each fossa often shows a groove into which the antennal scape fits; I have called this the antennal groove. The space between the upper outer margin of the antennal fossa and the inner orbit is conspicuously swollen in some species from Celebes and the Philippine Islands.

There is a considerable variation in the degree of coarseness and the density of the puncturation on front and vertex; the temples are very densely punctate in *Pithitis,* but in most of the other species they bear at most some scattered punctures.

Thorax. — The puncturation of the mesoscutum and the mesopleura is often characteristic. In *Pithitis* these parts are uniformly and densely punctate, but in most other species the anterior part of the mesoscutum is punctate, the posterior half or two thirds impunctate or at least more sparsely punctate; there is usually a transverse band of punctures at the posterior margin. The puncturation of the lateral areas of the mesoscutum (the parts between tegulae and parapsidal furrows) is often of special importance. As regards the shape of the propodeum, the species of *Pithitis* differ from all others discussed here; among the latter there is some variation in the angle between dorsum and declivity; it is smallest in *Chloroceratina.*

Anterior coxae transverse, outer side usually rounded at base, sometimes angular or tuberculate. Outer surface of hind tibiae with an apically directed, scale-like projection or denticle (absent in *Pithitis*), often indistinct in the male.

Abdomen. — I have examined and figured the terminal segments and the genitalia of a number of species. The differences occurring in these parts appear to be of considerable taxonomic significance. In future work on the "difficult groups" of this genus it would appear advisable not to describe any new species without paying due attention to the characters of the male abdomen.

Macrocephalic females. — In several species of this genus large female specimens are often "macrocephalic": they have the head relatively large and strongly produced behind the eyes, the inner orbits — usually parallel in normal specimens — conspicuously divergent towards the mouth. I have seen very striking examples of this phenomenon in *C. accusator, C. bryanti, C. flavolateralis, C. litoraria,* and *C. tropica.*

COLOUR PATTERN.

A few species of oriental *Ceratina* are metallic, with sparse yellow or

whitish markings on clypeus, labrum, pronotum and legs; this pattern is found in the subgenus *Pithitis* and in *C. propinqua*. *C. dentipes* is black with a similar pattern of pale markings.

In all other species discussed in this paper the yellow markings are more extensive. A female of the subgenus *Ceratinidia* with a "complete" pattern may show yellow markings on the following body parts: labrum; mandibles; clypeus (usually a mark shaped like a reversed T, sometimes reduced to a transverse band); paraocular areas (line along inner orbits, usually widened below, sometimes broken up into two spots); supraclypeal area (transverse band between antennal fossae and clypeus); front (two spots above antennae, here called: supra-antennal spots); antennae (in some species yellow spots at base and apex of scape); temples (vertical line, narrowed below); pronotum (transverse band, often connected with yellow spot on tubercles); mesoscutum (four longitudinal stripes, the inner two usually narrower than the outer two); scutellum (often whole disk yellow and then the quadrangular mark usually incised laterally near posterior angles; reduction of the mark tends to begin at posterior angles); mesopleura (spot at anterior margin, behind tubercles; often absent); postscutellum (in this group rarely with yellow mark); abdominal tergite 1: transverse apical band, with two black spots in it; when reduced, the band may be twice deeply incised anteriorly, or broken up into three spots; sometimes only small lateral spots or entirely black; tergite 2: apical band, abruptly widened laterally, often interrupted medially; tergite 3: as 2; tergite 4: band widened medially, narrowed laterally, often incised anteriorly or narrowly interrupted in the middle; tergite 5: band even more strongly widened in the middle, and also narrowed laterally. Legs with yellow spots and lines; coxae and trochanters black.

In the male the markings on labrum, clypeus, paraocular areas, and legs are usually more extensive than in the female, whereas there may be some reduction on other parts of the body (mesoscutum, scutellum, abdomen).

The females of the subgenera *Lioceratina* and *Xanthoceratina* have a similar pattern, but in addition there may be the following markings: a transverse spot on each side of the vertex near posterior margin (here called postocellar spots; they are sometimes connected by a transverse band); the mesopleura with large yellow marks, ventrally often with curved lines, in some species entirely yellow; metapleura partly or entirely yellow; propodeum (declivity and sides more or less yellow, sometimes also the dorsum); first abdominal tergite sometimes entirely yellow, second and following tergites each with yellow band on basal part (the band on the "pregradular area" is always partly hidden beneath the preceding tergite, it should not be confused with the apical band on that tergite!); sixth tergite rarely with median yellow

line; sternites more or less extensively pale yellow; legs also more extensively yellow.

In some species of these groups the black colour may be partly replaced by light brownish red (see *C. flavopicta lauta*; *C. cosmiocephala*).

BIOLOGICAL NOTES.

Several of the *Ceratina* species occurring in Java inhabit the cultivated areas where the original vegetation has entirely disappeared. In the direct neighbourhood of human dwellings in towns and villages we may find such species as *C. smaragdula, unimaculata, dentipes, cognata, bryanti,* and *nigrolateralis acuticauda.* They visit the flowers of cultivated plants as well as those of several weeds. Typical forest species are rare in Java, partly perhaps because remains of the original vegetation are so scarce nowadays. *C. perforatrix* and *C. ridleyi* are examples of this category; they are probably restricted to the flowers of indigenous species of plants. Less rare, and perhaps also adapted to conditions in secondary wild vegetation are *C. flavopicta xanthura, fuliginosa, cladura,* and probably also *C. accusator. C. litoraria* and *C. jacobsoni* have been found almost exclusively near the coast.

The nesting habits of *Ceratina* have been studied in certain palaearctic and nearctic species. In 1912 G. R. Dutt published some notes on the life history of the Indian "*Ceratina viridissima*" (see p. 22 of this paper), but I am not aware of special investigations on any other oriental representatives of the genus. Several incidental observations indicate that in this region, like elsewhere, these bees nest in branches of various plants. In Java, they have been reported a few times to cause damage to cultivated plants by tunneling in the branches. The tunnels are also used by the adults as a shelter and may harbour several specimens of both sexes together in periods of dark weather, and presumably also during the night.

ORIENTAL SPECIES NOT DISCUSSED IN THIS PAPER.

The following species have been recorded from the Oriental region, but are not included in this revision.

C. bhawani Bingham, Rec. Ind. Mus. I (1908): 360, ♀; Simla Hills, 8000′, Himalaya.

C. corinna Nurse, Jl. Bombay Nat. Hist. Soc. XV (1904): 576, ♀; Quetta, N.W. India.

C. egeria Nurse, Jl. Bombay Nat. Hist. Soc. XV (1904): 576, ♂; Quetta, N.W. India.

C. incognita Bingham, Jl. Bombay Nat. Hist. Soc. XII (1898): 127; Simla.

(The type of this species, a ♂ in the collection of the British Museum, is in poor condition; the abdomen is missing).

C. ino Nurse, Jl. Bombay Nat. Hist. Soc. XV (1904): 575, ♀ ♂; Quetta, N.W. India.

C. laevifrons Mor., Hor. Soc. ent. Ross. XXIX (1895): 18; Turcomenia (recorded from Quetta by Nurse, Jl. Bombay Nat. Hist. Soc. XV (1904): 577; occurs also at Deesa).

C. loquata Nurse, Jl. As. Soc. Bengal LXX (1902): 153, Simla.

C. morawitzi Sickm. (new name for *C. flavopicta* Mor. 1890, nec *flavopicta* Sm. 1858), Zool. Jahrb. Syst. VIII (1894): 263, China. (I am not sure that the ♂ described by Sickmann under this name is indeed conspecific with the female described by Morawitz (Hor. Soc. ent. Ross. XXIV, 1890: 356).

C. muscatella Nurse, Jl. As. Soc. Bengal LXX (1902): 152; Simla.

C. obtusicauda Ckll., Proc. U.S. Nat. Mus. 55 (1919): 174, ♂ — This species was based on a single specimen, collected at Pelabuan Ratu, South coast of West Java. The type is in the U.S. National Museum. Although Mr. Krombein sent me some notes on this specimen in addition to the original description, I have been unable to identify this species with complete certainty.

C. picta Smith, Cat. Hym. Br. Mus. II (1854): 224, no. 10, ♀, Ceylon.

C. unicolor Friese, Verhandl. zool.-bot. Ges. Wien 61 (1911): 126, ♀; Formosa. — Cockerell described the male of this species: Entomologist 44 (1911): 341, Formosa.

SPECIES ERRONEOUSLY THOUGHT TO BE ORIENTAL CERATINA.

Ceratina taprobanae Cam., Mem. Proc. Manch. Lit. Phil. Soc. XLI (1897), no. 4, p. 138, Ceylon (sex not mentioned) = *Nomioides taprobanae* (Cam.), ♀. I have examined the type, which is in the Rothney collection in the Oxford University Museum.

The following species, described as *Ceratina*, have already been transferred to *Nomioides* by previous authors:

Ceratina appendiculata Cam., in: Gardiner, Fauna and Geogr. of Mald. and Lacc. Archip. I (1901): 59 = *Nomioides appendiculata* (Cam.) according to Cockerell, Ann. Mag. Nat. Hist. (8) 4, 1909, p. 312.

Ceratina cerca Nurse, Jl. As. Soc. Bengal LXX (1902): 152, Simla = *Nomioides pulchella* Schck., according to Meade Waldo, Ann. Mag. Nat. Hist. (8) 12, 1913, p. 495.

Ceratina curvilineata Cam., Jl. Bombay Nat. Hist. Soc. 17 (1907): 1004, ♀, Deesa = *Nomioides curvilineata* (Cam.), according to Meade Waldo, Ann. Mag. Nat. Hist. (8) 12, 1913, p. 495.

Ceratina divisa Cam., Jl. Bombay Nat. Hist. Soc. 17 (1907): 1003, ♀, Deesa = *Nomioides divisus* (Cam.), according to Meade Waldo and Morley, Ann. Mag. Nat. Hist. (8) 14, 1914, p. 404.

Ceratina punjabensis Cam., Jl. Bombay Nat. Hist. Soc. 17 (1907): 1003, ♀, Punjab = *Nomioides comberi* Ckll., according to Meade Waldo and Morley, Ann. Mag. Nat. Hist. (8) 14, 1914, p. 404.

Ceratina spilaspis Cam., Jl. Bombay Nat. Hist. Soc. 18 (1908): 657, ♂, Deesa = *Nomioides divisus* (Cam.), according to Meade Waldo and Morley, Ann. Mag. Nat. Hist. (8) 14, 1914, p. 404.

Ceratina smaragdina Smith, Cat. Hym. Brit. Mus. II, 1854, p. 226, ♀, was described from Java, but after having examined the type in the Saunders collection (Oxford University Museum) I am convinced that the locality label is erroneous. *C. smaragdina* appears to be an American species, allied to *C. laeta* Spin.

KEY TO SPECIES

Females.

1. Propodeum truncate, the steep declivity separated from the very short dorsum by a raised edge. Vertex and temples separated from occiput by carina or sharp edge. Sixth abdominal sternite with fine median carina. Metallic green, bronzy or blue forms . . . . . Subgenus *Pithitis* Klug, see p. 15
— Junction of propodeal dorsum with declivity rounded or bluntly angular . 2
2. Head, as seen in front, almost circular. Small species, about 5 mm long, black or metallic blue, with spot on clypeus, pronotal tubercles and a few markings on the legs creamy white 3
— Head in most species distinctly wider than high; larger species (rarely less than 6 mm), more extensively marked with yellow 4
3. Mesoscutum with large impunctate area. Body black. Lateral areas of face sparsely punctate. Very widely distributed. . . . . *C. dentipes* Friese
— Mesoscutum entirely finely punctate. Body metallic blue. Lateral areas of face densely punctate. N. India . . . . . *C. propinqua* Cam.
— For other small species without pale markings on abdominal tergites see p. 27 and p. 28.
4. Space between eyes and ocelli impunctate. Mesopleura almost impunctate or, when rather densely punctate, at least with distinct and shiny interspaces; rarely more densely punctate (see *C. humilior*). Median part of clypeus shiny, in most species impunctate. (Pregradular area of tergites 2-4 often entirely or partly yellow; postscutellum often yellow) 5
— Space between eyes and ocelli with at least a few distinct punctures. Mesopleura rather dull, more or less densely punctate, only the hypo-epimeral area often partly impunctate and shiny. (Pregradular area of tergites 2-4 usually black; postscutellum black, rarely with small yellow spot) . . . Subgenus *Ceratinidia* Ckll. 16
5. Vertex impunctate, margined posteriorly by a fine, sharp carina. Large robust species, length 10-13 mm. (Supraclypeal area, mesoscutum and second abdominal tergite black). Burma to Java . . . . . *C. perforatrix* Sm.
— Vertex rounded posteriorly 6
6. Propodeum, as seen in profile, bluntly angular, the dorsum distinctly separated from the rather steep declivity. Body slender, pronotum narrower than usual. Head, seen

in front, almost circular, the eyes not wider above than below. Clypeus with a few large ill-defined punctures along anterior margin. Dark parts of body more or less distinctly metallic blue. Length 6-7 mm. Philippine Islands . . . . . Subgenus *Chloroceratina* Ckll., see p. 28

— Propodeum, as seen in profile, not distinctly angular, almost evenly convex. Head wider than high. Dark parts of body not metallic 7

7. Median part of clypeus finely coriaceous; basal area of propodeum with similar sculpture, but rather strongly shiny in the middle; anterior part of mesoscutum very finely and densely punctate, the punctures superficial and ill-defined. (Fore wing without cloud in marginal cell). Length 7.5-12 mm. (Compare also *C. kosemponis* Strd. and *C. canarensis* Ckll.) . . . . Subgenus *Lioceratina* n. subg. 8

— Clypeus polished, often slightly and superficially wrinkled, but not coriaceous . . Subgenus *Xanthoceratina,* n. subg. 10

8. Dorsum of propodeum with a shallow longitudinal median impression. Second abdominal tergite with an uninterrupted transverse black band. Length 7.5-11 mm. Philippine Islands . . . . . *C. flavolateralis* Ckll.

— Dorsum of propodeum flat, slightly concave in longitudinal direction, with a slightly raised median line (sometimes indistinct) 9

9. Thorax brownish black, richly marked with yellow. Inner side of mandibles rectangularly bent. Abdomen black with three interrupted yellow bands which are formed partly by lateral marks at posterior margin of tergites 1 and 2, partly by interrupted bands on pregradular areas of tergites 2-4. Length 10-12 mm. Malaya, Sumatra, Java . . . . . *C. ridleyi* Ckll.

— Thorax orange-yellow, the following parts black: mesoscutum (except for the usual four yellow lines), basal area of propodeum and sometimes also the hypo-epimeral areas of the mesopleura. Inner side of mandibles regularly arcuate. Abdomen orange-yellow with transverse black bands, the anterior segments sometimes only with dark lateral spots. Length 8-11 mm. Malaya, Borneo, Java. (For specimens from Celebes see *C. pictifrons* Sm.) . . . . . *C. flavopicta* Sm.

10. Fore wing with a conspicuous fuscous cloud, occupying the marginal cell and part of the area beyond it. Length 8-9 mm. Palawan, Borneo, Sumatra, Java . . *C. fuliginosa* Ckll.

— Marginal cell of fore wing subhyaline, scarcely darker than the submarginal cells 11

11. Anterior half of mesoscutum dull, densely covered with well defined punctures. Lateral face marks divided into two spots; mesoscutum and propodeum black. Length 5.5-6 mm. Palawan, Java. . . . . *C. humilior* Ckll.

— Anterior part of mesoscutum shiny, rather densely punctate, but the punctures superficial, fine and irregular. Lateral face marks not divided; mesoscutum with yellow lines; propodeum often with large yellow mark on each side, the two marks often confluent in the middle 12

12. Thorax light reddish brown with yellow markings; abdomen brown, the base of the posterior tergites with suffused black lateral spots. Length 7 mm. Borneo . . *C. cosmiocephala* Cam.

— Thorax black with yellow markings 13

13. Mesopleura entirely yellow; posterior face of propodeum smoky to blackish; lateral face marks wide; clypeus yellow, upper and lateral margins of median part narrowly black; first abdominal tergite yellow with two dark spots, following tergites with yellow apical bands (wide on 2 and 3), the sternites yellowish. Post-ocular spots absent? Length 9 mm. Formosa . . . . . *C. kosemponis* Strand

— Mesopleura partly dark brown or black (compare *C. cladura crocina*) . . 14

14. Face below antennae yellow. Mandibles pale yellow, suffused with red, their apices dark. Abd. tergites 1-3 reddish, marked with yellow (patch on 1 and yellowish

band on 2) and black (on each side of yellow mark on 1); the others black, posterior margins of 4 and 5 narrowly testaceous. Legs obscure reddish. Length 10 mm. India *C. canarensis* Ckll.

— Upper arm of clypeal mark separated from lateral face marks by dark line. First abdominal tergite yellow and dark brown, the following tergites dark, with testaceous or yellow apical margin, at least 2 and 3 yellow at base (on pregradular area) . 15

15. Length 4.5-5 mm. Supra-antennal spots long and rather narrow, slightly converging anteriorly where they are connected with a yellow line on the inter-antennal carina. Post-ocellar spots united in the middle; prothorax and lower part of mesopleura yellow; propodeum black, legs yellow. Abdominal tergites yellow at base and apex, first and sixth tergites with median yellow line; sternites entirely yellowish. Ceylon *C. beata* Cam.

— Length 6-8 mm. Supra-antennal spots shorter, not connected, interantennal carina black. Post-ocellar spots separate, sometimes absent. Propodeum partly yellow. Sumatra, Java, also Phil. Isl.? . . . . . *C. cladura* Ckll.

— Compare also *C. bipes* Ckll. and *C. metaria* Ckll., both described from Penang.

16. Paraocular areas below antennal fossae each with about 15-20, sometimes more, rather large and distinctly defined punctures, the lower (yellow) margin of these areas usually impunctate. Clypeus with shallow median longitudinal impression, on each side of it rather densely punctate (the impression is sometimes indistinct in *C. okinawana*). Upward extension of clypeal mark usually short. Lower end of lateral face marks curved inwards. Mesopleura black, very rarely with small yellow spot behind tubercles. Mid tibiae entirely dark or with small yellow spot at base; metatarsi dark. Transverse line on pronotum separated from yellow spot on tubercles. Abdominal bands rarely interrupted. Length 7-9 mm. (Compare *C. hieroglyphica* and *C. lepida*).
Ryukyu Islands: . . . . . *C. okinawana* Mats. & Uch.
Siam, Sumatra, Java, Bali: . . . . . *C. bryanti* Ckll.

— Paraocular areas below antennal fossae with a few scattered, usually ill-defined punctures; if more densely and distinctly punctate, the clypeus different, the lateral face marks divided or the legs more extensively yellow 17

17. Median portion of clypeus densely punctate 18

— Median portion of clypeus more or less shiny, its surface often irregularly and superficially wrinkled; if punctate, the punctures superficial and ill-defined . 22

18. Supraclypeal area faintly trituberculate. Median portion of clypeus almost uniformly densely punctate, the punctures small and rather well defined. Anterior part of clypeus with transverse yellow line which is slightly dilated in the middle. A small species, length 5-7 mm. Sumatra, Java . . . . . *C. litoraria,* n. sp.

— Supraclypeal area bluntly angular in the middle above 19

19. Anterior part of mesoscutum coarsely, but sparsely punctate, the interspaces distinct and shiny. Antennal fossae punctate throughout. Length 7 mm. Philippine Islands *C. bicuneata* Ckll.

— Anterior part of mesoscutum dull, more finely and densely punctate, at least laterally the interspaces much smaller than the punctures. Outer side of antennal fossae impunctate or with a few scattered punctures 20

20. Space between upper part of antennal fossae and eyes more or less swollen, impunctate 21

— This space not abnormally swollen. Mesoscutum black; lateral areas without large impunctate space . . . . . See *C. cognata* and *C. punctigena*

21. Lateral areas of mesoscutum distinctly and fairly densely punctate, rarely with a rather large impunctate space. Mesopleura densely punctate, but ventrally with distinct shiny interspaces. Lateral face marks divided; mesoscutum usually black, at most with inner yellow lines; mesopleura rarely with small yellow spot behind pronotal tubercles. Length 6-8 mm. Philippine Islands . . *C. tropica* Crawfd.

— Lateral areas of mesoscutum with large impunctate space (sometimes with a few scattered punctures); mesopleura dull, very densely and rugosely punctate, without shiny interspaces. Lateral face marks not divided; mesoscutum with four yellow lines or with only the lateral ones; mesopleura with yellow spot, which may be absent in dark specimens. Length 7-8 mm. Celebes . . . . . *C. rugifrons* Sm.

22. Lateral areas of mesoscutum with at least a single row of punctures along the parapsidal furrow, usually with a double row or even more densely punctate (for specimens from Palawan, Phil. Isl., compare also *C. nigrolateralis* Ckll.; do. from the Moluccas: *C. interrupta* Alfk.) 23

— Posterior part of lateral areas of mesoscutum impunctate or with a few scattered punctures 28

23. Mesoscutum with four yellow lines 24

— Mesoscutum black or with only the outer lines 26

24. Mesopleura with yellow spot behind the tubercles 25

— Mesopleura entirely black. Antennal scape black or dark brown. Markings pale yellow. Length 5.5-7 mm. India . . . . . *C. simillima* Sm.

25. Antennal scape yellow at base. Length 5.5-8 mm. Philippine Islands . . . . . *C. compacta* Sm. (= *philippinensis* Ashm.)

— Antennal scape black. Length 6.5-8 mm. Java, Siam . . *C. lieftincki,* n. sp.

26. Mesonotum black. Lateral face marks strongly dilated below. Tibiae yellow, brownish on inner side, tarsi ferruginous-yellow. Mesopleura sometimes with small yellow spot behind tubercles 27

— Mesoscutum with short yellow line on each side above tegulae. Lateral face marks slightly dilated below (fig. 62). Legs darker, tibiae III with short yellow line at knee. Length 6.5-8 mm. Java . . . . . *C. jacobsoni,* n. sp.

27. Temples with a few scattered, superficial punctures. Mesopleura with shining interspaces on ventral side in front of mid coxae. Length 6-8.5 mm. Siam to Celebes *C. cognata* Sm.

— Temples coarsely and rather densely punctate. Mesopleura coarsely, reticulately punctate, entirely dull. Coloration as in *C. cognata* Sm. Length 7 mm. Java . . *C. punctigena,* n. sp.

28. Anterior part of mesoscutum finely and sparsely punctate, punctures much smaller than interspaces, posterior half almost impunctate. Body more densely pilose than in other species. Mesoscutum and mesopleura black. Length 7-8 mm. N. India *C. ornatifera* Cam.

— Anterior part of mesoscutum densely, and as a rule rather coarsely, punctate; at least laterally the interspaces smaller than the punctures. 29

29. Transverse line on clypeus with small upper lobe, often this line only slightly dilated in the middle. Lateral face marks short, not or hardly reaching above level of antennae. Mesoscutum with four yellow lines; supra-antennal spots small; first abd. tergite with small spots, tergites 2 and 3 with lateral yellow marks "resembling a hand with index finger pointed" (Ckll.); tergites 4 and 5 with yellow bands. Length 5.5-6.5 mm. Siam, Malaya, Sumatra, Borneo, Java (specimens from the latter island are larger and darker) . . . . . *C. accusator* Ckll.

— Transverse line on clypeus with distinct upper lobe. Clypeus with more or less distinct median carina. Generally larger species 30

30. Upper arm of yellow clypeal mark more or less deeply incised. Mesoscutum black or with only the outer yellow lines 31

— Upper arm of clypeal mark not or only very shallowly incised. Mesoscutum usually with four yellow lines 32

31. Bands on abdominal tergites 2 and 3 widely interrupted. Clypeus with sharp median carina. Length 6.5-8 mm. Moluccas . . . . . *C. interrupta* Alfk.

— Abdominal bands not or scarcely interrupted. Clypeus with faint median carina. Length 6.5-8 mm. New Guinea . . . . . *C. papuana*, n. sp.

32. Yellow spot on scutellum more or less narrowed posteriorly, the posterior margin of the disk of the scutellum not yellow over its entire width. Face: fig. 65. Antennal scape often black. Hind tibiae black or with small yellow spot at base. Length 6.5-10 mm. Palawan, Malaya, W. Indonesia . . . . *C. nigrolateralis* Ckll.

— Yellow spot on scutellum rectangular, not narrowed posteriorly. Face: fig. 63. Antennal scape ferruginous or yellowish at base, sometimes also with small spot at tip. Hind tibiae with yellow ring at base, on outer side with longitudinal yellow spot. Length 6-8 mm. Siam, Malaya, Borneo, Sumatra, Java . *C. collusor* Ckll.

Males.

1. Propodeum truncate, the steep declivity separated from the very short dorsum by a raised edge. Head truncate behind, vertex and temples separated from occiput by carina or sharp edge. Body densely punctate. Sixth abdominal sternite with lateral teeth (figs. 1, 5); genitalia without tufts of hairs. Metallic green, blue or bronzy species. Length 6-8 mm. . . . . Subgenus *Pithitis* Klug 2

— Junction of propodeal dorsum with declivity rounded or bluntly angular . . 4

2. Abdominal tergites 4-6 each with two velvety black spots. Tergite 7 triangular, ending in a point. Femora III normal, uniformly covered with fine erect hairs. Throughout South East Asia . . . . . *C. smaragdula* (Fabr.)

— Tergites 4-6 without black spots. Apex of tergite 7 rounded. Femora III bluntly projecting posteriorly at about one fourth from base 3

3. Under side of hind trochanters and basal fourth of hind femora with a comb of long, whitish, curved hairs; the comb ends abruptly at the widest part of the femur (fig. 4). Apex of seventh tergite broadly rounded. From Siam to Celebes; not in the Philippine Islands? . . . . . *C. unimaculata* Sm.

— Hind trochanters and femora bare. Seventh tergite relatively longer, the sides converging towards the narrow apex which is roundly truncate. Pakistan, India *C. binghami* Ckll.

4. Body metallic blue, densely and finely punctate. Abdomen without yellow markings. Length 4-5 mm. . . . . *C. propinqua* Cam.

— If the body is metallic blue, the puncturation is sparse and superficial . . 5

5. Hind tibiae with tooth on inner side (fig. 8). Small species; black with creamy white marks on labrum, clypeus, pronotal tubercles, and legs. Length 4.5-6 mm. Very widely distributed . . . . . *C. dentipes* Friese

— Hind tibiae normal. Pale markings usually more extensive 6

6. Space between ocelli and eyes impunctate. Mesopleura rarely densely punctate (see *C. humilior* Ckll.). Median part of clypeus shiny, in most species impunctate. Postscutellum often yellow, usually also mesopleura, propodeum, and pregradular areas of abdominal tergites marked with yellow 7

— Space between ocelli and eyes at least with a few distinct punctures. Mesopleura densely punctate. Postscutellum rarely with vague yellow mark; mesopleura at most with yellow spot behind pronotal tubercles; propodeum and pregradular areas of abdominal tergites black . . . . . Subgenus *Ceratinidia* Ckll. 18

7. Vertex impunctate, separated from occiput by a fine, sharp carina. Supraclypeal area, mesoscutum and second abdominal tergite black. Apex of seventh abdominal tergite truncate. Length 8-9 mm. Burma to Java . . . *C. perforatrix* Sm.

