Subgeneric classification of the genus Ceratina Latreille of Asia and West Pacific, with comments on the remaining subgenera of the world (Hymenoptera, Apoidea)”

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Subgeneric classification of the genus *Ceratina* Latreille of Asia and West Pacific, with comments on the remaining subgenera of the world (Hymenoptera, Apoidea)"

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Abstract: Eight subgenera of the genus *Ceratina* Latreille (Anthophoridae) are recognized from Asia and West Pacific; they are *Chloroceratina, Lioceratina, Xanthoceratina, Catoceratina, Ceratinidia, Ceratina sensu stricto, Neoceratina* and *Euceratina.* Comments are made on the remaining subgenera of the world and the American species *Ceratina arironensis* now found on Oahu, Hawaiian Islands. Key to the subgenera of *Ceratina* of Asia and West Pacific and that of the species (males) of *Neoceratina* of the world are presented. Three new taxa are *Euceratina* Hirashima, Moure et Daly new subgenus from S. W. Asia, Europe and northern Africa, *Ceratina (Neoceratina) yasumatsui* new species from Laos, and *Ceratina (Neoceratinaj mariannensis trukensis* new subspecies from Micronesia.

Introduction

This paper concerns the classification of the subgeneraof the genus *Ceratina* Latreille occurring in Asia and West Pacific. Three papers have ever been published concerning the subject covering different parts of this region. Vecht (1952) recognizes 6 subgenera in his fine paper on *Ceratina* of the Oriental Region. They are *Pithitis, Chloroceratina, Catoceratina, Lioceratina, Xanthoceratina* and *Ceratinidia.* He leaves *Neoceratina* unstudied, although he recognizes the occurrence of *Caratina dentipes* and *Ceratina propinqua* in that region. He also did not report any species belonging to *Ceratina sensu stricto* whose representatives are, as shown briefly in this paper, not rare in the Oriental Region as far north as Japan. Michener (1965) recognizes three subgenera, *Ceratina*

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sensu stricto, Ceratinidia and *Pithitis,* from Australian and South Pacific regions. He thinks, however, *Neoceratina* is a synonym of *Ceratina sensu stricto.* Yasumatsu and Hirashima (1969) report 3 subgenera of *Ceratina* from Japan. They are *Ceratina sensu stricto, Ceratinidia* and *Neoceratina.* These 7 names of subgenera excepting *Pithitis* are all those available from Asia and West Pacific. All of them are reviewed in this paper. *Pithitis* Klug is excluded from this paper because Hirashima (1969) raised it to the generic rank.

Detailed description of *Neoceratina,* together with a key to the world species based on the males, is also made because its position has not previously been determined with certainty. Yasumatsu and Hirashima (1969) only briefly state that it is a distinct subgenus.

In this paper a new subgenus *Euceratina* Hirashima, Moure et Daly is described. Species of *Euceratina* are extensively European but a few species intrude into northern Africa and S. W. Asia as far east as W. Pakistan. Interestingly, one species of *Euceratina, dallatorreana,* has been introduced into North America and the presence of it in California was reported by Daly (1966).

Comments are also made on the American species *Ceratina arizonensis* which has been introduced into Oahu, Hawaiian Islands. This small American species was once included in *Ceratinula* which was proposed for the small Neotropical species.

Thus, the geographical range with which this paper concerns is world wide. Therefore, comments on the remaining subgenera of the world are also made in this paper.

For the subgeneric classification of *Ceratina,* the distribution of the graduli on the metasomal segments is of special interest and importance. This was first emphasized by Hirashima (1969) for separating *Pithitis* from *Ceratina* and again by Yasumatsu and Hirashima (1969) for distinguishing the Japanese subgenera of *Ceratina.* In order to examine the graduli, the metasoma should be dissected. They are represented by a longitudinal suture which devides the ventro-lateral surface on the 1st segment (Fig. 8). From 2nd segment onward, the gradulus is represented by a distinct transverse line near the base (Figs. 3, 9–13). It corresponds with the edge of the pregradular area which is elevated. Graduli are usually more distinct on the terga than on the sterna. So far as the genus *Ceratina* is concerned, it seems probable that the species with fewer graduli are more specialized (advanced).

Acknowledgement : I wish to thank Professor Keizô Yasumatsu for his constant kind guidance, encouragement and every possible assistance through my entomological career since school days. My interest in

bees has been multiplied through Professor Yasumatsu who also fonds of bees very much. Therefore, it is of my great pleasure to dedicate this paper to Professor Yasumatsu on the occasion of his retirement not only because *Ceratina* is one of his favorites but also he wrote the first paper on the Micronesian *Ceratina*.

My thanks are also due to Dr. J. L. Gressitt, Bishop Museum, Honolulu, Prof. C. D. Michener, University of Kansas, Lawrence, Dr. Karl V. Krombein and Dr. G. I. Stage, United States National Museum, Washington, D. C., Dr. M. A. Lieftink and Dr. J. van der Vecht, Rijksmuseum van Natuurlijke Historie, Leiden, Dr. S. Kelner-Pillault, Muséum National d'Histoire Naturelle, Paris, and Dr. F. Bachmeier, Zoologische Sammlung des Bayerischen Staates, Miinchen, for giving me the privilege of lending the valuable specimens under their supervision. A long series of unstudied Oriental material from Bishop Museum through Dr. Gressitt and a series of determined Oriental *Ceratina*, which was studied by Dr. van der Vecht, from Rijksmuseum van Natuurlijke Historie through Dr. Lieftinck (now retired) were especially helpful for my present study.

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KEY TO THE ASIAN AND WEST PACIFIC SUBGENERA OF *Ceratina*

1. Paraocular areas above antenna1 sockets impunctate ; color variable (usually decorated with yellow, or yellow and ferruginous, or rarely red); when black, at least paraocular areas with yellow marking in *both sexes* ; pregradular areas of metasomai tergn often yellow or ferruginous; medium-sized to large species, rarely more or less small like *humiiior* *2*

– Paraocular areas above antenna1 sockets punctate, at least with a few distinct punctures on space between eye and ocellus or with a row of fine punctures along inner margin of eye ; when these areas impunctate, species being small and black, with a few pale markings, if any, on head, tubercles and legs only; color variable, ground coloration black or metallic; paraocular areas without yellow marking *in female* except for *Ceratinidia* only ; pregradular areas of metasomal terga neither yellow nor ferruginous 5

2. Dorsal face of propodeum horizontal, sharply separated from posterior face which is steep; pronotum narrower than usual ; antennae of male very long, with 3rd segment of flagellum longer than broad ; apex of 7th tergum of male bluntly tridentate, the median tooth large triangular; 6th sternum

of male with a large concavity in middle of subapical portion (head and thorax largely impunctate ; dark parts of body slightly to distinctly metallic blue ; two species in Luzon only) ..... *Chloroceratina*

– Dorsal face of propodeum usually strongly slanting; antennae of male short as usual, with 3rd segment of flagellum broader than long 3

3. Preoccipital carina present, highly elevating specially in male ; vertex impunctate or nearly so; large, robust, black species with more or less rich yellow markings on head, thorax and metasoma, and further on fore legs ..... *Catoceratina*

– Note : For *Ceratina muscatella* Nurse from Simla, Northern India, see text.

– Preoccipital carina absent (vertex rounded posteriorly) 4

4. At least median part of clypeus finely coriaceous *in female;* basal area of propodeum also finely coriaceous, not coarsely sculptured; anterior part of mesoscutum with punctures superficial ; mesopleura also with punctures weak and rather sparse; tibia1 process (basitibial plate) of female legs rudimental ; genitalia of male without bundle of hairs . *Lioceratina*

– Clypeus polished, not coriaceous (rarely clypeus finely coriaceous like *Lioceratina);* basal area of propodeum often slightly more coarsely sculptured than *Lioceratina ;* tibia1 process of female hind legs distinct (although small) ; genitalia of male with 4 bundles of hairs; at least 3rd to 5th sterna of male with dense covering of hairs; color variable *Xunthoceratina*

5. Fifth tergum without a gradulus; 6th tergum with a longitudinal keel in middle; metallic species, with dense and strong punctures on face, frons, vertex and gennl areas ; 7th tergum of male strongly extending posteriorly, simple or bidentate at apex . ..... *Euceratina*

– Fifth tergum with a distinct gradulus 6

6. Black with rich yellow markings on head, thorax and metasoma, and further on legs (metasoma with tergal yellow bands, although sometimes more or less reduced); frons and vertex densely and rather coarsely punctate; mesopleura also densely punctate; medium-sized to large, robust species ..... *Ceratinidia*

