

## ON EUMENES ARCUATUS (FABRICIUS) AND SOME ALLIED INDO-AUSTRALIAN WASPS (HYMENOPTERA, VESPIDAE)

by

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In a study on the variation of *Polistes* and other Vespidae, K. Zimmermann (Zeitschr. Morph. Oek. Tiere, 22, 1931, pp. 173-230) concluded that the variation of the Indo-Australian *Eumenes arcuatus* (Fabricius) differs in a remarkable way from that of several European species of wasps.

The geographic variation of the palaeartic *Polistes*, *Odynerus* and *Eumenes* was found to be strongly influenced by external factors: black pigments increase in cold and humid environments, whereas the yellow pigments dominate in hot and dry areas. According to Zimmermann, there is considerable individual variation in this respect in the palaeartic region, and no constant geographic races have developed here. On the other hand, the Indo-Australian *Eumenes arcuatus* occurs in a number of clearly separated geographic races in which no influence of climatic factors on the distribution of the black and yellow pigments is recognizable.

Zimmermann distinguished twelve subspecies of *E. arcuatus*, all differing in colour characters; some of these are widely distributed, others inhabit only a restricted area. Some overlapping of the areas of distribution was said to occur: the Ceylonese *flavopicta* was recorded as "vereinzelte auf Sumatra und Java" (where this form certainly does not occur!); the Javanese *blanchardi* was recorded from Sumatra (incorrectly!) and the Saleyer Islands; in the latter locality it was therefore supposed to fly together with the black *saleyerensis*, described by Zimmermann from these same islands. New Britain was said to harbour both typical *arcuatus* and the subsp. *prasinus*.

Zimmermann published a series of diagrams showing the different colour patterns of the various subspecies, and was the first author to distinguish the form inhabiting continental South East Asia and Sumatra (subsp. *continentalis* Zimm.) from the similarly coloured nominate race *arcuatus* from New Guinea and Northern Australia. Whereas several other colour forms are easily distinguished, the patterns of these two are so much alike that they had always been confused by previous authors. Zimmermann noted that the lateral spots on the second gastral sternite are large in *arcuatus*, small or absent in *continentalis*.

For some time I have considered Zimmerman's conception of this group of wasps as a single polytypic species to be a satisfactory working basis, even though evidently the supposed sympatric occurrence of some of the subspecies seems to point to the existence of more than one species. Some of the records involved, however, are undoubtedly due to incorrect labelling, a common phenomenon in old collections, and more reliable data were therefore urgently required.

As gradually more and more material of *E. arcuatus* and allied wasps from the Indo-Australian area could be examined, it became apparent that the problems of the relationships and the taxonomy of these insects are much more complicated than Zimmermann and some other authors had thought them to be. The "*Eumenes arcuatus*" of these workers was found to comprise a number of closely allied species, differing not only in colour, but also in several hitherto overlooked structural characters. Some of these species are polytypic and widely distributed, others are restricted to certain islands or island groups where they are very uniformly coloured.

The present paper is a revision of these forms; it proved desirable to include in this study the previously described species *E. curvatus* Saussure and *E. incola* Giordani Soika, together with some new species and subspecies.

A considerable number of museums have contributed material to this study; they are listed below, together with the abbreviations used in the text.

BM = British Museum (Natural History), London.

CAS = California Academy of Sciences, San Francisco.

CSIRO = Commonwealth Scientific and Industrial Research Organisation,  
Division of Entomology, Canberra, A. C. T., Australia.

ETHZ = Entomologisches Institut der Eidgenössischen Technischen Hochschule, Zürich.

IRSNB = Institut Royal des Sciences Naturelles, Brussels.

MA = Zoologisch Museum, Amsterdam.

MCG = Museo Civico di Storia Naturale, Genova.

MCZ = Museum of Comparative Zoölogy, Harvard University, Cambridge,  
Mass.

MHNG = Musée d'Histoire Naturelle, Genève.

ML = Rijksmuseum van Natuurlijke Historie, Leiden.

MT = Museo di Zoologia della Università, Turin.

MZB = Museum Zoologicum, Bogor, Indonesia.

NMB = Naturhistorisches Museum, Basel.

NRS = Naturhistoriska Riksmuseum, Stockholm.

OUM = Oxford University Museum, Oxford.

USNM = United States National Museum, Washington, D.C.

ZMB = Zoologisches Museum der Humboldt Universität, Berlin.

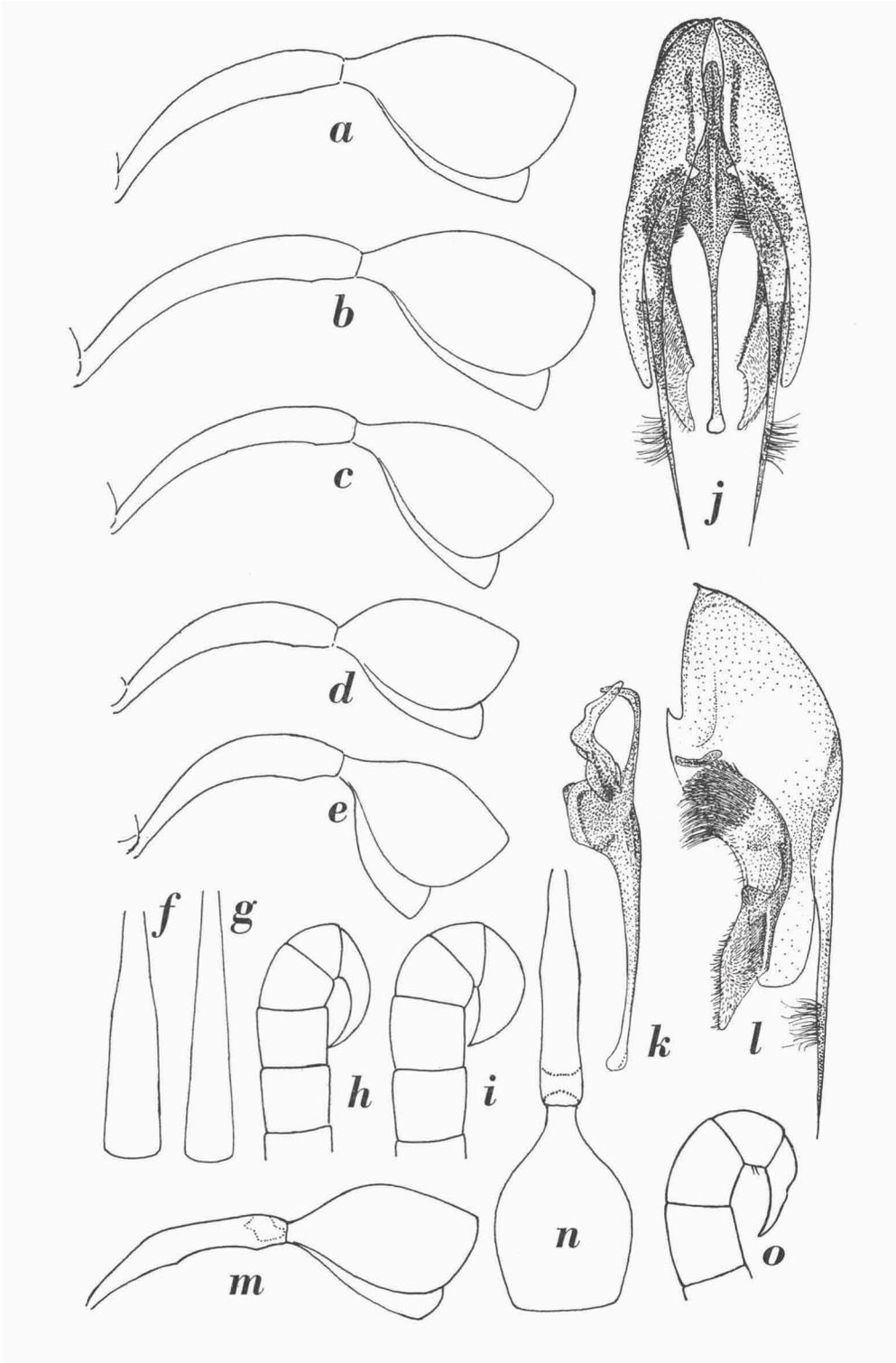
I am very much indebted to the authorities and the hymenopterists of these museums for their valuable assistance and cooperation. Furthermore I wish to thank Dr. Henry K. Townes, Ann Arbor, and Dr. A. Giordani Soika, Venice, who kindly allowed me to study specimens from their private collections.

The present paper deals with the taxonomy and distribution of 51 species and subspecies of *Eumenes*. The numbers under which these forms are described are the same as those used in fig. 4 and in the two accompanying maps, figs. 6 and 7. A discussion of the problem of the evolution of this complex in the Indo-Australian area will be published elsewhere.

Some valuable characters for the determination of the species are found in the shape of the anterior margin of the clypeus in the females (fig. 4), in the shape of the gastral petiole (fig. 1), and in the structure of the male genitalia, particularly the volsella (figs. 1-3). The degree of the density and the coarseness of the puncturation of head and thorax (including the propodeum) provides good characters in several species, the variation ranging from the sparsely and superficially punctate *E. curvatus* to such species as *E. zimmermanni* and *E. zamenes* which are more coarsely and densely punctate than most other species. The shape of the last antennal segment of the males is rather uniform throughout the group, but shows interesting deviations in *E. squalidus* and *E. incola*. The transition between the dorsal and lateral areas of the propodeum is angular in *E. flavopictus*, more or less rounded in several other species.