— Vertex rounded posteriorly 8

8. Antennae slender, the middle segments more than 1½ times as long as wide. Dark parts of head and thorax more or less distinctly metallic blue. Seventh abdominal tergite with median point and lateral angles. Length 6-7 mm. Philippine Islands. Subgenus *Chloroceratina* Ckll. 9

— Antennae short, the middle segments hardly longer than wide. (For specimens from India compare also *C. canarensis* Ckll.) 10
9. Abdomen black . . . . . *C. benguetensis* Ckll.
— Abdomen metallic blue . . . . . *C. cyanura* Ckll.
10. Apex of tergite 7 bilobate (fig. 21). Length 6.5-9 mm. Philippine Islands . . . *C. flavolateralis* Ckll.
— Apex of tergite 7 not bilobate 11
11. Apex of tergite 7 with median tooth and distinct lateral angles (figs. 15 and 18). Length 7-9 mm. Malaya, Indonesia 12
— Apex of tergite 7 arcuate, bluntly angular or faintly bituberculate; lateral angles bluntly rounded . . . . . Subgenus *Xanthoceratina,* n. subg.[1]) 13
12. Median tooth of tergite 7 blunt (fig. 15). Sixth sternite: fig. 14. Yellow bands on pregradular area of tergites 2 and 3 narrowed towards the middle and here interrupted . . . . . *C. ridleyi* Ckll.
— Median tooth of tergite 7 sharper than in *C. ridleyi* (fig. 18). Sixth sternite: fig. 17. Yellow band on pregradular area of tergites 2 and 3 usually entire. (See also *C. pictifrons,* Celebes) . . . . . *C. flavopicta* Sm.
13. Apex of tergite 7 faintly bituberculate in the middle (fig. 35). Mesopleura densely punctate. Sternites 2-4 with conspicuous white tomentum. Length 5-6 mm. Palawan, Java . . . . . *C. humilior* Ckll.
— Apex of tergite 7 rounded or bluntly angular 14
14. Thorax light reddish brown with yellow markings. Length 6-7 mm. Borneo . . *C. cosmiocephala* Cam.
— Thorax black and yellow 15
15. Mesopleura entirely yellow 16
— Mesopleura partly brownish or black (Malaya, W. Indonesia) 17
16. Length 9 mm. Formosa . . . . . *C. kosemponis* Strand
— Length 4 mm. Malaya (compare *C. cladura crocina* n. subsp., Sumatra) . . *C. metaria* Ckll.
17. Marginal cell smoky. Length 6-7 mm. . . . . *C. fuliginosa* Ckll.
— Marginal cell hyaline. Length 5.5-7 mm. . . . . *C. cladura* Ckll.
18. Space between upper part of antennal fossa and eye strongly swollen, impunctate (this character may be indistinct in small specimens of the Philippine *C. tropica* Crawfd.). Mesopleura very densely and finely punctate, almost granulate, dull and nowhere with shiny interspaces; head and mesonotum rather coarsely punctate 19
— No conspicuously swollen area on outer side of top of antennal fossae . . 20
19. Lateral areas of mesoscutum densely punctate. Clypeus coarsely and rugosely punctate. Mesoscutum and mesopleura black. Tibiae III dark brown with yellow spot at knee. Length 6-7.5 mm. Philippine Islands . . *C. tropica* Crawfd.
— Lateral areas of mesoscutum with a distinct impunctate space near the tegulae. Clypeus coarsely punctate, the punctures slightly confluent. Mesoscutum at least with the two outer yellow lines; mesopleura often with yellow spot behind tubercles. Tibiae III entirely yellow. Length 7 mm. Celebes . . . *C. rugifrons* Sm.
20. Median part of clypeus rather densely punctate, the punctures well defined. (Sixth sternite with two median teeth; upper arm of clypeal mark short or absent, outer side of all tibiae yellow) 21
— Median part of clypeus impunctate, or with a few shallow and ill defined punctures 22
21. Clypeus finely and densely punctate, anteriorly with transverse yellow band. Supraclypeal area trituberculate. Lateral areas of mesoscutum with at most a small

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1) The subgeneric position of *C. kosemponis* is uncertain.

impunctate space near the tegulae. Mesopleura black. Length 5-6.5 mm. Sumatra, Java . . . . . *C. litoraria,* n. sp.

— Clypeus coarsely punctate; yellow band at anterior margin abbreviated laterally, widened medially. Supraclypeal area normal. Lateral areas of mesoscutum with large impunctate space. Mesopleura with yellow spot behind tubercles. Length 6-7 mm. Philippine Islands . . . . . *C. bicuneata* Ckll.

22. Clypeus with broad and shallow, longitudinal impression, which covers almost the entire median part. (Upper arm of clypeal mark short, often irregularly truncate; paraocular areas densely punctate below antennal fossae; sixth sternite with two small teeth at apical margin; tergite 7 with distinct median tooth and prominent lateral angles. Mesopleura usually black; yellow markings on mesoscutum and abdomen sometimes reduced. Metatarsi dark.) Length 6-8.5 mm. Siam, Sumatra, Java. (Compare *C. hieroglyphica* Sm. and *C. lepida* Sm.) . . *C. bryanti* Ckll.

— Clypeus flat or slightly convex, sometimes with longitudinal impression on each side of a median carina 23

23. Lateral areas of mesoscutum with at least a continuous row of punctures along parapsidal furrow, often more densely punctate. Length 6-8 mm. . . . 24

— Posterior half of lateral areas of mesoscutum at most with a few scattered punctures (apart from a row of punctures along groove at outer margin) . 30

24. Mesoscutum with four yellow lines. Mesopleura with yellow spot behind tubercles (sometimes absent in the Indian *C. simillima* Sm.) 25

— Mesoscutum black or with only the outer lines present 27

25. Sixth sternite with two teeth in middle of posterior margin (fig. 56); small species with yellowish-white markings. India . . . . . *C. simillima* Sm.

— Sixth sternite with a Λ-shaped ridge (figs. 67, 69) 26

26. Antennal scape yellow at base. Sixth sternite: fig. 67. Philippine Islands . . . *C. compacta* Sm. (= *philippinensis* Ashm.)

— Antennal scape black. Sixth sternite: fig. 69. Siam, Java . *C. lieftincki,* n. sp.

27. Clypeus with a distinct median carina, which is black and divides the transverse yellow band at anterior margin. Lateral face marks narrow. Apex of tergite 7 broadly rounded. Moluccas . . . . . *C. interrupta* Alfk.

— Clypeus not or indistinctly carinate; clypeal mark with large upper arm . . 28

28. Apical margin of tergite 7 arcuate. Sternite 6 with two teeth (fig. 39). Abdominal tergites 1, 6, and 7 black, 2 and 3 with lateral spots, 4 and 5 with a transverse band; mesopleura black. Ryukyu Islands . . . . *C. okinawana* Mats. & Uch.

— Apical margin of tergite 7 with tooth, or bluntly angular in the middle. Sternite 6: figs. 68 and 70 29

29. Tibiae III yellow on outer side; metatarsi II and III yellow; mesoscutum black, scutellum with large yellow spot 30

— Tibiae III yellow at base only; metatarsi II and III dark; mesoscutum (often ?) with outer yellow lines; spot on scutellum reduced. Java . *C. jacobsoni,* n. sp.

30. Temples with a few scattered punctures. Siam to Celebes. . . *C. cognata* Sm.

— Temples densely punctate, the punctures deep and well defined. Mesopleura coarsely and densely punctate. Java . . . . . *C. punctigena,* n. sp.

31. Sixth sternite with two teeth in middle of posterior margin (fig. 51); small species (length 5-6 mm); bands on anterior tergites widely interrupted; apical margin of seventh tergite rounded, hardly angular in the middle. Hind metatarsi yellow. Siam to Java . . . . . *C. accusator* Ckll.

— Sixth sternite with a Λ-shaped ridge 32

32. Tarsi and outer side of all tibiae yellow; mesoscutum black, or with small lateral yellow lines; upper third or half of clypeus black, the yellow mark usually notched at top; antennal scape black; supra-antennal spots absent; yellow line on pronotum separated from tubercles. Bands on tergites 2 and 3 usually more or less interrupted. Length 6-7 mm. New Guinea . . . . . *C. papuana,* n. sp.

— Legs darker, at least the hind metatarsi brownish; yellow mark on clypeus usually more extensive 33

33. Thorax black, only the pronotal tubercles yellow. Lateral face marks crescent-shaped (fig. 47); abdomen black, tergites 2-4 with lateral yellow spots. Length 7 mm. N. India . . . . . *C. moderata* Cam.

— Thorax more extensively marked with yellow. Length 5.5-8 mm. . . . 34

34. Yellow spot on scutellum more or less narrowed posteriorly, the posterior lateral angles of the disk black. Metatarsi I brown, sometimes with yellow spot or line on upper side. Face: fig. 66. Scape of antennae black. Palawan, Malaya, W. Indonesia . . . . . *C. nigrolateralis* Ckll.

— Yellow spot on scutellum rectangular, not narrowed posteriorly. Metatarsi I pale ferruginous with yellow line or entirely yellowish. Yellow marks on clypeus and supraclypeal area more extensive (fig. 64). Scape of antennae pale ferruginous or yellow at base, often also with yellow spot at apex. Usually slightly smaller than the preceding species. Siam, Malaya, Sumatra, Borneo, Java . *C. collusor* Ckll.

A. Subgenus **Pithitis** Klug

Pithitis Klug, Magazin für Insektenkunde 6 (1807): 198, 225.

Metallic species with the following characters: vertex and upper part of temples separated from occiput by a sharp carinate edge. Dorsum of propodeum short, longitudinally carinate, sharply separated from the vertical declivity by the projecting edge of the latter. Body densely punctate; paraocular areas with large, rather shallow flat-bottomed punctures which are separated by a net of carinae; no impunctate shining areas on temples or mesoscutum. Tibiae III without denticle on outer side.

Sixth sternite of male with lateral teeth; apex of seventh tergite rounded or acute, genitalia without tufts of long hairs (see figs. 1-7).

Type: *Apis smaragdula* Fabr. = *Ceratina smaragdula* (Fabr.).

Ceratina smaragdula (Fabr.) (fig. 7)

1787. Fabricius, J. C., Mant. Insect. I: 305, no. 91 (*Apis smaragdula,* Tranquebar).
1804. Fabricius, J. C., Syst. Piez.. 334, no. 30 (*Megilla smaragdula*).
1807. Klug, F., Magaz. f. Insektenk. 6: 198, 225 (*Pithitis smaragdula*).
! 1854. Smith, F., Cat. Hym. Br. Mus. II: 226, no. 14, ♂ (*Ceratina maculata,* Java).
1869. Gerstaecker, A., Stett. Ent. Ztg. XXX: 177, nota, no. 2 (*Ceratina smaragdula* = *maculata*).
! 1879. Smith, F., Descr. New Sp. Hym. Br. Mus.: 92, no. 3, ♂ ♀ (*Ceratina sexmaculata,* Hongkong and Celebes).
1904. Saussure, H. de, Mission Pavie, III, Hyménoptères: 191, ♀ ♂ (*Ceratina maculata,* Indo-China).
1905. Cockerell, T. D. A., Trans. Am. Ent. Soc. XXXI: 324 (*Ceratina sexmaculata,* var. *wallacei,* Celebes).
1909. Friese, H., Ann. Mus. Nat. Hung. VII: 208, no. 43, ♀ ♂ (*Ceratina sexmaculata,* var. *aurata,* Kalidupa, Buton Isl.) (subsp. ?, new status).
1911. Cockerell, T. D. A., Trans. Am. Ent. Soc. XXXVII: 239 (*Ceratina sexmaculata*).

1911. Cockerell, T. D. A., Ann. Mag. Nat. Hist. (8), VIII: 185 (*Ceratina sexmaculata,* var. *purpurascens,* Formosa).
1926. Alfken, J. D., Entom. Mitt. XV: 318 (*C. smaragdula* = *sexmaculata*).
1927. Hedicke, H., Deutsch. Ent. Zeitschr. 1926: 420 (*C. sexmaculata,* Mindoro).

In the female of this species the abdomen is uniformly green above (except for two short, transverse, shining black lines on tergites 2 and 3, sometimes also on 4); in the male the tergites 4, 5 and 6 bear an almost square velvety black spot [1]) on each side of the middle. This peculiar sexual dimorphism, already noticed by Smith (1879), has given rise to considerable confusion.

A very remarkable error occurs in Bingham's review of *Ceratina* in the "Fauna of British India" (Hym., vol. I, 1897). This author separates *C. viridissima* D.T. (*C. viridis* Guér.), a species with "abdomen entirely green" from *C. sexmaculata* Sm., which has the "abdomen green, segments 4-6 with square velvety-black lateral spots". Under the latter name he describes both sexes, and fig. 168 on p. 501 even shows a female of *C. sexmaculata* adorned with the black spots which occur exclusively in the male!

The *C. viridissima* of Bingham has been regarded by Cockerell as identical with his *C. binghami,* but it is quite likely that Bingham's material included also females of *C. smaragdula.* The error of reporting the african *C. viridis* Guér. from the oriental region was first made by Smith in 1854 (Cat. Hym. Br. Mus. II, p. 224, no. 9), and it was made again by Bingham, although Gerstaecker (1869) had already criticized Smith's identification.

Cockerell has recorded *C. smaragdula* in most of his papers as *C. sexmaculata*; Friese in 1914 used the same name for specimens of both sexes from Java, but why and how he distinguished a few years later between *C. smaragdula* and *C. sexmaculata* (Zool. Jahrb. Syst. 41, 1918, p. 495) is unknown to me.

The type of *C. maculata* Sm. is in the Oxford University Museum (coll. Saunders); the locality label is not very legible, but I doubt whether it bears the name of a locality in Java. It seems possible that the label of this specimen has been changed by error for that of *C. smaragdina* Sm. in the same collection; the latter is labelled "Java" but is apparently not an Oriental species.

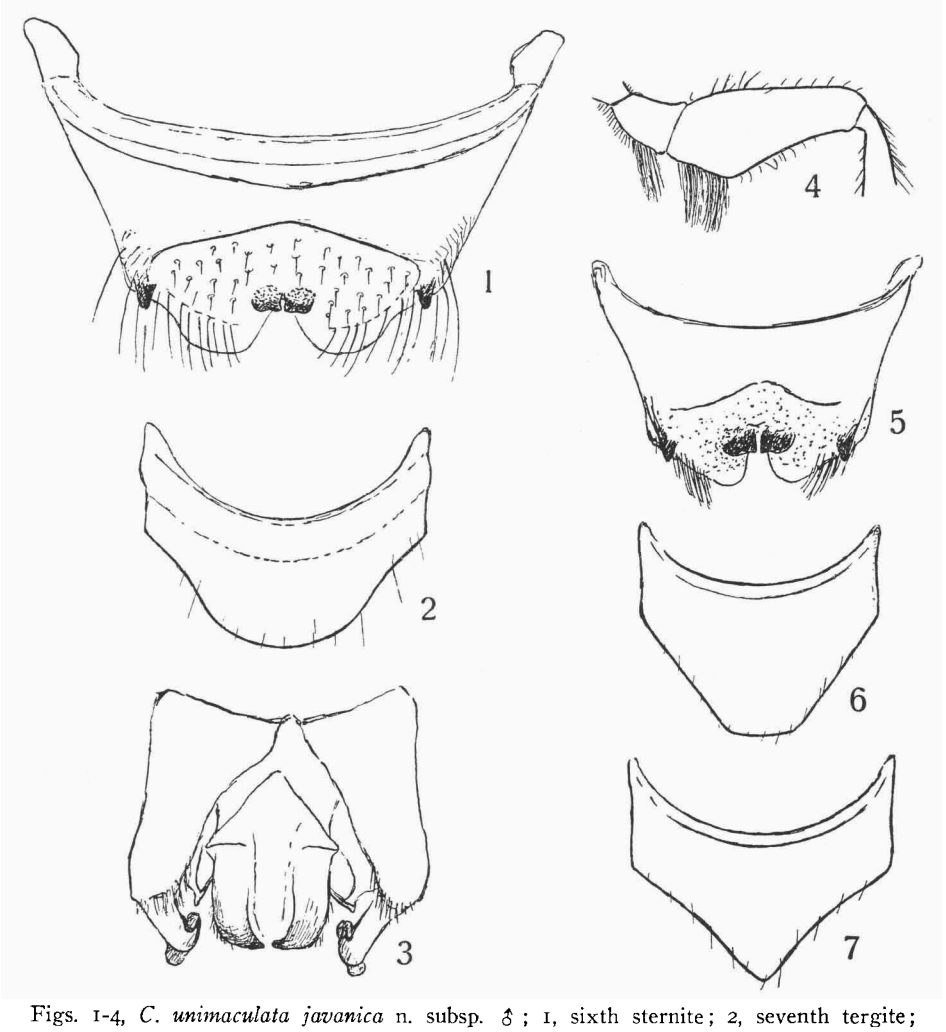
The type of *C. sexmaculata* Sm. is in the British Museum at London; Hongkong is the type locality.

The fact that *C. sexmaculata* var. *aurata* was described in Friese's "Bienenfauna von Neu Guinea" might give the impression that this insect belongs to the Papuan fauna. Kalidupa or Kaledupa, however, is a small island in

1) Fabricius described the species as having four black spots on the abdomen, two on the fourth and two on the fifth segment. The spots on the sixth segment had apparently been overlooked by him.

the Buton group, situated southeast of the eastern lower arm of the island of Celebes.

C. smaragdula is closely allied to *C. unimaculata* and *C. binghami*. The



Figs. 1-4, *C. unimaculata javanica* n. subsp. ♂ ; 1, sixth sternite; 2, seventh tergite; 3, genitalia; 4, part of hind leg.
Figs. 5-6, *C. binghami* Ckll. ♂ ; 5, sixth sternite; 6, seventh tergite.
Fig. 7, *C. smaragdula* (Fabr.) ♂, seventh tergite.

structure of the sixth sternite and the genitalia of the ♂ are very similar in all these species, but the shape of the 7th tergite shows reliable differences (fig. 7).

As regards structure and colour, *C. smaragdula* appears to be little variable,

and I have distinguished only one form of subspecific value. Specimens from Celebes and the Moluccas are usually more golden or coppery than those from elesewhere and may be regarded as subsp. *aurata* Friese; the purplish form described by Cockerell from Formosa as var. *purpurascens* is perhaps only an individual aberration.

This species is common and very widely distributed in southeast Asia. China: Foochow distr., Kellogg; Hangchow, VI-1927; Suifu to Hongya and Yachow to Mupin, Szechwan, VI 1929, D. C. Graham; Hainan Isl., Kachek and Nodoa; Canton (all in U. S. Nat. Mus., including ♂♂ from most of the localities mentioned); Formosa: 2 ♂♂, Sauter leg., U. S. Nat. Mus.; India: the distribution in India and Pakistan requires further study, because the females have undoubtedly been confused with those of *C. binghami*; I have seen males of *C. smaragdula* from Karachi (E. Comber leg., U. S. Nat. Mus.) and from Deesa (Nurse leg., Br. Mus.), but I suspect that the species occurs in many other localities.

With some doubt I regard also as *C. smaragdula*: two females from Karachi, with identical labels "Krchi" in type-script (coll. U. S. Nat. Mus.); one of these was identified by Cockerell as *C. comberi,* the other as *C. sexmaculata.*

Furthermore *C. smaragdula* has been found in Siam, Malaya, Sumatra, Bangka, Java, Borneo, and the Philippine Islands (Luzon, Mindanao, Negros, Panay); some females and a male from Flores (Wolawaru, Aug. 1950, author) do not differ from Java specimens, but two females from Ambon (Oct. 1949, M. A. Lieftinck) distinctly belong to the subsp. *aurata* Fr., which I know from some localities in Celebes and from the Sangir Islands (Tahulandang, Nov. 1948, C. J. H. Franssen leg., coll. m.).

Not all the specimens from Celebes, however, show the *aurata*-character very distinctly. Lieftinck did not find *C. smaragdula* in Misool and neither has it been collected in New Guinea; Ambon appears therefore to represent about the southeastern limit of its distribution area.

In the western Indonesian islands *C. smaragdula* occurs everywhere in cultivated areas and visits many different species of flowers. Apparently it adapts itself soon to species imported from abroad. Some of the flowers regularly visited are: Antigonon, Cassia, Turnera, Melastoma, Faradaya and Gardenia. Lieftinck took both sexes in W. Java on Vigna lutea, Lantana camara, and Wedelia biflora.

The two sexes of this species have been bred repeatedly from the nests which are made in hollow branches. In 1936 we found this bee nesting at Bogor in the stem of an Orchid. Keuchenius' notes on "*Ceratina viridissima*

D.T.", which is said to nest in the mark of young stumps of Hevea, and in branches of Erythrina, Leucaena and Jatropha curcas, undoubtedly refer to this species (Teysmannia 26, 1915: 168).

Ceratina unimaculata Smith (figs. 1-4)

! 1879. Smith, F., Descr. New Spec. Hym. Br. Mus.: 93, no. 6, ♀ ♂ (*C. unimaculata,* Makassar, Celebes).
1909. Friese, H., Ann. Mus. Nat. Hung. VII: 208, ♀ (*C. kuehni,* Kalidupa, Buton Isl. near Celebes).

In the male sex this species is easily recognized by the characteristic comb of hairs at the base of the hind legs, a feature that has hitherto been overlooked. The male differs from the female in the presence of a pale yellow spot on the labrum; the clypeal mark is usually dilated anteriorly.

The female resembles that of *C. smaragdula* very much. Representatives of the two species from Malaya and Indonesia can be distinguished as follows:

(1) Body emerald green, rather shiny; spot on clypeus truncate above, somewhat abruptly widened below, its sides concave. Pronotal tubercles white (pale yellow). *C. smaragdula* (Fabr.)

(2) Body duller, bluish, greenish blue or bronzy; spot on clypeus more regularly triangular, rounded above, the sides not concave. Pronotal tubercles often dark. *C. unimaculata* Smith

In contrast to *C. smaragdula,* this species shows a rather pronounced geographic variation. The following subspecies can be distinguished:

(1) Head and thorax bluish green, abdomen dark blue. Pronotal tubercles black; bright markings on legs: a short line on apical half of femora I, a line on basal half of tibiae I and a spot at base of tibiae III. — South Celebes. *C. unimaculata unimaculata* Sm.

(2) Body entirely greenish blue. Pronotal tubercles white. Legs as in the typical form. — Java. *C. unimaculata javanica,* n. subsp.

(3) Body dark and dull greenish, with bronzy and purplish reflections. Pronotal tubercles dark. Yellow markings on legs often reduced or absent. — Malaya, Sumatra, Borneo. *C. unimaculata palmerii* Cam.

(4) Very much like subsp. *javanica,* but more brightly blue, at most slightly greenish on face and anterior part of thorax. Pronotal tubercles with white spot; legs as in *javanica,* the spot on tibiae III short. — Siam. *C. unimaculata nanensis* Ckll.

C. unimaculata unimaculata Sm.

Celebes: 2 ♀, Celebes, 1 ♂, Makassar (incl. Smith's type, Br. Mus.); 1 ♀, Makassar, Wallace, identified (probably by F. Smith) as *C. viridis*

Guér. (coll. Oxf. Univ. Mus.); 1 ♀, S. Celebes, Bonto-bonto, March-April 1949, C. J. H. Franssen leg. (coll. m.); 1 ♂, Tondano, Forsten leg. (Mus. Leiden). Friese's description of *C. kuehni* [1]) leaves no doubt that this species is identical with *C. unimaculata,* but since the colour is described as "erzgrün bis graugrün", it may differ from the subspecies occurring in Celebes.

C. unimaculata javanica, n. subsp.

Java: 43 specimens (paratypes) from several localities in West Java (Depok, Bogor, Sukabumi, Bandung, Paseh near Kamodjan) and Bajukidul in East Java (coll. Lieftinck, Mus. Bogor, Mus. Leiden, coll. m.); type: a ♀ from Mt. Tjampea near Bogor, 5 May 1935, author, in my collection. In a female from Tjiburial, Bogor, the clypeus is entirely black; in some males the labrum is black.

The male of this species was taken by Lieftinck on the flowers of Antigonon, the female on Melastoma malabathricum. I took both sexes on Acacia villosa.

C. unimaculata palmerii Cam.

! 1908. Cameron, P., Deutsch. Ent. Zeitschr. 1908: 566, ♀ (*C. palmerii,* Kuching, Borneo) (new status).

! 1919. Cockerell, T. D. A., Ann. Mag. Nat. Hist. (9) III: 244, ♂ ♀ (*C. penangensis,* ♂ Penang Isl., ♀ Singapare) (new syn.).

Borneo: 1 ♀, Sarawak, Kuching, 1900 (type of *C. palmerii* Cam. in Br. Mus.); 1 ♂, Santubong, 1 ♂, Kuching, Sept.-Oct. 1950, M. A. Lieftinck; 1 ♀, Sandakan, Baker (coll. U. S. N.M.); 1 ♀, Ledo at Sambas river, W. Borneo, July 1933, H. R. A. Muller (coll. m.).

Malaya: 1 ♂, Penang, Baker (type of *C. penangensis* Ckll., Br. Mus.); 1 ♀, Penang, 2 ♂, Singapore, Baker (coll. U.S. N.M.). I am unable to distinguish *C. penangensis* Ckll. from the earlier described *C. palmerii* Cam.

Sumatra: 2 ♀, Djambi, Sarolangun, July 1925, O. Posthumus; 1 ♀, Deli, 1 ♀ 1 ♂, Padang, Sept. 1918, S. Leefmans (coll. m.); 1 ♂, Lampong Distr., Sungeilangka Est., 400 m, March 1937, author.

Bangka: 1 ♀, Mt. Menumbing, 450 m, Nov. 1939; 1 ♀, Aer Itam, Nov. 1935; 1 ♀, Mt. Mangkol, Tru, Dec. 1935, author.

C. unimaculata nanensis Ckll.

1929. Cockerell, T. D. A., Ann. Mag. Nat. Hist. (10) IV: 141, ♀ ♂ (*C. siamensis,* subsp. *nanensis,* Nan, Siam) (new status).

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1) The description of *C. kuehni* contains an obvious printing error: in the second line on p. 209 one should read: "Segmente" instead of "Segment 6".

Siam: 1 ♀ 1 ♂, Nan, Siam, Dec. 1927, Cockerell ("cotypes" of *C. siamensis nanensis* Ckll., coll. U.S. N.M.).

Ceratina binghami Ckll. (figs. 5 and 6)

1910. Cockerell, T. D. A., Ann. Mag. Nat. Hist. (8) I: 340 (*Ceratina binghami,* Calcutta).
1910. Cockerell, T. D. A., Ann. Mag. Nat. Hist. (8) V: 419 (Dehra Dun).
1911. Cockerell, T. D. A., Ann. Mag. Nat. Hist. (8) VIII: 185 (Nasik, N.W. India).
1929. Cockerell, T. D. A., Ann. Mag. Nat. Hist. (10) IV: 141 (Siam).

When Cockerell received from Sladen some specimens of the Indian green *Ceratina* which had long passed as *C. viridis* Guér., he found them to be different from the African *C. viridis* and named them *C. binghami,* sp. n. This new species, based on material collected at Calcutta and Siliguri, was hardly described, the author apparently being satisfied that Bingham's description of *"C. viridissima"* would suffice to recognize the species.

I have now seen a male cotype from Calcutta, Sladen leg., Jan. 1897 (coll. U.S. Nat. Mus.) which has enabled me to identify *C. binghami* with certainty. This specimen is slightly more bluish than the others recorded below, but otherwise not different.

Whereas the male of this species is very easily separated from its nearest allies, the female resembles that of *C. smaragdula* so much that I have been unable to find any characters by which the two can be distinguished with absolute certainty.

The specimens from Bombay show the following characters:

♀ — Bright metallic green, partly slightly golden green; sixth abdominal tergite more bluish. Clypeus with yellow spot which is very much like that in *C. smaragdula*: it is truncate above, the sides are slightly concave, the lower margin irregularly arcuate. Mandibles, labrum and lateral areas of clypeus black. Legs dark brown to blackish, tarsi ferruginous, coxae, trochanters and upper side of femora more or less metallic green; the following parts pale yellow: a line on under side of femora I, one on outer side of tibiae I and a spot or short line at base of tibiae III.

The median carina of the clypeus is indistinct in some specimens. The impunctate transverse black lines on tergites 2 and 3 are about as long as the distance between them. Fifth tergite without any trace of a median line.

In the ♂♂ the transverse impunctate lines on tergites 2 and 3 are indistinct and shorter than the space between them. This sex is easily distinguished from *C. smaragdula* and *C. unimaculata* by the characters given in the key on p. 12.

Bombay, a series of both sexes, Sept. 1924; Mormugao, 1♀ 1♂, July 1925, all coll. by J. C. Bridwell (coll. U.S. Nat. Mus.).

A ♂ from Nasik, Bombay Presidency, in the British Museum is apparently the specimen recorded by Cockerell in 1911 (l.c.); the occurrence of this species in Siam, however, needs confirmation. I have seen a female from Nan, Siam (U.S. Nat. Mus.), identified by Cockerell as *C. binghami* (compare Ann. Mag. Nat. Hist. (10) IV, 1929: 141), but this is undoubtedly a specimen of *C. smaragdula.*

The notes of G. R. Dutt on *Ceratina viridissima* (Mem. Dept. Agric. India, Ent. Series IV no. 4 (1912): 242-246) probably refer to this species. According to Dutt the bees nest in hollow reeds and thatch and excavate tunnels in dried pithy branches of trees. The bee takes from 4 to 5 weeks from egg to imago (egg 3-4, larva 10-13, pupa 11-18 days). "At night these bees hide themselves in such hollows as they choose for their nests, the mother bee always confining herself to her own nest. Early in the morning, 5 or 6 of these bees may be found huddled together in the central hollow of a single dried shoot of a bamboo". As a parasite Dutt noticed a small black Chalcid which he bred from the cells.

Ceratina aenea (Fabr.)