– Black or metallic, only with a few pale markings, if any, on head, tubercles and legs (metasoma without yellow marking) 7

7. Small to large, black species; maxillary palpi 5- or 6-segmented ; graduli of female on 1st to 5th terga and sterna respectively (except for the Hawaiian *arizonensis* female which does not have a gradulus on the 5th sternum); 6th tergum of male without gradulus; 7th tergum of male truncate or rounded posteriorly (in the *chinensis* group only it is triangular); 2nd sternum of male without tubercle ; gonostylus of male genitalia without downward curving projection ..... *Ceratina s. str.*

– Small (except for two Micronesian species), black or metallic species; maxillary palpi 5-segmented; graduli of female on 1st to 5th terga and 1st to 4th sterna; 6th tergum of male with a distinct gradulus (except for *bispinosa* and *nigra* from Asia Minor); 7th tergum of male strongly extending posteriorly into a long projection (weakly producing posteriorly in *nigra* only), which is simple or bidentate at apex; 2nd sternum of male with a tubercle in middle (except for *nigra* only); gonostylus of male genitalia with a downward curving projection ; frons with a flat disc which

is often distinctly punctate (this structure not always distinct) . . ***Neoceratina***

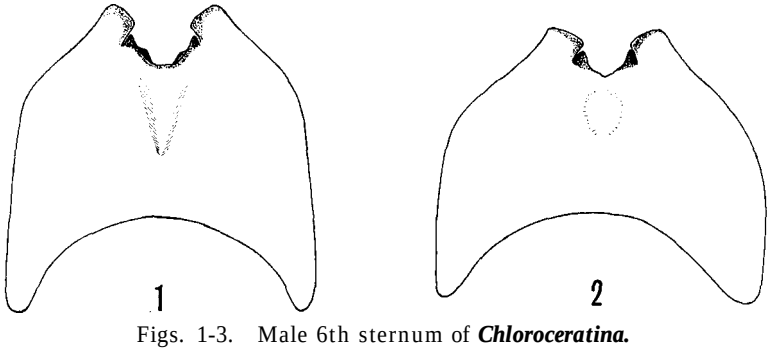
(1) Subgenus **Chloroceratina** Cockerell, 1918

Chloroceratina Cockerell, 1918, Philip. J. Sci. D 13: 143; Vecht, 1952, 2001. Verhandel., Leiden 16: 28.

Type-species : ***Cerafina*** (*Chloroceratina*) ***cyanura*** Cockerell, 1918. (Original designation)

This is a remarkable subgenus which is, so far as known, composed of but two species, ***Ceratina cyanura*** Cockerell, 1918, the type species, and ***Ceratina benguetensis*** Cockerell, 1916. Both species occur in the northern part of Luzon only. I have seen the authentic male specimens of these species in the collection of the United States National Museum. In addition to the characters given by Vecht (1952), the following description is made for the subgenus.

♂ : Maxillary palpi g-segmented ; hypostomal carinae moderately strong; mandibles bidentate, with lower tooth not much shorter and smaller than the upper one ; preoccipital carina absent; space between eye and ocellus impunctate; ***3rd segment of flagellum longer than broad, as*** long as 1st and 2nd combined; 4th and following segments of flagellum also much longer than broad respectively; cell 1st Cu of fore wing almost free of hairs; spurs of hind tibiae not specially curved; graduli present on 1st to 5th terga and 1st to 4th sterna, but gradulus on 4th sternum very weak; in ***cyanura,*** rudimental gradulus at the sides only of basal portion of 5th sternum; apical margin of 5th sternum emarginate in middle; 6th sternum with a round concavity in middle of subapical portion; median portion of apical margin of 6th sterunm deeply incised leaving a pair of large projections and a pair of denticles, as shown in Figs. 1 and 2; genitalia massive, especially so basally; gonostylus rounded at apex in general appearance, without hair tuft.



Figs. 1-3. Male 6th sternum of ***Chloroceratina.***
1: cyanura, 2 : *benguetensis.*

As shown by Vecht (1952), the difference between ***Ceratina cyanura*** and ***Ceratina benguetensis*** is very slight. In addition to Vecht's observation, the following characters are given to distinguish the two species.

Terminal segment of flagellum normal (i. e., gently tapering toward apex) in ***cyanura,*** while it is dilated, although very slightly so, in ***benguetensis;*** flagellum of ***benguetensis*** slightly more slender than in ***cyanura ;*** 6th sternum of ***cyanura*** slightly more elongate than in ***benguetensis ;*** apical incision of 6th sternum of ***cyanura*** slightly broader than that of ***benguetensis;*** apico-median depression of 6th sternum of ***benguetensis*** weak and not sharply marked as in ***cyanura.***

(2) Subgenus **Lioceratina** Vecht, 1952

Lioceratina Vecht, 1952, Zool. Verhandel., Leiden 16: 32.
Type-species **:** ***Ceratina*** *flavopicta* Smith, 1858. (Original designation)

This is a small subgenus of interesting species which are delicately sculptured and usually extensively decorated with yellow or yellow and ferruginous.

Maxillary palpi 6-segmented; at least the median part or clypeus finely coriaceous in female; mandibles of male bidentate or tridentate ***(ridleyi*** only) ; preoccipital carina absent (although sometimes vertex acute posteriorly) ; paraocular areas above antenna1 sockets impunctate ; basal area of propodeum finely coriaceous, not coarsely sculptured; tibial process (basitibial plate) rudimental in female, absent in male; wax glands of female on 2nd and 3rd sterna; graduli on 1st to 5th terga and sterna respectively in female, 1st to 5th terga and 1st to 6th sterna in male, but those on 5th and 6th sterna of male usually very weak or evanescent; genitalia of male without bundle of hairs, although hairy at apex of gonostylus.

I have seen the authentic specimens of ***Ceratina ridleyi*** Cockerell, 1916, ***Ceratina*** *flavopicta* Smith, 1858 and its allides, and ***Ceratina*** *flavolateralis* Cockerell, 1916 in addition to some Formosan specimens of ***Ceratina kosemponis*** Strand, 1913. Based on the males, these species may be divided into two species groups, as follows:

(1) *flavopicta*, ***ridleyi,*** and *flavolateralis :* apical margin of 7th tergum modified (see below) ; apical margin of 5th sternum slightly to distinctly emarginate in middle, with or without a pair of large triangular projections ; 6th sternum with **3-4** long spines in middle of apical portion ; aedeagus of male genitalia very large,

Further, this group may be divided into two subgroups, as follows :

(la) ***jlavopicta*** and ***ridleyi:*** 7th tcrgum with a median projection

and lateral angles, thus 7th tergum bluntly tridentate; apex of gonostylus with a long spine which curves inward.

(1b) *flavolateralis :* apical margin of 7th tergum roundly emarginate, thus 7th tergum largely bilobate; apical spine of gonostylus small.

(2) ***kosemponis:*** apical margin of 7th tergum entire, rounded; apical margin of 5th sternum entire; 6th sternum with two round teeth in middle of apical portion like ***Xanthoceratina*** (Fig. 3) ; genitalia large with small aedeagus; apical spine of gonostylus very small.

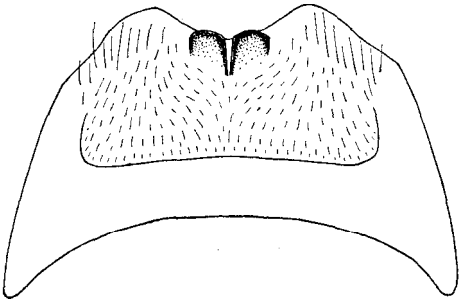


Fig. 3. Male Gth sternum of ***Ceratina kosemponis.***

Ceratina kosemponis occurs in Formosa, and, so far as known, this is the northern limit of the subgenus. ***Ceratina*** *flavolateralis* occurs in the Philippines only. ***Ceratina ridleyi*** has been known from Singapore, Sumatra and W. Java. Thailand is a new record for this species (1 ♂, Khaô Chong, near Trung, S. Thailand, 26. VI. 1965 (Y. Miyatake), Japan-U. S. Cooperative Science Program, in the collection of Kyushu Univ.). ***Ceratina jlavopicta*** occurs in Java, Bali, Borneo (Sarawak and Sabah) and Penang. Thailand is also a new record for this species (1 ♂, Khaô Chong, near Trung, S. Thailand, 26. VI. 1965 (Y. Miyatake), Japan-U. S. Cooperative Science Program, in the collection of Kyushu Univ.). According to the literature, ***Ceratina pictifrons*** Smith, 1861, is known from Makasar, Celebes, and ***Ceratina canarensis*** Cockerell, 1919, is described from "South Canara District, Nagody", India.