Mainly on the basis of the structure of the volsella of the male genitalia, the forms described below have been arranged as follows :

- A. Digitus of volsella long and thin, base of volsella with sparse pubescence (figs. 2a-2d) (see map fig. 6).
- (1) Petiole of volsella thin (figs. 2b-2d). Thorax oval; gastral petiole not conspicuously narrowed behind the middle. Black species with dark wings. Nrs. 1-9, group of *E. curvatus*.
  - (2) Petiole of volsella thick (fig. 4a). Thorax globular; gastral petiole narrowed behind the middle. Black and yellow, or almost entirely black. Nrs. 12-17, *E. incola*.
- B. Digitus of volsella wider, the base as a rule densely pubescent (figs. 2e-2i, fig. 3) (see map fig. 7).
- (1) Pubescence of base of volsella long and dense (figs. 3a-3f); the digitus dorsally with distinct blunt angle. Anterior margin of clypeus



of ♀ shallowly emarginate (fig. 4, nrs. 18-34). Colour pattern variable (see fig. 7). Nrs. 18-33, *E. flavopictus*, and no. 34, *E. eremnus*.

- (2) Pubescence of base of volsella short and dense (figs. 3g, 3h); the digitus dorsally (on left hand side of figure) with blunt angle. Anterior margin of clypeus of ♀ more deeply emarginate (fig. 4, nrs. 35-41). Wings usually with strong yellow tinge.

Nrs. 35-41, *E. arcuatus*.

- (3) Pubescence of base of volsella variable (figs. 2f-2i); the digitus dorsally at most with very blunt angle. Anterior margin of clypeus of female rather deeply emarginate (fig. 4, nrs. 41-46). Body black with few yellow markings; wings with yellow tinge.

Nrs. 42-47, group of *E. fulvipennis*.

- (4) Base of volsella with few hairs on the lamina, but with dense marginal fringe (fig. 2e). Anterior margin of clypeus of ♀ shallowly emarginate (fig. 4, no. 48). Nrs. 48 and 49, *E. solomonis*.

The nrs. 10, 11, 50, and 51, could not be incorporated in this arrangement, because the males of these species are not yet known.

The following key is based on structural differences as well as on colour characters; it does not represent relationships and is meant merely as a tool for the determination of the females, which are as a rule much more numerous in collections than the males. Males which cannot be associated with females should be identified by examination of the genitalia; furthermore consultation of the key to the females, and of the figures 5-7 will be useful for this purpose.

Fig. 1. a Lateral view of first and second gastral segments of *Eumenes viridipennis* n. spec. (♀, holotype, Durian I., Riouw Is.) — b. do. of *E. curvatus curvatus* Saussure (♀, Luzon, Philippine Is.) — c. do. of *E. sciarus* n. spec. (♀, Sumba) — d. and e. do. of *E. squalidus* n. spec. (♀ ♂ resp., Mindanao) — f. dorsal view of gastral petiole of *E. viridipennis* n. spec. (♀, Durian I., Riouw Archipelago) — g. do. of *E. sciarus* n. spec. (♀, Sumba) — h. antennal segments 9-13 of *E. fulvipennis fulvipennis* Smith (♂, Celebes) — i. do. of *E. rumphii* n. spec. (holotype, ♂, Amboina) — j. dorsal view of male genitalia of *E. flavopictus kalimantenus* n. subsp. (Borneo) — k. *E. flavopictus timorensis* n. subsp. (♂, Timor), lateral view of aedeagus — l. do., inner side of right paramere with volsella — m. *E. incola zonites* n. subsp. (♀, Hollandia, New Guinea), lateral view of first and second gastral segments — n. do., dorsal view — o. do. (♂, same locality), antennal segments 10-13.

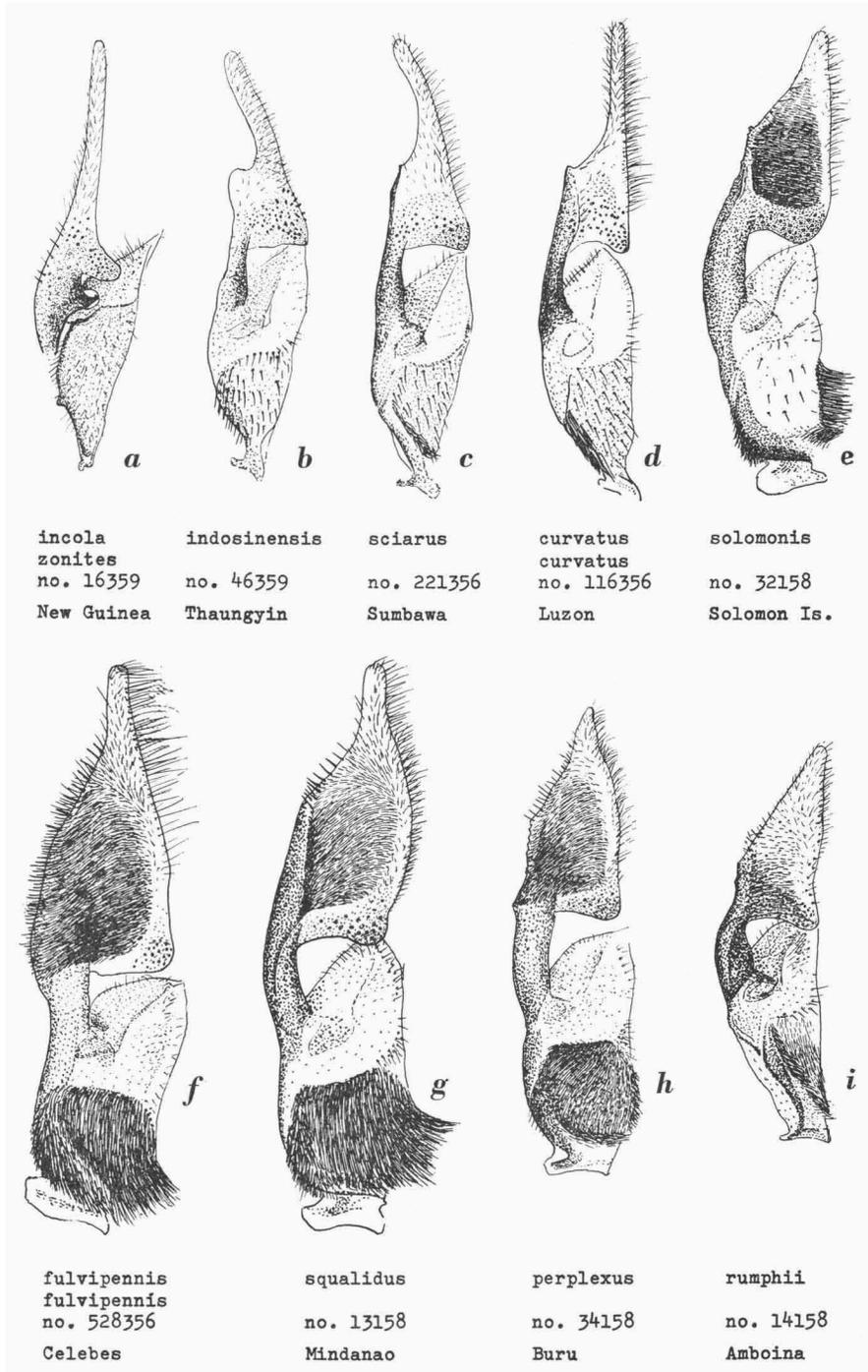


Fig. 2. Volsellae of various species of *Eumenes* (posterior end at top of figures).