1798. Fabricius, J. C., Suppl. ent. syst.: 277, no. 121-122 (*Apis aenea,* India Orientali).
1804. Fabricius, J. C., Syst. Piez.: 333, no. 26 (*Megilla aenea*).
1808. Klug, F., Magaz. Ges. Naturf. Freunde Berlin II: 55 (*Pithitis aenea*).
1869. Gerstaecker, A., Stett. Ent. Ztg. XXX: 177, nota, no. 1 (*Ceratina aenea*).

The original description of this species is as follows: "Nimis affinis A. smaragdula et forte mera eius varietas. Corpus totum nudum, viridi aeneum, nitidum. Labium cinereum. Antennae pedesque nigri". In 1804 the author added: "maculaque frontali alba".

So far as this description goes, *C. aenea* could be the female of *C. smaragdula* (F.), or either sex of *C. unimaculata* (Sm.) or *C. binghami* Ckll. This question can be answered only by a study of the type.

Why Gerstaecker (l.c.), and later Dalla Torre, reported *Apis aenea* to be a male, is unknown to me. If this statement is based on an examination of the type (coll. Daldorff in Mus. Berlin), this would exclude a possible identity with *C. smaragdula,* the male of which has always black spots on the abdomen. Gerstaecker recorded *C. aenea* from Tranquebar, Java and Ceylon.

Ceratina comberi Ckll.

1911. Cockerell, T. D. A., Ann. Mag. Nat Hist. (8) VIII: 185, ♀ (*Ceratina comberi,* Karachi; type in British Museum).

According to Cockerell (l.c.), this hurriedly created species is "perhaps only a variety of *C. binghami*", but it seems even more probable that it will eventually prove to be identical with *C. smaragdula,* the male of which was collected at the type locality by E. Comber (coll. U.S. Nat. Mus.). It appears better to leave this matter undecided until we know more about the distribution of the green *Ceratina* species in India and Pakistan.

A female from Karachi, identified by Cockerell as this species, agrees well with the brief description, but the green is only slightly golden. The clypeus has a distinct median carina; the clypeal spot is roundly truncate above; the impunctate black lines on tergites 2 and 3 are short, smaller than the distance between them. Legs with some yellowish white marks as in *C. binghami.*

Ceratina siamensis Ckll.

1927. Cockerell, T. D. A., Amer. Mus. Nov. 274: 14, ♀ (*C. siamensis,* Chiengmai, Siam).

I have not seen the type of this species which is in the collection of the American Museum of Natural History, New York. The description is rather incomplete, and the author's additional notes on the taxonomic position of the species do not help very much to identify it with certainty. He says that *C. siamensis* is nearest to *C. penangensis,* and this would indicate that it is also a *Pithitis,* but at the same time Cockerell calls it "a species with Palaearctic affinities" and this would hardly apply to a species of the latter subgenus. On the other hand, since Cockerell later described *C. nanensis* as a subspecies of *C. siamensis,* the latter will perhaps prove to be another subspecies of *C.* (*Pithitis*) *unimaculata* Sm.

B. *C. dentipes* group (? subgenus **Neoceratina** Perk.)

? *Neoceratina* Perkins, Ann. Mag. Nat. Hist. (8) 9 (1912): 117.

In this group I have placed some black or metallic species which are characterized by their small size (4.5-6 mm) and by the absence of yellow markings on thorax and abdomen, except on the pronotal tubercles. Whether these species are indeed closely allied, requires further investigation; in the material at my disposal only *C. dentipes* is represented by an adequate number of specimens. The presence of a slightly raised, flattened or somewhat concave, subcircular area on the front between the antennal fossae and the posterior ocelli is perhaps a character of this group.

I have not seen *Neoceratina australensis* Perk., the type of *Neoceratina,* but I suspect that this species is closely related to *C. dentipes* and perhaps

even identical with it. Very probably the name *Neoceratina* will prove to be available for this subgenus. *Neoceratina australensis* Perk. agrees with *C. dentipes* Friese in having 5-segmented maxillary palpi, but the palpi of the other species mentioned below could not be examined now.

Ceratina dentipes Friese (figs. 8-10)

1914. Friese, H., Tijdschr. v. Entom. LVII: 7, 32 ♂ (*Ceratina dentipes*, Buitenzorg, Java).
1915. Cockerell, T. D. A., Entomologist 48: 109 (Luzon).
1916. Cockerell, T. D. A., Phil. Jl. Science XI: 308 (Luzon).
1918. Cockerell, T. D. A., Phil. Jl. Science XIII: 143 (Mindanao).
1920. Cockerell, T. D. A., Phil. Jl. Science 16: 207 (Luzon).
1920. Cockerell, T. D. A., Phil. Jl. Science 17: 623 (Penang).
1929. Cockerell, T. D. A., Ann. Mag. Nat. Hist. (10) IV: 152 (Siam).
1951. Krombein, K. V., Proc. Haw. Ent. Soc. XIV: 294 (Solomon Isl.).

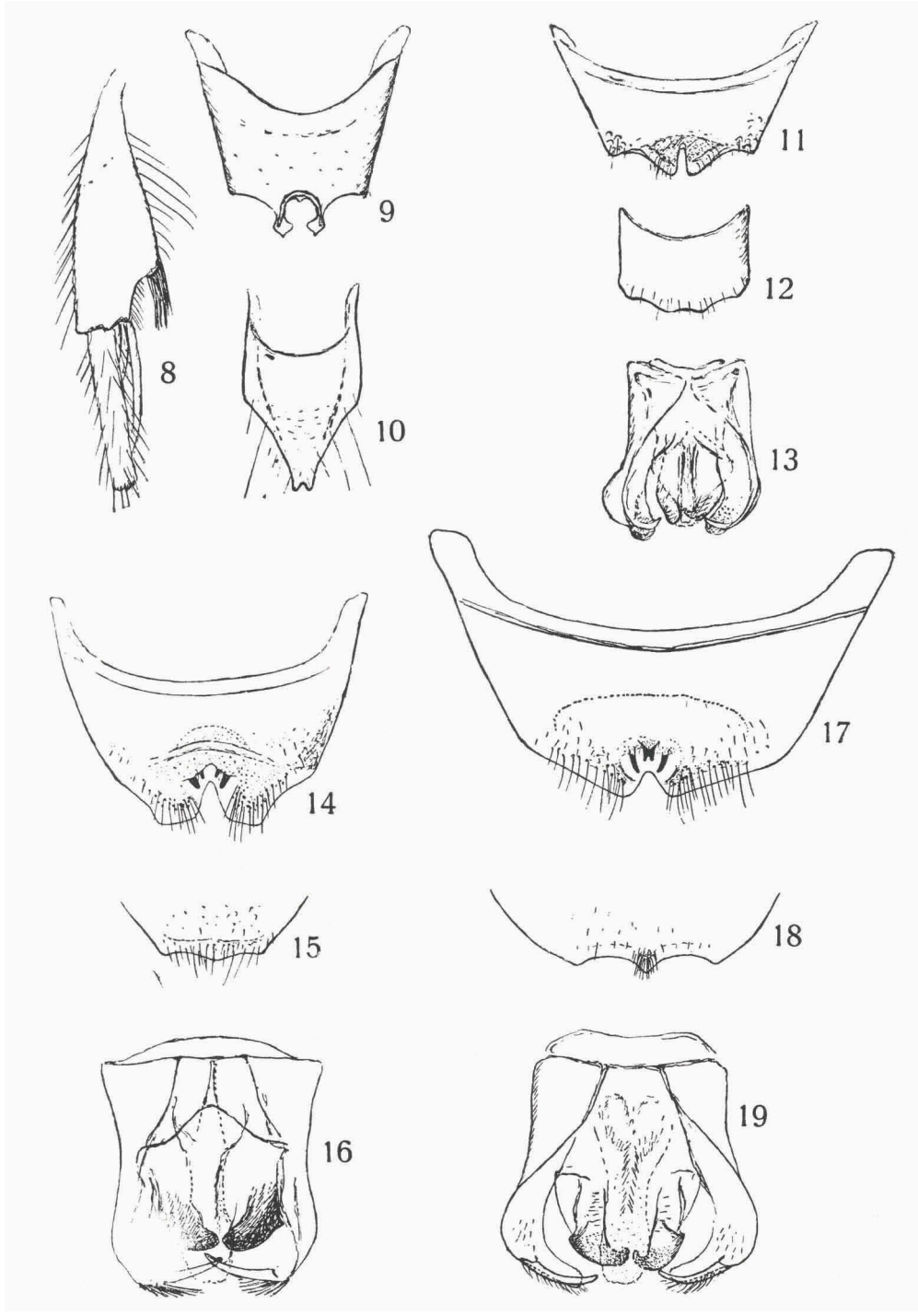
♀ — Length 4.5-6 mm.

Head about as wide as high, vertex and temples rounded posteriorly; the anterior ocellus lies on the posterior half of a longitudinally oval, flattened area, which is bordered by a shining, low rim. Maxillary palpi 5-segmented. Dorsum of propodeum short, slightly impressed in the middle and at the base, distinctly separated from the declivity, but the junction rounded. Greatest width of abdomen at middle of third segment. Denticle on outer side of tibiae short and blunt.

Clypeus slightly convex, not carinate, with a few punctures at sides and anterior margin; paraocular areas with about ten distinct punctures; inner side of antennal cavities, flattened space in front of anterior ocellus, posterior margin of vertex, and top of temples finely punctate; puncturation on anterior part of mesocutum and on scutellum fine and dense, on mesopleura sparser. Metapleura polished, impunctate. Dorsum of propodeum dull, finely granulate, declivity moderately shiny. Abdominal tergite 1 almost impunctate, 2 and 3 densely punctate at base and apex, more sparsely in the middle, 4-6 densely and somewhat rugosely punctate.

Black, the following parts ivory white: a spot on median portion of clypeus, about twice as long as wide and rounded at base and apex; pronotal tubercles, and a line at base of tibiae I and III, often also a small spot at base of tibiae II.

♂ — Similar to the female. Femora III dilated in the middle; inner side of tibiae III with a blunt tooth which bears a bundle of long hairs (fig. 8). Second abdominal sternite with median tubercle, posterior margin of sixth sternite with two flag-shaped projections (fig. 9), seventh tergite produced into a bidentate process (fig. 10); genitalia without tuft of hairs.



Figs. 8-10, *C. dentipes* Friese ♂; 8, hind tibia and metatarsus; 9, sixth sternite; 10, seventh tergite.
Figs. 11-13, *C. perforatrix* Sm. ♂; 11, sixth sternite; 12, seventh tergite; 13, genitalia.
Figs. 14-16, *C. ridleyi* Ckll. ♂; 14, sixth sternite; 15, seventh tergite; 16, genitalia.
Figs. 17-19, *C. flavopicta lauta* n. subsp. ♂; 17, sixth sternite; 18, seventh tergite; 19, genitalia.

Labrum with white spot; spot on clypeus dilated anteriorly on each side (thus shaped like a reversed T); tarsal segments 2-4 pale.

This common species is very widely distributed, but it is often overlooked on account of its small size. Cockerell recorded *C. dentipes* from Siam, Penang, and the Philippine islands Luzon and Mindanao; Krombein (1951) recorded its occurrence in the Solomon Islands. I have seen the following specimens:

Ryukyu Islands: 6 ♀ 4 ♂, Ie Shima, Aug. 1945, K. V. Krombein; 2 ♀ 1 ♂, Okinawa, Chizuka, July-Sept., G. E. Bohart and C. L. Harnage (coll. U.S. N.M.).

Siam: 1 ♀, Nan, Cockerell, 30 Dec. 1927 (coll. U.S. N.M.).

Bangka: 2 ♀, Batu Rusa, 28 Nov. 1935, author.

Java: many specimens in coll. Lieftinck and coll. m., several localities, both in West and in East Java, 0-900 m, throughout the year.

Bali: 2 ♀, Kintamani, 1500 m, 23 June 1939, Mrs. v. d. Vecht and author.

Celebes: 1 ♀ 2 ♂, South Celebes, Sengkang, Sept. 1930, author.

Philippine Islands: Mindanao, 1 ♀ Dapitan, 1 ♀ Davao, 1 ♀ Cagayan, Baker; Luzon, 1 ♀ Manila, McGregor, 1 ♀ Mt. Makiling, 1 ♂ Los Baños, Baker (all in coll. U.S. N.M.).

Misool: 1 ♀ Fakal, Sept.-Oct. 1948, 1 ♀ Haitlal Isl., Sept. 1948, M. A. Lieftinck.

New Guinea: 1 ♂, Nadzab, Markham, R. Val., 14 May 1944, K. V. Krombein.

Solomon Islands: Florida Isl. (see Krombein, Proc. Haw. Ent. Soc. XIV (1951): 294).

Ceratina dentipes occurs in cultivated areas, in gardens and secondary forest growth; it visits the flowers of several plants. Lieftinck took both sexes on Homalanthus populnea and Leea indica; his collection contains also a male from Globba marantina Bl. (Zingiberaceae) and one from Trevesia sundaica Miq. (Araliaceae).

Concerning the nest, Lieftinck kindly sent me the following note:

"In Aug. 1941 I found a nest of *C. dentipes* in a branch of a Mimosa species, at Dramaga near Bogor. One female, loaded with pollen, was collected as she entered the nest; the nest hole was then plugged with cottonwool and the branch cut off. The following day, I opened the nest; it proved to contain four females and two males, all completely developed. They were all directed with the head-end towards the bottom of the nest, and moved backwards to the opening, emerging tail-end first. Unfortunately I did not note

the sex of each specimen as it emerged. Further the nest was found to contain one teneral female, and two pupae, the oldest (darkest) of which was the one at the bottom. Neither the adults nor the pupae were separated from each other by transverse walls; there was only some marrow dust beyond the oldest pupa".

It seems possible that *Neoceratina australensis* Perk. from Queensland (Ann. Mag. Nat. Hist. (8) 9, 1912: 117, ♀) is identical with *C. dentipes* Friese, but this cannot be decided until the male of the Australian species has been studied.

The following species are known to me from the descriptions only:

Ceratina sauteri Strand; Suppl. Entom. II (1913): 40, ♂ (Hoozan, Formosa).

Ceratina kankauensis Strand; do.: 42, ♂ (Kankau, Koshun, Formosa).

Ceratina fumipennigera Strand; Archiv f. Naturgesch. 80 A, H. 1 (1914): 138, ♀ (Suisharyo, Formosa).

I suspect that *C. kankauensis* and *C. fumipennigera* will prove to be identical with—or closely allied to—*C. dentipes* Friese. *C. sauteri* is apparently a different species, characterized by the truncate apex of the seventh tergite in the male; the female is still unknown.

Ceratina propinqua Cam.

! 1897. Cameron, P., Mem. Proc. Manch. Lit. Phil. Soc. XLI: 137, ♀; pl. 4, f. 29 (*Ceratina propinqua*, Mussouri, N. India).
1897. Bingham, C. T., Fauna Br. India, Hym. I: 501, ♀.

♀ — Length 4-5 mm.

This small species resembles *C. dentipes* in many respects, but it is at once distinguished by the metallic blue colour and the denser puncturation.

Median part of clypeus slightly convex, polished and impunctate, except for a row of punctures along lateral margins; vertex and front, including the paraocular areas, densely and rather coarsely punctate; antennal cavities not deep, but more distinctly defined than in *C. dentipes*, finely punctate on inner side and above, margined on outer side by an impunctate rim which runs parallel to inner orbit and is separated from it by a row of punctures; a shining rim on each side at inner top corner of antennal cavity is curved backwards towards ocelli, the two rims enclose a subcircular, finely punctate and slightly concave area, which lies between posterior ocelli and antennal cavities. Head strongly narrowed behind the eyes, temples narrow, occiput not margined.

Thorax finely and rather densely punctate; mesoscutum uniformly

punctate, without shiny areas; dorsum of propodeum short, finely granulate, junction between dorsum and declivity rounded; sides and declivity dull.

Abdominal tergites, including the first, densely and finely punctate, second tergite with interrupted smooth transverse line, the third almost uniformly punctate, the following somewhat rugosely punctate.

Body black, with metallic blue shine, legs dark brown, tarsi pale ferruginous; the following parts ivory white: a longitudinal mark on clypeus, rounded at top and hardly widened anteriorly; pronotal tubercles; a line on under side and a small spot at tip of femora I, a line on outer side of tibiae I, one at basal half of tibiae II and on basal two thirds of tibiae III.

This description is based on a specimen in the Oxford University Museum, which bears a label: "*Ceratina propinqua* Cam. type" in Cameron's handwriting. There is no locality label, but the species was described from Mussouri, Northern India. Bingham spells this name "Mussooree".

I have seen a few specimens which resemble *C. propinqua* very much. They appear to indicate that this species is either very widely distributed, or that there are some closely allied species in other parts of the oriental region.

A female from Mangalore, India, 1926, J. C. Bridwell (coll. U.S. N.M.) is more greenish and has the lateral areas of the mesoscutum less densely punctate; a male from Mindanao: Tangcolan, Bukidnon, Baker leg. (coll. U.S. N.M.) is also more greenish, it has the apical third of the hind tibiae somewhat dilated on inner side and the apex of the seventh tergite carinate and produced into a rather sharp point.

A female from South Celebes in my collection appears also to belong here, but unfortunately the head of this specimen is lacking.

I think it advisable to postpone a further study of these forms until more material of both sexes is available.

C. Subgenus **Chloroceratina** Ckll.

Chloroceratina Cockerell, T. D. A., Philipp. Jl. Science XIII D (1918): 143.

The exact position of the two forms belonging here cannot be determined until it has been possible to study their mouth parts and the terminal abdominal segments and genitalia of the males. In the delicate sculpture of the body they agree with *C. cladura* and allies, but the shape of the antennae and the propodeum are different (compare the keys). The pronotum is narrower than usual; the dorsum of the propodeum is depressed below the level of the postscutellum, its base concave with distinct longitudinal striae, the posterior two thirds flattened, finely granulate; declivity rather steep, with distinct median impression.

The male has a comb of curved hairs at the posterior side of the hind trochanters and at the base of the hind femora, similar to that in *C. binghami* Ckll. The sixth sternite is deeply incised.

Type: *Ceratina (Chloroceratina) cyanura* Ckll. 1918.

I have some doubt as to whether *C. benguetensis* and *C. cyanura* are really specifically different. The males agree in so many respects that they could easily be regarded as subspecies. For two reasons I have refrained from doing so. Firstly there is a slight difference in the shape of the seventh tergite: in *C. benguetensis* the middle tooth is slightly longer than in *C. cyanura*. Whether this difference is constant cannot be determined until more material is available. Secondly both forms occur in the northern part of Luzon, and the localities where they have been collected are not very far apart. Subspecific differentiation could hardly be expected in such a small area, unless these bees prove to be restricted to high altitudes, in which case the populations of the two forms may be geographically separated. Unfortunately no details are known about the places where these insects were collected.

The female of *C. benguetensis* is still unknown; the males of the two forms can be distinguished as follows:

(1) Abdomen without metallic shine, the first tergite yellow with large dark spot on each side, second tergite with narrow yellow band at apical margin, the following tergites narrowly testaceous at apex. Base of tergites 2 and 3 yellow, tip of seventh tergite yellowish brown. Supraclypeal area, a line at lateral margins of mesoscutum, a large mark at anterior margin of mesopleura, scutellum and postscutellum, and a line on metapleura yellow. Fore and mid legs yellowish. Antennae ferruginous below, the last two segments dark. *C. benguetensis* Ckll.

(2) Black parts of abdomen with strong metallic blue shine; first abd. tergite yellow at base only; mesopleura black, with yellow spot behind tubercles; supraclypeal area, mesoscutum and postscutellum without yellow markings; scutellum with transverse yellow line, almost interrupted medially; metapleura dark. The three last antennal segments dark below.
C. cyanura Ckll.

Ceratina benguetensis Ckll.

1916. Cockerell, T. D. A., Phil. Jl. Science XI: 307, ♂, fig. 1 B (*Ceratina benguetensis*, Benguet, Baguio, Luzon).
1918. Cockerell, T. D. A., Phil. Jl. Science XIII D: 144 (*C. (Chloroceratina) benguetensis*).

Philippine Islands: I have examined one male from the type locality: Baguio, Benguet, Luzon, Baker leg. (coll. U.S. N.M.); it agrees

well with the description, but the dark parts of head and thorax have a distinct greenish metallic shine.

The type is not in the British Museum.

Ceratina cyanura Ckll.

! 1918. Cockerell, T. D. A., Phil. Jl. Science XIII D: 143, ♀ (*C. (Chloroceratina) cyanura,* Imugin, N. Viscaya, Luzon).

The female of this species agrees in most respects with the male, but whereas the face is less extensively marked with yellow, the markings on pronotum and scutellum are slightly larger. The anterior part of the mesoscutum is more sparsely punctate than in the male, but the punctures are larger.

Philippine Islands: 1 ♀, Imugin, N. Viscaya, Luzon, Baker, type Br. Mus.); 1 ♀ 1 ♂, same locality and collector (coll. U.S. N.M.).

D. Subgenus **Catoceratina,** n. subg.

Related to the following subgenera, but distinguished by the shape of the head, which is sharply margined posteriorly, and by the structure of the terminal abdominal segments and the genitalia of the male (the latter without tufts of long hairs). Yellow markings less extensive than in most species of *Ceratinidia* Ckll.

The subgenus contains only one rare species which is probably restricted to virgin forests.

Type: *Ceratina perforatrix* Smith, 1879.

Ceratina perforatrix Smith (figs. 11-13)

! 1879. Smith, F., Descr. New Spec. Hym. Br. Mus. 92 ♂ (*C. perforatrix,* Burma).
1897. Bingham, C. T., Fauna Br. India, Hym. I: 502, ♀ ♂, fig. 169 (*C. perforatrix,* Assam; Pegu Hills; Tenasserim).
1911. Friese, H., Deutsch. Ent. Zeitschr.: 448, ♀ (*C. macrocephala,* Nias) (subsp., new status).
! 1919. Cockerell, T. D. A., Ann. Mag. Nat. Hist. (9) 3: 246, ♀ (*C. pyramidalis,* Singapore) (subsp., new status).

♀ — Length 9-10.5 mm.

Head thick, wider than high; temples wide; vertex and upper part of temples separated from occiput by a sharp carinate edge; supra-clypeal area bordered posteriorly (above) by an arcuate rim; antennal cavities shallow, not sharply defined, in middle of upper part with groove which runs inwards towards posterior ocellus. Pronotum very short, strongly depressed below level of mesoscutum; collar poorly developed, with carinate edge. Propodeum short, sloping; dorsum slightly concave; junction between dorsum

and declivity scarcely indicated. Base of coxae I rounded on outer side; tibiae III with distinct denticle.

Front, vertex and temples impunctate; clypeus with a few punctures at anterior margin; anterior part of mesoscutum finely punctate, the posterior two thirds polished and impunctate; mesopleura more coarsely punctate, especially behind the tubercles; scutellum with only a few punctures at the sides; propodeum with silky shine, not punctate or rugose, puncturation of abdomen dense and rather fine.

The coloration differs in some respects from the usual pattern: labrum with yellow mark, the line on the temples almost reaches the mandibles; no spot on supra-clypeal area; supra-antennal spots very small or absent; no post-ocellar spots; line on pronotum narrow and widely interrupted in the middle or almost absent; no lines on mesoscutum; postscutellum sometimes with distinct yellow band; markings on abdomen and legs much reduced as compared with species of the subgenus *Ceratinidia* Ckll.

♂ — Apex of sixth sternite with two large triangular teeth; apex of seventh tergite bluntly bituberculate; genitalia without bundles of hairs (figs. 11-13). Head and thorax more extensively yellow than in the female (always?); mandibles with large yellow spot, posterior margin of pronotal tubercles yellow; transverse band on pronotum only narrowly interrupted. Length 8-9 mm.

There is some variation in the size and shape of the yellow mark on the clypeus. In the ♂ from Burma (type) it is slightly higher than in those from Java and Singapore.

C. pyramidalis Ckll. (type, ♀ from Singapore, Baker leg., coll. Br. Mus.) differs from the Java females only in having the clypeal mark slightly narrower, more exactly triangular.

The description of *C. macrocephala* Friese leaves no doubt that this is another colour form of *C. perforatrix* Sm.

There is not sufficient material of this species available to enable me to determine the degree of colour variation in the different parts of its distribution area. For the time being, it seems therefore advisable to retain *macrocephala* and *pyramidalis* as subspecies.

The three known forms may be distinguished as follows:

1. Third abdominal tergite black (also in ♀?). Burma.
C. perforatrix perforatrix Smith

2. Third abdominal tergite with yellow lateral spots or transverse lines. Malaya, Sumatra. *C. perforatrix* subsp. *pyramidalis* Ckll.

3. Third abdominal tergite with uninterrupted yellow fascia. Nias Island.
C. perforatrix subsp. *macrocephala* Friese

Burma: 1 ♂ in coll. Br. Mus. (type of *C. perforatrix* Sm.).

Singapore: 1 ♀ in coll. Br. Mus. (type of *C. pyramidalis* Ckll.); 1♀ 1♂, Baker leg. (coll. U.S. N.M.).

Nias Island: 1 ♀, Raap leg., in coll. Magretti (type of *C. macrocephala* Friese) (not examined by me).

South Sumatra: 1 ♀, Lampong Districts, Mt. Tanggamus, 600 m, Dec. 1939, Mrs. M. Lieftinck (coll. Lieft.).

West Java: 1 ♀, Djasinga, Mirabaja, 100 m, March 1941, M. A. Lieftinck, on Costus speciosus (coll. Lieft.); 1 ♀ 1 ♂, South coast, Tjisolok, Dec. 1936, F. Dupont leg. (coll. m.).

E. Subgenus **Lioceratina,** n. subg.

The first three of the species placed here are undoubtedly closely allied. They agree in the general structure of the sixth sternite and the genitalia in the male, and differ in these respects from *C. cladura* and its allies. Like the latter, the species of this group are rather delicately sculptured. In most species the face is very finely coriaceous. Yellow markings usually extensive; supra-antennal spots not transverse; post-ocellar spots often present, postscutellum rarely black. Pregradular part of second and following abdominal tergites entirely or partly yellow.

Apex of sixth abdominal tergite of male with 2-4 long spines in the middle; seventh tergite with median point and lateral angles, or roundly emarginate (*C. flavolateralis*); genitalia without tufts of hairs.

Whether *C. pictifrons, canarensis* and *kosemponis* are correctly placed here, must be confirmed by a study of the males of these species.

Type: *Ceratina flavopicta* Smith, 1858.

Ceratina ridleyi Ckll.(figs. 14-16)

! 1910. Cockerell, T. D. A., Trans. Am. Ent. Soc. 36: 218, ♀ ♂ (*C.* (*Ceratinidia*) *ridleyi,* Singapore).

♀ — Length 10-12 mm, fore wing 7-8.5 mm.

Head large, rather thick, temples well developed, widest below the middle, where they are almost as wide as the eyes. Inner orbits slightly diverging towards the clypeus. As seen in profile, the face below the antennae is distinctly raised above the level of the eyes. Mandibles very wide at base, the apical half much narrower, rectangularly bent on inner side, outer side more rounded; the inner tooth well developed, slightly dilated at a short distance from the tip, in the largest specimens almost bilobate, the middle tooth slightly longer than the outer (lower) one. Labrum large, slightly wider than long, the disk flattened, the anterior margin strongly sloping, narrowly and shallowly

emarginate in the middle. Median portion of clypeus flattened, almost a little concave; the lateral parts slightly sloping towards the base of the mandibles. Lower part of paraocular areas (below antennal fossae) flattened, laterally sloping towards inner orbits. Antennal fossae large, but not very deep, separated by a sharp carina, laterally almost reaching the inner orbits, the space between the fossae and the eyes faintly convex; at the inner side of the upper margin of each fossa is a small convex area, just below the ocelli. The major part of the supraclypeal area takes part in the formation of the antennal fossae, only a narrow strip, slightly wider in the middle than at the sides, being convex. Ocelli close together on a slightly convex hump, which lies in a shallow cavity of the vertex. Vertex and temples rounded posteriorly.

Thorax almost globular, slightly longer than wide, nowhere flattened or angular; pronotum short, deeply depressed below the level of the mesonotum; coxae I somewhat inflated, rounded laterally, not spinose; scutellum and postscutellum moderately convex; propodeum short, rounded, in profile forming an almost unbroken arc, the dorsum and the declivity being scarcely differentiated.

Abdomen ovate, with the greatest width (third segment) slightly beyond the middle. Sixth tergite with faint median impressed line.