(3) Subgenus **Xanthoceratina** Vecht, 1952

Xanthoceratina Vecht, 1952, Zool. Verhandel., Leiden 16: 39.
Type-species **:** ***Ceratina*** *cladura* Cockerell, 1919. (original designation)

The subgenus ***Xanthoceratina*** is so close to ***Lioceratina*** that one may

not bc fully convinced that the former is distinct. More detailed study of them will be necessary.

Coloration fairly variable: black to red, usually with rich yellow markings ; at least paraocular areas with yellow marking in both sexes, like *Ceratinidia;* pregradular areas of metasomal tcrga often yellow; maxillary palpi 6-segmented ; head smooth with sparse punctures like *Lioceratina;* clypeus polished (for exception see below) ; vertex rounded posteriorly ; basal area of propodeum usually slightly more coarsely sculptured than in *Lioceratina ;* tibia1 process of hind legs of female distinct; *wax* areas of female on 2nd and 3rd sterna; graduli of female on 1st to 5th terga and sterna respectively, but those on 4th and 5th sterna sometimes very weak or evanescent; graduli of male on 1st to 5th terga and 1st to 6th sterna, but gradulus on 6th sternum sometimes evanescent or nearly absent; at least 3rd to 5th sterna of male with dense covering of short white hairs: 6th sternum of male with two small rounded teeth in middle of apical portion; apex of male genitalia with 4 bundles of hairs like some species of *Ceratinidia.*

Vecht (1952) includes 7 species in this subgenus. Of them, I have seen the authentic specimens of 4 species only ; they are *Ceratina cladura* Cockerell, 1919, ***fuliginosa*** Cockerell, 1916, *bipes* Cockerell, 1920, and *humilior* Cockerell, 1916. A paratype female of *Ceratina cladura crocina* Vecht, 1952, from Sumatra, has the clypeus as well as the lower parts of paraocular areas coriaceous, like those of *Lioceratina,* although not distinctly so as in *ridleyi.*

A female specimen of *Ceratina picta* Smith from Ceylon, which is included in this subgenus for the first time, has the metasoma, underside of thorax and legs red. I have seen a female specimen in the Paris Museum.

1 have seen two more new species of *Xanthoceratina* from China collected by the Metasequoia Expedition held by the California Academy of Sciences, San Francisco. These species will be described in a separate paper.

The following new records of two species are interesting in view of their distribution.

Ceratina fuliginosa Ckll., previously known from Palawan, Borneo, Java, and Sumatra : 1 ♀, Ban Me Thuot, 500 m, Viet Nam, 20-24. XII. 1960 (C. M. Yoshimoto) ; 1 ♀, Banna, Nakhon, 108 m, S. Thailand, 5-10. V. 1958 (T. C. Maa), all in the collection of Bishop Museum, Honolulu.

Ceratina humilior Ckll., previously known from Palawan and Java: 5 ♀♀, Changdao, 450 m, Changmai Prov., Thailand, 5-11. IV. 1958 (T. C. Maa), in the collection of Bishop Museum, Honolulu. Females from Thailand are larger than those from Borneo (1 ♀, Forest camp, 3.2-4.8

km WSW of Cocoa Research Station, Quoin Hill, Tawau, Sabah, 25. VII. 1962 (Y. Hirashima), also in the collection of Bishop Museum).

Now, *Xanthoceratina* is known from the Philippine Islands (Palawan and Bazilan), Borneo, Java, Sumatra, Penang, Thailand, Viet Nam, Burma, Ceylon and China.

(4) Subgenus **Catoceratina** Vecht, 1952

Catoceratina Vecht, 1952, Zool. Verhandel., Leiden 16: 30.
Type-species: *Ceratina yerforatrix* Smith, 1879. (Monobasic and original designation)

This subgenus contains but one large robust species, *Ceratina perforatrix* Smith, 1879. One of the most interesting characters of this species, which was overlooked by the previous authors, is that the female is provided with long, rather dense, mostly curled silvery hairs on the venter of metasoma; these hairs may be named as *ventral scopa,* because I observed some of the museum specimens having more pollens on these hairs than on the tibia1 scopa which is, in comparison with other species of *Ceratina,* rather scanty. Similar feature is known to an African ceratinid, *Megaceratina bouyssoui* (Vachal, 1903) (Hirashima, 1971). More interestingly, the pronotum, not always but often in larger specimens, *is* provided with a longitudinal carina *or* ridge at the sides, the feature similar to the Neotropical subgenera *Crewella* and *Calloceratina.* Other characters of importance of *Catoceratina* are given below.

Black with more or less rich yellow markings on head, thorax, metasomal terga and fore legs; maxillary palpi 6-segmented; hypostomal carinae strong; labrum elevated with a large flat disc, specially distinct in male; clypeus and supraclypeal area strongly elevated; supraclypeal area with an arcuate rim above (rarely not distinct); antennal fossae rather large and deep; antenna1 groove distinct; upper paraocular areas, frons, vertex and genal areas nearly impunctate; preoccipital carina strong, especially highly elevating in male (feature similar to the Neotropical *Crewella)*; anterior spur of hind tibiae distinctly curved at apex; tibia1 process (basitibial plate) of hind legs very strong in female, absent in male; graduli on 1st to 5th terga and 1st to 4th sterna in female, on 1st to 5th terga and sterna respectively in male, but gradulus on male 5th sternum often weak or evanescent; wax areas of female on 2nd and 3rd sterna; wax area of 3rd sternum very large; apex of 7th tergum of male bluntly bituberculate; apex of 6th sternum of male deeply incised leaving a pair of large triangular projections; genitalia of male much longer than broad; apex of gonostylus bifid with a sharp spine curving inward and backward, and

with a round projection decorated with short hairs.

The subgenus has previously been known from Burma, Singapore, Nias Island, South Sumatra and West Java (Vecht, 1952). I have seen the following specimens of ***Ceratina perforatrix*** from Borneo, Palawan and Thailand.

3 ♂♂ 5 ♀♀, Cocoa Research Station, Quoin Hill, Tawau, British North Borneo (now Sabah), 9. VIII. – 5. IX. 1962 (Y. Hirashima) ; 1 ♀, Punta Baha, Palawan, Philippine Islands, ***26.*** V. 1956 (H. E. Milliron) ; 2 ♀♀, Banna, 108 m, S. Thailand, 5-10. V. 1958 ('I'. C. Maa), all in the collection of Bishop Museum, Honolulu.

(5) Subgenus **Ceratinidia** Cockerell et Porter, 1899

Ceratinidia Cockerell et Porter, 1899, Ann. Mag. Nat. Hist. (7) 4 : 406 ; Vecht, 1952, Zool. Verhandel., Leiden 16 : 49; Yasumatsu and Hirashima, 1969, Kontyû 37: 66.

Type-species : ***Ceratina hieroglyphica*** Smith, 1854. (Monobasic and original designation)

This is the largest subgenus of ***Ceratina*** in Asia. Vecht (1952), in his fine monograph of the Oriental ***Ceratina,*** recognizes 21 species of ***Ceratinidia.*** He leaves ***Ceratina morawitzi*** Sickmann, 1894 known from China and Formosa unstudied. Although ***Ceratinidia*** is primarily Oriental, some species intrude upon the northern part of the Chinese Continent as well as Japanese Archipelago. Four additional species of ***Ceratinidia,*** which were not studied by Vecht, in these parts of the world are : *flavipes* Smith, 1879, and ***japonica*** Ckll., 1911 from Japan where they occur as far north as Hokkaido, ***emigrata*** Ckll., 1924 from the Maritime Province of Siberia, and *flavovaria* Gussakovskii, 1933 from Ussuri. Probably the 50 degrees north latitude is the limit of their distribution.

I have seen the type series of ***Ceratina emigrata,*** which is known only from the female, in the collection of the United States National Museum, and found that it is hardly separable from *Ceratina flavipes* **of** Japan. Difficulty in ***Ceratinidia*** is that the females are often almost impossible to identify with certainty unless the males are associated. For the definite treatment of synonymy, therefore, we have to wait for the male of ***emigrata.*** According to my unpublished data, in addition, one or two closely related forms to *flavipes* occur in Formosa and China.

After Vccht (1952), only Wu (1963) dared to describe three additional species ; they are ***Ceratina popovi*** (♀♂), ***denticulata*** (♀♂) and *laeviuscula* (♀ only) from Yunnan, China.