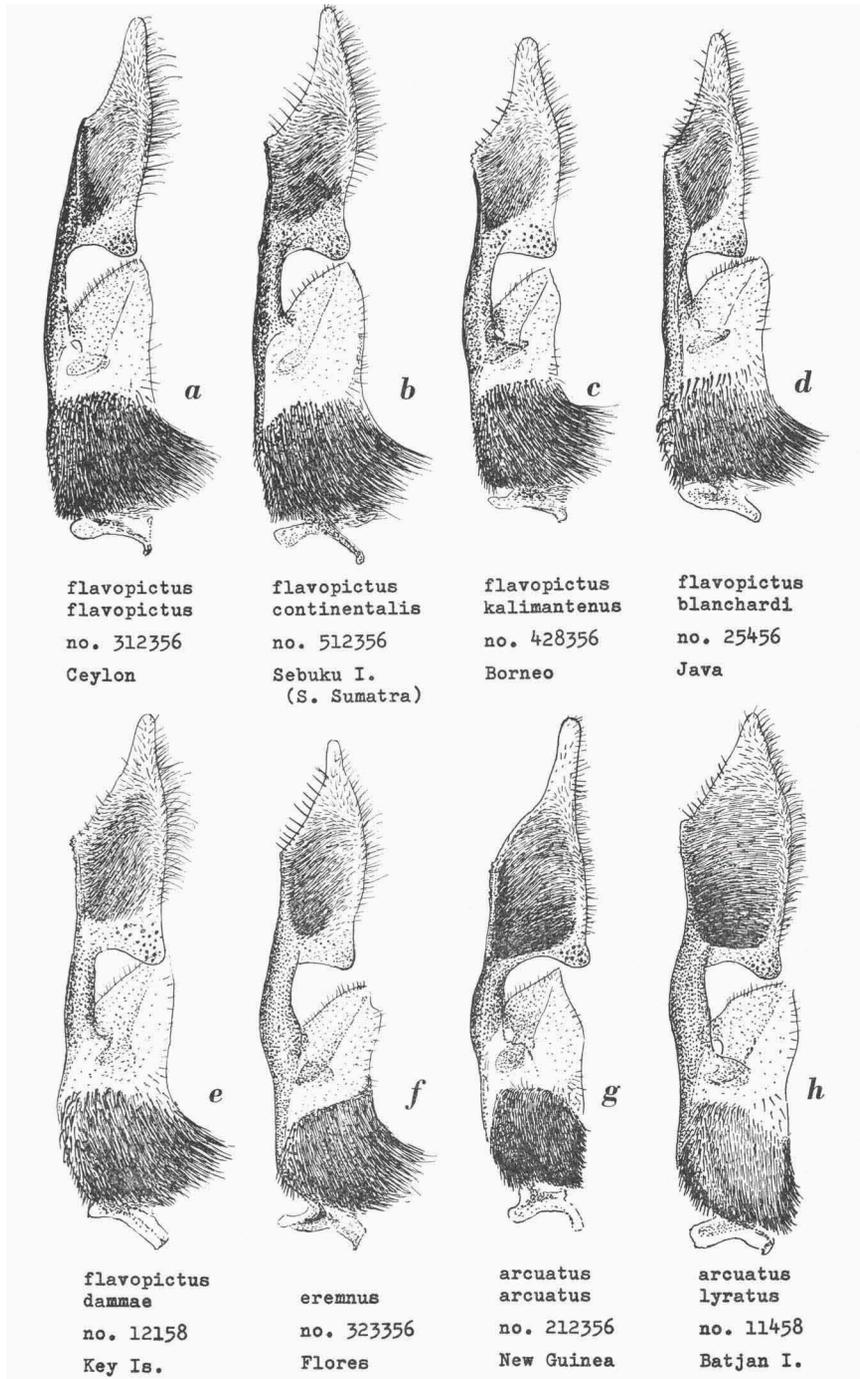


Fig. 3. Volsellae of five subspecies of *E. flavopictus*, of *E. eremnus*, and of two subspecies of *E. arcuatus*.

## Artificial key to the females (species and subspecies).

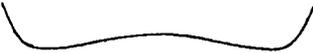
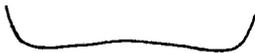
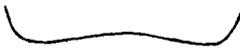
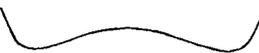
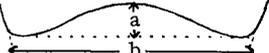
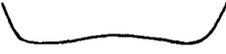
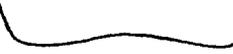
1. Thorax short, almost globular, only slightly longer than it is wide in front of the tegulae (6 : 5); humeral angles of pronotum distinctly tuberculate; propodeum rounded, the lateral areas punctate and nowhere distinctly separated from the dorsal (posterior) area; gastral petiole, as seen in profile, conspicuously swollen near the middle, in dorsal view distinctly constricted behind the spiracles (figs. 1m and 1n), the posterior part with shallow, median, longitudinal groove; second gastral segment strongly constricted at the base. Wings with pronounced golden or coppery shine. Length (h. + th. + t. 1 + 2): 16-20 mm. — Northern Australia; New Guinea and neighbouring islands. (*E. incola* Giord. Ska., see fig. 6). 2
- Thorax relatively longer (length : width in front of the tegulae = 4 : 3); humeral angles of pronotum weakly indicated; lateral areas of propodeum usually more or less distinctly separated from the dorsal area; gastral petiole more gradually widening from base to apex; second gastral segment less strongly constricted anteriorly. Wings less shiny. Generally larger species. 7
2. Thorax entirely black. (Gaster black, except for a narrow yellow band at the apex of the petiole; legs black). 3
- Thorax with several yellow markings. 4
3. Head black, with at most a small inter-antennal spot and small spots at the inner orbits pale yellow. — Northern New Guinea. 14. *incola zonites* n. subsp.
- Head with two rather large, subcircular, pre-ocellar spots (separated by a narrow black line) and with an almost equally large inter-antennal spot, which has the shape of a triangle with the top pointing downwards; furthermore there are small yellow marks at inner and outer orbits. — Misool I. 13. *incola octomaculatus* n. subsp.
4. Gaster black, except for a yellow band at the apex of the petiole. Legs black, outer side of femora and tibiae of the fore legs yellow. — Vogelkop, Western New Guinea. 12. *incola mauritsi* n. subsp.
- At least the gastral tergites 2-4 with yellow apical bands. Also the mid and hind tibiae yellow on the outer side. 5
5. Gastral petiole with two elongate yellow spots near the middle; the second gastral tergite with two large yellow spots near the base. 6
- First and second gastral tergites with yellow apical band only. — Eastern New Guinea. 15. *incola incola* Giordani Soika
6. Gastral tergites 2-5 of female with yellow band. Labrum (♀) yellow. — Kei and Aru Is. 16. *incola aruensis* Giordani Soika

- Gastral tergites 2-4 of female with yellow apical band. Labrum (♀) black. Spots on second gastral tergite slightly smaller; wings somewhat darker. — Queensland. *17. incola teleporus* n. subsp.
7. Thorax almost entirely black, at most with a short transverse line on pronotum and small markings at apex of propodeum. 8
- Thorax with several yellow, orange-yellow or red markings. 31
8. Second and following gastral segments black. 9
- Second and following gastral segments marked with yellow or ochreous. 27
9. Wings yellowish, sometimes fuscous at base. 10
- Wings fusco-hyaline to dark brown, often with bronzy or violet effulgence. 16
10. Basal fourth of fore wing and nearly the basal half of the hind wing fuscous. Mesoscutum dull, very densely punctate. Gastral petiole entirely black. Large form; length (h. + th. + t. 1 + 2): 28 mm. — Celebes. *11. zamenes* n. spec.
- Wings either less extensively infuscated at base, or entirely yellowish. Mesoscutum less densely punctate, at least anteriorly and in the middle with some flat interspaces. Length (h. + th. + t. 1 + 2): 20-22 mm. 11
11. Gastral petiole with two or three pairs of yellow spots, or with only the basal spots. 12
- Gastral petiole entirely black, or with only the median pair of spots (in the male also with faint basal spots). 14
12. Gastral petiole with two yellow spots at base (and with or without spots in the middle and at apex). 13
- Gastral petiole with two yellow spots in the middle and two at apex. — Buru. *46. perplexus* Smith
13. Gastral petiole at least with yellow spots at base and in the middle, the apical spots often small or absent. — Celebes. *42. fulvipennis fulvipennis* Smith
- Gastral petiole with the second pair of spots faintly indicated or absent. — Saleyer or Salajar Is. (subspecific value doubtful). *43. fulvipennis saleyerensis* Zimmermann
14. Pronotum and upper part of mesopleura densely, somewhat rugosely punctate; the interspaces generally smaller than the punctures. Gastral petiole black, or with a pair of spots in the middle. (Locality uncertain). *44. fulvipennis niasanus* Zimmermann
- Pronotum and upper part of mesopleura less densely punctate; if locally the punctures are arranged in rows, there are always distinct interspaces between these rows. Gastral petiole black. 15

15. Pronotum sparsely punctate; all interspaces at least as large as the punctures. Wings not infuscated at base. Gastral petiole slender. Antennal hook of male abnormally swollen (fig. 1i). — Amboina.  
47. *rumphii* n. spec.
- Pronotum with some punctures arranged in short and irregular rows. Extreme base of wings infuscated. Gastral petiole slightly thicker and more strongly curved than in all other forms (figs. 1d, 1e). Antennal hook of male normal. — Mindanao. 45. *squalidus* n. spec.
16. Wings fusco-hyaline, of the same colour as in *E. flavopictus blanchardi* from Java, or slightly darker. 17  
— Wings brown to dark brown, with distinct bronzy or violaceous reflections. 20
17. Thorax more coarsely punctate than in *E. flavopictus*; scutellum slightly more convex. A black form with vestigial yellow markings on pronotum and apex of propodeum; in the type the gastral petiole has two small subcircular yellow spots at the apex. — Malaita, Solomon Is.  
49. *solomonis malaitensis* n. subsp.
- Thorax less coarsely punctate; scutellum normal. Gastral petiole black. 18
18. The pale yellow lines at the inner orbits reach the middle of the eye-emarginations. Sides of propodeum with only a few indistinct and super-

Fig. 4. Anterior margin of the clypeus of 36 species and subspecies of *Eumenes*. The numbers correspond with those under which the forms are discussed in the text and under which they are figured on the maps, figs. 6 and 7. The method of measuring the depth of the emargination is shown under no. 37: depth (a) : width (b) = 1 : 7.