Body shining, partly covered with fine setiferous punctures; the surface of the head very finely coriaceous, the sculpture slightly coarser on the face below the antennae; the anterior lateral areas of the clypeus and the outer margins of the paraocular areas more shining. Flattened part of labrum with coarse and irregular, but superficial, punctures; face below antennae with scattered ill-defined and shallow punctures and moreover superficially wrinkled; the antennal fossae punctate along the median carina; vertex behind ocelli with some coarse, but shallow and ill-defined, punctures, the punctures becoming smaller towards the temples; except for a few scattered punctures near the top of the eyes the latter are impunctate. Sides of pronotum finely granulate, dull. Anterior half of mesonotum very finely and densely punctate, the punctures superficial and not distinctly defined, posterior half polished and strongly shining, except for a narrow densely punctate band at the posterior margin; the two punctate areas of the mesonotum are connected on each side by a very narrow band of punctures along the lateral margins. Mesopleura and sternum finely and sparsely punctate, with distinct shining interspaces, the punctures superficial, not sharply margined, more remote towards the metapleura; hypoepimeral area polished anteriorly, the posterior part finely punctate. Dorsum and declivity of propodeum impunctate, finely coriaceous, the dorsum polished in the middle of

the base and with a narrow, slightly raised, median polished line; sides of propodeum less shining, rather densely covered with microscopic punctures.

Abdominal tergites 1-3 finely coriaceous, a small area in the middle of the posterior part of the first tergite finely and sparsely punctate, second and third tergites sparsely to moderately punctate, the punctures fine and much smaller than the interspaces, the posterior depressed margins of these tergites densely punctate; tergites 4-6 much less shining than the preceding ones, densely rugosely punctate; sternites 2 and 3 sparsely, somewhat coarsely, punctate, 4-6 densely and more finely punctate, the apical margins of these sternites narrowly impunctate.

Body dark brown to brownish black, with extensive yellow markings as follows: basal half of mandibles (except for dark line at inner side), labrum (basal pit brown, a translucent spot on each side of basal half brownish), clypeus (sides and upper margin of median portion narrowly black), broad lateral face marks (covering almost entire paraocular areas below antennal fossae, narrowed to half the width besides the fossae and obliquely cut off at the level of the lower margin of the anterior ocellus), a transverse spot, very broadly triangular, on the convex part of the supraclypeal area, two oval spots above antennae (almost parallel), two obliquely transverse spots near posterior margin of vertex (behind the space between eyes and ocelli), the temples entirely (obliquely cut off near top of eyes); a broad band on posterior half of pronotum (not connected with the yellow tubercles), four longitudinal lines on the mesonotum (the lateral ones much wider than those on the disk), the convex part of the scutellum, the axillae, mesopleura and mesosternum (posterior margin and hypoepimeral area of mesopleura brown), a transverse line on postscutellum (sometimes indistinct), two large spots on propodeum, connected in the middle, leaving a basal triangle and the lower part of the declivity and the sides dark brown; three bands on base of abdomen, gradually narrowed from the sides to the middle, where they are more or less widely interrupted (the first and second of these bands are partly formed by yellow marks at the posterior margins of tergites 1 and 2, partly by such marks at the bases of tergites 2 and 3, the third band consists only of yellow markings at the base of tergite 3, the latter band is almost invisible when the fourth segment is much telescoped into the third); the fifth and sixth tergites appear also to be yellow at the base; sternites 1-3 more or less yellowish, suffused with brownish to blackish. Antennae dark brown, the scape ferruginous anteriorly.

Legs yellow, coxae and trochanters I brown, partly yellowish, femora I yellow with vague brownish mark above; coxae, trochanters and femora II and III brown, the femora yellow at apex above; posterior tibiae brownish

on inner side of posterior third, second and following tarsal segments pale ferruginous.

Punctate areas of body sparsely covered with fine, rather long, pale yellowish hairs, the scopal hairs on hind tibiae and metatarsi arise from dark, raised punctures, which are very fine on the upper side, but larger and more conspicuous on outer side and beneath.

Wings subhyaline with yellowish tinge.

♂ — Slightly more slender than the female and, apart from the sexual characters, very similar. Scape of antennae yellow anteriorly. Sixth abdominal sternite deeply incised and armed with four dark spines (fig. 14); 7th tergite: fig. 15; genitalia: fig. 16.

Malaya: Singapore, 1 ♂, labelled "95-209", in Br. Museum (type); this specimen is discoloured, the yellow markings having become reddish. There are two further specimens from Singapore, one ♀ labelled "Ridley, 1903-353" (cotype), one ♀ "Ridley, 1907-51" (Br. Mus.); 1 ♂, Penang, Baker (U.S. N.M.).

North East Sumatra: Sibolangit, 450 m, 2 ♀ 2 ♂, 16-17 Nov. 1950 (on Leea spec.) Lieftinck (1 ♀ 1 ♂ in coll. m.).

South Sumatra: Lampong Districts, Mt. Tanggamus, 700 m, 1 ♀ 3 ♂, 19-31 XII. 1940, on a Rhododendron species with yellow flowers, Mrs. Mia Lieftinck.

West Java: Mt. Gedeh near Djasinga, 950 m, 1 ♀, 25 III. 1941, "dead with spider in inflorescence of Ixora spec.", M. A. Lieftinck; Djasinga, 100 m, 1 ♀, 25 XII. 1940, on flower of tree (fam. Araliaceae), Mrs. Mia Lieftinck.

Ceratina flavopicta Smith (figs. 17-19)

! 1858. Smith, F., Jl. Proc. Linn. Soc. Zool. II: 47, no. 2, ♂ (*C. flavopicta*, Sarawak, Borneo).

This species is closely allied to *C. ridleyi* Ckll. The female differs only slightly in structure and sculpture. In *C. flavopicta* the mandibles are more regularly arcuate, the supra-clypeal area is higher, and the puncturation of mesoscutum and mesopleura is finer and sparser than in *C. ridleyi*. The males are easily distinguished by the characters of the terminal abdominal segments.

Apex of fifth sternite weakly emarginate in the middle; sixth sternite: fig. 17; seventh tergite: fig. 18; genitalia: fig. 19.

Length: ♀ 9-11 mm, ♂ 7-9 mm.

The colour pattern of *C. flavopicta* is more like that of *C. flavolateralis* Ckll. than that of *C. ridleyi* Ckll. There appears to be some geographic variation, but this aspect could not be studied in detail, because I have seen

only a few specimens from other localities than Java and Bali. My preliminary conclusion is that both the Malayan and the Javan representatives are subspecifically distinct from the first described form occurring in Borneo. Unfortunately, the latter is known in the male sex only, and it is therefore quite possible that examination of further material will lead to different conclusions.

The subspecies may be distinguished as follows:

1. Supra-antennal spots united and connected by broad yellow inter-antennal line with yellow spot on supra-clypeal area. Hypo-epimeral area of mesopleura brown. Dark bands on abd. tergites 2 and 3 narrowly (♂) or widely (♀) interrupted. (Malaya) *C. flavopicta xanthura* Ckll.
— Supra-antennal spots separated, inner side of antennal fossae brown or black . 2
2. Mesopleura with broad dark vertical line along posterior margin, also the metapleura dark. Bands on tergites 2 and 3 not interrupted (♂). Hind femora and tibiae partly brownish. (Borneo) . . . . . *C. flavopicta flavopicta* Sm.
— Mesopleura and metapleura yellow or orange-yellow. Tergites 2 and 3 orange-yellow, with interrupted dark band (♂) or small dark spot on each side (♀). Hind femora and tibiae orange-yellow. (Java, Bali). . . *C. flavopicta lauta* n. subsp.

C. flavopicta flavopicta Sm.

The female of this form is as yet unknown. I have examined the type, a male labelled "Sar." (Sarawak, Borneo) in the Saunders collection (Oxf. Univ. Mus.), and a male from Sandakan, Borneo, Baker (coll. U.S. N.M.). The latter specimen is not different from the type; a study of its terminal abdominal segments showed that these agree well with those of male specimens from Java (see fig. 17), the only difference being that the middle tooth of the sixth sternite is slightly less deeply incised at apex.

C. flavopicta xanthura Ckll.

1919. Cockerell, T. D. A., Ann. Mag. Nat. Hist. (9) 3: 245, ♂ (*C. xanthura,* Penang).

I have not seen the type of *C. xanthura* Ckll. and I do not know where it is preserved. The U.S. N.M. collection contains one male and one female from the type locality (Penang, Malaya); the latter was probably collected together with the type, for it bears the same number (Baker, 9285). Both specimens (especially the female) are somewhat discoloured, presumably by cyanide.

C. flavopicta lauta, n. subsp.

♀—Body orange-yellow, tips of mandibles and a narrow line along the sutures on the lower half of the face brownish; front and vertex black or brownish, except for the supra-clypeal area, broad lines along inner orbits (not reaching top of eyes), two almost coalescent oval spots below ocelli and two obliquely

transverse spots (often connected by curved yellow line on occiput) at posterior margin of vertex. Antennae black, the scape reddish. Mesoscutum black with four orange-yellow lines; propodeum with bluntly triangular black mark on dorsum; the remainder of the thorax, and the legs yellow; posterior tibiae somewhat brownish above, tarsi partly ferruginous. Abdominal segments 1-3 orange-yellow; 2nd and 3rd segments with a basal black spot on each side of the tergite, the spots rarely connected; segments 4-6 brownish black, 4 and 5 yellow at base (often hidden beneath preceding segments) and with a pale yellow band at posterior margin. Wings hyaline with a slight yellowish tinge, veins and stigma brown. — The ♂ resembles the ♀; scape of antennae ferruginous-yellow anteriorly; second and third tergite with narrowly interrupted—sometimes entire—black transverse band.

The type is a ♀ from Mt. Tjiampea near Bogor, 5 May 1935 (author) in my collection; the allotype a ♂ from the same locality, 15 Nov. 1936, C. J. H. Franssen leg. (coll. m.).

West Java: Several specimens of both sexes (paratypes) in coll. Lieftinck, coll. Mus. Zool. Bogor, Mus. Leiden, and coll. m., from various localities in W. Java from 50 to 700 m above sea level: Bodjonglopang, Bolang (Tjilangkap), Djasinga, Tjampea, Depok, Bogor, Djampangwetan, Genteng, Sukanegara.

Central Java: Pekalongan, Subah, 1 ♀ VI-1940, Mrs. M. E. Walsh (paratype, coll. Mus. Zool. Bogor).

Bali: 1 ♂, Den Pasar, June 1935, Awibowo leg. (paratype, coll. m.).

In Depok Dr. Lieftinck took both sexes of this species on flowers of Stachytarpheta and in Genteng on Hyptis capitata (Labiatae); in Bodjonglopang a male was taken on Urena lobata (Malvaceae).

Ceratina pictifrons Sm.

! 1861. Smith, F., Journ. Proc. Linn. Soc. Zool. V: 92, no. 1, ♀ (*Ceratina pictifrons*).

The type, a female labelled "Mak" (Makassar), is in the Oxford University Museum.

This species is closely allied to *C. flavopicta* (Sm.), but it is distinguished by the coarser sculpture. Clypeus (except for a median impunctate line) and the lateral areas of the face closely and coarsely punctate. Inner side of antennal fossae densely punctate and dull. Supraclypeal area with 5-6 deep and coarse punctures. Vertex densely punctate, but space between eyes and ocelli impunctate. Puncturation of mesonotum slightly coarser than in *C. flavopicta*.

Basal area of propodeum moderately shiny, finely granulate, with a few fine wrinkles at the base.

As in the typical form of *C. flavopicta,* the dark bands on the second and third abdominal tergites are not interrupted.

Ceratina flavolateralis Ckll. (figs. 20-22)

1916. Cockerell, T. D. A., Phil. Jl. Science XI: 306, ♂, fig. 1a (*C. flavolateralis,* Los Baños, Luzon).
1918. Cockerell, T. D. A., Phil. Jl. Science XIII D: 142, ♂ ♀ (*C. flavolateralis,* Luzon and Mindanao).

The female resembles *C. flavipicta* Sm. with entire black bands on abdominal tergites 2 and 3, but is distinguished by the structure of the propodeum. The anterior part of the mesoscutum is more sparsely punctate, the posterior part is more shiny. The males are easily distinguished (figs. 20, 21, and 22). The size of this species varies considerably: ♀ 8-10 mm, ♂ 6.5-9 mm.

Perhaps *C. flavolateralis,* although certainly specifically different, is the Philippine representative of *C. flavopicta,* so that the two may be regarded as belonging to one "superspecies".

C. pictifrons Sm. from Celebes probably belongs to the same superspecies.

C. flavolateralis flavolateralis Ckll.

Mesopleura and legs entirely yellow.

Philippine Islands: 5 ♀ 2 ♂, Mt. Makiling, Luzon; 1 ♀ 2 ♂, Sibuyan Island; 1 ♂, Samar Island; 1 ♂, Cuernos Mts., Negros; all collected by Baker (U.S. N.M.).

C. flavolateralis mindanaonis, n. subsp.

Mesopleura with dark band or isolated spots at posterior margin, often also the ventral side with a large dark spot. Metapleura partly or entirely brown. At least the hind femora fuscous, sometimes also the hind tibiae and part of the mid legs darker than in the typical form.

Philippine Islands: type: ♀, Kolambugan, Mindanao, Baker (U.S. N.M.); paratypes: Mindanao: 2 ♀ 1 ♂ Butuan, 1 ♀ Zamboanga, 1 ♀ 1 ♂ Dapitan, 1 ♀ Surigao, 2 ♂ Iligan, 1 ♂ Davao (no. 7428); 1 ♀, Basilan Island; 2 ♀ 2 ♂, N.W. Panay; all collected by Baker (U.S. N.M.). — In the specimens from Panay, except in one female, the inner yellow lines on the mesoscutum are absent.

Ceratina (? Lioceratina) canarensis Ckll.

1919. Cockerell, T. D. A., Ann. Mag. Nat. Hist. (9) III: 195, ♀ (*C. canarensis,* South Canara Distr., Nagody, India).

Upon examination of the type of this species, a female in the collection of the Br. Mus. ("pres. by Imp. Inst. Ent. B.M. 1933-582"), I noted:

"Apparently allied to *C. ridleyi* and *C. flavopicta,* but the clypeus is not finely coriaceous and the thorax is more shiny. The bright markings are less extensive than in *C. flavopicta lauta*".

Ceratina (? Lioceratina) kosemponis Strand

1913. Strand, E., Suppl. Entom. II: 39, ♂ ♀ (*C. kosemponis,* Formosa).
1914. Strand, E., Archiv für Naturg. 80 A, H. 1: 138 (Formosa).

This species is known to me from the description only. It appears indeed to be allied to *C. ridleyi,* with which it is compared by Strand, but the apex of the seventh tergite of the ♂ is said to be broadly rounded, without any teeth or similar projections. The structure of the sixth sternite was not described.

F. Subgenus **Xanthoceratina,** n. subg.

The species placed here agree with those of the subgenus *Lioceratina* in the delicate sculpture of head and thorax; only in *C. humilior* the mesopleura are more coarsely punctate. Clypeus polished, not coriaceous. Yellow markings extensive, supra-antennal spots nearly parallel, postocellar spots often present, postscutellum rarely entirely black. Pregradular part of second and following abdominal tergites entirely or partly yellow. Apex of sixth abdominal tergite of male with two rounded teeth in the middle, seventh tergite without sharp angles or teeth; genitalia with four tufts of hairs.

Type: *Ceratina cladura* Ckll., 1919.

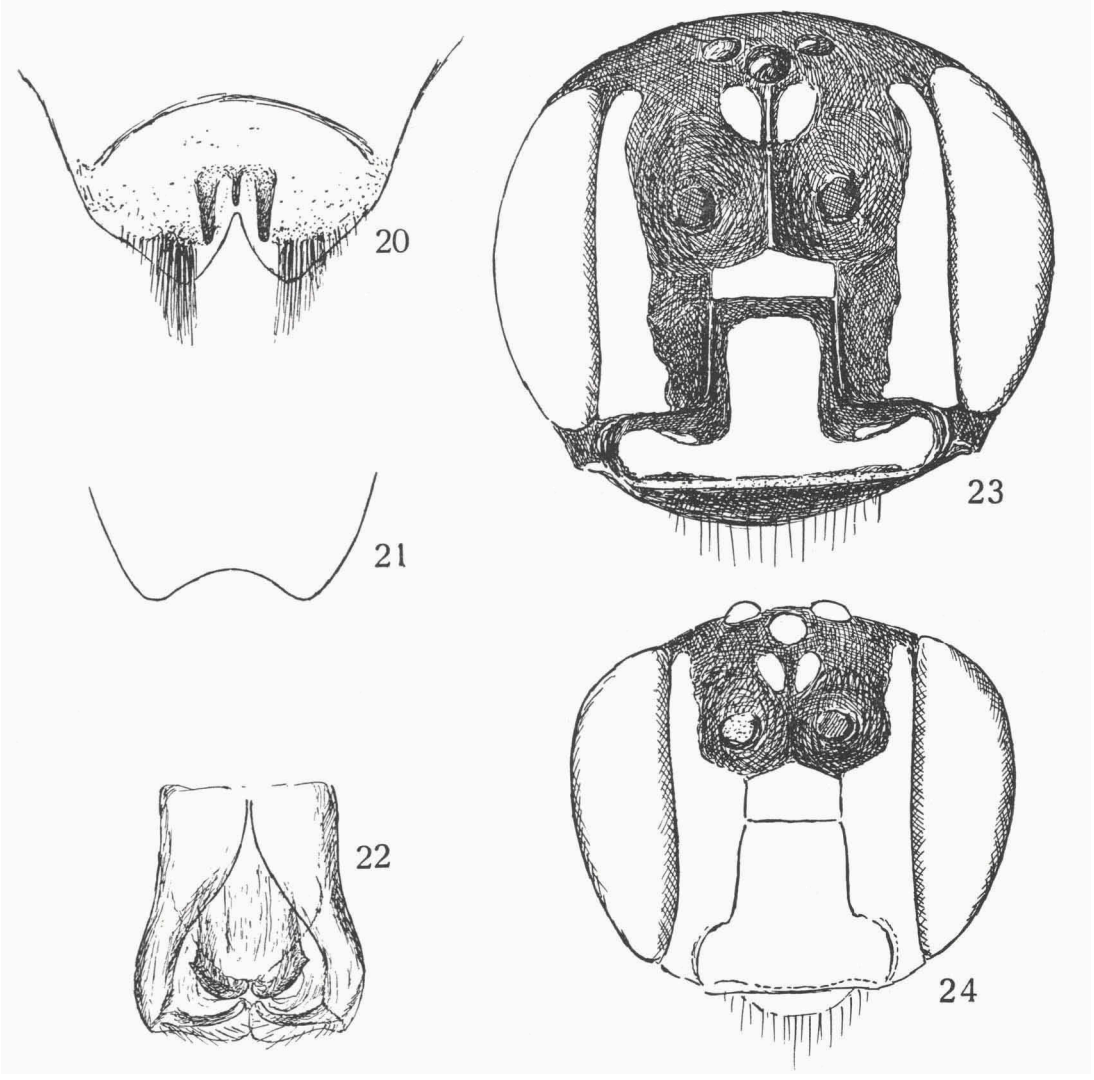
Ceratina cladura Ckll. (figs. 23-27)

1919. Cockerell, T. D. A., Proc. U. S. Nat. Mus. 55: 173, ♀ (*C. cladura,* Buitenzorg, Java).

The original description is apparently based on a discoloured specimen, for all available Javan specimens have the bright markings yellow, not creamy-white.

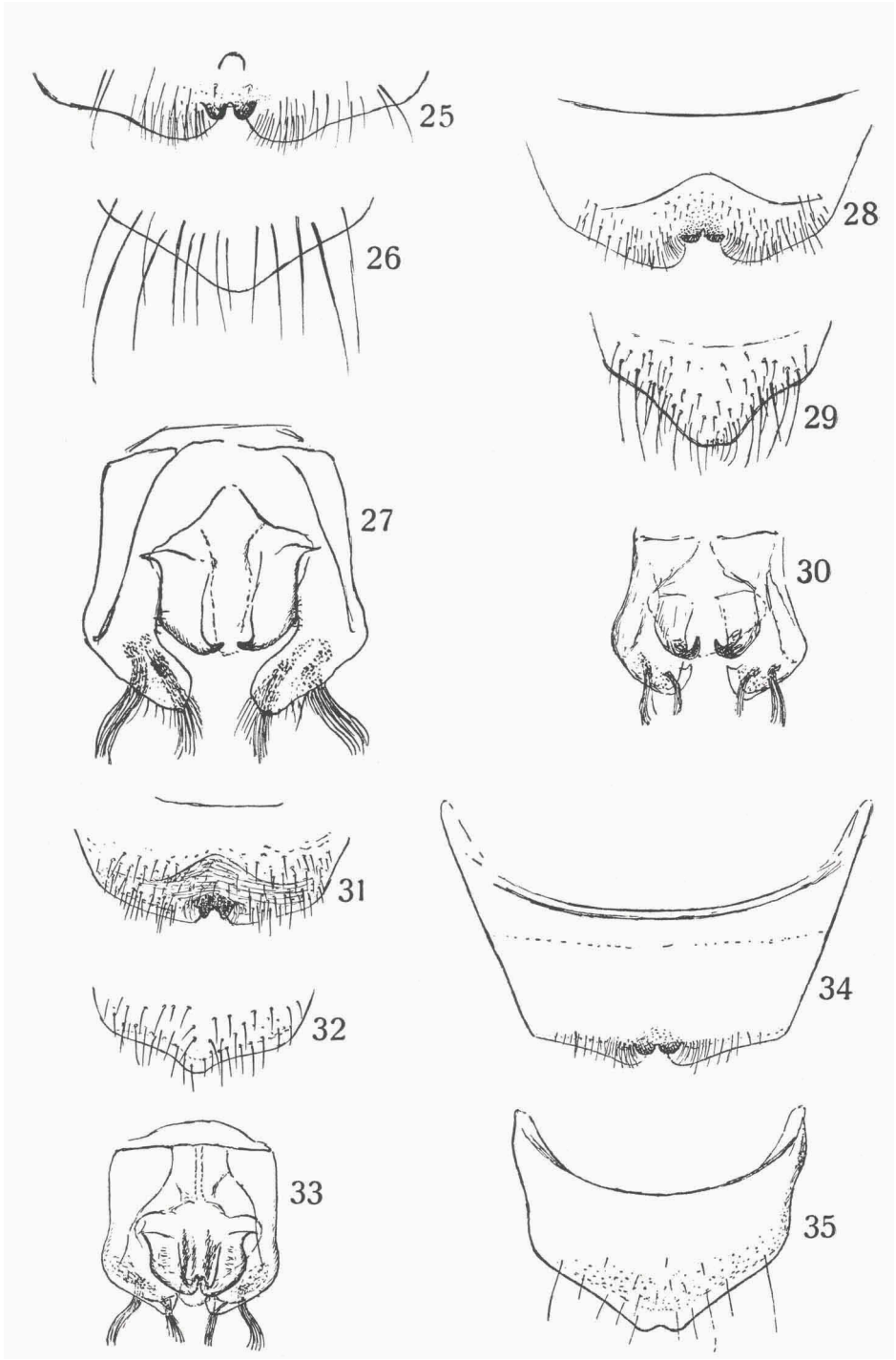
Some additions to Cockerell's description: ♀ — Labrum with a blunt transverse rim near the anterior margin. Anterior lateral areas of clypeus and the lower part of the paraocular areas with a few scattered shallow punctures. Antennal fossae impunctate, except for a few fine punctures on each side of the median carina. Posterior margin of vertex with some coarser, irregular punctures, densest in the middle. Temples almost impunctate. Anterior half of mesoscutum and a narrow band at the posterior margin finely, superficially punctate, the punctures not sharply defined. Mesopleura distinctly punctate, the punctures larger than on the mesoscutum, the shining interspaces about as large as the punctures, larger near the posterior margin;

the hypoepimeral area shining, impunctate. Base of scutellum almost impunctate, except at the sides. Dorsum and declivity of propodeum very weakly



Figs. 20-22, *C. flavolateralis* Ckll. ♂; 20, sixth sternite; 21, seventh tergite; 22, genitalia.
Figs. 23-24, *C. cladura* Ckll.; 23, head of ♀; 24, head of ♂.

differentiated; the former dull, finely coriaceous, not "obscurely transversely wrinkled" (orig. descr.). The "elongated patch beneath wings" is a mark on the metapleura; the word "metathorax" in the original description should be



Figs. 25-27, *C. cladura* Ckll. ♂ ; 25, sixth sternite; 26, seventh tergite; 27, genitalia.
Figs. 28-30, *C. cosmiocephala* Cam. ♂ ; 28, sixth sternite; 29, seventh tergite; 30, genitalia.
Figs. 31-33, *C. fuliginosa* Ckll. ♂ ; 31, sixth sternite; 32, seventh tergite; 33, genitalia.
Figs. 34-35, *C. humilior* Ckll. ♂ ; 34, sixth sternite; 35, seventh tergite.

replaced by "propodeum". The mesosternum has a yellow line on each side of the median carina; anteriorly these lines are bent outwards and (in brightly coloured specimens) connected with the marks on the anterior half of the mesopleura, posteriorly they diverge towards the middle coxae, enclosing a triangular dark spot. The coxae of all legs and the hind trochanters are more or less extensively marked with yellow. The basal three or four sternites of the abdomen are pale greyish yellow, more or less suffused with dark markings. The first abdominal tergite bears more or less extensive yellow markings, the following tergites have the pregradular area yellow and the posterior margin narrowly testaceous; the number of visible yellow bands on the abdomen varies with the extent to which the segments are protracted.

♂ — The hitherto undescribed male of *C. cladura* resembles the female in many respects, but except for the dark sutures the face below the antennal fossae is entirely yellow (fig. 24) and the marks on the mandibles are larger. In the specimens before me the spots on the vertex are absent, the lines on the disk of the mesonotum are very narrow and the legs are more extensively marked with yellow than in most females (under side of femora I yellow, tibiae I and II yellow, the latter with dark line on inner side). Sixth sternite with two small rounded teeth (fig. 25); seventh tergite: fig. 26; genitalia on each side with two tufts of long hairs (fig. 27).

Variability. — Among the available specimens there is much variation in size, the smallest female measuring only 6 mm, the largest almost 9 mm. As regards the coloration, it is of interest to note that some of the yellow markings are much more subject to variation than others. The lateral face marks, for instance, are much more variable than the mark on the clypeus; in dark specimens the spots on the vertex disappear sooner than those above the antennae.

The variability of the coloration in the Javan specimens may be demonstrated by the following differences between the most brightly coloured and the darkest female:

Mandibles	with yellow spot	entirely dark
Labrum	yellow	dark, with small spot at the base
Scape of antennae	ferruginous yellow in front	ferruginous at extreme base only
Lateral face marks	wide below, upper half parallel-sided, truncate at top	narrower below, upper half shorter, narrowed to a point
Spots on vertex	present	absent
Line on pronotum	connected with tubercles	not connected
Anterior mark on mesopleura	large, connected with yellow lines on sternum	smaller, on upper half only, widely separated from lines on sternum

Posterior mark on mesopleura	present	absent
Lines on disk of mesoscutum	distinct	almost obsolete
Knees of mid legs	yellow	dark
Hind tibiae	yellow spot at base	dark
Propodeum	yellow, only small triangle on basal area and the greater part of the sides dark	yellow, basal area and sides dark
First abdominal tergite	yellow, with irregular sinuate transverse band in the middle and two transverse spots at posterior margin dark	dark, extreme base and two transverse oval spots on disk yellow

The available Javan specimens represent various transitions between these two extremes. Females from East Java are generally smaller and darker than the others, but very dark specimens may also be found in West Java. On this island *C. cladura* has been found only in places where the original forest has not yet been entirely devastated.

West Java: Djasinga, 100 m, 1 ♀, V. 1940, on Peperomia spec., 1 ♀, XII. 1940 on Saurauia nudiflora, M. A. Lieftinck; Mt. Tjiampea near Bogor (= Buitenzorg), 250 m, 1 ♀, XII. 1940 on Rubus moluccanus, author; Mt. Panggerango, Tjisarua, 1000-1200 m, 3 ♀, I. 1939, X. 1941 and VII. 1948, one on Impatiens platypetala, Mrs. and Mr. Lieftinck; 1 ♀, Tjibodas, Mt. Gedeh, Nov. 1950, on Polygonum chinense, author; Djampang, 1 ♀, VII. 1940, Lieftinck; do., 1 ♂, IX. 1936, Mrs. M. E. Walsh (coll. m.); do., 1 ♀, Mt. Tjimerang, April 1938, Mrs. M. E. Walsh (Mus. Leiden); Bodjong Lopang, 1 ♀, V. 1940, Lieftinck; Udjung Genteng, Tjiguha, 1 ♀, II. 1939, Mrs. M. E. Walsh.