Species of this subgenus may easily be recognizable by the rich

yellow markings on the black body, which is robust and usually distinctly punctate; maxillary palpi 6-segmented ; preoccipital carina present (in most species of the *bryanti* group although it is often incomplete) or absent ; wax glands of female on 2nd and 3rd sterna; graduli on 1st to 5th terga and sterna respectively in both sexes, but gradulus on male 5th sternum weak, sometimes evanescent or rarely nearly absent; 6th sternum of male either with, in middle of apical portion, a pair of black projections (represented by small round teeth in the *bryanti* group and sharp spines in the *flavipes* group) or a $\wedge$-shaped ridge (the *compacta* group) ; gonostylus of male genitalia with a comb of hairs which is sometimes separated into two parts (then 4 bundles of hairs at apex of genitalia).

For dividing of the subgenus into the species groups, see further Yasumatsu and Hirashima (1969).

Ceratinidia is now known from Siberia (Maritime Province), Ussuri, China, Japan including Ryukyu Islands, Formosa, Philippine Islands, Borneo, Celebes, Tukang Besi Islands, Buru, New Guinea (Vogelkop only), Bali, Java, Krakatau, Sumatra, Bangka, Singapore, Malaya, Penang, Thai-

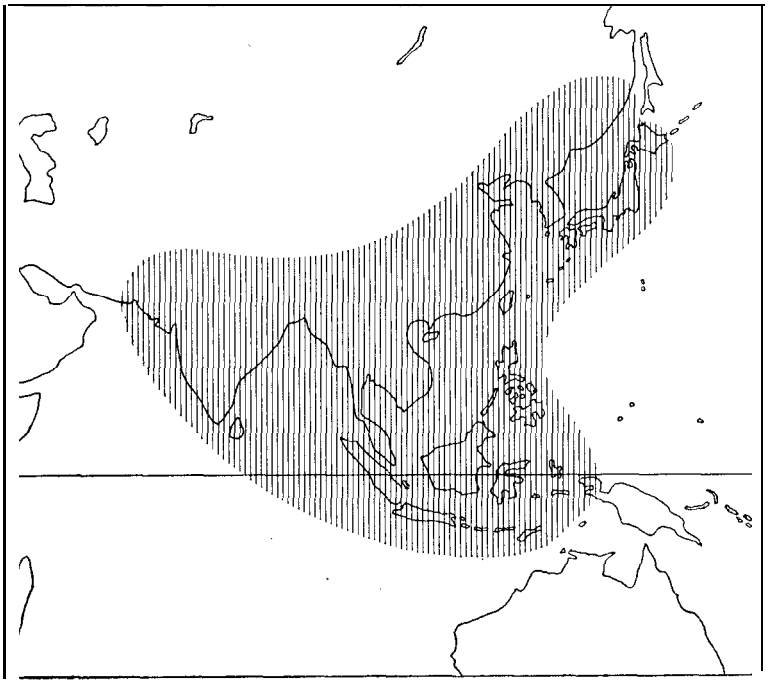


Fig. 4. Map showing the distribution of ***Ceratinidia.***

land, Burma, Hong Kong, Ceylon (I have seen a number of unidentified specimens of Ceylonese ***Ceratinidia*** in the collection of the Snow Entomological Museum, University of Kansas), and India (Fig. 4).

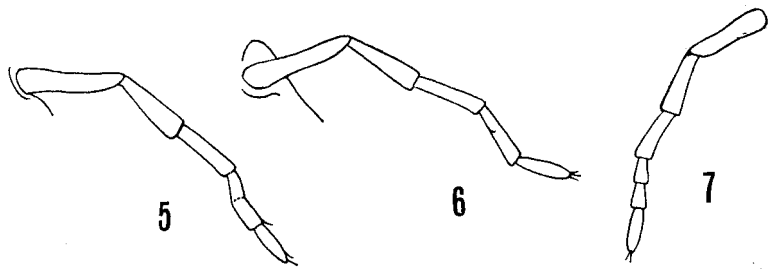
(6) Subgenus **Ceratina** Latreille, **1802**

Ceratina Latreille, 1802, Hist. nat. fourmis, p. 380; Friese, 1896, Termes. Fuzetek., 19: 34; Cockerell and Porter, 1899, Ann. Mag. Nat. Hist. (7) 4: 404; Cockerell, 1924, Proc. Ent. Soc. Washington, 26 : 77; Michener, 1965, Amer. Mus. Nat. Hist. 130 : 220 ; Yasumatsu and Hirashima, 1969, Kontyû 37 : 61.

Type-species : *Hylaeus albilabris* Fabricius, 1793=*Apis* ***cucurbitina*** Rossi, 1792. (Autobasic)

This is a rather large subgenus of small to large, nonmetallic black species (with a few pale markings) which occur in Europe, Africa and Asia. According to Michencr (1965), the small Neotropical species named ***Ceratinula*** are not separable from the present subgenus. As stated below, the American species ***Ceratina arizonensis*** now found on Oahu, the Hawaiian Islands, is also placed in this subgenus. Metallic species occurring mostly in Europe such as *callosa*, ***cyanea*** and others are separated from the present subgenus (see ***Euceratina*** new subgenus).

There are only two species of the present subgenus in Europe. They are C. ***cucurbitina*** (Rossi) and C. ***parvula*** Smith. The former, the type species of the genus, is found also in northern Africa. As shown in Figs. 5-7, the segmentation of the maxillary palpi of ***cucurbitina*** is variable and this was a cause of certain confusion (see Michener, 1965).



Figs. 5-7. Maxillary palpi of ***Ceratina cucurbitina male.*** ***5,*** 6 : transitional, and 5-segmented, from the same individual, 7 : e-segmented.

From Africa I have seen the following species of ***Ceratina s. str.:*** ***Ceratina aloes*** Brauns, ***braunsiana*** Friese, ***subulata*** Brauns, and *truncata* Friese. Of these, *truncata* does not have a gradulus on the 5th tergum in both sexes, and in this respect it is related to ***Euceratina*** new subgenus. There are in Africa still many black species which do not belong to

the present subgenus.

From Asia, or primarily Oriental Region including Japan, I recognize no less than a dozen species of the present subgenus, about half of them are still undescribed from Formosa, China (Fukien) and Thailand. Named species are ***Ceratina megastigmata*** Yasumatsu et Hirashima, ***esakii*** Yasumatsu et Hirashima, ***iwatai*** Yasumatsu, and ***satoi*** Yasumatsu from Japan and adjacent areas, ***unicolor*** Friese and ***sauteri*** Strand from Formosa, and ***chinensis*** (Wu) from China (Yunnan). The latter species was erroneously assigned to ***Neoceratina*** by the original author (see discussion under ***Neoceratina).***

Revision of the Old World species of this subgenus is not yet available. For Japanese species, see Yasumatsu and Hirashima (1969).

Comments on Ceratina arizonensis Ckll. of the Hawaiian Islands

Ceratina arizonensis Cokerell is a small black species previously known from Arizona, California and Mexico. So far as I am aware, the occurrence of this species in the Hawaiian Islands is not well known. Discovery of ***arizonensis*** on Oahu was first announced by Mr. D. T. Fullaway on July 14, 1952 at the 559th meeting of the Hawaiian Entomological Society and again on December 8 of the same year at the 564th meeting (Proc. Hawaiian Ent. Soc. 15: 11 and 20, 1953). It is said that the first discovery of ***arizonensis*** in the Hawaiian Islands was on Oahu (on the University campus) in November, 1950. Mr. Fullaway reported the species is believed to be established on Oahu. However, nobody knows when and how ***arizonensis*** was introduced. Sixteen years later from the first discovery, I was able to collect a good series of both sexes of this species at Alawai, Honolulu on August 13, 1966. Although I did not make any extensive field survey of this species during my visit to Hawaii (Bishop Museum) in 1966-1967, I was impressed that this species has been established and spreading over on Oahu. No record is available from other islands at present.

This small American species together with its relative ***Ceratina cockerelli*** Smith were once transfered from the subgenus ***Ceratina s. str.*** to the subgenus ***Ceratinula*** Moure. However, Michener (1965) thinks that ***Ceratinula,*** which is primarily Neotropical, is not separable from ***Ceratina s. str.*** of the Old World. Although I am not familiar with the Neotropical species of the so-called ***Ceratinula, I*** also prefer to place ***Ceratina arizonensis,*** together with ***cockerelli,*** in the subgenus ***Ceratina s. str.*** tentatively. I think they constitute the ***arizonensis*** species group which is fairly distinctive.