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|---|--|
| 2. <i>viridipennis</i> — Durian I.          | 28. <i>flavopictus kalimantenus</i> — Borneo |
| 3. <i>violaceipennis</i> — Java             | 29. — <i>aidrytus</i> — Palawan              |
| 4. <i>sciarus</i> — Rua, Sumba              | 30. — <i>blanchardi</i> — Java               |
| 5. <i>wicneckei</i> — Timor                 | 32. — <i>timorensis</i> — Timor              |
| 7. <i>curvatus curvatus</i> — Luzon         | 33. — <i>dammae</i> — Kei Is.                |
| 8. — <i>talaudensis</i> — Talaud Is.        | 34. <i>eremmus</i> — Sumba                   |
| 9. — <i>sangirensis</i> — Sangir Is.        | 35. <i>arcuatus arcuatus</i> — New Guinea    |
| 10. <i>zimmermanni</i> — Palawan            | 36. — <i>transilis</i> — Misool              |
| 11. <i>zamenes</i> — Celebes                | 37. — <i>amboincensis</i> — Saparua          |
| 18. <i>flavopictus flavopictus</i> — Ceylon | 38. — <i>buruanus</i> — Buru                 |
| 19. — <i>continentalis</i> — Sumatra        | 40. — <i>obiensis</i> — Obi                  |
| 20. — <i>formosanus</i> — Formosa           | 41. — <i>prasinus</i> — New Britain          |
| 21. — <i>andamanicus</i> — Andaman Is.      | 42. <i>fulvipennis fulvipennis</i> — Celebes |
| 22. — <i>nicobaricus</i> — Nicobar Is.      | 45. <i>squalidus</i> — Mindanao              |
| 23. — <i>simalurensis</i> — Simalur         | 46. <i>perplexus</i> — Buru                  |
| 25. — <i>telonus</i> — P. Telo              | 48. <i>solomonis</i> — Guadalcanal           |
| 26. — <i>maidli</i> — Siberut               | 50. <i>pagdeni</i> — Nggela                  |
| 27. — <i>engganensis</i> — Enggano I.       | 51. <i>transmarinus</i> — Freycinet I.       |

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	19		40
	20		41
	21		42
	22		45
	23		46
	25		48
	26		50
	27		51

ficial punctures in upper part. Wings with yellowish reflections. Length (h. + th. + t. 1 + 2): 25 mm. — Philippine Islands.

29. *flavopictus aidrytus* n. subsp.

— Here belongs also a form from the Bawean Islands, the female of which is still unknown.

31. *flavopictus baweanus*, n. subsp.

— The pale yellow lines at the inner orbits end near the middle of the lower side of the eye-emarginations. 19

19. Gastral petiole slender, gradually widening from base to apex, the sides straight. — Timor. 5. *wieneckeii* n. spec.

— Gastral petiole with the sides more strongly diverging in the basal than in the apical part, the spiracles slightly, though bluntly, projecting. — Tenasserim; Indo-China. 1. *indosinensis* n. spec.

20. Mesoscutum dull, densely punctate, the punctures large, but not very deep, each with a small tubercle in the centre of the flat bottom, the interspaces generally smaller than the punctures. 21

— Mesoscutum shiny, the punctures smaller than the interspaces (in specimens from the Sangir Islands nearly as large). 25

21. Pronotum, mesoscutum and mesopleura dull and very densely punctate; on pronotum and mesopleura the narrow interspaces show a tendency to run together into transverse ridges; the mesoscutum is almost reticulately rugose, with only a few flat interspaces in the middle of the posterior half. Median part of clypeus with distinct and rather large punctures, which are scattered in the centre, but closer and also slightly coarser anteriorly, where they leave only a very narrow margin impunctate. (Posterior face of propodeum densely and coarsely rugosely punctate, rather sharply separated from the shiny sides which bear some scattered punctures. Anterior margin of clypeus distinctly emarginate. Wings brown with bronzy effulgence). — Palawan.

10. *zimmermanni* Giordani Soika

— Mesoscutum less densely punctate, its anterior half with several flat interspaces. Median part of clypeus almost impunctate. 22

22. Anterior margin of clypeus wide, very slightly emarginate (fig. 4, no. 2). Wings slightly darker than in *zimmermanni*, with bronzy and greenish effulgence. Posterior half of petiole wide, its sides almost parallel (fig. 1f). — Durian Island, Riouw Archipelago. 2. *viridipennis* n. spec.

— Anterior margin of clypeus narrower, often more distinctly emarginate. Abdominal petiole very gradually widening from base to apex. 23

23. Wings dark brown with violet effulgence. Emargination of clypeus as in *eremnus* (fig. 4, no. 3). — Java; Bali; very rare.

3. *violaceipennis* n. spec.

- Wings slightly less dark, with bronzy and greenish or purplish effulgence. — Lesser Sunda Islands. 24
24. Anterior margin of clypeus very shallowly emarginate (fig. 4, no. 4). Sides of propodeum with at least 15-20 distinct punctures near the junction with the posterior face. Wings broader than in the following species. 4. *sciarus* n. spec.
- Anterior margin of clypeus slightly more deeply emarginate (fig. 4, no. 34), the lateral angles slightly depressed, shining. Sides of propodeum almost impunctate. 34. *eremnus* n. spec.
25. Effulgence of wings dark purple and bronzy. 26
- Effulgence of wings purple with a pronounced bluish tinge. Thorax sparsely and superficially punctate. — Talaud Is. 8. *curvatus talaudensis* n. subsp.
26. Mesoscutum with well defined punctures; except in the centre the interspaces not distinctly larger than the punctures; the space between the tegulae and the parapsidal sutures distinctly punctate. — Sangir Is. 9. *curvatus sangirensis* n. subsp.
- Mesoscutum more sparsely punctate, the punctures less distinctly defined; the interspaces generally larger than the punctures; the space between the tegulae and the parapsidal sutures impunctate. — Philippine Is. 7. *curvatus curvatus* Saussure
27. Second gastral tergite almost entirely yellow. 28
- Second gastral tergite with two well separated yellow or ochreous bands. 29
28. Gastral petiole with two middle and two apical spots (basal spots sometimes present). Wings pale brownish. — Andaman Islands. 21. *flavopictus andamanicus* Zimmermann
- Gastral petiole with apical spots only. Wings dark brown. — Mentawai Is. (Siberut and Sipora). 26. *flavopictus maidli* Giordani Soika
29. Gastral markings ochreous. Emargination of clypeus rather deep (fig. 4, no. 38). — Buru. 38. *arcuatus buruanus* n. subsp.
- Gastral markings bright yellow. Emargination of clypeus less deep (fig. 4, nrs. 25, 30). 30
30. Gastral petiole with three pairs of yellow spots, the basal pair sometimes indistinct or absent. — Java and certain neighbouring small islands; Lesser Sunda Islands to Flores. 30. *flavopictus blanchardi* Saussure
- Gastral petiole black or with small apical spots only. — Batu Is. (West of Sumatra). 25. *flavopictus telonus* n. subsp.
31. Gaster black. — Simalur Island (West of Sumatra). 23. *flavopictus simalurensis* Giordani Soika

- Gaster with yellow or reddish markings. 32
32. Markings of mesoscutum lyre-shaped, consisting of two complete hooks. 33
- Mesoscutum with two pairs of spots (in species from the Solomon Is. with one pair of spots or entirely black). 37
33. Markings of thorax yellow. 34
- All markings orange-brown to dull red. 36
34. Anterior margin of clypeus shallowly emarginate (fig. 4, no. 18). Body very extensively marked with yellow (see fig. 7). — India; Ceylon. (Compare also *E. flavopictus continentalis* Zimm.).
18. *flavopictus flavopictus* Blanchard
- Anterior margin of clypeus more deeply emarginate (fig. 4, nrs. 36, 37). Yellow markings less extensive; pronotal band narrower, tegulae with black spot, scutellum with separate spots. 35
35. Band at base of second gastral tergite normal. Wings with pronounced yellowish tinge. — South Moluccas. 37. *arcuatus amboinensis* n. subsp.
- Band at base of second gastral tergite strongly reduced or absent. Wings brownish hyaline with faint yellowish tinge. — Misool.
36. *arcuatus transilis* n. subsp.
36. Markings rather dark red. Apical band of second gastral sternite complete or narrowly interrupted. Propodeum usually with black median line, rarely with distinct cross. — North Moluccas, except Obi I.
39. *arcuatus lyratus* n. subsp.
- Markings orange-red. Apex of second gastral sternite with lateral spots which are much smaller than the black space between them. Propodeum with the usual black cross. — Obi Island. 40. *arcuatus obiensis* n. subsp.
37. Markings orange-red. — Bismarck Archipelago.
41. *arcuatus prasilimius* Guérin
- Markings of head and thorax yellow. 38
38. Mesoscutum with two pairs of yellow spots. Scutellum usually marked with yellow. 39
- Mesoscutum black, or with only the anterior pair of yellow spots. Scutellum black. 49
39. Bands on gastral tergite 2 distinctly separated laterally. 40
- Bands on gastral tergite 2 anastomosing laterally (and gastral petiole very extensively marked with yellow), or this tergite almost entirely yellow. 46
40. Clypeus shallowly emarginate anteriorly (fig. 4, nrs. 20-32). Posterior angles of pronotum black (except in some specimens from Timor). 41
- Clypeus more deeply emarginate (fig. 4, nrs. 35-37). Posterior angles