East Java: Mt. Semeru, R. Darungan, 800 m, 4 ♀, VII. 1941, on Trevesia sundaica Miq. (Araliaceae), Lieftinck; Idjen Mts.: Djerukundjur on W. slope, 500 m, 4 ♀, VI, X and XI. 1939, Mrs. Lucht, Mrs. van der Vecht and author; do., Silapak slope, 1200 m, 1 ♂, X. 1939, Mrs. Lucht (coll. m.).

Philippine Islands: 1 ♀, Island of Basilan, Baker (coll. U.S. N.M.). This female agrees well with brightly coloured specimens from Java.

The occurrence of this species in the Philippine Islands needs confirmation, especially because it has not yet been found in Borneo.

C. cladura crocina, n. subsp.

♀ — Length 6-7 mm; slightly smaller than most West Javan specimens, and more extensively marked with yellow. Dark line between clypeal mark

and lateral face marks narrow; sides and ventral face of thorax yellow, only the mesopleura with dark lines or markings at anterior and posterior margin. Legs yellow; femora, tibiae and tarsi of hind legs brownish, apical margin of abdominal tergites 2-5 with yellow bands, the bands more testaceous posteriorly. — One of the specimens is rather distinctly macrocephalic.

Sumatra: 1 ♀ S.W. Lampong Districts, Mt. Tanggamus, 600 m, Dec. 1939, M. A. Lieftinck (type, Mus. Leiden); paratypes: 5 ♀ from type loacality, Dec. 1939 and March 1940 (Mus. Leiden), and 1 ♀ North Sumatra, Sibolangit near Medan, 450 m, 16 Nov. 1950, M. A. Lieftinck.

Ceratina metaria Ckll.

1920. Cockerell, T. D. A., Phil. Jl. Science 17: 624, ♂ (*C. metaria,* Penang Isl., Malaya).

The type of *C. metaria* is a male from Penang Island, Baker leg. (coll. Br. Mus.); I have not seen any other material. Perhaps this is a very small male of a form of *C. cladura,* but it may also represent a separate species resembling the Ceylonese *C. beata* Cam. A decision about the status of this form cannot be reached until additional material becomes available for study.

Ceratina cosmiocephala Cam. (figs. 28-30)

! 1908. Cameron, P., Entomologist XLI: 285, ♀ (*C. cosmiocephala,* Kuching, Borneo).

♀ — Head as in *C. cladura,* but labrum and base of mandibles entirely yellow; scape of antennae yellow, brownish at apex above; postocellar spots absent. — Thorax and abdomen as in *C. cladura,* but the black colour replaced by bright ferruginous brown, only the fourth and following abdominal tergites darker at the sides.

Length 6-7 mm.

♂ — Like the female, but the face entirely yellow below antennal fossae, lateral face marks strongly narrowed at lower margin of antennal fossae, and narrowed again at top of fossae, produced as a narrow line to top of eye; a triangular brown spot between supraclypeal area and antennal insertions; supra-antennal spots smaller than in the female. The terminal abdominal segments and the genitalia appear to be sufficiently different from those of *C. cladura* to regard these forms as specifically distinct (figs. 28-30).

Length 5-6 mm.

North Borneo: 1 ♀, Kuching, Sarawak, Hewitt, ex coll. Cameron (Br. Mus., this specimen was not marked as the type, but I have labelled it as such in September 1951); 1 ♀ 1 ♂, Mt. Matang, Sarawak, G. E. Bryant, 1914-382 (Br. Mus.).

Ceratina fuliginosa Ckll. (figs. 31-33)

1916. Cockerell, T. D. A., Phil. Jl. Science XI: 306, ♀ (*C. fuliginosa,* Palawan).
? 1920. Cockerell, T. D. A., Phil. Jl. Science 17: 227, ♂ (*C. flavonitens,* Sandakan, Borneo) (n. syn.).

Allied to *C. cladura,* but generally slightly larger and darker and easily distinguished by the fuscous cloud in the fore wing.

♀ — Clypeus with only a few punctures at lateral margins; paraocular areas and posterior part of vertex sparsely punctate; anterior part of mesoscutum finely and densely punctate, the posterior two thirds (except for some punctures at posterior margin) impunctate, with an oily shine. Mesopleura more coarsely punctate than mesoscutum, the punctures superficial and at least posteriorly and ventrally much smaller than the interspaces. Abdomen more densely punctate and less shiny than in *C. cladura*; especially the fourth and following tergites very densely rugosely punctate and dull.

Coloration almost as in dark specimens of *C. cladura* (compare p. 42); mandibles with large yellow spot, labrum yellow with dark spot on each side at base; post-ocellar spots absent; pronotal tubercles sometimes dark; the inner lines on mesoscutum thin, but distinct; metapleura black or with yellow spot; yellow mark on propodeum variable, but generally smaller than in *C. cladura*; knees of mid legs with small yellow spots; first abdominal tergite with curved transverse yellow band (concave anteriorly, abbreviated and rounded laterally) which posteriorly is confluent with testaceous-yellow line in middle of apex; apex of second and following tergites narrowly ferruginous-yellow, posterior margin of fifth tergite with yellow band strongly widened in the middle; the pregradular areas of tergites 2-5 are yellow, but the basal bands thus formed are emarginate posteriorly at the sides, that on the fifth tergite almost over its entire width. Marginal cell and the area beyond it strongly infuscated.

♂ — The male resembles that of *C. cladura,* but at least in Javan specimens the black line between supraclypeal spot and the lateral face marks is wider, the lateral face marks reach beyond the top of the eyes, and all abdominal tergites have a yellow apical band; the middle part of the sixth tergite entirely yellow. Dark cloud in fore wing less pronounced than in the female. Terminal abdominal segments and genitalia: figs. 31-33.

In Java the coloration of this species is fairly constant, but in Sumatra it appears to be more variable. One of two females, collected by Lieftinck at Sibolangit, a large and somewhat macrocephalic specimen (length 10.5 mm) has the yellow markings on the thorax much reduced: mesoscutum and mesopleura black, the latter with very small spot behind tubercles; scutellum with central yellow spot; postscutellum with small transverse mark,

propodeum with x-like spot; mid and hind legs without yellow markings.

Palawan: 1 ♀, Puerto Princesa, Baker (coll. Br. Mus.), type of *C. fuliginosa*; the specimen is reddish-discoloured. Two females from this locality, labelled *C. fuliginosa,* in coll. U.S. N.M. proved to belong to *C. nigrolateralis* Ckll.

Borneo: Loa Tebuk, S. Borneo, 1 ♀, 3 July 1937; Tanggarang, Mt. Pandjang, S. Borneo, 1 ♂, 4 July 1937; both coll. by Mrs. M. E. Walsh (coll. m.); the latter specimen agrees well with the type of *C. flavonitens* Ckll., a male from Sandakan, Borneo (Br. Mus.), but the yellow mark on the metapleura is slightly smaller.

West Java: Depok, 4 ♀, on Melastoma malabathricum, M. A. Lieftinck; Djasinga, 1 ♀, Dec. 1935, M. A. Lieftinck (Mus. Bogor); Bodjonglopang, 1 ♀, M. A. Lieftinck; do., Djampangtengah, Mt. Tjimerang, 1 ♀, April 1938, Mrs. M. E. Walsh (Mus. Leiden); do., Mt. Tjisuru, 2 ♀, March 1935, 1 ♂, Sept. 1936, Mrs. M. E. Walsh (coll. m.), Sukabumi, 1 ♀, April 1933 (coll. m.).

East Java: Patjitan, 1 ♀ 3 ♂, 12 Dec. 1937, author (coll. m.); Ranu Darungan, Mt. Smeru, 800 m, 1 ♀, June 1941, M. A. Lieftinck; Mt. Tengger, 1 ♀, Febr. 1936, Mrs. M. E. Walsh (coll. m.); Mt. Idjen, W. slope, 1 ♀, June 1939, Mrs. Lucht.

Sumatra: Mt. Tanggamus, Lampong Distr. (S. Sum.), 1 ♀, March 1940, on Cucurbitacea with yellow flowers; Sibolangit, Deli (N. Sum.), 450 m, 2 ♀ 1 ♂, 16 Sept. 1950, M. A. Lieftinck.

Ceratina bipes Ckll.

1920. Cockerell, T. D. A., Phil. Jl. Science 17: 624, ♀ (*C. bipes,* Penang, Malaya).

I do not know where the type of *C. bipes* is preserved, but the U.S. Nat. Museum possesses a female from Penang (coll. Baker) which agrees very well with the description. It is rather large (8 mm) and perhaps slightly macrocephalic.

It agrees in many respects with *C. fuliginosa,* but the paraocular areas are more coarsely punctate (with about 8-10 punctures); the abdomen, though more densely punctate than in *C. cladura,* is more shiny than in *C. fuliginosa*; post-ocellar spots absent; yellow lines at inner orbits abruptly widened and curved inwards to top; metapleura yellow; yellow bands on pregradular areas of second and following tergites not emarginate laterally; posterior margins of tergites 2-5 testaceous; fore wings without dark cloud at anterior margin.

Ceratina humilior Ckll. (figs. 34 and 35)

1916. Cockerell, T. D. A., Phil. Jl. Science XI D: 305, ♀ (*C. philippinensis,* subsp. *nigrolateralis,* var. *humilior,* Puerto Princesa, Palawan).

1919. Cockerell, T. D. A., Phil. Jl. Science XIV: 557 (*C. humilior*).

This species is undoubtedly allied to *C. cladura,* but it is more coarsely sculptured, and the mesopleura particularly are more strongly punctate than in any other species of the *cladura* group.

♀ — Head wide, seen in front much wider than high, the eyes narrow; antennal fossae shallow, ill-defined; sides of clypeus and the paraocular areas with a few scattered rather coarse punctures, inner side of antennal fossae finely punctate, vertex punctate at posterior margin only. Anterior third of mesoscutum finely and densely punctate, the posterior portion polished and impunctate, except for a row of punctures at lateral margins and a narrow transverse band at posterior margin. Mesopleura more coarsely punctate, except on impunctate lower half of hypoepimeral area; the punctures well defined, the interspaces slightly smaller than the punctures except posteriorly on ventral side. Dorsum of propodeum dull, finely granulate, with short longitudinal wrinkles at base; the declivity not distinctly separated, more shiny than the dorsum. Abd. tergite 1 punctate at posterior margin, 2 and 3 densely and finely punctate, except for a transverse band in the middle of the segment, 4-6 densely rugosely punctate, rather dull.

The sculpture of the abdominal tergites is coarser than in *C. cladura,* more like in *C. fuliginosa.*

Black; yellow markings: clypeal mark, resembling a reversed T, stem short and thick, arms relatively long, widened apically; transverse spot on supra-clypeal area, two spots at inner orbits, one at lower margin of paraocular areas, and one above it, the latter not produced beyond level of antennae; supra-antennal spots (slightly converging towards antennae); a line on temples; a transverse line on pronotum, separated from spots on tubercles, almost the whole scutellum, a spot on axillae, a transverse line (sometimes indistinct) on postscutellum, a line on femora I, one on tibiae I, small spots at base of tibiae II and III. Abdomen variable; first tergite more or less yellowish, apical margins of following tergites narrowly testaceous, sometimes even slightly yellowish; basal sternites pale yellowish.

Length 5.5-6.5 mm.

A macrocephalic specimen from P. Princesa measures 7 mm, on one side of the face the two spots on the paraocular areas are connected, and the mesoscutum shows traces of yellow lateral lines (a short, inconspicuous line on each side above the tegulae).

♂ — Very similar to the female; the face below the antennal fossae yellow, except for the black lines along sutures between clypeus, supra-clypeal area and paraocular areas; the lateral face marks narrowed above, not reaching top of antennal fossae; a spot at apex of femora II and lines on outer side of tibiae II and III yellow.

Sternites 2-4 with conspicuous whitish tomentum; sixth sternite with two short, rounded teeth at posterior margin (fig. 34), seventh tergite faintly bituberculate (fig. 35); genitalia with four bundles of hairs, hardly different from fig. 33. Length 5-6 mm.

This is a rare species which so far has been found only in Palawan and Java. Initially Cockerell described this form as a variety of a subspecies of *C. philippinensis*; later he noted that it is a good species, however, without adding any details to the poor original description.

Philippine Islands: 3 ♀ 1 ♂, Puerto Princesa, Palawan, Baker (coll. U.S. N.M.).

Java: 2 ♀, Djerukundjur at western slope of Idjen mountains in East Java, 500 m, at margin of virgin forest, 29 June 1939, Mrs. A. Lucht and author (coll. m.).

Ceratina beata Cam.

! 1897. Cameron, P., Mem. Proc. Manch. Soc. XLI, no. 4: 139 (*Ceratina beata,* Trincomali, Ceylon).
1897. Bingham, C. T., Fauna Br. India, Hym. I: 504, ♀ (*Ceratina beata,* Ceylon, Burma, Tenasserim) (partly!).

In the original description the sex was not mentioned. The type, kindly sent to me by Prof. G. C. Varley, Oxford University Museum, is a female, which measures barely 5 mm and differs in several points from the continental species, so that I think Bingham was incorrect in using the name *beata* for specimens from Burma and Tenasserim. In 1915 Cockerell (Entomologist 48: 109) recorded a species from the Philippine Islands under this name, but he corrected this error in the next year, describing the species as *C. flavolateralis* (Phil. Jl. Sci. XI, 1916: 307).

Bingham's description agrees well with the type, but the two varieties described by him were perhaps both different species. I have little doubt that *C. beata* is closely allied to *C. cladura,* but its exact position cannot be determined until the ♂ is known.

The most striking characters of *C. beata* are: (1) interantennal carina yellow and connecting the yellow supra-antennal spots with the large yellow mark on the supraclypeal area; (2) postocellar spots connected medially, forming a transverse postocellar line; (3) prothorax entirely yellow; (4) mesoscutum with 4 yellow lines, impunctate and shiny except on anterior third which is densely and finely punctate; (5) propodeum dull and entirely black (dorsum short, distinctly rugose at base); (6) abdomen yellow, the tergites with transverse black bands, being yellow at base and apex only, first and sixth tergite with narrow median yellow line; (7) legs entirely yellow.

G. Subgenus **Ceratinidia** Ckll. & Porter

Ceratinidia Cockerell & Porter, Ann. Mag. Nat. Hist. (7) 4 (1899): 406.

Sculpture generally coarser than in the three preceding subgenera. Front and vertex coarsely punctate, space between eyes and ocelli with at least a few distinct punctures; mesopleura densely punctate; sides of propodeum very finely and granulately punctate.

Supra-antennal spots obliquely transverse; postocellar spots absent; yellow mark on temples usually ending below at about one third of the height of the eyes; mesopleura black or with spot behind tubercles; postscutellum, propodeum, pregradular areas of abdominal tergites, coxae and trochanters black; abdominal bands sometimes more or less reduced.

Parameres (gonostyli) of male genitalia with a comb of long hairs.

Type: *Ceratina hieroglyphica* Smith, 1854.

I. Species-group *bryanti*

Posterior margin of sixth sternite of male with two teeth, sometimes with an additional small tooth between the two larger ones.

The type of the genus, *C. hieroglyphica* Smith, probably belongs in this group, but since the male of that species is as yet unknown, I have preferred to call the group after the better known *C. bryanti* Ckll.

Ceratina hieroglyphica Smith

1854. Smith, F., Cat. Hym. Br. Mus. II: 226, no. 13, ♀ ♂ (*C. hieroglyphica,* Northern India, Hongkong and the Philippine Islands).

The true identity of this species has always remained a problem. The name *hieroglyphica* has been used by several authors for any black and yellow oriental *Ceratina* which agreed more or less with the incomplete and confusing original description. Cockerell (Ann. Mag. Nat. Hist. (9) 3, 1919: 245) concluded from Smith's locality records that this author must have had more than one species before him. This view is undoubtedly correct. A study of the *Ceratina* collection in the British Museum revealed, however, that Smith himself had already come to this conclusion.

In his "Descriptions of New Hymenoptera in the British Museum", published posthumously in 1879, Smith described five new species of black and yellow oriental *Ceratina*. It is evident from the type specimens that three of these were based on material that must already have been studied by him previously. These species are: *C. cognata* and *C. rugifrons* from Makassar, Celebes (collected by Wallace and recorded as *C. hieroglyphica* in Journ. Proc. Linn. Soc. Zool. VII, 1863: 140, and do. XI, 1871: 391) and *C. compacta* from the Philippine Islands. The type of the latter species was acquired

by the British Museum in 1842 and was probably included in the original material of *C. hieroglyphica,* for at present there is no specimen from the Philippines under this name in the collection. Neither is there any *C. hieroglyphica* from Northern India, and I thought at first that the original Northern Indian specimen of *hieroglyphica* would have been redescribed in 1879 as *C. lepida.* This, however, appears improbable, since the type and only specimen of *C. lepida* Smith bears a label "55-76", which means that it was acquired by the British Museum in 1855 and therefore after the publication of Smith's Catalogue, part II.

The only specimens of *C. hieroglyphica* in the British Museum, dating from before 1854, are a female from Hongkong, labelled "48-29" (obtained in 1848 from J. C. Bowring Esq.) and a female from Too-chow-foo, China, labelled "45-65" (obtained in 1845 from Mr. Lay). As the locality Hongkong was mentioned in the original description, I have selected the former specimen as the lectotype of *C. hieroglyphica* Smith.

This specimen is in many respects very similar to *C. bryanti* Ckll., which may ultimately prove to be only subspecifically distinct. Since specific differences in this group are generally more pronounced in the males than in the females, it would be very interesting to study a good series of both sexes of *C. hieroglyphica* from the type locality. So long as this has not been possible, it appears preferable to regard *C. bryanti* as a separate species.

In the type of *C. hieroglyphica* the clypeus has no distinct longitudinal impression; it is rather coarsely, but not very closely, punctate, except along the median line which is impunctate. Vertex and mesoscutum are more densely punctate than in *C. bryanti.* The lateral areas of the mesoscutum are punctate throughout, but anteriorly the interspaces are smaller than on the posterior half; the posterior margin of the mesoscutum is dull and very densely punctate. The upper side of the transverse yellow band on the clypeus is triangularly produced in the middle, as in most specimens of *C. bryanti.*

Ceratina lepida Smith

1879. Smith, F., Descr. New Spec. Hym. Br. Mus.: 92, no. 2, ♂ (*C. lepida,* Northern India).

The type in the British Museum is a male labelled "N. Ind." and "55-76"; according to the Accessions Register of the Museum it was obtained 6 November 1855, collected by Capt. Reid and bought from Stevens.

When comparing this specimen with a male of *C. bryanti* from Java, I made the following notes: "The two are very similar, but in *C. lepida* the anterior part of the mesoscutum is much more sparsely punctate. The lateral areas of the mesoscutum are almost impunctate posteriorly. Seventh tergite

with median point and distinct lateral angles, but the shape is slightly different from that in *C. bryanti* Ckll."

Perhaps *C. lepida* Sm. will eventually be regarded as conspecific with *C. hieroglyphica* Sm. and *C. bryanti* Ckll., but I prefer to leave this question open until it has been possible to study more material from the Asiatic continent. Compare the notes on *C. hieroglyphica* Sm.

In 1929 Cockerell described two new forms from Siam which he regarded as varieties of *C. lepida* Sm. In this paper they are discussed under *C. bryanti* Ckll.

Ceratina bryanti Ckll. (figs. 36-38, 42, 43)

1919. Cockerell, T. D. A., Proc. U. S. Nat. Mus. 55: 175, ♂ (*C. bryanti,* Pelabuan Ratu, Java).

? 1929. Cockerell, T. D. A., Ann Mag. Nat Hist. (10) 4: 150, ♀ (*C. lepida,* var. *sublepida* and var. *sutepensis,* Siam) (subsp. *sublepida,* n. status).

♀ — Length 6-8.5 mm. Clypeus with a wide median impression, the concave part in large specimens often tranversely rugose, lateral margins of median part of clypeus densely punctate; paraocular areas below antennal fossae with similar puncturation, except at lower margin. Antennal fossae shallow, not sharply defined. Vertex between eyes and ocelli rather sparsely punctate, with large interspaces. Temples almost impunctate.

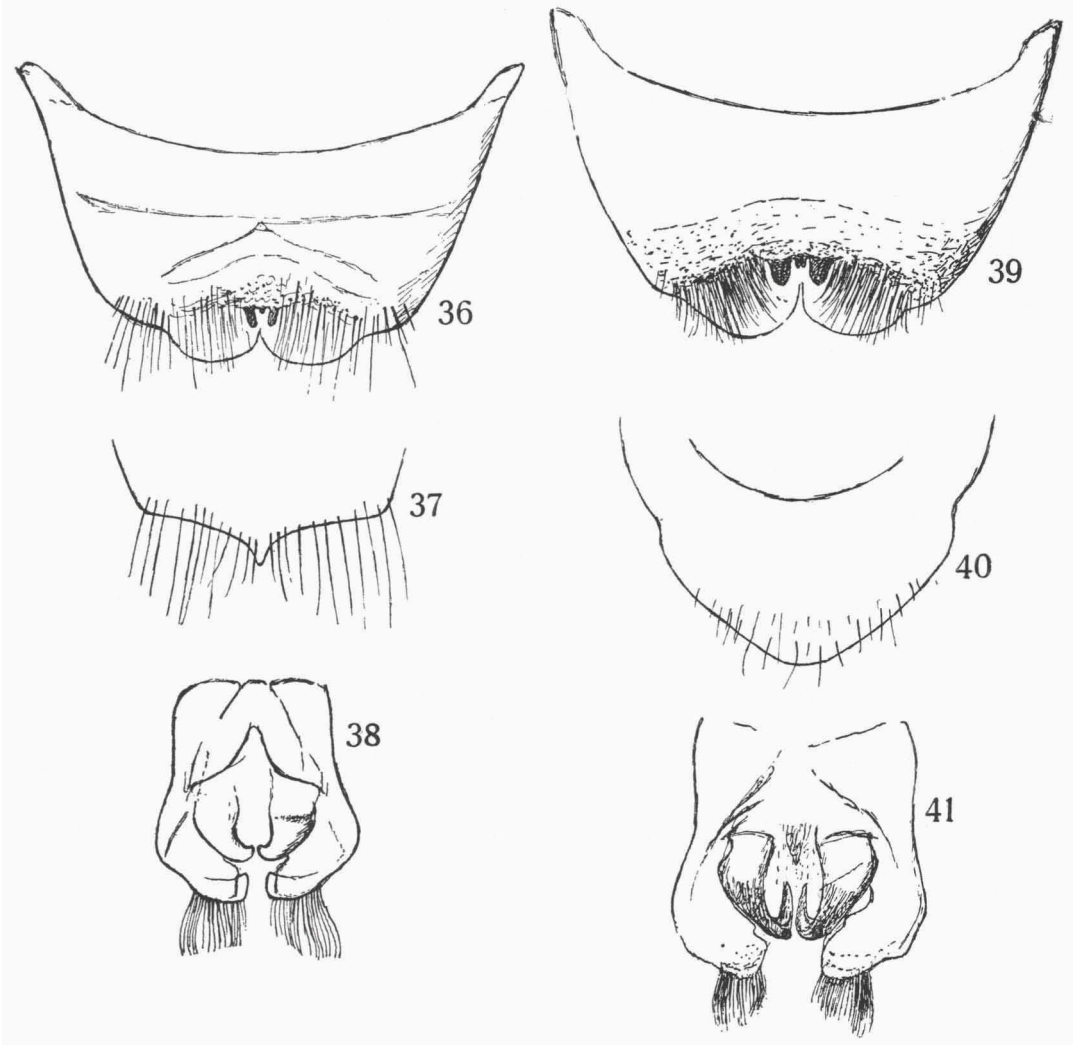
Anterior third of mesoscutum densely, in the middle more sparsely, punctate, the punctures not very coarse but well defined; the punctate part projecting backwards in the middle, but here the punctures forming only a double row, posteriorly a single row, on each side of the median line; puncturation of lateral areas of mesoscutum more variable than in most other species: the posterior part of these areas sometimes impunctate over the entire width or with only a few scattered punctures, sometimes with a double row of punctures along the parapsidal line or even more densely punctate. Specimens with different puncturation may be found in the same locality. Posterior margin of mesoscutum with the usual transverse band of punctures.

Mesopleura densely punctate, hypoepimeral area with longitudinal impunctate space at lower margin; puncturation on ventral side slightly less dense, but also here the interspaces smaller than the punctures.

Dorsum and declivity of propodeum both dull, finely sculptured, the posterior margin of the basal area moderately shiny, angularly produced backwards in the middle. Coxae I rounded at base on outer side. Abdominal tergites finely, somewhat irregularly punctate, the posterior tergites rugosely punctate.

Yellow markings on face variable; upper arm of clypeal mark never very

high, lateral face marks linear, curved inwards along lower margin of paraocular areas, this part shorter and thicker in small specimens (see figs. 42 and 43); antennal scape black; supra-antennal spots distinct; line behind



Figs. 36-38, *C. bryanti* Ckll. ♂; 36, sixth sternite; 37, seventh tergite; 38, genitalia. Figs. 39-41, *Cokinawana* Mats. & Uch. ♂; 39, sixth sternite; 40, seventh tergite; 41, genitalia.

upper two thirds of eyes widest above; yellow line on pronotum separated from spot on tubercles; mesoscutum with four yellow lines, but in dark specimens the inner lines may be faint or absent; spot on scutellum narrowed

posteriorly; mesopleura rarely with small yellow spot behind the tubercles; abdominal bands rather narrow in the middle, but rarely interrupted; legs dark, apex of femora I with yellow spot above and below, sometimes entirely black; tibiae I with yellow line (apical fourth dark), II and III with small spot at base, tarsi dark. Specimens from mountain areas are often darker than those collected at low altitudes.

♂ — Length 6-8 mm. Similar to the female; the clypeus usually distinctly, though widely and shallowly, impressed, sometimes only flattened; this part shiny, not distinctly punctate or rugose; mesoscutum slightly more coarsely punctate than in the female. Yellow mark on clypeus larger, but sides and upper margin of median part always black; lateral face marks narrow above, abruptly widened below; labrum black, rarely with vague yellow spot; supra-antennal spots reduced or absent; post-ocular line reduced; inner lines of mesoscutum usually absent, sometimes also the outer ones lacking; mesopleura black; scutellar spot often reduced; band on tergite 1 reduced or absent, on 2 and 3 as a rule widely interrupted, on 4 at most narrowly interrupted; tergite 6 black or with narrow yellow line at posterior margin. Markings on legs only slightly more extensive than in the female: femora I with short line at under side and spot at tip, line on tibia I almost reaching the apex, tibiae II and III with short yellow line at base, tarsi brown.

Sixth sternite with two teeth (fig. 36); tergite 7 with sharp median tooth and prominent lateral angles (fig. 37); genitalia: fig. 38.

The type of this species is a male from Pelabuan Ratu at the south coast of West Java (coll. U.S. N.M.); Mr. K. V. Krombein kindly compared it with some specimens which I sent him and confirmed my identification.

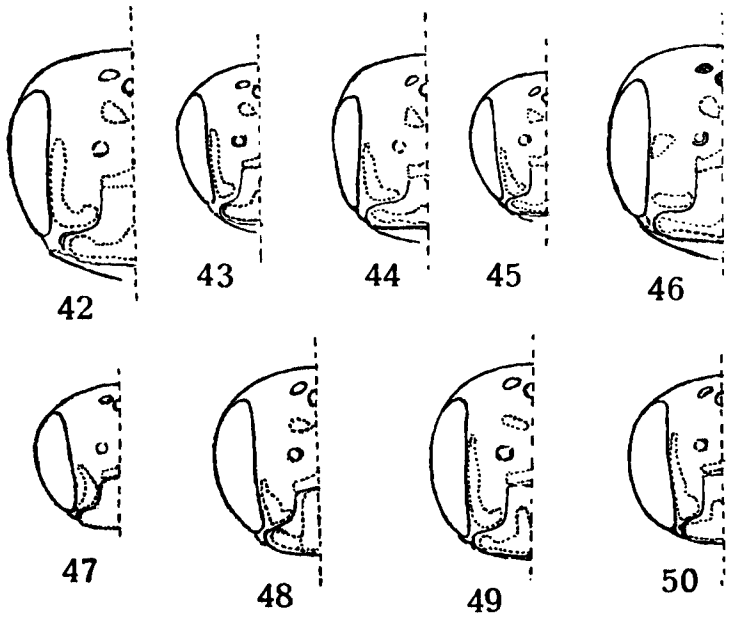
Java: one of the most common species, occurring in cultivated areas, both in the plains and in the mountains. It has been found at higher altitudes than any other *Ceratina* species occurring in Java. There are many specimens of both sexes in Mus. Bogor, Mus. Leiden, coll. Lieftinck and coll. m., mostly from West Java, but it is also common in Central and East Java. Dr. Lieftinck took a female on flowers of Cinchona (Tjisarua, Mt. Gedeh), both sexes on Borreria (same locality), a female on Blumea spec., and a male on Leea indica (Genteng, South West Java). In Central Java Mrs. M. E. Walsh collected this species on Mt. Muria, and in East Java Dr. Lieftinck found it in the Tengger Mountains, 2250 m above sea level (!) on "an umbelliferous plant with yellow flowers" (male, 15 June 1941), and on Mt. Smeru, Ranu Darungan, in June 1941. In June 1939 my wife and I collected several specimens on Mt. Idjen; one female was taken on Rosa spec. in a garden at 2000 m.