The species group is characterized in having the maxillary palpi 5-segmented (5- or 6-segmented in the Old World species of ***Ceratina s.***

str.), the graduli present on 1st to 5th terga and 1st to 4th sterna in both sexes (concerning ***cockerelli,*** I have seen only two male specimens and observed a very weak gradulus further on the 5th sternum) (1st to 5th terga and sterna respectively in the female and 1st to 5th terga and 1st to 6th sterna in the male in the Old World species such as ***cucurbitina, megastigmata, esakii, iwatai*** and ***satoi),*** and the lower paraocular areas of the male pale colored like the clypeus (usually black in the small species of the Old World ***Ceratina s. str.).***

Thus, so far as the distribution of the graduli on the metasomal segments is concerned, the ***arizonensis*** group is fairly different from the Old World species as well as the Neotropical ones previously included in ***Ceratinula.*** This would suggest that the ***arizonensis*** group differs phyletically from them.

(7) Subgenus **Neoceratina** Perkins, 1912

Neoceratina Perkins, 1912, Ann. Mag. Nat. Hist., (8) 9 : 117; Michener, 1965, Amer. Mus. Nat. Hist. 130 : 220 ; Yasumatsu and Hirashima, 1969, Kontyû 37 : 66.
Type-species : ***Neoceratina australensis*** Perkins, 1912. (Monobasic)

This is another interesting subgenus of usually small species, but exceptionally two large (relatively) species occur in Micronesia. I have seen at least 8 species of this subgenus; they are ***Ceratina nigra*** Handlirsch, ***bispinosa*** Handlirsch, ***dentipes*** Friese complex, ***yasumatsui*** n. sp., ***palauensis*** Yasumatsu, ***mariannensis*** Yasumatsu with a new subspecies ***(trukensis), propinqua*** Cameron and ***australensis*** (Perkins). As shown in Fig. 14, most of them occur in West Pacific. Michener (1965) says that this group also occurs in Africa, but I have not seen any African species.

In 1963, Wu described ***Neoceratina chinensis*** from Yunnan. His fine drawings of the genitalia and associated structures of the male suggest that ***chinensis*** deviates from ***Neoceratina.*** Very recently I have seen several male specimens of the ***chinensis*** complex from Fukien, Viet Nam and Formosa. I studied them in details and came to the conclusion that they comprise the ***chinensis*** species group in ***Ceratina s. str.***

Yasumatsu and Hirashima (1969) treated ***Neoceratina*** as a distinct subgenus. Again I will emphasize the following characters as characteristic to this subgenus.

First of all, the distribution of the graduli on the metasomal segments is distinctive. They are seen on the 1st to 5th terga and 1st to 4th sterna in the female, and on the 1st to 6th terga and sterna respectively (although very weak on the 6th sternum) in the male (Figs. 8-13). However, there is a slight variation only in the males, which are, according to the distribution of the graduli, divided into three

groups as follows:

Group 1 includes ***dentipes*** complex, ***yasumatsui*** n. sp., ***mariannensis*** and ***palauensis.*** Distribution of the graduli is as described above.

Group 2 includes ***australensis*** and ***propinqua.*** Gradulus is seen further on the 7th tergum.

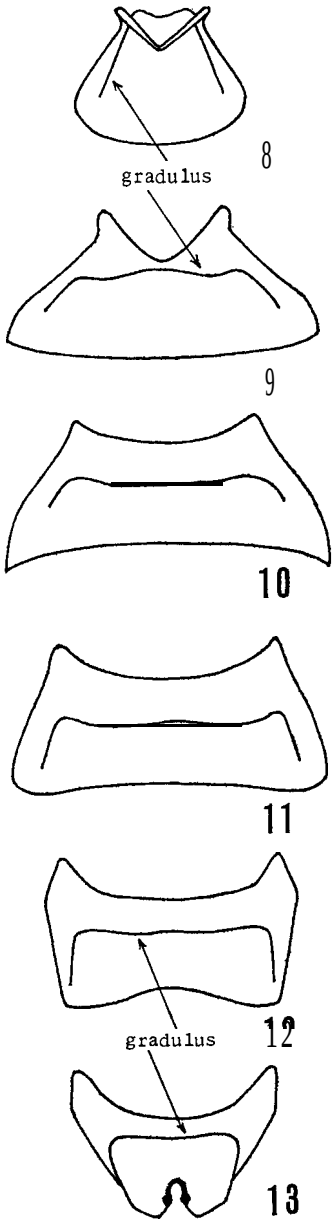
Group 3 includes ***nigra*** and ***bispinosa.*** Graduli on 5th and 6th terga are much reduced or almost disappeared.

Male 7th tergum is also distinctive to the subgenus. It elongates or extends posteriorly like ***Euceratina,*** and the apex is either unidentate or bidentate. It is unidentate in ***australensis, propinqua, yasumatsui*** n. sp., ***mariannensis,*** and ***palauenesis.*** It is distinctly bidentate in ***nigra*** and ***bispinosa.*** It is weakly bidentate in ***dentipes*** complex, although the apical portion of the tergum is strongly extending posteriorly like ***palauensis*** and ***mariannensis.***

Male 6th sternum also provides an interesting feature. There is a pair of flag-like projections, which are variable in size and shape from species to species, in the middle of apical portion except for ***australensis*** and ***propinqua.*** In the latter two species the corresponding portion of the sternum is provided with a round incision which is accompanied with a u-shaped carina basally (Fig. 13).

Gonostylus of the male genitalia is provided with a downward curving small projection in all the species. This is one of the striking characteristics of the subgenus.

Male 2nd sternum is provided with



Figs. ***8-13.*** Distribution of graduli on the 1st (8) to 6th (13) **sterna of the male of** *Ceratina* ***australensis*** (specimen from Guadalcanal).

a small tubercle in the middle except for ***nigra*** only.

Maxillary palpus is 5-segmented in all the species.

Elevated frontal disc which bears distinct punctures is also one of the interesting characters for the subgenus, but this is rarely not distinct.

Reduced pale markings, either white or pale yellow, is also unique. Clypeus of the female is with an elongate mark in the middle; that of the female is entirely pale or with an elongate central mark like the female. Labrum of the male is with a yellow marking except for ***mariannensis trukensis*** n. subsp. only. Paraocular areas are black in both sexes. Tubercles are usually pale. Legs are decorated with whitish markings, those on the hind tibiae usually more or less extensive in both sexes. Markings on the legs are rather reduced in ***mariannensis*** only.

Ceratina palauensis from Micronesia is unique not only being large in size like ***mariannensis*** but also having the hypostomal carinae very strong (highly elevating) and the preoccipital carina distinctive although they are best seen when the head is separated from the thorax.

Distribution : Australia (Queensland including Bribie I., New South Wales), Solomon Islands (Florida, Guadalcanal), New Britain, New Guinea, Misool, Celebes, Bali, Java, Bangka, Borneo, Philippine Islands, Micronesia, Bonin Islands, Takara-jima, Ryukyu Islands, Formosa, China (Yunnan, Fukien), Thailand, Penang, India, Asia Minor, and Cyprus. According to Michener (1965), this subgenus occurs also in Africa. I have seen the specimens of the following species.

1. ***Ceratina dentipes*** Friese complex. This complex, or superspecies, includes ***dentipes*** Friese, 1914 from Java, New Guinea and other parts of southeastern Asia, ***kankauensis*** Strand, 1913 and ***fumipennigera*** Strand, 1914 from Formosa, and ***boninensis*** Yasumatsu, 1955 from Bonin (Ogasawara) Islands. I have seen a number of specimens from Australasia and West Pacific mostly in the collection of Bishop Museum (BISHOP). New Britain (1 ♀, Ti, Nakanai Mts., 28. VII. 1956 (R. J. Ford, Jr.), in BISHOP), Borneo (1 ♀, Forest camp, 19 km N. of Kalabakan, North Borneo (now Sabah), 31. XI. 1962 (Y. Hirashima), in BISHOP), and Palawan (1 ♀, 3 km NE. of Tinabog, 15. V. 1962 (H. Holtmann), in BISHOP) are new records for this species. Wu (1963) recorded ***dentipes*** from Yunnan. I have also seen a male specimen of ***dentipes*** from China (Shaowu, Tachuland, Fukien, 24. IV. 1945 (T. C. Maa), in BISHOP).

2. ***Ceratina nigra*** Handlirsch, 1889. 1 ♂, Balgakum bei Djulek Turkest. (S. Malischew), in Museum National d'Histoire Naturelle, Paris (MP).