- of pronotum marked with yellow. (Wings with pronounced yellowish tinge. Yellow mark between antennae much dilated above).
41. Wings dark brown. Gastral petiole black, or with small yellow spots at apex. Hind tibiae black. — Nias. 24. *flavopictus umbripennis* n. subsp.  
— Wings subhyaline. Gastral petiole marked with yellow. 42
42. Bands of second gastral tergite very narrow, the distance between the two bands more than three times the width of one band (see fig. 7). — Borneo. 28. *flavopictus kalimantenus* n. subsp.  
— Bands distinctly wider. 43
43. Hind tibiae with yellow line. (Clypeus entirely yellow). — Eastern India to Sumatra. 19. *flavopictus continentalis* Zimmermann  
— Hind tibiae black or with small yellow spot (rarely with yellow line in ♂). 44
44. Second gastral sternite near the middle with large lateral spots (the spots as long as their distance from the spots at the apical margin). Yellow margin of tegulae narrow, or reduced to one or two spots. Spots on scutellum small or absent; band on postscutellum reduced. Yellow markings of gaster relatively extensive. Lateral margins of clypeus very narrowly black. — Enggano Island. 27. *flavopictus engganensis* n. subsp.  
— Second gastral sternite with small spots near the middle, or with only the apical spots. 45
45. Lateral margins of clypeus very narrowly black. Yellow markings almost as in *continentalis*; posterior angles of pronotum sometimes with small yellow spot. — Timor. 32. *flavopictus timorensis* n. subsp.  
— Generally darker; black margins at sides of clypeus wider; scutellar spots and basal pair of petiolar spots smaller, etc. — Formosa. 20. *flavopictus formosanus* Zimmermann
46. Second gastral tergite almost entirely yellow. Wings brown; gastral petiole with three pairs of yellow spots, the last pair coalescent. — Nicobar Is. 22. *flavopictus nicobaricus* Meade-Waldo  
— Second gastral tergite with two broad bands, anastomosing laterally. Gastral petiole more extensively marked with yellow than in any other known form (see fig. 7). — Damma I.; Kei Is. 33. *flavopictus dammae* Dalla Torre
47. Anterior band of second gastral tergite strongly reduced or absent. — Misool. see 36. *arcuatus transilis* n. subsp.  
— Anterior band of second gastral tergite normal. 48
48. Wing veins ferruginous. Markings of legs and abdomen orange-yellow; apical margins of tergites 3-5 (behind the bands) brown. — Amboina. 37. *arcuatus amboinensis* n. subsp.

- Wing veins mostly dark brown. Markings of legs and abdomen yellow; extreme apical margins of tergites 3-5 black. — New Guinea; Northern Australia. 35. *arcuatus arcuatus* (Fabricius)
49. Mesoscutum black. (Thorax densely punctate. Femora and tibiae black. Wings moderately infuscated. Propodeum with two nearly triangular marks on posterior half). — Solomon Is. 48. *solomonis* n. spec.
- Mesoscutum with one pair of yellow spots. 50
50. Thorax rather sparsely punctate; several interspaces on mesoscutum and mesopleura much larger than the punctures. Postscutellum black; propodeum with narrow yellow line at lateral margins of posterior face. Femora and tibiae ferruginous brown. Wings subhyaline. — Solomon Is. 50. *pagdeni* n. spec.
- Thorax densely punctate, only a few interspaces in the centre of the mesoscutum being larger than the punctures. Postscutellum with yellow band; posterior face of propodeum yellow, except for the usual median black band (black cross-band faintly indicated). Femora black, fore femora yellow beneath; tibiae black with yellow line on outer side, on hind tibiae this line reduced to spot on apical third. — De Freycinet I., N. Australia. 51. *transmarinus* n. spec.

#### Group of *E. curvatus* Saussure (nrs. 1-9)

The following six species<sup>1)</sup> appear to be very closely related; they agree in having the body almost entirely black, with pale brown to dark brown wings, but there are slight differences in structural characters which have induced me to regard the various forms as different species. These species, however, are all allopatric, and the whole group may therefore be considered to represent a typical example of a superspecies.

The most characteristic feature of the members of this group is the shape of the volsellar digitus of the male (see fig. 2). This character could not be examined in all the species which I have placed in this group, the males of *E. viridipennis* and *E. wienecke* being still unknown. However, the females of these are so similar to the other species of which both sexes are available, that I have little doubt that they are correctly placed here.

It is possible that *E. zimmermanni* from Palawan and *E. zamenes* from Celebes will prove to belong to this same group, but in the case of these more aberrant forms I do not dare to take a decision before I have had an opportunity to study the male genitalia.

1) Seven species if the doubtful *E. inflexus* Saussure is included.

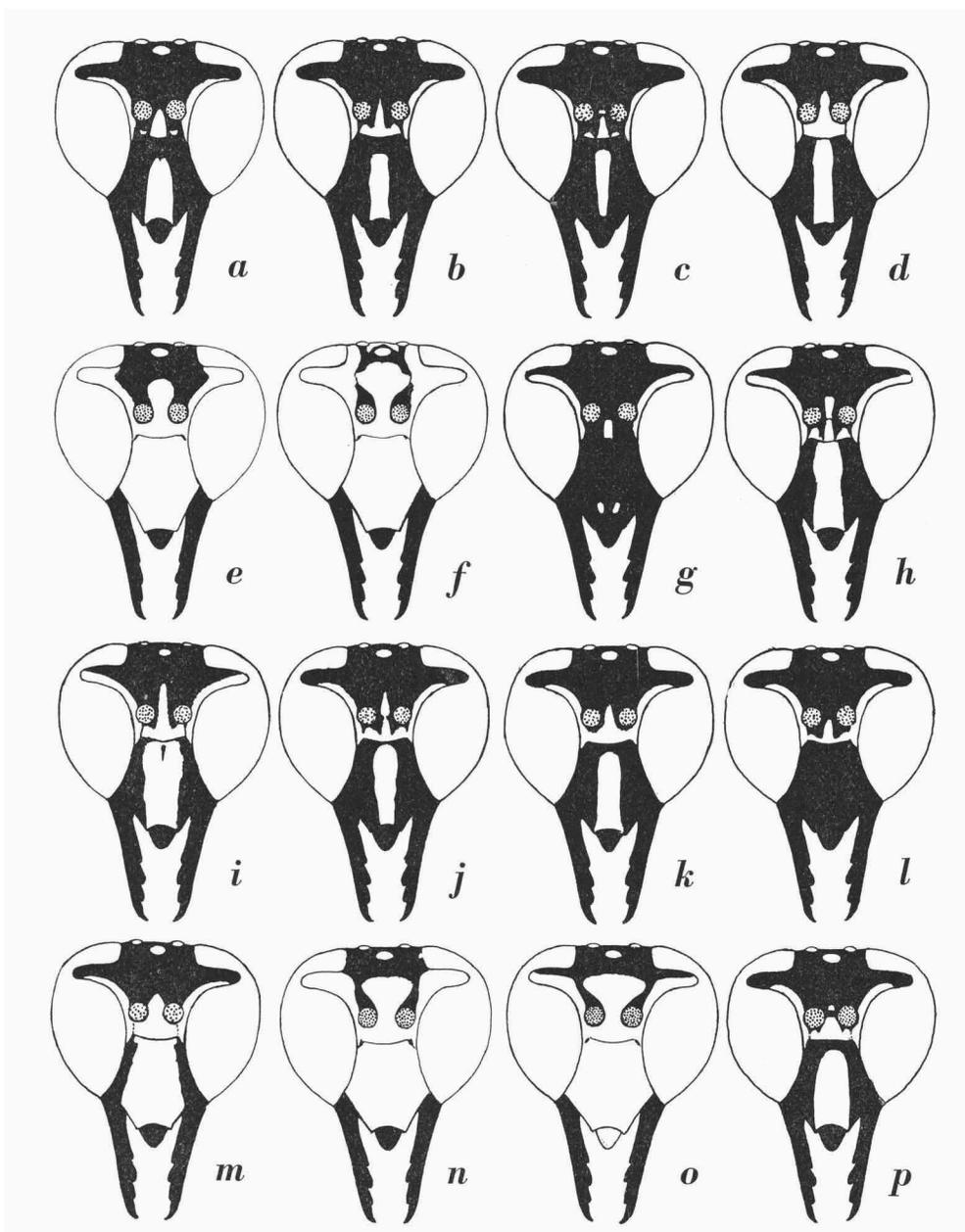


Fig. 5. Diagrams of the colour pattern of the male head of *Eumenes*:  
 a. *indosinensis* (holotype, Thaungyin) — b. *sciarus* (Sumba) — c. *curvatus* (Luzon) — d. *curvatus sangirensis* (Sangir Is.) — e. *flavopictus continentalis* (North Sumatra) — f. *flavopictus simalurensis* (Simalur I.) — g. *flavopictus blanchardi* (Java, unusually dark specimen) — h. *flavopictus blanchardi* (Sumba, unusually bright specimen) — i. *flavopictus baweanus* (holotype, Bawean I.) — j. *eremnus* (Flores) — k. *fulvipennis* (Celebes) — l. *squalidus* (Mindanao) — m. *rumphii* (holotype, Amboina) — n. *arcuatus arcuatus* (Hollandia, New Guinea) — o. *arcuatus lyratus* (Batjan, North Moluccas) — p. *solomonis* (Tulagi, Solomon Is.).

1. ***Eumenes indosinensis***, new species

♀ — Structurally very similar to *E. flavopictus*, but slightly more slender.

Anterior margin of clypeus moderately emarginate (1 : 12), its width about equal to half the interocular distance at the base of the clypeus; lateral angles slightly depressed. Clypeus sparsely punctate, the punctures not well defined. Interocular distance on the vertex equal to that at the base of the clypeus.

Gastral petiole slender, rather gradually widening from the base to the slightly projecting spiracles; the sides of the post-spiracular part hardly diverging, the relative widths at base, behind the spiracles, and at apex being 11 : 19 : 24; the greatest width smaller than the interocular distance on the vertex (24 : 27). Wings only slightly longer than head + thorax + gastral petiole (17.5 mm and 16 mm, respectively).