Bali: 1 ♀, Kintamani, 1500 m, 23 June 1939, author.

Sumatra: several specimens of both sexes from Tapanuli and Deli in North Sumatra and Padang in West Sumatra, collected by S. Leefmans in 1918 (coll. m.); do., Fort de Kock and Tandjunggadang, 1925-1926, Edw. Jacobson (Mus. Amst.); Djambi (Mus. Leiden); Benkulen, Tandjong Sakti, Mrs. Walsh (coll. m.); Lampong Districts: both sexes on Mihania cordata and on yellow Cucurbitacea, Mt. Tanggamus, M. A. Lieftinck; do.: Kedaton and Sungeilangka, March 1937, author.

Bangka: 1 ♀, Pangkalpinang, Oct. 1929, author.

Siam: The types of *C. lepida,* var. *sublepida* Ckll. and var. *sutepensis*



Figs. 42-50, right half of face of various *Ceratina* species; 42, large and macrocephalic ♀ of *C. bryanti*; 43, small ♀ of *C. bryanti*; 44, large and macrocephalic ♀ of *C. litoraria* n. sp.; 45, small ♀ of *C. litoraria*; 46, *C. tropica* Crawfd. ♀; 47, *C. moderata* Cam. ♂ (type): 48, *C. ornatifera* Cam. ♀ (type); 49, *C. papuana* n. sp. ♀; 50, *C. papuana n.* sp. ♂.

Ckll., both females from Doi Sutep, are in the British Museum. They agree with *C. bryanti,* but the yellow markings are reduced, especially in the var. *sutepensis,* which has the clypeal band almost interrupted medially, and the scutellum black (traces of a yellow mark are still visible). For the moment both forms may be regarded as representing a subspecies *sublepida* of *C. bryanti.* Their status should be considered again when males from this locality have become available for study.

Ceratina okinawana Mats. & Uch. (figs. 39-41)

1926. Matsumura, S., and Uchida, T., Insecta Matsumurana I, no. 2, p. 67, pl. III fig. 10 "♀" (recte ♂?) (*C. okinawana,* Okinawa Island).

The description of *C. okinawana* agrees so well with the male of a species which is represented in the collection of the U.S. National Museum by a beautiful series from the Ryukyu Islands, that I am forced to conclude that the Japanese authors misidentified the sex of their specimens. I would not be surprised if the female recorded by them as *C. simillima* Smith (same locality and collector as the three "females" of *C. okinawana*) would prove to be the true female of the species discussed here.

C. okinawana is evidently very closely allied to *C. bryanti* Ckll.; the females are very similar, but the males differ in the shape of the seventh tergite.

♀ — Length 6-8.5 mm. Clypeus somewhat variable, the median impression usually shallower than in *C. bryanti,* sometimes almost absent; in some specimens a median raised line is faintly indicated. Sides of clypeus, the paraocular areas below the antennal fossae (except at lower margin), front above antennal fossae, and vertex rather densely covered with well defined punctures; temples shining with only a few scattered superficial punctures. Anterior part of mesoscutum less densely punctate in the middle than at the sides, where the surface is dull; the polished area with an irregular line of punctures on each side of the median line (obliterated posteriorly) and of the parapsidal lines (here sometimes partly absent); the punctate band at the posterior margin of the usual width, dull, with some scattered punctures anteriorly. Mesopleura densely punctate; impunctate space on hypoepimeral area small; on the ventral side the punctures slightly more remote, but even in front of the mid coxae the surface dull and the interspaces smaller than the punctures. Dorsum of propodeum finely rugose and rather dull, the posterior margin not shiny. Anterior coxae bluntly projecting on outer side at base.

Colour pattern as usual; legs rather dark; mandibles and labrum black; clypeal mark variable, the upper arm often short and acute, triangular, but in several specimens rather high and hardly narrowed above; lower end of lateral face marks curved inwards, the transverse part longer and thinner in larger specimens; antennal scape black; supra-antennal spots sub-ovate, obliquely transverse; yellow band on pronotum sometimes very narrowly connected with yellow spot on tubercles; mesopleura black, rarely with faint indication of a yellow spot behind the pronotal tubercles; lines on mesoscutum distinct, the inner ones long; yellow spot on scutellum narrowed posteriorly; abdominal bands as usual, on tergite 3 at most narrowly interrupted; femora

I as a rule only with yellow spot at tip on upper side, sometimes also with a spot at under side; femora II and III with similar, but smaller, spots or entirely black; outer side of tibiae I with yellow line, almost reaching the apex; tibiae II and III with spot or short line (at most on basal third); tarsi dark brown.

♂ — Labrum yellow, with three dark spots; clypeus not distinctly impressed, sparsely punctate, the punctures not well defined; clypeal mark larger than in the female, usually only the upper margin of the clypeus and a narrow line at lateral margins black; lateral face marks narrow, but the lower part wider than in the female; supra-antennal spots and line on temples reduced. Mesoscutum more densely punctate than in the female, at least on the lateral areas, black or with only the outer yellow lines, rarely also with traces of the inner lines; mark on scutellum reduced, narrowed posteriorly; abdominal tergite 1 black, 2 and 3 with lateral spots, 4 and 5 with apical bands which are sometimes narrowly interrupted medially (in a few specimens on 4 rather widely interrupted). Markings on legs slightly more extensive than in the female: under side of femora I with short yellow line; yellow line on outer side of tibiae II and III reaching about halfway the tibia; in some specimens these tibiae also have a yellow spot at apex; outer side of metatarsi I and II with minute yellow spot at base, III with yellow line, sometimes also the second tarsal segment of hind legs with yellow spot. Sixth sternite with two teeth; apical margin of tergite 7 rounded (figs. 39-41).

Ryukyu Islands: 17 ♀ 4 ♂, Chizuka, Okinawa Island, July-Sept., G. E. Bohart and C. L. Harnage; Ie Shima, 1 ♀ 1 ♂, 5 Aug. 1945, 15 ♀ 14 ♂, 12 Aug. 1945, 4 ♀ 11 ♂, 19 Aug. 1945, all collected by K. V. Krombein (U.S. N.M., some duplicates in coll. m.).

Ceratina accusator Ckll.

1919. Cockerell, T. D. A., Ann. Mag. Nat. Hist. (9) 3: 249, ♀ ♂ (*C. accusator*, Penang, Malaya).
1920. Cockerell, T. D. A., Phil. Jl. Science 17: 624 (mentioned in key).
1929. Cockerell, T. D. A., Ann. Mag. Nat Hist. (10) 4: 150 (Nan, Siam).

Some additions to the original description: Clypeus and lower part of paraocular areas (below antennal fossae) sparsely, but rather coarsely punctate, the punctures not sharply margined; the clypeus shining and impunctate along the median line, which bears a faint and blunt carina; anterior lateral areas of clypeus almost impunctate. Yellow part of supraclypeal area sloping towards the clypeus, faintly impressed in the middle, but not tritubercule as in *C. litoraria*. Space between upper part of antennal fossae and eyes shining, only very slightly swollen. Anterior punctate part of mesoscutum

shorter than the polished disk, the puncturation not produced backwards along the median line; the densely punctate band at the posterior margin narrow. Mesopleura densely punctate, dull, shining space on hypoepimeral area very small, hardly visible; interspaces on ventral side of mesopleura, in front of mid coxae, visible, but smaller than in *C. nigrolateralis* and allies. Sculpture of propodeum as in *C. litoraria*. The shape of the yellow band on the clypeus is variable, the median lobe is never very high, but it may be triangular or more or less truncate, rarely almost absent. The yellow spot behind the tubercles is present in all specimens recorded below.

In the male the shape of the sixth sternite is very similar to that in *C. litoraria* (compare fig. 51); there is a small denticle between the two apical teeth; the apex of the tergite 7 is rounded, very slightly produced in the middle and laterally; parameres of genitalia each with a comb of long hairs.

Sumatra: Pakan Baru, 1 ♀, X.1925, Fulmek & Karny (Mus. Bogor); Sarolangun, 2 ♀, VII.1925, O. Posthumus (Mus. Bogor); Lampong Distr., Mt. Tanggamus, 600 m, 1 ♀ 1 ♂, XII.1939, Dr. & Mrs. Lieftinck.

Bangka: Mt. Mangkol near Pangkalpinang, 1 ♂, XII. 1935, author; Toboali, 2 ♂, XII.1935, author (coll. m.).

Borneo: Sarawak, Santubong, 3 ♀, IX-X.1950, M. A. Lieftinck; West Borneo, Ledo at Upper Sambas, 2 ♀ 1 ♂, VII. 1933, H. R. A. Muller (coll. m.); East Borneo, Palawan Besar, 1 ♀, VI. 1937, Mrs. M. E. Walsh (coll. m.); do., Balikpapan, Mentawir River, 1 ♀, X.1950, A. M. R. Wegner.

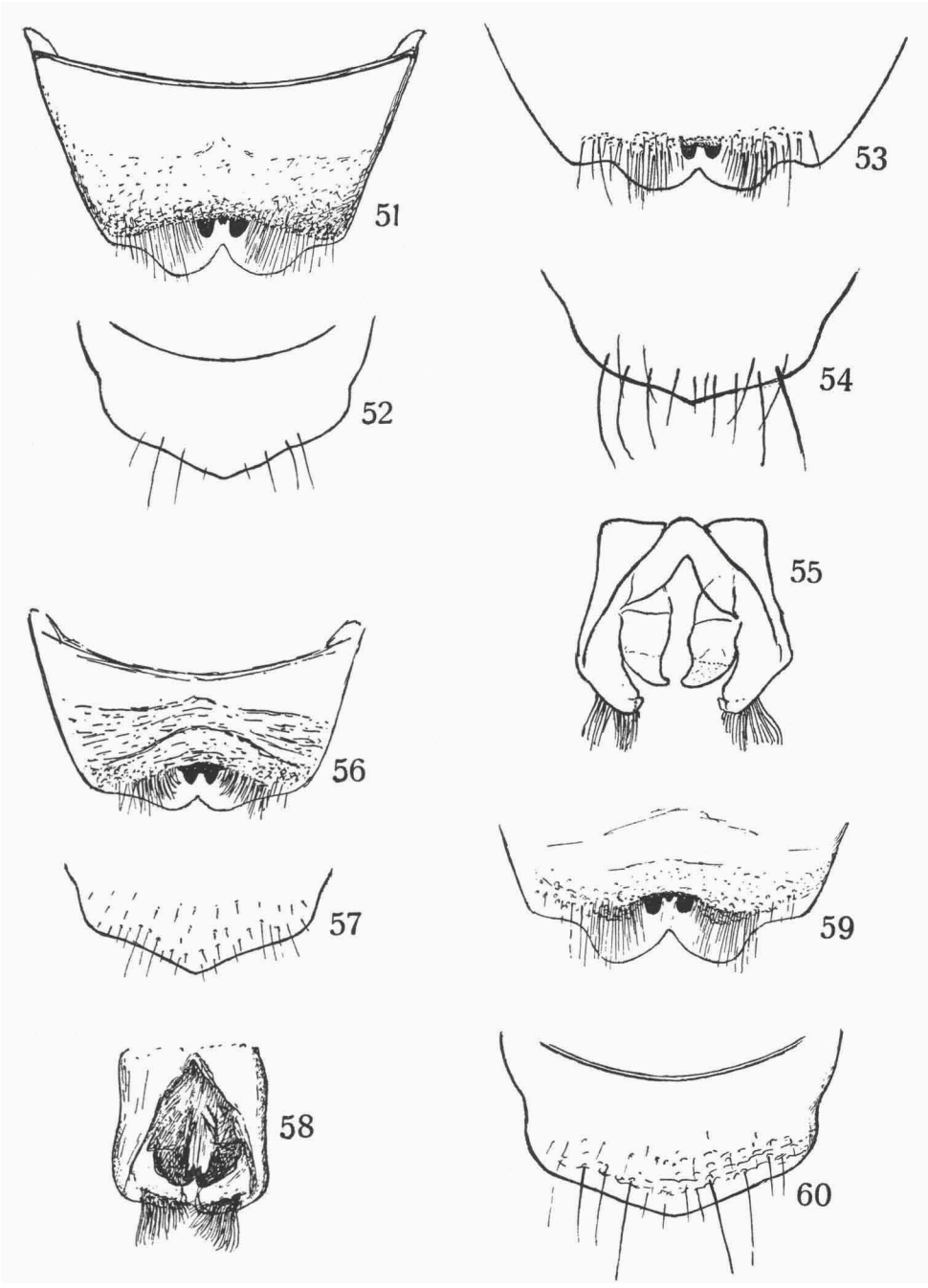
Java: West Java, Banten, Udjung Kulon, Tjigenter, 1 ♀, IX. 1942, M. A. Lieftinck.

C. accusator mutabilis n. subsp. (figs. 51, 52)

♀ — Slightly larger than the typical form (length: ♀ 6.5-7 mm, ♂ 6-6.5 mm) and characterized by a reduction of the yellow markings. Lateral face marks cut off at level of supraclypeal area; spots above antennae very small; pronotal band more or less widely interrupted, in darker specimens not connected with the spot on the tubercles; no spot on mesopleura behind the tubercles; mesoscutum black or with minute lateral lines; first abdominal tergite black, the second with small lateral spots, the third with similar spots, but here they are produced over a short distance along the posterior margin of the tergite (as in typical *accusator*); band on fourth tergite sometimes rather widely interrupted.

Mid and hind legs black, knees with small yellow or ferruginous spots; second and following tarsal segments brownish to ferruginous.

♂ — Clypeus with transverse line, sometimes incised in the middle; lateral



Figs. 51-52, *C. accusator mutabilis* n. subsp. ♂ ; 51, sixth sternite; 52, seventh tergite.
Figs. 53-55, *C. litoraria* n. sp. ♂ ; 53, sixth sternite; 54, seventh tergite; 55, genitalia.
Figs. 56-58, *C. simillima* Sm. ♂ ; 56, sixth sternite; 57, seventh tergite; 58, genitalia.
Figs. 59-60, *C. tropica* Crawfd. ♂ ; 59, sixth sternite; 60, seventh tergite.

face marks shorter than in the ♀; mark on supraclypeal area incised below, or divided by a black line; supra-antennal spots minute or absent; line on temples short and narrow; pronotum on each side with short yellow line, posterior half of tubercles yellow; mesoscutum black; spot on scutellum reduced; first and second abdominal tergites black, sometimes the latter with minute lateral spots; third and fourth with lateral spots; fifth with entire band, narrowed sub-laterally, sixth with short and vague median transverse line. Femora I and all tibiae with yellow lines (on tibiae II narrowed, on III interrupted near the middle); tarsi ferruginous, metatarsi I with yellow line, III yellowish).

West Java: Bunar, Toge, 1 ♀, XI.1938, Mrs. Lieftinck; Bolang Tjilangkap, 1 ♀, II.1940, Mrs. Lieftinck; Radjamandala, 1 ♀, VI. 1940, M. A. Lieftinck (paratypes).

East Java: Idjen Mts., Blawan Estate, 900 m, 1 ♀, 26.VI.1939, author (type); do., 1 ♂, III. 1940, Mrs. Lucht; Djerukundjur on West slope of Idjen Mts., 500 m, 3 ♀ 1 ♂, VI.1939, Mrs. E. v. d. Vecht and author (paratypes).

The specimens from the Idjen-complex in East Java are slightly darker than those from West Java.

Ceratina litoraria, n. spec. (figs. 44, 45, 53-55)

Easily recognized by the characteristic supraclypeal area and the dense puncturation of the face below the antennae.

The size is very variable, length 5-7 mm, one of my specimens measures 7.5 mm. The larger specimens are very distinctly macrocephalic (compare figs. 44 and 45).

♀ — Head wide, produced behind the eyes, seen from above strongly concave posteriorly; temples thick, particularly in the larger specimens. Eyes narrow, inner orbits almost parallel, in small specimens slightly converging below. Labrum with an arcuate transverse ridge (slightly impressed in the middle) near the anterior margin. Median part of clypeus flattened, very slightly depressed anteriorly, lateral areas slightly convex; lower part of paraocular areas also flat, faintly convex near inner orbits. Supraclypeal area swollen, with two weak impressions in upper half, thus being faintly trituberculate. Thorax of normal shape, its sides somewhat flattened; anterior coxae swollen, but without projecting tubercle.

Face below antennae very densely punctate; the puncturation less dense at upper margin and on lateral areas of clypeus and near lower and outer margins of paraocular areas; clypeus with a faint and narrow impunctate median line (sometimes scarcely visible); supraclypeal area impunctate;

antennal fossae densely and rugosely punctate at inner side (along median carina), outer half polished with at most a few scattered punctures; no distinct impunctate swollen area at inner eye margin near top of antennal fossae. Front and vertex more coarsely, but less densely punctate than lower half of clypeus, particularly between eyes and ocelli with large shining interspaces; the area behind the ocelli very closely punctate, the yellow supra-antennal spots almost impunctate; upper half of temples with narrow median band of punctures, lower half almost impunctate.

Anterior half of mesoscutum dull, densely and finely punctate, the punctures even slightly smaller than those on the clypeus; the punctate area produced backwards along the median line and the parapsidal lines, but the punctures here more remote. Lateral margins of mesoscutum with very narrow, densely and finely punctate, band; punctate band at posterior margin rather wide; the remainder of the mesoscutum polished. Sides of thorax dull, densely and finely punctate; shining space on hypoepimeral area (below hind wings) very small. Dorsum of propodeum finely rugose on basal half, the posterior part more finely sculptured, in the middle projecting triangularly into the dull and finely and rugosely punctate declivity. Abdomen with the usual puncturation.

Black, with yellow markings as follows: transverse line on clypeus, widened in the middle or with short upper lobe; lateral face marks reaching up to —or just beyond—level of antennae, widened below, in larger specimens more strongly produced inwards than in the smaller ones; transverse band on supraclypeal area at most slightly widened in the middle; line on temples behind upper two thirds of eyes, widest at short distance from top, gradually narrowed downwards; supra-antennal spots roundly triangular or kidney-shaped; band on pronotum widened laterally, connected by narrower line with yellow tubercles; mesonotum with the usual four lines, the lateral ones much shorter and scarcely wider than those on the disk; large spot on scutellum, with short black median line anteriorly. Most specimens have no yellow spot on the mesopleura behind the tubercles, but a very small spot is present in the largest female from Malingping and a larger one (same size as in *C. lieftincki*) in a female from Patjitan.

The usual bands on tergites 1-5 generally entire, only that on the third tergite sometimes narrowly interrupted.

Legs black; anterior femora with yellow mark (posteriorly much longer below than above, anteriorly visible as a narrow line at under side); femora II and III with yellow spot at apex above; tibiae I yellow, inner side brown; tibiae II with yellow line on outer side; tibiae III with yellow ring at base and a stripe on the outer side of the basal two thirds, wide at base and much

narrowed beyond the tibial spine. Tarsi ferruginous, the metatarsi brown.

♂ — Very similar to the ♀, but the face narrower, the puncturation of head and thorax denser; the supraclypeal area more swollen, with deeper impressions and therefore more distinctly trituberculate; the lateral areas of the mesoscutum with only a small impunctate space; seventh tergite with small and blunt median tooth, the sides rounded.

Transverse yellow band on clypeus relatively wider, somewhat dilated in the middle; the lateral face marks gradually narrowed towards the top, their inner side almost straight; labrum with more or less distinct traces of a yellow spot; spots above antennae very small or absent; lines on mesoscutum often somewhat reduced, the lateral ones in some specimens almost obsolete; bands on abd. tergites 2 and 3 more or less interrupted in the middle; sixth tergite with hat-shaped macula, legs as in the female, but slightly more extensively yellow, outer side of tibiae III entirely yellow, tarsi yellowish.

The type is a female from West Java, Malingping at South coast of Banten, 22-24 March 1940, author; the allotype is a male from West Java, Salatri, South coast of Priangan, 13 October 1937, L. J. Toxopeus; all specimens recorded below are paratypes.

South Sumatra: Lampong Districts, 1 ♀, Mt. Betung, 400 m, Sungeilangka Estate, 27 March 1937, Mrs. E. v. d. Vecht (a rather dark specimen: outer lines on mesoscutum absent, band on second tergite interrupted); do., 1 ♀, Kedaton Estate near Tandjongkarang, 150 m, 23 March 1937, author (coll. m.).

Krakatau Island: 1 ♀, May 1908, Edw. Jacobson leg. (Mus. Leiden).

West Java: Udjung Kulon, Tjigenter, 1 ♀, 8 Sept. 1942; Wijnkoops Bay, 1 ♀, April 1939; Genteng, Tjikepuh, 200 m, 1 ♂, 2 July 1939; Djampangtengah, 600 m, 1 ♀ 1 ♂, Febr. 1941 (all coll. by M. A. Lieftinck); Malingping, South Banten, 12 ♀ 1 ♂, 22-24 March 1940, author; Batavia, 2 ♀, Oct. 1907, and Tandjong Priok, 1 ♀, June 1908, Edw. Jacobson (Mus. Leiden).

Central Java: South coast, Patjitan, 1 ♀, 12 Dec. 1937, author.

Ceratina simillima Smith (figs. 56-58)

! 1854. Smith, F., Cat. Hym. Br. Mus. II: 225, no. 11 ♂ (*C. simillima,* East Indies).
! 1911. Cockerell, T. D. A., Ann. Mag. Nat. Hist. (8) 8: 185, ♀ (*C. eburneopicta,* Salsetta, N.W. India).

This species is allied to *C. bryanti,* as is shown by the structure of the sixth sternite and the genitalia of the male. The seventh tergite, however, is bluntly angular in the middle, the lateral angles somewhat less prominent

than in *C. bryanti*. Parameres of male genitalia as in *C. bryanti* with a comb of hairs, decreasing in size towards tip.

The main characters of the female are:

Length 6-7 mm. Clypeus at most with a very faint, wide and shallow median impression, the sides with some scattered punctures; paraocular areas with about 10-15 punctures; front above antennal fossae and vertex rather densely punctate; anterior punctate area of mesoscutum produced backwards along each side of parapsidal furrows, on the posterior half there is a single row of punctures (often widely interrupted) on the inner side, and a double one (somewhat irregular) on the outer side, of the parapsidal furrows.

Yellow pattern as usual, the markings rather pale; labrum dark brown, scape of antennae black; upward extension of clypeal mark broad, moderately high (higher than in *C. bryanti*), lateral face marks bent inwards below; mesoscutum with four lines, spot on scutellum reduced, posteriorly not covering more than half of width of scutellar disk; mesopleura black or with yellow spot behind tubercles; abdominal bands of the usual shape, on tergites 2 and 3 more or less interrupted; femora with spot at knee, femora I with line on under side; tibiae with line on outer side, often partly reduced on II and III; tarsi ferruginous.

India: The type is a ♂, labelled "E. Ind.". It agrees well with a series of males, collected by C. G. Nurse at Deesa in 1899 (4 ♂ in Br. Mus., 1 ♂ in U.S. N.M.); 1 ♀, Matheran, Nurse, 1899 (U.S. N.M.); 6 ♀, Bombay, Nov. 1924, J. C. Bridwell (U.S. N.M.). — A female from Goa, Mormugao, June 1925, J. C. Bridwell (U.S. N.M.) has only a single line of punctures on outer side of parapsidal furrows and the markings are less pale, lemon yellow.

The type of *C. eburneopicta* Ckll., a female from Salsetta in Bombay Residency, collected by Comber, is in the British Museum; it is apparently not different from *C. simillima* Sm.

A female in the British Museum from Ataran Valley, Tenasserim, collected by Bingham and identified by him as *C. simillima* Sm., is undoubtedly a different species.

Ceratina tropica Crawf. (figs. 46, 59, 60)

1910. Crawford, J. C., Proc. U. S. Nat. Mus. 38: 119, ♀ (*C. tropica,* Manila).
1911. Cockerell, T. D. A., Proc. U. S. Nat. Mus. 39: 636.
1918. Cockerell, T D. A., Phil. Jl. Science XIII D: 142 (*C. tropica,* Luzon, Mindanao).
1920. Cockerell, T. D. A., Phil. Jl. Science 16: 146 (*C. tropica,* Culasi, Phil. Isl.).
1925. Cockerell, T D. A., Phil. Jl. Science 26: 54 (*C. tropica,* Bangui, Ilocos Norte).
? 1925. Cockerell, T. D. A., Phil. Jl. Science 26: 54, ♂ (*C. mcgregori,* Manila) (n. syn.).
1927. Hedicke, H., Deutsch. Ent. Zeitschr. 1926: 419, ♀ (*C. (Ceratinidia) luzonica,* incl. forma *reducta* nov., Mindoro, Luzon) (n. syn.).

This species is easily recognized by the characters given in the key. It varies considerably in size, the length of the females at hand ranging from 5.5-9 mm. The largest specimens are strongly macrocephalic, with the temples very much wider than the eyes. In the ♀ the two spots on the paraocular areas generally far apart (fig. 46); the clypeal mark slightly widened medially; supra-antennal spots subcircular to triangular. Yellow band on pronotum separated from spot on tubercles. Coxae I bluntly angular on outer side at base. Puncturation on anterior part of mesoscutum much denser and finer than on the head; mesopleura densely, reticulately punctate, but on ventral side posteriorly the interspaces distinct; mesoscutum usually black, but in 3 out of 15 females before me the inner yellow lines are faintly indicated. Yellow spot on scutellum reduced, narrowed posteriorly.

Yellow bands on abdominal tergites narrow; tergite 1 sometimes entirely black, the bands on 2 and 3 usually interrupted, sometimes also that on tergite 4. Legs dark; tips of femora, a short line at under side of tibiae I, a line on outer side of tibiae I and spots at base of tibiae II and III, yellow.

♂ — Labrum with yellow spot; clypeal mark wider and its upward extension sometimes larger; the spots on paraocular areas connected by a narrow line along inner orbits; supra-antennal spots reduced; mesopleura dull, very densely and reticulately punctate, also on hypoepimeral areas, without shining interspaces.

Legs more extensively yellow than in the female: all tibiae with yellow line on outer side; metatarsi pale yellowish, the other tarsal segments pale ferruginous. In two specimens from Mindanao tibiae II and III are dark with only a yellow spot at the base.

Abdominal bands 2-4 usually interrupted; tergite 6 with short band, apical margin of sixth sternite bilobate and with two rounded teeth (fig. 59), seventh tergite without median point, the apex bluntly angular, the sides rounded. Length 6.5-8 mm.

Restricted to the Philippine Islands: Luzon: Manila, 2 ♀ 1 ♂, W. A. Stanton and R. Brown (paratypes); Los Baños, 5 ♀ 1 ♂; Mt. Makiling, 3 ♀. — Negros: Cuernos Mts., 2 ♀, Samar, 1 ♀. — Panay: N.W. Panay, 1 ♀; Culasi, 1 ♀, June 1918, McGregor. — Mindanao: Dapitan, 11 ♀ 2 ♂, Baker; Davao, 1 ♀, Kolambugan, 5 ♀; Surigao, 4 ♀; Bukidnon, Tangcolan, 1 ♀ (unless otherwise stated: coll. by Baker, and all in U.S. N.M.).

According to Cockerell, *C. mcgregori,* apparently based on a single male from Manila, differs from *C. tropica* Crwfd. as follows: "Apical yellow band of clypeus broader, gradually rising to the median point (abruptly in *C. tropica*). Clypeus higher, face narrower; lateral face marks narrowly

continuous, the upper part elongate, the broadened (bell-shaped) lower part with a small notch on inner upper side, no yellow frontal spots; yellow mark on scutellum narrower, quadrate, area of metathorax rougher; hind tibiae with a yellow stripe extending their whole length posteriorly; hind basitarsi pale yellow, red at tip."