3. ***Ceratina bispinosa*** Handlirsch, 1889. 1 ♀ 1 ♂, Adana, in MP; 1 ♀ 1 ♂, Cyprus, in United States National Museum (USNM).

4. Ceratina palauensis Yasumatsu, 1939. 1♂, Peliliou, Palau Islands, 11. VIII. 1939 (Teiso Esaki), in Kyushu Univ. ;1♂, Potangeras Islet, Ulithi Atoll, 10. XI. 1947, in USNM (this specimen was once recorded by Krombein, 1950), plus the type series and other specimens in Kyushu Univ.

5. ***Ceratina mariannensis*** Yasumatsu, 1939. 1♀, Shinaparu, Rota Is., ***24.*** IV. 1946 (Townes, 862), in USNM (this was also once recorded by Krombein, 1950), plus the type and another specimen in Kyushu Univ. For the new subspecies see the description given below.

6. ***Ceratina yasumatsui*** n. sp. See the description given below.

7. ***Ceratina propinqua*** Cameron, 1897. 1♂ from Tangcolan, Bukidnon, Mindanao, in USNM. This specimen was recorded by Vecht (1952, p. 28) as the one resembles C. ***propinqua*** very much. I have not seen any other specimen of ***propinqua so*** that my recognition of ***propinqua*** is based on this specimen.

8. ***Ceratina australensis*** (Perkins, 1912). 2 ♀♀***2***♂♂, Queensland and New South Wales, Australia, X-XI. 1958 (C. D. Michener), in Univ. of Kansas ;***2***♂♂, Port Moresby, New Guinea, 25. IV. 1959 (C. D. Michener), in BISHOP ;2♂♂, 4♀♀, Mt. Austen, 100 m, Guadalcanal, Solomon Islands, 6. X. 1969 (Y. Hirashima), in BISHOP. This is the only representative of ***Ceratina*** in Australia. Michener (1962, 1965) states the

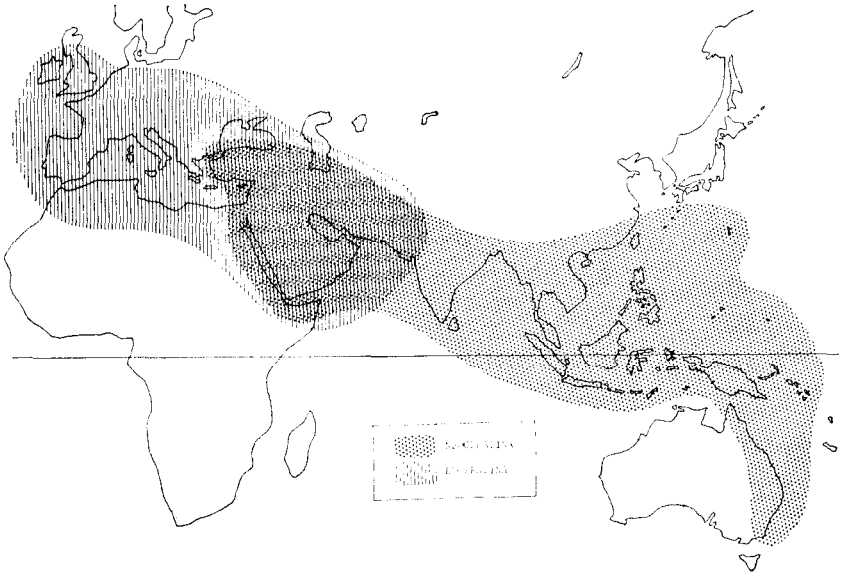


Fig. 14. Map showing the distributions of ***Neoceratina*** and ***Euceratina.***

possible identity of this species with the Indian species *propinqua,* but I think they are different species, although they are undoubtedly very close to each other.

Ceratina (Neoceratina) yasumatsui n. sp.

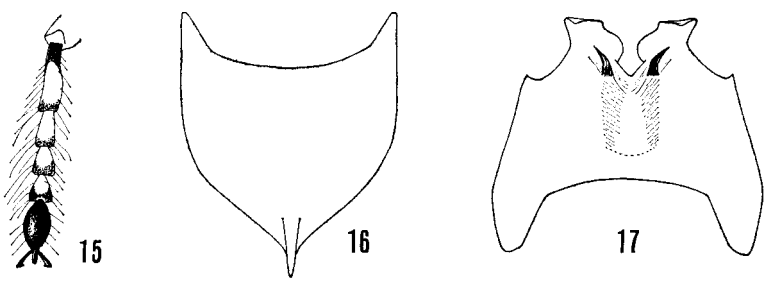
Size, general habitus, and coloration very similar to *dentipes,* but anterior area of mesoscutum, especially central portion of that area, more finely and densely punctate in both sexes. Sometimes the female of *yasumatsui* is very hard to separate from that of *dentipes,* because the latter is fairly variable in punctulation. However, the male is rather easily separable from *dentipes* in having the 7th tergum being unidentate with sharp apex (Fig. 16), 6th sternum with a pair of projections robuster and different in shape (Fig. 17), and hind tibiae neither with a projection nor with a bundle of long hairs.

The dilated and blackened distitarsus, pale colored mediotarsus and also pale colored basitarsus (although basal portion black) of the fore legs of the male (Fig. 15) are characteristic of this species, although the feature is shared with *dentipes.*

Type material: Holotype male (BISHOP 9317) and 1 paratype female, Vientiane, Laos, 3. II. 1966 (Native collector) ; 2 paratype females, Tah Ngone, Vientiane Prov., Laos, 9 and 17. II. 1966 (Native collector) ; 1 paratype female, Paksane, Borikhane Prov., Laos, 14. II. 1966 (Native collector).

Type depositories: Holotype male and 3 paratype females are in the collection of Bishop Museum, Honolulu, Hawaii, and 1 paratype female in the collection of Kyushu Univ.

This species was named in honor of Professor K. Yasumatsu.



Figs. 15-17. *Ceratina (Neoceratina) yasumatsui* n. sp., male.
15: fore tarsus, 16: 7th tergum, 17: 6th sternum.

Ceratina (Neoceratina) mariannensis trukensis n. subsp.

Male: Length about 7 mm.

Black ; weakly metallic blue on head and thorax; metasoma brownish (black in fresh specimens ?) with very slight purple-bluish tint (body entirely metallic blue in the nominate subspecies) ; legs brownish; pale markings confined to clypeus and fore legs as follows : a small hat-like marking which is pointed above, a line on underside of fore femur, and 2nd to 4th segments of fore tarsi, pale yellow; another pale marking on tubercles almost evanescent (pale yellow markings are further present on labrum and basal portions of all tibiae in the nominate subspecies). Wings strongly brownish, only subhyaline at near base (only slightly brownish in the nominate subspecies).

Head rather coarsely punctate; punctures on lower face and space between eye and lateral ocellus much coarser than in the nominate subspecies; hypostomal carinae weak like the latter (this character easily separates ***mariannensis*** from ***palauensis,*** as already pointed out by Krombein, 1950) ; supraclypeal area delicately sculptured, dull (largely convex, smooth and shiny in the nominate subspecies) ; mesoscutum largely impunctate in middle, with punctures on anterior and lateral portions more distinct than in the nominate subspecies ; scutellum finely and very densely punctate (punctures more or less sparse in the nominate subspecies) ; tubercle on 2nd sternum very weak; 6th sternum with a pair of projections more or less small (robust and transverse in the nominate subspecies).

Type material: Holotype male, Sabote, Pata Island, Truk Islands, Caroline Islands, 4. IV. 1940 (K. Yasumatsu and S. Yoshimura).

Type depository : Kyushu University.

The holotype of this new subspecies was once reported as the male of ***mariannensis*** by Yasumatsu (1942). It seems probable to me that this subspecies may be recognizable as a species when the Micronesian fauna is sufficiently studied.

Species and subspecies of Micronesian ***Ceratina*** are now known as follows :

Ceratina palauensis : Palau Islands (Babeldaob (type locality), Babelthuap, Angaur, Peliliou), Yap, Ulithi Atoll.

Ceratina mariannensis : Rota (type locality), Saipan.

Ceratina mariannensis trukensis: Truk Islands (Pata Island is the type locality).