Pronotum densely punctate, the interspaces with a pronounced tendency to form transverse striae (most distinct in frontal view).

Black; a very short line at the inner orbits (from clypeus to middle of lower side of eye-emargination), and an inconspicuous, short and narrow line at outer orbits, pale yellowish. Legs black, the fore tibiae not reddish. Wings moderately infuscate, intermediate between *E. flavopictus blanchardi* and *E. curvatus*, with distinct violaceous tinge.

♂ — Agrees in most respects with the female. Apical antennal segment pale brownish yellow on outer side. Face more extensively marked with pale yellow (fig. 5a), the clypeal mark slightly wider than in *E. violaceipennis* and *E. sciarus*. Tarsi partly yellowish brown; fore tibiae brownish. Wings slightly paler than in the female, with yellowish shine, iridescent at outer margin, but not distinctly violaceous.

The genitalia (fig. 2b) show that this species belongs to the *curvatus* group, but the shape of the volsella is sufficiently characteristic to regard it as a good species; the basal part of the volsellar digitus bears a number of short, blackish, blunt spinulae, which I have not seen in other species.

Length (h. + th. + t. 1 + 2): ♀ 20-22 mm, ♂ 19-20 mm.

Holotype: ♂, "Thaungyin, 3-93, *Eumenes curvata*", in the Rothney collection, in a box containing specimens collected and presented by Bingham (OUM; volsella on slide no. 46359); allotype: ♀, Laos, Mouc Dahan, J. F. Godfrey, 1920-244 (with label: *E. arcuatus* var. *philippinensis* Zimm. 1931 nec Beq. 1928, det Giord. Ska.) (BM).

2. ***Eumenes viridipennis***, new species

♀ — Structurally very similar to *Eumenes flavopictus*, but slightly larger, more robust, and with relatively longer wings. — In the following description

the unique type of the new species is compared with a Sumatran specimen of *E. flavopictus continentalis*, here indicated as "*continentalis*".

Anterior margin of clypeus wide, more than half the length of the clypeus (17 : 32) (in *continentalis* 15 : 32), very shallowly emarginate (1 : 16). Gastral petiole (figs. 1a, 1f) relatively wide, as in *continentalis* consisting of an anterior part with distinctly converging sides, and a posterior part with almost parallel sides; the relative widths at the base of the anterior part, at the base of the posterior part (just behind the spiracles), and at the apex of the posterior part (i.e. the greatest width) are 14 : 24 : 30 (in *continentalis* 13 : 21 : 27); greatest width of petiole distinctly exceeding the interocular distance on the vertex (30 : 26) (in *continentalis* 27 : 26). Wings large, distinctly longer than head + thorax + gastral petiole (21.5 : 19) (in *continentalis* the wings as long as these parts of the body taken together).

Black; with only a short line at inner orbits (emarginate on inner side by the black margin of the antennal sockets, and ending before the middle of the lower side of the eye-sinus), and a short and very narrow line on the temples, pale yellowish. Legs black; only the claws brownish.

Wings dark brown, with conspicuous greenish and violet iridescence.

Length (h. + th. + t. 1 + 2) : 27 mm.

Holotype: ♀, Durian Island, Riouw Archipelago, Nov. 1923, K. W. Damermerman (*E. arcuatus curvatus*, det. Schulthess) (ML).

### 3. *Eumenes violaceipennis*, new species

♀ — Clypeus convex, disk somewhat flattened; the anterior, pre-ocular portion less than half the length (13 : 32); anterior margin narrow (less than half the length of the clypeus (14 : 32), distinctly emarginate (1 : 10), its lateral angles slightly depressed.

Surface of clypeus dull, finely coriaceous, with some sparse and indistinct punctures, the punctures in the basal half a little coarser, but ill-defined and very superficial; lateral angles of anterior margin rather shiny, with a few punctures.

Eyes slightly further apart on the vertex than at the clypeus (26 : 24.5).

Gastral petiole slender, rather gradually widening from base to apex (relative widths at base, behind spiracles and at apex 11.5 : 16 : 22, respectively; in paratype 11 : 15.5 : 21; greatest width smaller than inter-ocular distance on vertex (22 : 26).

Wings long, longer than head + thorax + gastral petiole (18 mm and 15 mm, resp.).

Structure and sculpture in other respects as in *E. flavopictus* Blanch.

Black; a short line at inner orbits (as in *E. viridipennis*) and a short and very narrow line on the temples, pale yellow.

Wings dark brown, with conspicuous blue-violaceous iridescence.

♂ — Very similar to the female. Inter-ocular distance on vertex much greater than that at the clypeus (20 : 15). Gastral petiole slender, relative widths at base, behind spiracles, and at apex 9 : 15 : 20, resp.

Black; in addition to the pale markings of the female there are a reversed T-shaped inter-antennal spot (delimited below by the basal margin of the clypeus, and by the sutures between antennae and clypeus; above reaching the level of the middle of the antennal sockets), and a median band on the clypeus (almost parallel-sided, at the base as wide as the black areas on each side of it, its distance from the base almost equal to its width, but anteriorly almost reaching the apical margin of the clypeus). Antennal hook (= apical segment) ferruginous yellow, with dark base.

Length (h. + th. + t. 1 + 2): ♀ 21-22 mm, ♂ 19-20 mm.

Holotype: ♀, West Java, Radjamandala, 26 Nov. 1939, J. Olthof (ML).

J a v a: 1 ♀ West Java, Radjamandala, ult. Dec. 1940, J. Olthof (paratype, ML).

B a l i: 1 ♂ "Bali", coll. Gribodo (? *curvatus*, det. Giordani Soika) (MCG).

Two females from the type locality Radjamandala, collected 1 May 1941 by Erie, are slightly larger and more robust. These specimens agree in having the abdominal petiole relatively wider than in the two specimens described above, the relative width at base, behind the spiracles and at apex being 12 : 19 : 24, and 13 : 21 : 25, respectively; the greatest width is almost equal to the inter-ocular distance on the vertex (24 : 25, and 25 : 26, respectively).

As I am unable to find any other differentiating characters, I suspect that the differences noted above may be due to seasonal influences. However, I do not wish to exclude other possibilities, and I have therefore thought it advisable not to label these specimens as paratypes.

It would be very interesting to obtain a good series of both sexes of this wasp, collected at the type locality in different seasons.

#### 4. *Eumenes sciarus*, new species

♀ — Clypeus mainly as in *E. violaceipennis*, but the anterior margin faintly depressed in the middle as well as at the sides, the emargination shallower (1 : 20 to 1 : 24), the lateral angles almost as dull as the rest of the clypeus, the puncturation slightly more distinct, also at the anterior margin, but the punctures still superficial and not very well defined.

Pro- and mesoscutum densely punctate, with very few flat interspaces.

Lateral areas of propodeum forming a distinct angle with the dorsal area, except in the upper third or fourth; in upper part with at least 20 well-defined, crater-like punctures, and several smaller ones.

Gastral petiole (fig. 1c, 1g) slender, gradually widening from base to apex; relative widths at base, behind the spiracles and at apex from 10 : 16 : 22 to 12 : 18 : 24; greatest width of petiole less than inter-ocular distance on vertex (from 22 : 25 to 24 : 28); width of second gastral segment more than 2½ times the greatest width of the petiole (from 59 : 22 to 64 : 24).

Wings large, slightly longer than head + thorax + gastral petiole (from 19 : 17.5 to 17 : 16).

Black; a short line at inner orbits (ending near the middle of the lower side of the eye-sinus), and a very short and thin line on temples pale yellowish. Antennae slightly brownish at under side, mainly at base and apex. Legs partly somewhat brownish, but nowhere with yellowish markings. Wings dark brown with a bronzy shine and greenish and purplish reflections.

♂ — Very similar to the female; agrees in the puncturation of the lateral areas of the propodeum, which is more distinct than in *eremnus*.

Pale yellow markings of face (fig. 5b) almost as in *E. violaceipennis*; suture between antennal sockets and clypeus dark, clypeal mark further away from the base of the clypeus than from the apex. Antennal hook (apical segment) brownish yellow on outer sides, the preceding two or three segments ferruginous yellow below. Pronotum with more or less distinct traces of pale yellow band at anterior margin (two or four irregular, short and narrow lines). Propodeum black. Tibiae and tarsi dark brown to blackish, without yellowish markings.

Genitalia: fig. 2c.

Length (h. + th. + t. 1 + 2): ♀ 21-24 mm, ♂ 18-20 mm.

Holotype: ♀, Labuan Badjo, Flores, June 1937, J. K. de Jong (ML); all other females recorded below are paratypes.

Sumbawa: 1 ♀ Sumbawa Besar, 20 May 1949, leg. Swiss Exp. (NMB); 1 ♂ Raba, 20 May 1949, leg. Swiss Exp. (ML, genitalia on slide 2. 21. 3. 56).

Komodo: 1 ♀ 3 ♂ July 1937, J. K. de Jong (MZB, ML; ♂ genitalia on slides 4. 12. 3. 56 and 1. 23. 3. 56, ML).

Flores: 2 ♀ 2 ♂ Labuan Badjo, June 1937, J. K. de Jong (MZB, ML; ♂ genitalia on slide 4. 23. 3. 56, ML). 1 ♀ Wolosambi, 1950, Miss H. C. Vos, ex coll. van der Vecht (ML).