So far as the coloration is concerned, there appears to be no difference whatsoever between *C. tropica* from Manila (paratype ♂) and *C. mcgregori*. The shape of the clypeal mark is variable. In fact, there is nothing in this description to show that *C. mcgregori* is a good species. Unfortunately Cockerell says nothing about the terminal abdominal segments and these should be examined before the name is definitely sunk into synonymy. I do not know the present location of the type of *C. mcgregori* Ckll.

Ceratina rugifrons Smith

! 1879. Smith, F., Descr. New Spec. Hym. Br. Mus.: 93, no. 7, ♂ (*C. rugifrons*, Makassar, Celebes).

♀ — Face very coarsely punctate, but on each side at inner orbits, slightly above level of antennae, with convex impunctate area, as in large males of *C. tropica*. Scape of antennae black, slightly brownish at base. Antennal fossae ill-defined, outer side with some scattered punctures. Lateral face marks short, curved inwards below, not reaching beyond level of antennae. Supra-antennal spots absent. Coxae I rounded on outer side at base. Anterior third of mesoscutum densely punctate, this part posteriorly with some larger, scattered punctures, the posterior two thirds with a few punctures at the sides and the usual band of punctures at posterior margin (narrowed laterally); all pleura and sides of propodeum dull, densely, finely, granulately punctate, the puncturation distinctly finer and closer than on anterior part of mesoscutum; dorsum of propodeum rugose, but more shiny than the sides. Markings on abdomen variable: in one female from Udjung Lemuru the bands are wide, only narrowly interrupted medially on tergites 2 and 3, in all other specimens they are narrower and rather widely interrupted on these tergites. Legs as in *C. tropica*, but in the brightly coloured specimen from U.L. all tibiae are yellow on outer side, only the hind ones brownish in the middle. The latter specimen has a yellow spot on the labrum, four lines on mesoscutum and a vague transverse line on postscutellum. Length 6.5-8 mm.

♂ — Similar to the female, particularly as regards the swollen areas of the face, and the characteristic puncturation of mesopleura and mesoscutum, the latter with a few more scattered punctures, along median line and parapsidal lines. Labrum yellow, yellow markings on clypeus and paraocular areas larger, clypeal mark reaching above the middle of the clypeus; antennal scape

brownish, with small yellow spots at base and apex; supra-antennal spots absent; line on pronotum connected with spots on tubercles; mesoscutum with four yellow lines; mesopleura with yellow spot at anterior margin; scutellum with subquadrate mark, its anterior margin narrowly black; bands on tergites 2 and 3 interrupted, on 6 narrowed laterally. Legs yellow, except for coxae, trochanters, dark streak at base of femora I and basal half of femora II and III; apical tarsal segments pale ferruginous. Apical margin of sixth sternite almost as in *C. tropica,* but the lobes a little flatter and more angular, and the two median teeth slightly closer together. Seventh tergite with blunt median point, the sides rounded. Length 6.5-7.5 mm.

Celebes: Makassar, 1 ♂, Wallace (type in Br. Mus.); Sengkang, 1 ♂, 29 Sept. 1930, author; Bonto-bonto, 1 ♀, April 1949, C. J. H. Franssen; Makassar, 9 ♀ 1 ♂, March 1949 and Sungguminasa, 1 ♀ 1 ♂, May 1949, Kalosi, 750 m, 2 ♀ 2 ♂, Febr. 1950, all collected by C. J. H. Franssen (the specimens from Kalosi rather large and dark); Udjung Lemuru, 2 ♀, 30 May 1948, author. The two latter specimens were flying in a small plot of secondary forest near the village.

The localities recorded above are all in South Celebes, but the species occurs also in the northern arm of the island: the Mus. Leiden possesses an old and poorly preserved specimen collected by Forsten at Tondano.

Ceratina bicuneata Ckll.

1918. Cockerell, T. D. A., Phil. Jl. Science XIII D: 143, ♀ (*C. bicuneata,* Baguio, Luzon).
1920. Cockerell, T. D. A., Phil. Jl. Science 16: 207 (descr. of ♂, Baguio, Luzon).
1920. Cockerell, T. D. A., Phil. Jl. Science 17: 624 (mentioned in key).

Some additions to Cockerell's descriptions are:

♀ — Front and clypeus, including the antennal fossae and the supraclypeal area, densely and coarsely punctate; the punctures not sharply margined and confluent in some places; the only impunctate and shining area is a narrow ridge at inner orbits above the antennal fossae. Vertex also coarsely punctate, but the punctures more remote, between eyes and ocelli smaller than the interspaces. Temples coarsely, but sparsely punctate. Anterior third of mesoscutum rather coarsely, somewhat rugosely punctate, but more sparsely than in allied species, this part therefore more shiny; the punctures finest anteriorly, coarser and more remote posteriorly; posterior two thirds polished and with only a few punctures on lateral areas and some indistinct pucturation at lateral and posterior margins. Mesopleura hardly less coarsely, but more densely punctate than anterior part of mesoscutum, ventrally with distinct interspaces, lower half of hypoepimeral area polished. Metapleura and sides of propodeum finely granulately punctate, less shiny than meso-

pleura. Mesoscutum black. — For further details see the original description. Length 7-8 mm.

♂ — Very similar to the female, but the face flatter, with the antennal fossae more sharply defined; lateral face marks larger, supra-antennal spots lacking (always?), scape of antennae ferruginous at base and apex; bands on tergites 2 and 3 slightly interrupted medially, the following bands widened in the middle, spot on sixth tergite hat-shaped; seventh tergite with distinct, though not very sharp, median point, the sides rounded; sixth sternite very similar to that of *C. tropica*. Length 6.5 mm.

Philippine Islands: Luzon, Benguet, Baguio, 1 ♀ (cotype) 1 ♂, Baker (U.S. N.M.).

A very distinct species, easily recognized by the characteristic sculpture of head and thorax.

II. Species-group *compacta*

Posterior margin of sixth sternite of male with a ∧-shaped ridge in the middle.

The species of this group are distinguished by slight differences in sculpture, structure and coloration, but these are generally so subtle that most species are difficult to identify unless a good series is available for study. Since the matter is further complicated by the rather pronounced sexual differences, it appears advisable not to describe new species unless sufficient material of both sexes is at hand.

The colour pattern of each species varies more or less within a given locality, but there is also a tendency towards the development of geographic variation. This makes it sometimes difficult to decide whether certain geographically isolated populations should be regarded as species or subspecies. In this respect it is of importance to note that no less than six of the forms described below as species have been found in West Java. In the case of these forms the specific distinctness appears to be well established, but in many respects the present treatment must be regarded as preliminary.

Up to the present only two forms have been found in the eastern part of Indonesia and New Guinea; they are treated here as species, but it seems probable that they have relatively recently developed from a common ancestor.

Ceratina compacta Smith (fig. 67)

! 1879. Smith, F., Descr. New Spec. Hym.: 91, no. 1, "♀" = ♂ (*C. compacta,* Phil. Isl.).

1904. Ashmead, W. H., Jl. New York Ent. Soc. 12: 2, ♀ (*C. philippinensis,* Manila, Luzon).

1915. Cockerell, T. D. A., Entomologist 48: 109 (*C. philippinensis,* Negros).

1916. Cockerell, T. D. A., Phil. Jl. Science XI: 304 (*C. philippinensis* = ? *compacta* Sm., Phil. Isl.).
1918. Cockerell, T. D. A., Phil. Jl. Science XIII: 142 (*C. philippinensis,* Mindanao, Palawan).
1920. Cockerell, T. D. A., Phil. Jl. Science 16: 146 (*C. philippinensis,* Culasi, Batbatan Isl.).
1920. Cockerell, T. D A., Phil. Jl. Science 16: 207 (*C. philippinensis,* Manila).
1925. Cockerell, T. D. A., Phil. Jl. Science 26: 54 (*C. philippinensis,* Bangui, Ilocos Norte; Manila).
1925. Cockerell, T. D. A., Phil. Jl. Science 27: 172 (*C. philippinensis,* Samar Isl.).
1927. Hedicke, H., Deutsch. Ent. Zeitschr. 1926: 419 (*C. philippinensis,* Mindanao, Mindoro, Luzon).

This species has long been known as *C. philippinensis,* but Cockerell as early as 1916 suspected that *C. compacta* Sm., described as a female, would prove to be based on a male. Examination of Smith's type in the British Museum confirmed this view and showed that *C. compacta* Sm. is indeed identical with *C. philippinensis* Ashm.

♀ — Length 5.5-8.2 mm; large specimens only slightly macrocephalic. Clypeus with some punctures at lateral margins, the surface irregularly and superficially wrinkled, median carina rarely distinct; paraocular areas irregularly and sparsely punctate; supraclypeal area with distinct transverse rim (∧-shaped); antennal fossae finely punctate along interantennal carina; front (above antennal fossae) and vertex densely and rather coarsely punctate, the punctures well defined; the interspaces smallest in front of the ocelli, larger behind the ocelli and between ocelli and eyes; upper part of temples punctate in the middle, the lower part with only a few scattered punctures.

Puncturation of mesoscutum characteristic: anterior part densely and finely punctate, this part angularly produced backwards in the middle (between the inner yellow lines); there is at least a double row of punctures on each side of the parapsidal lines; the posterior margin has a rather wide punctate band, the punctures very closely spaced along the scutellum, gradually thinning out anteriorly; there are thus two polished areas on each side of the mesoscutum: a small one above the tegulae (sometimes almost absent) and a larger one, pointed anteriorly, between median and parapsidal line.

Mesopleura dull, very densely and reticulately punctate, only posteriorly on ventral side the punctures distinctly separated; polished space on hypoepimeral area very small; metapleura very densely and finely punctate.

Dorsum of propodeum dull, rather coarsely rugose, with distinct median ridge, the posterior margin shiny; declivity shiny in the middle, finely and irregularly punctate laterally; the sides dull, very finely and granulately punctate.

Second and following abdominal tergites densely punctate, pregradular area of tergites 2 and 3 punctate at posterior margin; postgradular areas of

these tergites without transverse impunctate line; fourth and fifth tergites rugosely punctate, the sixth rugose and dull.

Coxae I with rounded angle on outer side at base.

Colour pattern rather constant; labrum with yellow spot; antennal scape yellow at base and apex; upper lobe of clypeal spot sometimes incised above; lateral face marks never reaching above top of antennal fossae; lines on temples wide above, narrowed below and ending here at about one fourth of height of eyes; yellow line on pronotum connected with yellow spot on tubercles; mesopleura always with yellow spot behind tubercles; mesoscutum with four lines; sclerites at base of wings yellow; yellow mark on scutellum large and quadrangular, entirely filling the space between anterior and posterior margin; postscutellum black or with short transverse yellow spot; band on first tergite enclosing two black spots, on third tergite not or hardly interrupted in the middle; legs very extensively marked with yellow: femora I below and at apex, II and III at apex; all tibiae (except for a brownish stripe on inner side) and metatarsi; the remaining tarsal segments pale ferruginous.

♂ — Length 4.7-7.2 mm. Similar to the female; temples narrower; the head more densely punctate; antennal fossae sharply defined; scattered punctures on temples large and well defined. Mesoscutum more densely punctate, lateral areas punctate throughout, the impunctate areas on the disk smaller than in the female; sternites with thin apical fringe of white appressed hairs; sixth sternite: fig. 67, seventh tergite with median point.

Labrum yellow, with small brown spot on each side at base, sometimes only the middle yellow; face below antennal fossae yellow, except for black lines along the sutures (the line at top of clypeus usually wider than the others), lateral face marks narrowed along outer side of antennal fossae, slightly curved inwards at top and ending a short distance below upper margin of fossae; supra-antennal spots narrower than in the female; lines on mesoscutum often reduced (inner lines sometimes absent); bands on tergites 2 and 3 usually interrupted, on 4 hardly interrupted; tergite 6 with hat-shaped spot; lines on inner side of tibiae thinner than in the female, tarsi more yellowish; otherwise as in the female.

C. compacta appears to be restricted to the Philippine Islands:

Batbatan: 1 ♂, June 1918, McGregor.

Luzon: Manila, 2 ♀ 4 ♂, R. Brown; do., 2 ♀, W. A. Stanton; do., 1 ♀, R. C. McGregor, on Antigonon leptopus; Los Baños, 9 ♀ 1 ♂, Baker; do., 1 ♀, E. M. Ledyard, on "okra"; Baguio, Benguet, 3 ♀ 2 ♂, Baker (1 ♀ 1 ♂ 7430, 1 ♀ 4996); Mt. Makiling, 1 ♀ 1 ♂, Baker; Alabang, 1 ♀ G. Merino; Tayabas, Candelaria, 1 ♂, 23 June 1930, McGregor.

Sibuyan: 20 ♀, 5 ♂, Baker.

Samar: 1 ♀, Baker.

Panay: N.W. Panay, 3 ♀ 3 ♂, Baker; Culasi, 1♀, June 1918, Baker.

Negros: Cuernos Mts., 5 ♀ 6 ♂, Baker (no. 3131); Bacolod, 1 ♀, Oct. 1935, W. F. Jepson (coll. m.).

Mindanao: Surigao, 5 ♀ 7 ♂; Butuan, 1 ♂ (3653); Cagayan, 1 ♀; Iligan, 2 ♀ 1 ♂; Kolambugan, 16 ♀ 4 ♂; Dapitan, 10 ♀ 12 ♂; Davao, 9 ♀ 1 ♂ (no. 7431); Bukidnon, Tangcolan, 3 ♀ (all coll. by Baker).

Basilan: 8 ♀ 2 ♂, Baker.

The specimens recorded above are in the U.S. N.M., some duplicates in my collection. There is also a female from P. Princesa on Palawan, but the occurrence on this island needs confirmation.

The Leiden Museum possesses 4 specimens from Mindanao: Camiguio, 1 ♀ 2 ♂, and Butuan 1 ♂ (identified as *C. philippinensis* by H. Hedicke).

In 1929, Cockerell (Ann. Mag. Nat. Hist. (10) 4: 151) erroneously recorded this species from Siam (compare p. 74 of this paper).

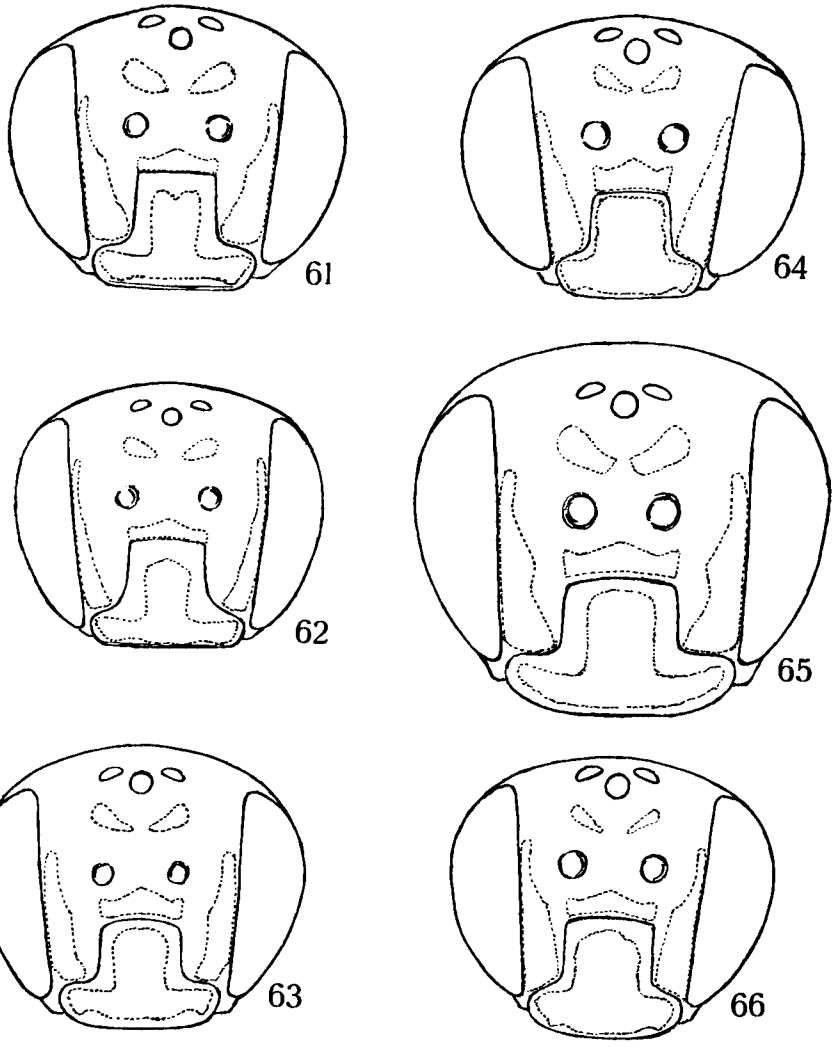
Ceratina cognata Smith (figs. 61 and 68)

! 1879. Smith, F., Descr. New Spec. Hym. Br. Mus.: 94, no. 8, ♂ (*C. cognata,* Makassar, Celebes).
! 1919. Cockerell, T. D. A., Ann. Mag. Nat. Hist. (9) 3: 247, ♂ (*C. conscripta,* Penang, Malaya).
? 1919. Cockerell, T. D. A., Ann. Mag. Nat. Hist. (9) 3: 248, ♂ (*C. selangorensis,* Selangor).
1920. Cockerell, T. D. A., Phil. Jl. Science 17: 624 (*C. conscripta,* mentioned in key).
! 1929. Cockerell, T. D. A., Ann. Mag. Nat. Hist. (10) 4: 151, ♀ (*C. laosorum,* Nan, Siam).

♀ — Length 6-8.5 mm. Closely resembling *C. compacta,* but differing as follows: Clypeus and paraocular areas more finely and sparsely punctate; also the punctures on the mesoscutum slightly more remote and this part therefore a little more shiny; punctured areas, however, the same as in *C. compacta*; lower part of mesopleura more shining, with well separated punctures. Declivity of propodeum dull, finely sculptured, except for a median band, which is narrow above, widened below.

Colour pattern as in *C. compacta,* but labrum, mesoscutum and mesopleura black (the latter rarely with yellow spot behind tubercles); lateral face marks variable, but usually slightly narrower (see fig. 61); anterior margin of scutellum narrowly black; postscutellum always dark; yellow band on first tergite often reduced and broken up into three spots; legs as in *C. compacta,* the posterior tibiae usually slightly brownish at apex above. Scape of antennae black or slightly ferruginous at base only. As in *C. compacta,* the upper arm of the clypeal mark is sometimes incised above.

♂ — Length 6-7.5 mm. In many respects similar to *C. compacta* ♂ (puncturation of mesoscutum, colour of legs) but mesoscutum always black.



Figs. 61-66, front view of head of: 61, *C. cognata* Sm. ♀; 62, *C. jacobsoni* n. sp. ♀; 63, *C. collusor* Ckll. ♀; 64, *C. collusor* Ckll. ♂; 65. *C. nigrolateralis acuticauda* Ckll. ♀; 66, *C. nigrolateralis acuticauda* Ckll. ♂. The yellow markings are indicated by dotted lines.

Labrum with large yellow spot; face below antennal fossae yellow, except for black lines along the sutures, those at top and sides of median part of clypeus sometimes as wide as antennal scape; supra-antennal spots narrow;

bands on tergites 2 and 3 often interrupted, sometimes 2 only with lateral spots; posterior tibiae with brown streak on inner side of apical half; antennal scape black or with small yellow spot at base. Yellow spot on scutellum often trapezoidal, narrowed posteriorly.

Apex of sixth sternite: fig. 68; seventh tergite rounded, with small median point.

C. conscripta Ckll., type from Penang in the British Museum, is a male of *C. cognata*; its colour pattern agrees so well with specimens from Celebes and Java that there is no reason to regard this form as a subspecies.

C. selangorensis Ckll., type (♂) from Selangor, Malaya, in the British Museum, agrees in most respects with *C. cognata,* but the yellow markings are much reduced, particularly on the abdomen: tergites 2 and 3 with lateral spots, 4 with minute lateral spots, remaining segments black. There is a paratype (also Baker, no. 9287) in the U.S. National Museum; it is reddish-discoloured, but agrees well with the type. I am inclined to regard this form as an extreme variation of *C. cognata,* but its status cannot be determined until it has been possible to study additional material, including females, from the type locality.

The type of *C. laosorum* Ckll., a female from Nan, Siam, in the British Museum, cannot be distinguished from *C. cognata*; it is a rather small specimen, but I have seen *cognata* females of exactly the same size from Java and Sumatra.

South Celebes: Makassar, Wallace, 1 ♂, type (coll. Br. Mus.); Udjung Lamuru, 3 ♀, May 1948, author; S. Celebes, 3 ♀ 3 ♂ (coll. m.); Sengkang, 1 ♀, Sept. 1930, author.

Tukang Besi Islands: Binongko, 1 ♀, Snellius Expedition (Mus. Leiden).

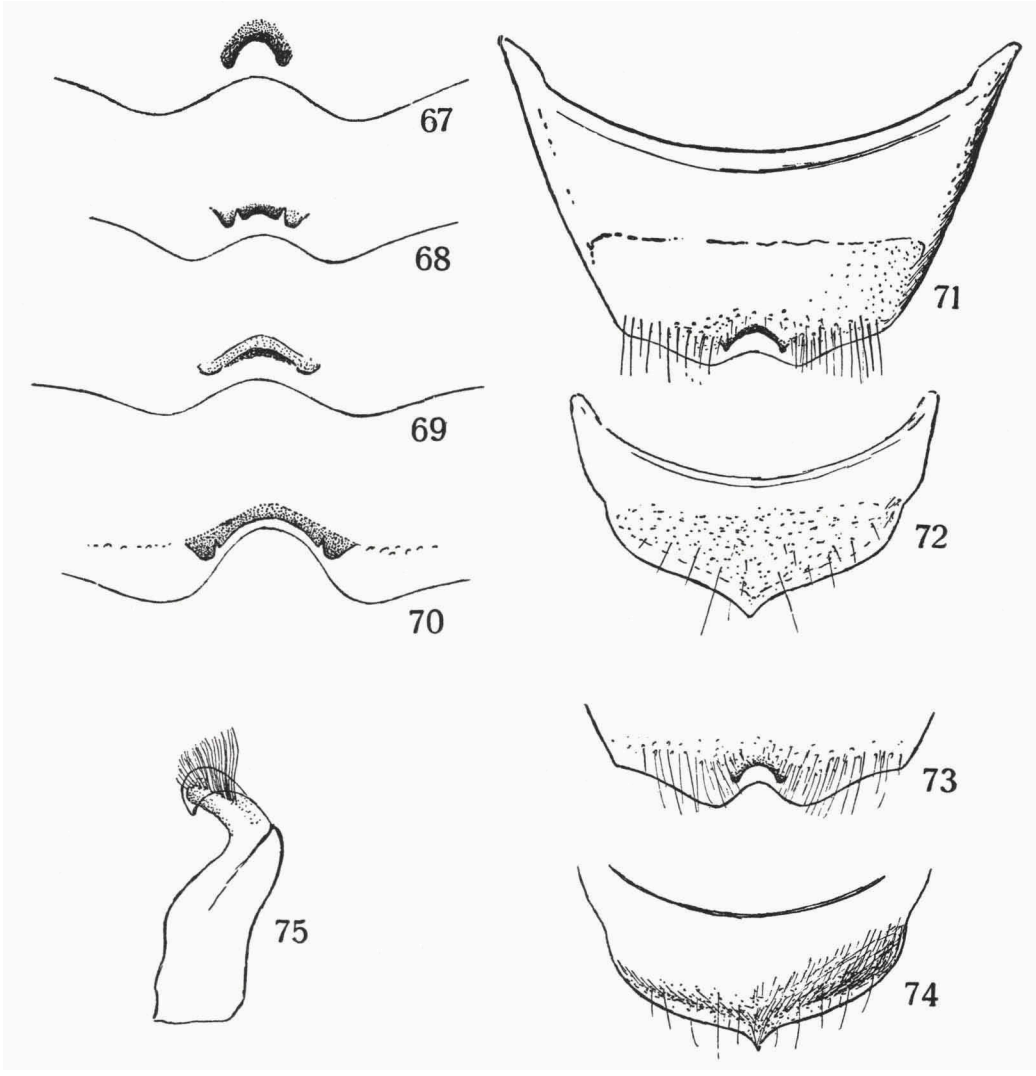
West Java: a common species, occurring in cultivated areas and secondary forests, from the coast up to about 900 m above sea-level; many specimens from several localities in coll. Lieftinck, Mus. Bogor, Mus. Leiden, coll. m. Dr. Lieftinck has taken this species on Mihania cordata, Melastoma and Lantana; it visits also Antigonon and Borreria latifolia. The U.S. N.M. possesses a ♂ from Buitenzorg (= Bogor), Schmiedeknecht, identified as *C. hieroglyphica* by H. Friese in 1904.

Central Java: Tjolo, Mt. Muria, 1 ♂, Oct. 1939, Mrs. Lieftinck; Salatiga, Oct. 1910, W. Roepke; Semarang, Jacobson (Mus. Leiden).

East Java: Djember, 6 ♀ 1 ♂, Jan.-Febr. 1940, in tunnels in stems of recently pruned young Hevea-plants, H. J. de Fluiter (coll. m.).

Bangka: Mt. Mangkol, 1 ♀, Dec. 1935, author; Batu Rusa, 1 ♀, Nov. 1935, author.

South Sumatra: Bergen Estate, Lampong Distr., 3 ♀, 1 ♂; Sungeilangka Estate, Lampong Distr., 2 ♂, all March 1937, author; Surulangun, Djambi Exp., 1 ♀, April 1878 (Mus. Leiden); Padang, West coast, 1 ♀,



Figs. 67-70, median part of posterior margin of sixth sternite (♂) of: 67, *C. compacta* Sm. (= *philippinensis* Ashm.); 68, *C. cognata* Sm.; 69, *C. lieftincki* n. sp.; 70, *C. jacobsoni* n. sp.
Figs. 71-72, *C. nigrolateralis nigrolateralis* Ckll. ♂; 71, sixth sternite; 72, seventh tergite.
Figs. 73-75, *C. papuana* n. sp. ♂; 73, sixth sternite; 74, seventh tergite; 75, part of genitalia.

Aug. 1918, S. Leefmans (coll. m.); Fort de Kock, West coast, 1 ♂, Oct. 1913, Edw. Jacobson leg. (Mus. Leiden).

Malaya: Penang, Baker 1 ♂ (type of *C. conscripta,* Br. Mus.); do., 2 ♀ (coll. U.S. N.M.); perhaps also Selangor, Baker, 1 ♂ (type of *C. selangorensis* in Br. Mus.) and 1 ♂ (coll. U.S. N.M.).

Siam: Nan, 1 ♀, 5 Jan., Cockerell (type of *C. laosorum,* Br. Mus.).

Burma: 1 ♀, Bhamo, Fea, Nov. 1880 (coll. U.S. N.M.).

Ceratina punctigena, n. spec.

♀ — Like *C. cognata* Sm., but head and thorax more densely and coarsely punctate; clypeus with ill-defined punctures, paraocular areas more distinctly punctate; vertex densely covered with large, well defined punctures, between eyes and ocelli only one or two interspaces larger than the punctures.

Whereas in *C. cognata* the temples bear only a few scattered superficial punctures, they are densely covered with large and deep, well defined punctures in this form.

Mesopleura densely and coarsely, reticulately punctate, dull, without shining interspaces on ventral side in front of mid coxae. Yellow mark on clypeus incised above; yellow band on tergites 2 and 3 interrupted.

♂ — Differs from *C. cognata* by the same characters as the female; I have examined the terminal segments and genitalia of one specimen, but they did not appear to be different from those of *C. cognata.*

The status and the distribution of this form require further investigation.

Java: West Java: Kuripan (between Djakarta and Bogor), 2 ♂ (type and paratype), 19 Aug. 1934, author; Djakarta, 1 ♀, June 1917 (paratype, coll. W. Roepke); Central Java: Kaliwungu, 1 ♀, Aug. 1910, Edw. Jacobson (allotype, Mus. Leiden).

Ceratina lieftincki, n. spec. (fig. 69)

♀ — Length 6.5-8 mm. Clypeus with distinct, rather blunt, median carina, flanked on each side by a very shallow longitudinal impression. Transverse rim at top of supra-clypeal area less distinct than in other species of this group. Puncturation of head as in *C. cognata,* but front and vertex less densely punctate, especially at inner orbits near top of antennal fossae and between eyes and ocelli; sculpture of thorax and abdomen as in *C. cognata.* Colour pattern as in that species, but: mesoscutum with four yellow lines, mesopleura with yellow spot behind pronotal tubercles; spot on scutellum more narrowed posteriorly; legs slightly darker, apical half of hind tibiae and metatarsi brown.