KEY TO THE WORLD SPECIES OF ***Neoceratina*** BASED ON THE MALES

1. Apex of 7th tergum bidentate; black species 2
– Apex of 7th tergum simple; metallic or black species 4
2. Distitarsus of fore legs dilated, black; mediotarsus (2nd to 4th segments) of the same legs white or nearly so except for their extreme apices which are ferruginous; basitarsus of the same legs sometimes whitish apically; inner side of hind tibiae with a subapical blunt projection which bears a bundle of long bright hairs; small species from Solomon Is., New Britain (new record), New Guinea, Misool, Celebes, Bali, Java, Bangka, Penang, Thailand, China (Yunnan, Fukien), Borneo (new record), Palawan (new record), Mindanao, Luzon, Formosa, Ryukyu Is., Takara-jima, and Bonin Is. ..... ***dentipex*** complex
– Distitarsus of fore legs neither dilated nor blackened, although sometimes slightly darker in color than the preceding segments which are ferruginous 3
3. Apical projections of 7th tergum close together: hind tibiae only slightly dilated subapically; apical third of inner side of hind tibiae truncate with appressed hairs; 2nd sternum with a small tubercle in middle; small species from Asia Minor and Cyprus ..... *bispinosa*
– Apical projections of 7th tergum widely separated; hind tibiae rather distinctly dilated subapically; hairs on inner side of hind tibiae rather long, neither arranged in a special manner nor appressed; 2nd sternum without a median tubercle; small species from Asia Minor ..... ***nigra***
4. Metallic species, at least head and thorax with bluish or greenish tint; fore tarsi uniform in color except for ***mariannensis trukensis*** n. subsp. from Micronesia (Truk) 5
– Black species; mediotarsus of fore legs much paler than distitarsus 8
5. Median portion of mesoscutum largely impunctate; large species from Micronesia 6
– At least median portion of mesoscutum finely and very densely punctate; small species from Australia, Solomon Is., New Guinea, and other islands and peninsula westward to India 7
6. Fore tarsi uniform in color, blackish; labrum with a large pale yellow marking; clypeus with a large silk hat-like pale yellow marking; supraclypeal area largely impunctate and shiny; head with fine punctures; wings not strongly darkened; 6th sternum with apical projections robust; Rota and Saipan ..... ***m a r i a n n e n s i s***
– Mediotarsus of fore legs whitish; labrum without yellow marking; clypeus with a small hat-like yellow making which is pointed above; supraclypeal area delicately sculptured, dull; head with coarse punctures; wings strongly brownish; 6th sternum with apical projections smaller; Truk Is. ..... ***mariannensis trukensis***
7. Mesoscutum uniformly densely punctate, without shiny areas except for sutures; apical third of hind tibiae slightly dilated on inner side; small blue or green species from India, Mindanao and Celebes *propinqua*
– Mesoscutum with impunctate shiny areas laterally, or occasionally mesoscutum largely shiny in middle in the specimens from Solomon Is.; hind tibiae not much dilated apically; inner side of hind tibiae with a tuft of long

white hairs in middle; small bluish species from Australia, New Guinea and Solomon Is. ..... ***australensis***

8. Large species from Micronesia ; hypostomal carinae very strong ; apical projection of 7th tergum very robust ..... ***palauensis***

– Small species from Laos; hypostomal carinae weak as in other species; apical projection of 7th tergum, as seen from above, slender and sharp; hind tibiae only slightly dilated apically ; inner side of hind tibia with a single row of moderately long hairs along its nearly full length ... ***yasumatsui***

(8) Subgenus **Euceratina** Hirashima, Moure[1] et Daly[2], n. subg.

Type-species : ***Apis*** *callosa* Fabricius, 1794.

This is a rather large subgenus of the metallic species. Majority of them occur in Europe but some species intrude into northern Africa (*callosa*, ***dallatorreana, mandibularis, moscaryi)*** and south-western Asia including Asia Minor ***(chrysomalla, corinna, dallatorreana, laevifrons, mandibular-is, tibialis).*** There is only one species ***(cyanea)*** in Britain, and Sauders (1896, The Hymenoptera Aculeata of the British Islands) gives a description of the genus. Presence of *Ceratina* ***dallatorrreana*** in California was reported by Daly (1966). He says that the first bees appeared in the upper Sacramento Valley of California in 1949, and, interestingly, the "alien bee" reproduces by parthenogenesis there.

The new subgenus is very distinctive and easily separable from any of the Old World subgenera by the head (as well as the thorax and metasoma) densely punctate (more extensively punctate than in *Ceratinidia),* the basal area of the propodeum having a weak to distinct transverse carina at each side posteriorly, and the 5th tergum lacking a gradulus, in addition to the 7th tergum of the male strongly modified (see below description). Regarding the strong punctation as well as the coloration (metallic with a few pale markings) of the body, ***Euceratina*** recalls ***Zadontomerus,*** *Crewella* and ***Calloceratina*** of the New World. ***Euceratina*** is easily separable from ***Zudontomerus,*** however, by the absence of the gradulus on the 5th tergum (in ***Zadontomerus,*** graduli present on the 1st to 5th terga and 1st to 3rd sterna in both sexes), absence of a pair of impunctate swellings on the frons, and unmodified hind femora of the male. It is also easily differentiated from *Crewella* and ***Calloceratina*** in having the different distribution of the graduli on the metasomal segments (see comments on *Crewella* and ***Calloceratina*** presented elsewhere in this paper), and the pronotum without a distinct transverse carina extending downward at each side to the anterior

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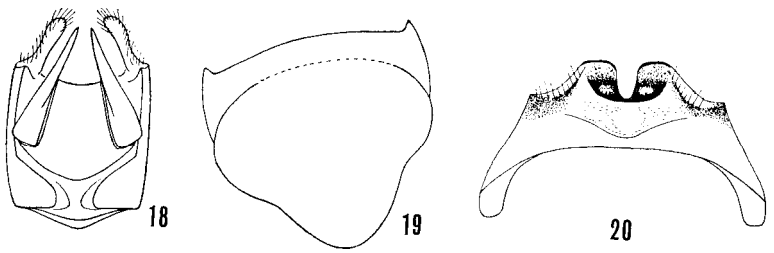
2) H. V. Daly, Division of Entomology, University of California, Berkeley, California 94720, U. S. A.

coxae. Male genitalia of ***Euceratina*** is also unique in having the slender and hairy gonostylus (Fig. 18).



Figs. 18-20. Male structures of *Euceratina*.
18 : Genitalia of *Zoewii,* **19** : 7th tergum of *callosa,* 20 : 6th sternum of *callosa ;* all were seen obliquely from above.

Medium-sized to large, robust, metallic species; pale markings restricted to clypeus (absent in females of *acuta*, ***cyanea),*** labrum of male, tubercles (absent in ***cyanea, chalcites, gravidula, laevifrons,*** and others), and bases of tibiae, and further very rarely on mandibles of male ***(mandibularis).*** Head strongly and densely punctate including frons, paraocular and genal areas; thorax also well punctate; metasoma strongly punctate, with punctures elongate and confluent in longitudinal rows on 4th and 5th terga. Maxillary palpi 5-segmented (*acuta*, ***chalcites,*** *laevifrons*, ***moricei,*** and others) or 6-segmented ***(chrysomalla, corinna,*** *dallatorreana,* ***gravidula, mandibularis,*** and others) ; antenna1 fossae shallow, punctate; frons not specially convex (without a pair of impunctate swellings which are characteristic to the American ***Zadontomerus)*** ; vertex more or less acute posteriorly, rarely with weak preoccipital carina ; basal area of propodeum transverse, usually slanting and coarsely sculptured, with a short transverse carina (sometimes weak) at each side behind; graduli of female on 1st to 4th terga and sterna respectively, but rarely gradulus on 4th sternum absent (*tibialis,* ***dentiventris)*** ; graduli of male on 1st to 4th terga and 1st to 5th sterna; 6th tergum of both sexes with a longitudinal keel in middle: 7th tergum of male (Fig. 19) strongly extending posteriorly into a robust, often triangular and reflecting projection (somewhat similar to *Neoceratina),* simple ***(callosa,*** and many others) or bidentate ***(cyanea,*** *laevifrons*) at apex; wax glands of female on 2nd and 3rd sterna; 2nd sternum of male sometimes with a tubercle (*chalcites*, ***dentiventris)*** or transverse carina ***(chrysomalla)*** or simply convex ***(dallatorreana)*** in middle ; 6th sternum of male (Fig. 20) with a strong concavity in middle of subapical portion ; gonostylus of male genitalia slender, hairy, sharply separated from gonocoxitc (Fig. 18) ; tibia1 process present in

both sexes; tibia1 scopa of female rather well developed.

Included species: I have seen the following species.