Sumba: 1 ♀ Laora, 100 m, April 1925, K. W. Dammerman ("*curvatus*, det. Schulthess") (ML). 1 ♀ 1 ♂ Rara, 340 m, 3 ♀ 1 ♂ Waimangura, 436 m, 2 ♀ Rua, sea-level, 2 ♀ Langgaliru, 400-600 m, 1 ♀ Laluku, 100 m, 2 ♀ 1 ♂

Mau Marru, 500 m (♂ genitalia on slide 1. 21. 3. 56, ML), 1 ♀ Melolo, sea-level, 1 ♀ Prai Jawang, 50 m; all leg. Swiss Exp. 1949 (NMB, MZB, ML); 1 ♀ "Sumba", ex coll. Gribodo (coll. Giordani Soika).

##### 5. *Eumenes wienecke*, new species

♀ — Clypeus as in *E. violaceipennis* and *E. eremnus*, with the lateral angles of the anterior margin distinctly depressed and more shining than the disk; width of anterior margin about two fifths of the length of the clypeus; emargination rather deep (1 : 8).

Pronotum and mesoscutum densely punctate, approximately as in *E. sciarus*, on the pronotum the puncturation reticulate, the interspaces with a distinct tendency to run into obliquely transverse striae.

Lateral areas of propodeum sharply separated from dorsal area in lower three fourths, along the transition with at least 20 distinct, though superficial, punctures.

Gastral petiole slender, its greatest width distinctly less than the interocular distance on the vertex (from 20.5 : 24 to 23 : 26, in smaller and larger specimen, resp.); relative widths of petiole at base, behind spiracles and at apex from 9 : 14.5 : 20.5 to 11 : 16 : 23.

Black; a line at inner orbits (from clypeus to middle of lower side of eye-sinus) and a very thin and narrow line on temples, pale yellow; interantennal spot very small (2 ♀) or absent (2 ♀); anterior margin of pronotum with small pale yellow spots in the middle (1 ♀) or entirely black (3 ♀). Legs black; tibiae I and II slightly brownish. Wings fusco-hyaline, as in *E. flavo-pictus blanchardi*, but with distinct violaceous reflections.

Length (h. + th. + t. 1 + 2) : 21-23 mm.

Holotype: ♀, "Timor, Wienecke" (ML); the specimens recorded below are paratypes.

Timor: 3 ♀ "Timor, Macklot", slightly damaged (ML); 1 ♀ "Timor", ex coll. Saussure (MHNG). The specimens in the Leiden Museum stood under a label "*inflexus* Sauss." and may have been identified as such by de Saussure himself in 1862, when he received a collection of oriental Vespidae from the Leiden Museum for identification. The specimen in Geneva may originally have formed part of this same series.

The status of this form remains somewhat uncertain as long as the male has not been discovered, but I believe that eventually the study of the male genitalia will show that *E. wienecke* is indeed a member of the *curvatus* group.

6. **Eumenes inflexus** Saussure

*Eumenes inflexus* Saussure, 1855, Ét. Fam. Vesp., vol. 3, p. 145, ♀ — “Cayenne”, coll. Smith, but according to de Saussure probably Asiatic (type ♀ BM). Smith, 1857, Cat. Hym. Brit. Mus., vol. 5, p. 24 (cat., *inflexa*). Dalla Torre, 1894, Cat. Hym., vol. 9, p. 25 (cat., *inflexa*); 1904, Gen. Insect., vol. 19, p. 23 (cat., *inflexa*). Bequaert, 1928, Ann. Mag. Nat. Hist., ser. 10, vol. 2, p. 169, 170 (type examined; syn. of *E. curvatus* Sauss.).

The type of this species (no. 18,163, BM) bears a label “Cayenne”, but already de Saussure suspected that it is of Asiatic origin. It is not identical with *E. curvatus* de Saussure, the head and the thorax being more densely punctate than in that species. In this respect *E. inflexus* agrees with the species described above, but I have been unable to decide with complete certainty whether it is identical with one of them. For the moment *E. inflexus* must therefore be listed as a doubtful species.

7. **Eumenes curvatus curvatus** Saussure

*Eumenes curvatus* Saussure, 1855, Ét. Fam. Vesp., vol. 3, p. 145, “♀”, pl. 8 fig. 1 — “Iles Philippines”, coll. Smith (type ♂ [?] BM). Smith, 1857, Cat. Hym. Brit. Mus., vol. 5, p. 25 (cat., *curvata*); 1871, Jl. Proc. Linn. Soc. Zool., vol. 11, p. 372 (cat., *curvata*). Maindron, 1882, Ann. Soc. Ent. France, ser. 6, vol. 2, p. 272 (cat.). Dalla Torre, 1894, Cat. Hym., vol. 9, p. 22 (cat., *curvata*). Bingham, 1895, Ann. Mag. Nat. Hist., ser. 6, vol. 16, p. 444 (Cape Engano, Luzon); 1897, Fauna Brit. India, Hym., vol. 1, p. 347 (Philippine Is.) [erroneously recorded from Burma and Tenasserim]. Dalla Torre, 1904, Gen. Insect., vol. 19, p. 22 (cat., *curvata*). Ashmead, 1904, Jl. New York Ent. Soc., vol. 12, p. 8 (cat., *curvata*; Manila); 1904, Proc. U.S. Nat. Mus., vol. 28 (no. 1387), p. 151 (cat., *curvata*; Philippine Is.). Williams, 1919, Bull. Hawaii Sugar Pl. Ass., Ent. Ser., vol. 19, p. 28, 152, figs. 82-86 (*curvata*; bionomics in Luzon). Bequaert, 1928, Ann. Mag. Nat. Hist., ser. 10, vol. 2, p. 169 (supposed holotype in BM is a male; syn.: *E. inflexus* Sauss.). Tosawa, 1934, Trans. Kansai Entom. Soc. Osaka, no. 5, p. 5 (in key), p. 14, pl. fig. 12 (*curvata*; Botel Tobago I.) [erroneously recorded from Burma and Tenasserim]. Yasumatsu, 1937, Mushi, vol. 9, p. 122 (Botel Tobago I.) [erroneously recorded from Eastern Java, Burma, and Tenasserim].

Types. — As already noted by Bequaert (1928), the specimen labelled as the type in the British Museum is a male, and this is in agreement with

the differences noted by Saussure between *curvatus* and *inflexus*. Nevertheless the specimen figured in de Saussure's work is almost certainly a female, and the author probably had a specimen of this sex before him when he drew up the description. He could hardly have overlooked the facial markings of the male, which are so different from those of the female. Therefore I am inclined to think that the species was based on at least one specimen of each sex. Probably the author first described a female (? the specimen labelled "*Eumenes incurva* Sauss." in the BM?) and subsequently used the male for a comparison with *inflexus*.

Both sexes of this species are easily distinguished by the sparse and superficial puncturation of head and thorax; these parts are more shiny than in any of the related forms.

♀ — Clypeus dull, convex, disk somewhat flattened; anterior margin moderately emarginate (1 : 12), its lateral angles slightly depressed and shiny. Transition between dorsal and lateral areas of propodeum rather sharp in lower two thirds, rounded in upper third. Shape of gastral petiole (fig. 1b) somewhat variable (some extreme measurements in Luzon specimens: 12 : 18 : 25, and 13 : 22 : 29), the greatest width generally slightly less than the inter-ocular distance on the vertex.

Puncturation of clypeus denser than in *E. flavopictus*, and rather coarse, approximately as in *E. zamenes* and *E. zimmermanni*. Front above antennae rather sparsely and irregularly punctate, with distinct shiny interspaces; an extensive area in front of the ocelli impunctate and shiny; vertex sparsely and finely punctate.

Pronotum moderately shiny, rather coarsely, but not very densely, punctate, the shiny interspaces nevertheless with a tendency to form a superficial transverse striation; mesoscutum, scutellum and postscutellum sparsely punctate, the punctures smaller than on the pronotum, the interspaces generally larger than the punctures, except in the posterior angles of the mesoscutum. Mesopleura more coarsely punctate, but everywhere with distinct interspaces, which in the lower half are partly as large as the punctures, or even larger. Metapleura and lateral areas of propodeum polished; the latter with a few scattered punctures near the upper margin; dorsal area of propodeum rather shiny, although coarsely and rugosely punctate, at base the punctures finer and sparser. Gaster impunctate, with very short tomentum, shiny.

Black with faint bluish shine; a short line at inner orbits (hardly reaching the eye-emarginations, and often reduced to two separate spots), and a short and very narrow line on the temples, pale yellowish. Wings dark brown, with pronounced bronzy and violaceous (not bluish) reflections.

♂ — Very similar to the ♀; face more extensively marked with pale yellow (fig. 5c); antennal hook of the usual shape, partly pale yellowish, dark at base; genitalia: fig. 2d.

Length (h. + th. + t. 1 + 2): ♀ 24-27 mm, ♂ 23-25 mm.

Philippine Islands: 2 ♀ "Ins. Philipp.", leg. A. van der Valk (ML); 1 ♀ "Philip. Isl." (round label), "F. Smith coll., 79-22", "*Eumenes incurva* Sauss." (BM; this is the specimen discussed by Bequaert, 1928, p. 170; it is perhaps the true type of *E. curvatus*).