This species resembles *C. compacta* very closely, but it has the antennal scape dark and the mesopleura less densely punctate.

♂ — Length 6-8 mm. Clypeus and paraocular areas more densely punctate than in ♀, yellow face markings less extensive than in *C. cognata* ♂, the black lines at top and sides of median part of clypeus rather wide; labrum with yellow spot; band on third tergite usually slightly interrupted; tergite 6 with large transverse spot; only apical fourth of hind tibiae dark; the remainder as in the female.

Sixth sternite: fig. 69, the lateral projections of the median structure less pronounced than in related species; apical margin of seventh tergite forming a very blunt angle with very small median point, the lateral angles rounded.

West Java: not rare in areas with remains of original forest or with a rich secondary vegetation, from about 100-700 m above sea level. The majority of the specimens I have seen have been collected in the neighbourhood of Djasinga by Dr. and Mrs. Lieftinck and by Mrs. van der Vecht and author; type (♂) and allotype (♀) are labelled: Djasinga, 150 m, Tjibarangbang, 15 Nov. 1936, resp. E. v. d. Vecht-B. and J. v. d. Vecht; paratypes: Togè, Bolang, Depok, Mt. Tjampea, Mt. Tjileueur, Tjiapus on Mt. Salak, Mt. Pantjar, Kretek, Tjiburial (the latter six localities near Bogor). The only specimen I have seen from a locality near the coast is a female from Batavia, collected in June 1908 by Edw. Jacobson (Mus. Leiden); it has the hind tibiae dark with small yellow spot at the base. Dr. Lieftinck took a female on Curculigo latifolia (Amaryllidaceae).

Siam: A female from West of Weing Sa, Siam, Febr. (coll. U.S. N.M.), identified by Cockerell as *C. philippinensis* (Ann. Mag. Nat. Hist. (10) IV, 1929: 151) appears to belong to this species.

Ceratina jacobsoni, n. spec. (figs. 62 and 70)

This form is closely allied to *C. cognata* and *C. lieftincki* and agrees with these two in the puncturation of the mesoscutum.

♀ — Length 6.5-8 mm. Structure and sculpture as in *C. cognata*; yellow markings (except on mesoscutum) less extensive than in that species; lateral face marks linear, slightly wider below than above (fig. 62); scape of antennae black, line on temples narrower; line on pronotum interrupted medially and separated from yellow spot on tubercles; mesoscutum usually with the two outer yellow lines (they are present, but hardly visible in one of the four females at hand); spot on scutellum reduced, strongly narrowed posteriorly; mesopleura black; legs dark brown to blackish, with pale yellow markings as follows: a line at under side and a spot at tip of femora I (the two separated by a narrow dark line); outer side of tibiae I and II and a

short line at base of tibiae III; tergite I with three yellow spots, the bands on the following tergites of the usual shape but narrower than e.g. in *C. cognata,* that on tergite 3 narrowly interrupted medially. In the allotype the band on tergite 2 is narrowly interrupted on each side of the middle, in the darkest specimen from C. Java (♀, 1939) the median part of this band consists of some indistinct transverse spots; in this specimen the band on 3 is widely, that on 4 narrowly interrupted.

♂ — Length 6-7.5 mm. Like the female, but the markings on the face slightly more extensive, except for the supra-antennal spots which are linear; labrum with yellow spot; yellow line on pronotum very narrow; scutellar spot as in the ♀ or divided by a black median line (type); legs as in the female, but outer side of tibiae III yellow, except for the apical fourth or fifth; markings on tergites reduced: 1 with small lateral spots, 2 with larger spots, band on 3 widely interrupted, that on 4 narrowly; 5 with band, 6 with median spot.

The colour pattern is variable; the type specimen is rather dark; a male from Antjol has three spots on tergite 1, the band on tergite 2 moderately interrupted, that on 3 very narrowly.

Sixth sternite: fig. 70; seventh tergite broadly rounded, with small median point.

West Java: Tandjong Priok, 1 ♂ (type), 1 ♀ (allotype), 21 Febr. 1937, F. Dupont leg. (coll. m.); Antjol near Tandjong Priok, 1 ♂, 25 Jan. 1931, author (paratype).

Central Java: Semarang, 1 ♀ 1 ♂, July 1910, Edw. Jacobson, no. 1867 (paratypes, Mus. Leiden); Gedangan near Semarang, teak forest, 1 ♀, 16 May 1931, L. G. E. Kalshoven; do., 1 ♀, 9 Sept. 1939, P. A. Blijdorp (paratypes, coll. m.).

Ceratina collusor Ckll. (figs. 63 and 64)

! 1919. Cockerell, T. D. A., Ann. Mag. Nat. Hist. (9) 3: 248, ♂ (*C. collusor,* Singapore).

1920. Cockerell, T. D. A., Phil. Jl. Science 17: 227, ♂ ♀ (*C. collusor,* var. *a,* Sandakan, Borneo).

? 1937. Cockerell, T. D. A., Amer. Mus. Novitates 950: 12, ♀ (*C. incertula,* Siam) (n. syn.).

♀ — Clypeus and paraocular areas with only a few scattered punctures; clypeus with weak median keel; outer half of antennal fossae impunctate; front and vertex coarsely, but not very densely, punctate; space between ocelli and eyes with only a few scattered punctures. Anterior part of mesoscutum densely punctate, the punctures rather coarse, sharply margined and larger than the interspaces; posterior two thirds of mesoscutum impunctate

and shining, except along the median line where a row of rather widely spaced punctures connects the anterior punctate area (here triangularly produced backwards) with the usual dull and densely punctate band at the posterior margin. Coxae I angularly produced on outer side at base, but the tooth less sharp than in *C. nigrolateralis* Ckll. Mesopleura densely punctate, anteriorly the punctures larger and more remote than on the mesoscutum, the puncturation below the shining part of the hypoepimeral area finer and very dense; on the ventral side the punctures more remote, in front of the mid coxae the shining interspaces larger than the punctures. Propodeum finely coriaceous, moderately shiny, the basal area finely rugose with a median raised line, the lateral areas densely and finely punctate, dull; declivity with only a few scattered punctures.

The coloration of this form appears to be fairly constant. Labrum with yellow spot; sides of upper arm of clypeal mark usually slightly convex, the top sometimes incised. Lateral face marks widened below, but never strongly produced inwards at lower end. Base of scape as a rule yellow or pale ferruginous, sometimes also the apex with small yellow spot (some specimens from mountain localities have the scape rather dark). Transverse band on pronotum connected with yellow spots on tubercles; mesoscutum with four yellow lines; spot on scutellum large, not or hardly narrowed posteriorly; mesopleura rarely with small spot behind tubercles; postscutellum often with small yellow spot; abdominal bands well developed, tergite 1 with wide band enclosing two black spots, band on tergite 3 often narrowly interrupted; yellow mark at apex of femora I not divided; outer side of tibiae I and II yellow, inner side brownish; tibiae III with yellow ring at base and a short yellow line on outer side, the apical three fourths to two thirds of these tibiae dark brown; metatarsi brown, other tarsal segments pale ferruginous.

♂ — Length 5.5-7.5 mm. Face more extensively marked with yellow than in *C. nigrolateralis* (compare figs. 64 and 66); antennal scape yellow at base and often with yellow spot at apex; supra-antennal spots and line on temples smaller than in female; yellow mark on scutellum as in female; band on tergite 3 often more widely interrupted, that on 4 narrowly interrupted; tergite 6 with hat-shaped spot; tarsi of fore legs pale ferruginous, the metatarsus with yellow line or almost entirely ferruginous yellow; basal half of tibiae III yellow on outer side. The $\wedge$-shaped ridge at apical margin of sternite 6 distinctly separated from the small lateral teeth, as in *C. jacobsoni* n. sp.; tergite 7 with well pronounced median point, the sides rounded.

C. incertula Ckll. from Nan, Siam, is unknown to me. It is very probably a slightly darkened form of the present species, differing from typical *collusor* by the black labrum and the broadly interrupted band on tergite 3.

Malaya: Singapore, 1 ♂ (type, no. 9281, Baker, Br. Mus.); do., 1 ♀ 1 ♂, coll. U.S. N.M.

Borneo: Sandakan, 3 ♀ 4 ♂, Baker, coll. U.S. N.M. (1 ♀ 1 ♂ are labelled "*C. collusor* var. *a*" by Cockerell, 1 ♀ bears Baker's number 9973); Sarawak, Santubong, 1 ♀ 1 ♂, Sept.-Oct. 1950, M. A. Lieftinck; East Borneo, Pelewan Mt., 2 ♀ 3 ♂, June 1937, Mrs. M. E. Walsh (Br. Mus.).

Sumatra: Deli, Sibolangit, 450 m, 2 ♀, 16 Nov. 1950, M. A. Lieftinck; Tapanuli, Siboga, 1 ♀, 3 Nov. 1909, Van Dedem (Mus. Amst.); Padang, 1 ♀ 1 ♂, Oct.-Dec. 1918, S. Leefmans (coll. m.); Anei Kloof, 500 m, 1 ♀, Fort de Kock, 920 m, 1 ♂, Edw. Jacobson (Mus. Amst.); Djambi, Sarolangun, 2 ♀, O. Posthumus (Mus. Bogor); 1 ♂ Aer Tarbit, Dec. 1913, Edw. Jacobson (Mus. Leiden).

West Java: Batavia (= Djakarta), 5 ♀, Oct. 1907, no. 2593, Edw. Jacobson (Mus. Leiden); several specimens of both sexes from Tjarita (Banten), Djasinga, Depok, Bogor (Mt. Tjampea, Mt. Tjileueur, Tapos, Tjiapus, Tjiburial) Sukanegara, Radjamandala, etc. (Mus. Bogor, Mus. Leiden, coll. Lieft., coll. m.). Some specimens were taken by me on flowers of Melastoma malabathricum and Lantana camara; Lieftinck collected the female on Leea indica.

Central Java: 1 ♀, Semarang, Aug. 1936, Betrem (coll. m.); 1 ♂, Semarang, Edw. Jacobson (Mus. Leiden); 1 ♀, Bodja, Merbuh (coll. m.); 1 ♂, Pager Gunung, Kedu, 2 Oct. 1932, Docters van Leeuwen (Mus. Leiden).

Bangka: 1 ♂, Mt. Menumbing near Muntok, 450 m, Nov. 1939, author.

Ceratina nigrolateralis Ckll.(figs. 65, 66, 71 and 72)

1916. Cockerell, T. D. A., Phil. Jl. Science XI: 305, ♀ (*C. philippinensis,* subsp. *nigrolateralis,* Palawan) (n. status).

♀ — Length 6-10 mm. Very similar to *C. collusor,* but usually slightly larger and less extensively marked with yellow. Anterior part of mesoscutum densely punctate at the sides, but in the middle the punctures are slightly more remote, smaller and less clearly defined. Posterior half of lateral areas of mesoscutum impunctate, rarely with a few scattered punctures; in some specimens from Palawan slightly more densely punctate, but always less so than in *C. compacta* and allies. Coxae I with strong tubercle on outer side at base. Basal area of propodeum slightly less rugose, more granulate; the dense granulate puncturation of the lateral areas produced on each side on the upper half of the declivity.

Labrum black; sides of upper arm of clypeal mark parallel or converging towards the top; lateral face marks often with inwardly directed point;

transverse band on pronotum separated from spot on tubercles; mesopleura always black; mesoscutum usually with four lines; spot on scutellum narrowed posteriorly, at least the posterior lateral angles of the disk of the scutellum narrowly black; postscutellum black; yellow band on tergite 1 often more or less reduced, on 2-4 more or less interrupted; legs dark, tarsi dark brown with only the claw joint ferruginous; yellow markings on legs somewhat variable, but always less extensive than in *C. collusor*; base of hind tibiae without a yellow ring, dark on inner side.

♂ — Length 6-8 mm. Clypeus with longitudinal impression on each side of the median keel. Face more densely punctate than in the female. Posterior half of mesoscutum often with some scattered punctures along the parapsidal lines. Coxae I less strongly tuberculate and legs more extensively marked with yellow than in the female. Face: fig. 66. Sixth sternite with Λ-shaped ridge, seventh tergite with median point, the sides rounded.

This species varies considerably in size and coloration. Even in a series of specimens from one locality one may find distinct differences in these respects. There is also a tendency towards geographic variation, but when studying this aspect, one is sometimes inclined to wonder whether the present distribution of this bee is entirely natural. Undoubtedly these insects, which nest in branches of many kinds of trees and shrubs, may be easily transported with cultivated plants. It seems quite possible that certain local forms have been spread in recent years by human agency beyond their original distribution areas.

As defined here, *C. nigrolateralis* includes the following forms, which until now have been regarded as species:

1919. *C. acuticauda* Ckll., Proc. U.S. Nat. Mus. 55: 175, ♂; type locality Buitenzorg (presently "Bogor"), Java, type in U.S. N.M.

1919. *C. incerta* Ckll., Ann. Mag. Nat. Hist. (9) 3: 247, ♀ ♂; type locality Singapore, type in Br. Mus.; do., Phil. Jl. Science 17 (1920): 624 (mentioned in key); do., Ann. Mag. Nat. Hist. (10) 4 (1929): 150 (recorded from Siam).

1929. *C. corbetti* Ckll., Ann. Mag. Nat. Hist. (10) 4: 151, ♀ ♂; type locality Kuala Lumpur, Malaya, type (♀) and "cotypes" in U.S. N.M.

The females of these forms, which may be provisionally regarded as subspecies, can be distinguished as follows:

1. Antennal scape with yellow spot at base. Tibiae II with yellow line on outer side. Abdominal tergites slightly duller and more densely punctate than in the other forms. Palawan . . . . . *C. nigrolateralis nigrolateralis* Ckll.
— Antennal scape dark 2

2. Mid and hind tibiae entirely black. Singapore, Sumatra . . . . . *C. nigrolateralis incerta* Ckll.
— Mid and hind tibiae with yellow markings 3
3. Mid tibiae with yellow line on outer side; hind tibiae with spot at base. Yellow line on under side of femora I usually separated from spot on upper side at apex. Java, Sumatra. . . . . *C. nigrolateralis acuticauda* Ckll.
— Mid and hind tibiae with yellow spot at base. Yellow marks on femora I confluent, the whole tip of the femora being yellow. Bands on tergites 3 and 4 often interrupted. Malaya, Borneo, Bangka, Sumatra . . . . *C. nigrolateralis corbetti* Ckll.

These forms are not sharply separated, and transitions between *acuticauda* and *corbetti* especially appear to be common. Instead of recording the distribution of each form separately, it seems therefore preferable to discuss the appearance of the species in the different parts of its distribution area, at least so far as the available material permits.

Siam: 1 ♀, Pah Muong, Jan. 18, Alice Mackie; 1 ♀, Nan, Jan. 24, Cockerell (both in coll. U.S. N.M.). — This is fairly typical *incerta,* but in the first specimen the spots on femora I are separated by a narrow line.

Malaya: 7 ♀ 6 ♂, Singapore, Baker; the series includes a paratype ("cotype") of *C. incerta* Ckll. (no. 9283); 1 ♀, Singapore, H. N. Ridley (labelled "*C. hieroglyphica*") (all in coll. U.S. N.M.). These specimens are all typical *incerta.* A series of specimens from Penang (7 ♀, 1 ♂), also collected by Baker and identified by Cockerell as *C. incerta,* agrees better with *C. corbetti* Ckll. I examined a paratype of the latter form: 1 ♂, Kuala Lumpur, coll. U.S. N.M.

Sumatra: West Coast, Fort de Kock, 13 ♀ 1 ♂, 920 m, 1925-1926, Edw. Jacobson (Mus. Amst.). These specimens agree with *C. incerta* Ckll. from Singapore; in the female the yellow markings are reduced: tibiae II and III are black on outer side, the bands on tergites 3 and 4 are interrupted; the male agrees well with males of *C. acuticauda* from Java.

Further specimens from Sumatra have the mid and hind tibiae more or less marked with yellow and are therefore not typical *incerta.* As a rule the mark on femora I is not divided; tibiae II have a yellow line on outer side, which is rarely indistinct; base of tibiae III with small spot. In some specimens the pronotal band is connected with the spot on the tubercles by a narrow yellow line. The band on tergite 3 is usually narrowly interrupted, the other bands are entire. Many specimens could be classified as *corbetti,* but there are various transitions to *acuticauda.*

Lampong Districts, 10 ♀ 3 ♂, Tandjong Karang and Mt. Betung (Sungeilangka Estate), March 1937, Mrs. van der Vecht and author (coll. m.); several specimens, Mt. Tanggamus, March 1940, M. A. Lieftinck; Benkulen, Tandjong Sakti, 1 ♀, May 1935, Mrs. M. E. Walsh (coll. m.); Padang, 1 ♀,

June 1926, Edw. Jacobson (Mus. Amst.); Deli, 2 ♀, Sungei Putih, Serdang, 21 May 1909, Van Dedem (Mus. Amst.).

Bangka: Specimens from this locality agree well with those from South Sumatra; the spot at the base of tibiae III is sometimes small, but never entirely absent. Pangkalpinang, 2 ♀ 3 ♂; Batu Rusa, 2 ♀; Aer Mesu, 2 ♀, one on flowers of Styphelia malayana, Febr. 1931; Tru, 2 ♀; Toboali, 1 ♀; all collected by author (coll. m.).

Borneo: East Borneo: 1 ♀, Samarinda, 1 ♀, Balikpapan, Nov. 1950, A. M. R. Wegner (Mus. Bogor); Sarawak: 3 ♀ 1 ♂, Kuching, Oct. 1950, M. A. Lieftinck; West Borneo: 1 ♀, Ledo at Bengkajang River, July 1933, H. R. A. Muller; South Borneo: 1 ♀, Barabei, Pool leg. 1883 (Mus. Amst.). The latter bears a label "*C. hieroglyphica,* det. Friese 1897". All Bornean females agree well with the description of *C. corbetti* (base of tibiae II and III with small spot), but in some specimens a yellow line on outer side of tibiae II is faintly indicated.

Palawan: Puerto Princesa, 1 ♀, Baker (type in Br. Mus.); do., 3 ♀ 1 ♂, Baker; do., 2 ♀, Aug. 1917, McGregor, no. 6897, both identified by Cockerell as *C. philippinensis nigrolateralis*; 3 ♀ 1 ♂, 2 Sept. 1923, McGregor (all in U.S. N.M.).

In the ♀ of this form, *C. nigrolateralis nigrolateralis* Ckll., the puncturation of the abdominal segments is slightly denser than in the other forms. Base of antennal scape with yellow spot. Yellow mark on femora I not divided. Tibiae I and II on outer side with yellow line which almost reaches the apex; tibiae III with yellow spot at base. Bands on tergites 2 and 3 in some specimens rather broadly interrupted, on 4 narrowly interrupted.

In the ♂ the puncturation is slightly coarser than in the ♀, especially on the head. Labrum with yellow spot. Lateral face marks relatively narrow; upper arm of clypeal mark more or less abbreviated; supra-antennal spots reduced; tibiae I and II yellow with dark stripe on inner side, tibiae III with yellow line which almost reaches the apex. Apical point of tergite 7 moderately sharp.

West Java: Common in cultivated areas, up to about 800 m above sea level. I have examined many specimens from Bogor (type locality of *C. acuticauda* Ckll.) and several other localities in Mus. Bogor, Mus. Leiden, coll. Lieftinck and coll. m.; one ♀ from Buitenzorg (= Bogor), Schmiedeknecht leg., in U.S. N.M.

In the female of the Javan form, *C. nigrolateralis acuticauda* Ckll., the antennal scape is black; lateral face marks at lower end as a rule with inwardly directed point; mesoscutum with four yellow lines, in some specimens the inner ones indistinct or absent. Yellow mark at under side of

femora I distinctly separated from spot at upper side. Markings on tibiae as in the Palawan race, the spot on base of tibiae III small and not produced on inner side of tibiae as in *C. collusor* Ckll. Band on tergite 2 entire, on 3 as a rule narrowly interrupted.

The male is like the male of the Palawan race, but the antennal scape is black; upper arm of clypeal mark not reduced (fig. 66); yellow markings on femora I sometimes separated, apical third or fourth of tibiae III dark; as a rule the bands on tergites 3 and 4 interrupted, the latter only narrowly; apical point of tergite 7 slightly sharper than in the typical form.

Central Java: Telawa near Semarang, 3 ♀ 3 ♂, L. G. E. Kalshoven and P. A. Blijdorp (coll. m.); Bodja, Merbuh, 3 ♀, 9 March 1941 (coll. m.); Purwokerto, 1 ♀ (coll. m.); Tjandi near Semarang, 1 ♂, F. C. Drescher (Mus. Amst.). The latter specimen had been identified by Friese as *C. hieroglyphica.*

East Java: Idjen Mountains, Blawan, 3 ♀ 3 ♂, H. Lucht (coll. Roepke).

Specimens from Central and East Java do not appear to be different from those collected in West Java.

Bali: Den Pasar, 4 ♀ 4 ♂, June 1935, R. Awibowo leg. (coll. m.). These specimens are close to *C. nigrolateralis acuticauda,* but the scutellar mark is not much narrowed posteriorly, the mark on femora I is not divided and the band on tergite 3 is not or hardly interrupted.

Ceratina moderata Cam. (fig. 47)

! 1897. Cameron, P., Mem. Proc. Manch. Lit. Phil. Soc. XLI, no. 4: 139 (*C. moderata,* Mussouri, N. India).
1897. Bingham, C. T., Fauna Br. India, Hym. I: 504, "♀" (recte ♂!).

♂ — Length 6-6.5 mm. Puncturation rather coarse, but not dense, sparser than in most other species of this group; interspaces on lower half of mesopleura larger than the punctures; basal area of propodeum granulate, coarsest at its base. Groove at top of antennal fossae not sharply defined. Outer side of base of coxae I rounded. Structure of sternite 6 not distinctly visible in the only specimen available for examination, but there do not appear to be median teeth. Body more densely pubescent than in the allied species.

Head black; clypeus, spot on labrum, supraclypeal area and lateral face marks yellow; the latter crescent-shaped (outer side concave), not reaching above top of supra-clypeal area (fig. 47). Thorax black, only the pronotal tubercles yellow. Abdomen black, tergites 2 and 3 with transverse yellow spot on each side at apical margin, tergite 4 with very small lateral spots. Legs dark brown, femora I with yellow mark at apex on under side; all tibiae

yellow on outer side, the hind ones with a short brown streak in the middle; metatarsi I with yellow spot at the base.

These notes are based on the type, a male in the Rothney collection in the Oxford University Museum.

The existing descriptions contain some disturbing errors. Cameron did not mention the sex of this species; the description of the yellow markings on the head is poor and confusing, and in the description of the abdomen the yellow markings, mentioned in the diagnosis: ... "lineisque abdominis flavis", are forgotten.

Bingham's description is apparently based on Cameron's type in the Rothney collection, which was at Bingham's disposal, but he erroneously described the specimen as a female, and gave the length as only 5 mm.

Ceratina ornatifera Cam. (fig. 48)

! 1897. Cameron, P., Mem. Proc. Manch. Lit. Phil. Soc. XLI, no. 4: 141, ♀ (and ♂ ?) (*C. ornatifera,* Mussouri, N. India).

Cameron described both sexes of this species, but it appears very probable that his *ornatifera*-♂ will prove to belong to a different species. *C. ornatifera* could perhaps be the female of *C. moderata* (see above), with which it agrees in the sculpture of the mesoscutum and in the unusually dense pubescence of head and thorax, but in view of the marked differences in coloration it seems better to keep the two apart for the moment.

In addition to the characters given in the key it may be noted that the colour pattern is similar to that of the other species of this group, with the following peculiarities: labrum black; lateral face marks shaped like inverted commas, not reaching above top of supraclypeal area (fig. 48); supra-antennal marks almost transverse; yellow marks on temples restricted to upper half; band on pronotum interrupted in the middle, separated from spots on pronotal tubercles; mesoscutum and mesopleura black; yellow mark on scutellum reduced; band on tergite 1 with a deep and square incision on each side; bands on tergites 2-4 narrow, abruptly widened laterally, on 5 reduced and indistinct (always?). Legs black; femora I with short yellow line at apex below; tibiae I and II with yellow line on outer side, III with yellow mark at base.

Clypeus with a sharp median carina, and with some coarse and ill-defined punctures. Paraocular areas shining, with a few coarse punctures. Vertex behind ocelli densely punctate, but the space between ocelli and eyes with only a few scattered punctures. Dorsum of propodeum dull, granulate, somewhat rugose at base, with fine median carina. Length 7.5-8 mm.

The only specimen I have seen is the type, a female labelled as such and

bearing a red number 9, in the Rothney collection, Oxford University Museum.

Ceratina interrupta Alfk.

1926. Alfken, J. D., Treubia 7: 268, ♀ ♂ (*C. interrupta,* Buru Island).

♀ — Clypeus with sharp median keel. Anterior punctate part of mesoscutum rather extensive, laterally produced backwards along the parapsidal lines, but the lateral areas posteriorly with a large impunctate space; there are also some punctures on the disk along the median line. Propodeum more coarsely sculptured than in the related species. Coxae I rounded at base on outer side, slightly projecting.

Upper arm of clypeal mark deeply incised at top; mesoscutum black; transverse yellow line on pronotum separated from spot on tubercles; mesoscutum black; tibiae III dark or with yellow spot at base.

♂ — The two males before me have a transverse yellow line at anterior margin of clypeus, it is widened towards the middle and here narrowly interrupted by the black median carina. Lateral face marks narrow. Temples rather densely and very coarsely punctate. Yellow mark on scutellum reduced, abdominal tergites 2-5 with lateral spots or lines, the last pair almost united in the middle. Apex of seventh tergite broadly rounded, without median point.

For further details compare the original description.

Moluccas: Buru Island: the original material consisted of 3 ♀ and 1 ♂; one of the females, a specimen labelled "9 June 1921, on Compositae" and "*C. interrupta,* det. Alfken, cotype", is in the Museum at Leiden. The present location of the type could not be determined. Dr. M. A. Lieftinck collected a female of this species on Saparua Island, 22 October 1949, and two males at Ambon, 27 July 1948 and October 1949 respectively.

Ceratina papuana, n. spec. (figs. 49, 50, 73-75)

♀ — Length 6.5-8 mm. Clypeus and paraocular areas with a few scattered punctures, the former with a faintly indicated median carina; front and vertex rather densely punctate, temples almost impunctate. Puncturation of mesoscutum about as in *C. collusor,* posterior half with only a few scattered punctures, anterior punctate area connected with transverse punctate band at posterior margin by a narrow band of widely spaced punctures along the median line. Mesopleura densely punctate, even in front of the mid coxae the interspaces not larger than the punctures; shining part of hypoepimeral area small. Dorsum of propodeum finely rugose, dull, the posterior margin of the

basal area coriaceous and moderately shiny; sides and declivity very finely sculptured, dull.

Labrum black; transverse line on clypeus with V-shaped upward extension which rarely reaches above the middle of the clypeus; lateral face marks narrow, curved inwards below, terminating above at level of antennae; transverse yellow line on supraclypeal area slightly angular above; scape of antennae black; supra-antennal spots transverse; yellow line on pronotum narrowly interrupted medially, separated from spot on tubercles; mesoscutum black or with faint traces of the outer yellow lines; mesopleura black; scutellar mark rather large, but narrowed posteriorly; abdominal bands as usual, rarely narrowly interrupted on tergite 3; femora with yellow spot at apex above, femora I with yellow line on under side (usually confluent with apical spot); outer half of tibiae I and II yellow (inner half reddish brown); basal two thirds of tibiae III with yellow mark on upper side; tarsi pale ferruginous.

♂ — Length 6-7 mm. Labrum with yellow spot; transverse line on clypeus wider, the upward extension broad and with only a shallow incision at the top which lies in or slightly above the middle of the clypeus; lateral face marks widened below, inner side almost straight or emarginate at some distance from the lower end (fig. 50); supra-antennal spots absent; yellow line on temples and scutellar mark reduced; mesoscutum black; bands on tergites 2 and 3 often interrupted; tergite 6 with yellow spot. Legs more extensively yellow than in the female: the mark on the hind tibiae almost reaches the apex; hind metatarsi yellow, other tarsal segments pale ferruginous, metatarsi I and II often with yellow line or entirely yellow. Sixth sternite: fig. 73, seventh tergite with distinct median point.

New Guinea: 8 ♀ 1 ♂, Sorong, 13 ♀ 8 ♂, Sorong, Kampong Baru, 8 July-14 August 1948, M. A. Lieftinck. The type (♀) and some paratypes are in the Leiden Museum; further paratypes have been deposited in the Museum collections at Amsterdam, Bogor, London, and Washington, and in the collections of Dr. Lieftinck and myself.