1. ***Ceratina acuta*** Friese, 1896, ♂♂ in United States National Museum (USNM).
2. ***Ceratina callosa*** (Fabricius, 1794), ♀♀♂♂ in Zoologische Sammlung des Bayerischen Staates, Miinchen (STAATSSLG), Museum National d'Histoire Naturelle, Paris (MP), USNM.
3. ***Cerutina chalcites*** Latreille, 1809, ♀♀♂♂ in MP and USNM.
4. ***Cerutina chrysomalla*** Gerstaecker, 1869, ♀♂ in USNM.
5. ***Ceratina corinna*** Nurse, 1904, ♀♂ in USNM.
6. ***Cerutina cyanea*** (Kirby, 1802), ♀♀♂♂ in MP and USNM.
7. ***Ceratina dallatorreana*** Friese, 1869, ♀♀♂♂ in MP and USNM.
8. ***Ceratina dentiventris*** Gerstaecker, 1869, ♀♀ in MP and USNM.
9. ***Ceratina gravidula*** Gerstaecker, 1869, ♀ in MP.
10. ***Ceratina Iaevifrons*** Morawitz, 1895, ♀♀♂♂ in MP, STAATSSLG and USNM.
11. ***Ceratina loewii*** Gerstaecker, 1869, ♀♂ in MP.
12. ***Ceratina mandibularis*** Friese, 1869, ♀♀♂♂ in MP and USNM.
13. ***Ceratina mocsaryi*** Friese, ♀ in MP.
14. ***Ceratina moricei*** Friese, 1899, ♀♀ in USNM.
15. ***Ceratina nigroaenea*** Gerstaecker, 1869, ♀ in MP.
16. ***Ceratina tibialis*** Morawitz, 1895, ♀♂ in Snow Entological Museum, University of Kansas.

Among them, ***Ceratina corinna*** Nurse is known from Quetta, W. Pakistan, which is the easternmost record of the subgenus. This species is very like ***Ceratina tibialis*** Morawitz, known from Turkestan, and is probably the same species.

Palaearctic species of the present subgenus were reviewed by Friese (1896). According to the original description, it is probable that ***Ceratina ahngeri*** Kokujev, 1905, from Transcaspica, is also included in ***Euceratina.***

Distribution : Europe, Northern Africa, Asia Minor, and S. W. Asia as far east as W. Pakistan, and California (introduced).

Note: In 1967 at the museums in U. S. A., I found several specimens of ***Ceratina*** bearing an unpublished name ***Oxyceratina.*** This was done by Dr. J. S. Moure of Brazil a few years prior to my visit. His ***Oxyceratina*** is identical with ***Euceratina*** Hirashima, Moure et Daly here described.

(9) Species of uncertain subgenus

1. ***Ceratina muscatella Nurse*** and C. ***loquata*** Nurse were described from

Simla, Northern India in 1902. I have seen a female specimen of *muscatella* and a male of *loquata,* which belong to the Nurse's collection, in the collection of the United States National Museum. It seems probable to me that they are the same species.

Ceratina muscatella is an interesting species relating to *Catoceratina* in having the frons, upper paraocular areas and vertex almost impunctate, vertex carinate posteriorly (although not strongly so as in *C. perforatrix*), paraocular areas with pale markings (pale markings of the male much smaller than those of the female), basal portions of mandibles of the male with yellow markings, and supraclypeal area without yellow markings. It deviates from *Catoceratina,* however, by the absence of yellow marking on the metasomal terga, different distribution of gradulus (1st to 5th terga and sterna respectively in the female, and 1st to 5th terga and 1st to 6th sterna in the male, like *Ceratina s. str.),* absence of yellow marking on the female labrum, and others. In the present state of knowledge of the genus, this species cannot be placed with certainty in any of the 8 subgenera described above.

2. In the collection of the Paris Museum, I have seen an unidentified male specimen of interesting *Ceratina* from "Pondichery", S. E. India (M. Maindron, 1902). It is a *Pithitis-like* species resembling very much to the African species *Ceratina lunata* Friese, *Ceratina moerenhouti* Vachal and others. It is so similar to them that I was impressed at first that this specimen came actually from Africa. Because I am not very familiar with Indian *Ceratina, I* think I had better to leave the question until more material is available from India. The *lunata-moerenhouti* group of Africa does not belong to any of the subgenera described in this paper (see below discussion).

(10) **Comments on the remaining subgenera of the world**

The 8 subgenera of *Ceratina* discussed in this paper are all of those now known from the Old World. In addition, I think at least three more subgenera should be elected for the African species, one is for the group of *Ceratina lunata* Friese, *Ceratina moerenhouti* Vachal and others, one is for the group of *Ceratina sulcata* Friese, *Ceratina ericia* Vachal and others, and the third for the group of *Ceratina lativentris* Friese, *Ceratina rothschildiana* Vachal and others. These will be discussed in a separate paper.

From the New World, 4 subgenera have ever been described. They are *Zadontomerus, Crewella, Calloceratina* and *Ceratinula.* Michener (1954) provides a key for them.

Zadontomerus Ashmead, 1899, is a subgenus of the small to rather large metallic blue or green species occuring mostly in the temperate zone ; maxillary palpi 6-segmented ; paraocular areas well punctate,

although punctures sparser than in ***Euceratina;*** frons with a pair of impunctate swellings ; preoccipital carina usually present; hind femora of male often dilated: as Yasumatsu and Hirashima (1969) pointed out, transverse graduli present on 2nd to 5th terga and 2nd and 3rd sterna in both sexes. ***Ceratina laticeps*** Friese from Central America is an anomalous species having a projection on the hypostomal area in the female like an African species ***Megaceratina*** *bouyssoui* ***(see*** Hirashima, 1971), a large covering of hairs on the underside of the thorax in the male, and the gradulus on the 5th tergum represented by a short transverse carina at each side in both sexes. It deviates from ***Zadontomerus*** also in other respects.

Crewella Cockerell, 1903, is a Neotropical subgenus of the rather large metallic species ; maxillary palpi B-segmented; head, as well as thorax and metasoma, very strongly punctate; preoccipital carina highly elevating; pronotum with a distinct tranverse carina extending downward at each side to the anterior coxae like ***Calloceratina;*** clypeus and paraocular areas usually with yellow or white markings in both sexes ; transverse graduli present on 2nd to 5th terga and sterna respectively in female, on 2nd to 6th terga and sterna respectively in male (gradulus on 6th tergum of male sometimes weak).

Calloceratina Cockerell, 1924, ***is*** also a Neotropical subgenus of the Crewella-like species; females lacking pale marking on the paraocular areas; usually more brilliantly metallic, but I have seen a dull colored species from Mexico; maxillary palpi variable, 5- or 6-segmented (I have seen some species having the 6-segmented maxillary palpi from Mexico and Costa Rica) ; hind tibia with an oblique carina (sometimes absent in males) on outer side basally (this is very characteristic to ***Calloceratina)*** ; 7th tergum of male with a projection in middle of apical portion except for ***laeta*** Spinola; graduli present on 1st to 5th terga and 1st to 3rd sterna in both sexes like ***Zadontomerus,*** but gradulus on 5th tergum often represented by a short transverse carina at each side ***(amabilis*** Ckll., ***itzarum*** Ckll., and others) or sometimes completely disappeared ***(aurata*** Friese, *laeta* Spinola). I am not sure that ***amabilis*** and ***aurata*** are the same species with ***eximia*** Smith (see Michener, 1954).

Ceratinula Moure, 1941, was proposed for the small black or metallic species occuring extensively in the Neotropical Region. I have seen ***zeteki*** Ckll., ***trimaculata*** Friese and several undetermined species from the Neotropical Region in addition to *arizonensis* and ***cockerelli*** from U. S. A. Distribution of the graduli is identical with ***Ceratina s. str.*** (namely, graduli present on the 1st to 5th terga and sterna respectively in female, and 1st to 5th terga and 1st to 6th sterna in male, although gradulus on 6th sternum of male ***Ceratinula*** sometimes very

weak) except for the *arizonensis* group only (see comments presented elsewhere in this paper) ; maxillary palpi either 5- or 6-segmented; head broadly impunctate like Japanese species of *Ceratina s. str.* Thus, characters of *Ceratinula* are shared with *Ceratina s. str.* except for the pale marking on the head only (in *Ceratinula*, paraocular areas often with pale marking even in the females). Michener (1965) treats *Ceratinula* as a synonym of *Ceratina s. str.* Probably he is correct.

In addition to these, I think two more subgenera should be elected for the South American species. These are strictly Neotropical elements having the wax glands of the female on the 2nd sternum only.

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