Luzon: 3 ♀ 1 ♂ Los Baños, ex coll. van der Vecht (ML); 1 ♀ Buranen, 1 ♂ Lamao (ML); 5 ♀ 2 ♂ Los Baños, 1 ♂ Manila 1952-4, Townes family (HT; ML); 1 ♀ Mt. Arajat, Centr. Luzon, 94-64 (BM); 1 ♀ Pt. Laguna, W. Schultze (ZSM); 3 ♀ 2 ♂ Los Baños, 2 ♀ Mt. Makiling, leg. Baker (USNM); 5 ♀ Luchan, Tayabas, May 1926, R. C. McGregor, 1 ♀ Ube, Laguna, 13 April 1930, R. C. McGregor (USNM); 1 ♀ Malinao, Tayabas, leg. Baker (USNM); 1 ♀ Mt. Makiling, 1 Oct. 1932, F. C. Hadden (CAS).

Sibuyan: 2 ♀, leg. Baker (USNM).

Samar: 1 ♀ Borongam (ZSM).

Leyte: 1 ♀ Maripipi, 10 Aug. 1952, H. Townes (ML; abnormal specimen: anterior margin of clypeus strongly swollen, but otherwise not different).

Panay: 1 ♂ N. W. Panay, leg. Baker (USNM).

Negros: 1 ♂ Mt. Canlaon, 3600', Negros Or., 30 April 1953, Townes fam. (HT).

Mindanao: 2 ♀ Dapitan, 1 ♀ Butuan, 1 ♀ Davao, 2 ♀ Surigao, 1 ♀ Iligan, all leg. Baker (USNM); 1 ♀ Dapitan, 1 ♀ Surigao, leg. Baker (ML); 1 ♀ Pikit, Cotabatu, 13 June 1953, H. Townes (ML); 1 ♀ Davao, Exp. Sta., 9 Febr. 1953, H. Townes (HT).

Jolo: 3 ♀ 1 ♂ "Jolo" (MHNG, 1 ♀ ML).

? Palawan: 1 ♂ (ML). — The occurrence in this island needs confirmation.

? Borneo: 1 ♂ "North Borneo", "collected by Pryer, Bingham coll., 96-30" (BM). — The occurrence in Borneo needs confirmation.

### 8. *Eumenes curvatus talaudensis*, new subspecies

♀ — Very similar to *Eumenes curvatus curvatus*, but slightly more sparsely punctate (on upper part of mesopleura the interspaces mostly larger than the punctures), and the wings with a pronounced bluish tinge.

Length (h. + th. + t. 1 + 2): 25-26 mm.

Holotype: ♀, Kiami, Talaud Is., Oct. 1949, C. J. H. Franssen (ML); the specimens recorded below are paratypes.

T a l a u d Is.: 1 ♀ Beo, June 1930, S. Leefmans, ex coll. van der Vecht

(ML); 4 ♀ Lirung, 1 ♀ Kiami, Oct. 1949, C. J. H. Franssen, ex coll. van der Vecht (ML, 1 ♀ Lirung in USNM); 3 ♀ Rainis, 1 ♀ Beo, May 1925, S. Leefmans (MA, 1 ♀ ML).

9. ***Eumenes curvatus sangirensis***, new subspecies

♀ ♂ — Very close to *Eumenes curvatus curvatus*, differing only in the puncturation, which is slightly coarser and denser; the punctures are deeper and better defined, especially on the mesoscutum, and the space between the tegulae and the parapsidal sutures is distinctly punctate.

In the two available males the facial markings are more extensive than in my male specimens of the nominate race (fig. 5d); the genitalia are not different.

Length (h. + th. + t. 1 + 2): ♀ 25-26 mm, ♂ 23-24 mm.

Holotype: ♀, Tahulandang, Sangir Is., Nov. 1948, C. J. H. Franssen, ex coll. van der Vecht (ML); the specimens recorded below are paratypes.

Sangir Is.: 1 ♀ 1 ♂ with same data as holotype (ML, genitalia of ♂ on slide 16. 3. 56. 5; 1 ♂ "Sangir", leg. Rosenberg (ML, genitalia on slide 14. 3. 56. 3).

10. ***Eumenes zimmermanni*** Giordani Soika

*Eumenes arcuata philippinensis* Zimmermann, 1931, Zeitschr. Morph. Oek. Tiere, vol. 22, p. 207, ♀ — Palawan, Philippine Is., leg. Doherty (type ♀ ZMB) [invalid primary homonym of *Eumenes pyriformis philippinensis* Bequaert, 1928].

*Eumenes arcuatus zimmermanni* Giordani Soika, 1934, Mem. Soc. Ent. Ital., vol. 12 (1933), p. 224 (new name; specimen from Laos, Indo-China, in BM).

Zimmermann's description is very short, but it leaves no doubt that it refers to a form which differs by its dark wings from *Eumenes flavopictus aidrytus*, with which it occurs together in Palawan. Further differences are the very short lines at the inner orbits, which hardly extend into the eye-emarginations, and the slightly denser puncturation of the thorax and the upper part of the lateral areas of the propodeum (here with at least 20 distinct punctures). The clypeus is always more distinctly punctate than in *E. flavopictus*, but there is some variation in the degree of coarseness of the punctures. The puncturation of the clypeus is densest near the anterior margin, the anterior fourth of the clypeus showing at least 25 fairly well defined punctures. Anterior margin of clypeus more deeply emarginate than in *E. flavopictus* (1 : 10).

Gastral petiole moderately slender, at apex as wide as the inter-ocular distance on the vertex, or very slightly narrower.

The available specimens show some variation in the colour of the effulgence of the wings; it is noteworthy that in all the more recently collected specimens (leg. McGregor, leg. Blakemore, and leg. Townes) the wings have a pronounced greenish tinge, whereas in some older specimens the wings show more or less distinct violaceous reflections.

Unfortunately this species cannot be described completely, for I have not found a single male among the 20 specimens which I received from various sources.

Length (h. + th. + t. 1 + 2): ♀ 25-27 mm.

Palawan: 1 ♀ "North Palawan", 2 ♀ "Palawan", from Staudinger (ML). 1 ♀ "Nord Palawan", 1 ♀ "Palawan" (coll. Giordani Soika). 4 ♀ Palawan, 1898, Doherty, ex coll. Fruhstorfer (2 ♀ MHNG, 2 ♀ coll. Giordani Soika). 4 ♀ Puerto Princesa, Oct. 1925, R. C. McGregor (USNM, 1 ♀ MCZ). 4 ♀ "near Puerto Princesa", March-June 1945, H. H. Blakemore (CAS, 1 ♀ ML). 1 ♀ Puerto Princesa, 7 Dec. 1952, H. Townes (coll. HT), 1 ♀ Tagbueros, 11 Dec. 1952, H. Townes (ML).

The specimen from Laos, Indo-China, recorded by Giordani Soika under this name, has proved to belong to a different species: see *E. indosinensis*, p. 18.

#### 11. *Eumenes zamenes*, new species

This species is easily distinguished by its large size, the denser puncturation of clypeus and of lateral areas of propodeum, and the yellow wings with dark base.

♀ — Clypeus moderately convex, flattened in the middle, its anterior margin slightly depressed, but the depressed area much wider at the sides than in the middle; anterior margin moderately wide, approximately two fifths of the length of the clypeus; emargination 1 : 10. Inter-ocular distance on vertex about equal to that at the clypeus (30 : 29).

Transition between lateral and dorsal areas of propodeum not very sharp, except in lower fourth. Gastral petiole slender, the sides slightly more convergent in anterior than in posterior half; relative widths at base, behind spiracles, and at apex 14 : 21 : 28; greatest width usually slightly less than inter-ocular distance at vertex (28 : 30). (In one female, from Kendari, the petiole at apex is as wide as this distance). Second gastral tergite large, its greatest width approximately three times that of the petiole (82 : 28). Wings large, slightly longer than head + thorax + gastral petiole.

Puncturation slightly denser than in *E. flavopictus*; flattened disk of cly-

peus with more than 50 distinct punctures; lateral areas of propodeum more densely punctate than in any of the preceding species; the puncturation densest and coarsest along the transition to the dorsal area, the punctures sparse and indistinct near the metapleura.

The exceedingly fine tomentum which covers most of the body is black and appears to be denser than in the related species; the densely punctate parts of head and thorax are very dull, the clypeus, metapleura, and gaster only moderately shiny.

Black; a short line at inner orbits (not reaching the middle of the lower side of the eye-sinus), and a very short and narrow line on temples, pale yellow. Wings russet-yellow, darkest at anterior margin of fore wings; basal fourth of fore wing and nearly the basal half of hind wing strongly infuscated.

Length (h. + th. + t. 1 + 2): 27-29 mm.

Holotype: ♀, Mt. Bugason, 300 m, N. Celebes, Aug. 1941, F. Dupont, ex coll. van der Vecht (ML); the specimens recorded below are paratypes.

Celebes: 1 ♀ "Celebes, 57-101", "*fulvipennis* of Smith's coll." (BM) [the round blue label indicates that this specimen was collected by Wallace]. 1 ♀ "Celebes, coll. Gribodo" (coll. Giordani Soika). North Celebes, 1 ♀ Tondano (ML); 1 ♀ Kaleosan, July 1941, F. Dupont, ex coll. van der Vecht (ML). Central Celebes: 1 ♀ Nanggala, Rante Pao, Nov. 1936 (ML). Southwest Celebes: 1 ♀ Todjambu, Palopo, July 1936, L. J. Toxopeus (ML); 1 ♀ "Mak" (pale blue round label of the Wallace collection), coll. Gribodo (MCG). Southeast Celebes: 1 ♀ Kandari, April 1874, O. Beccari ("*arcuatus niasanus*" det. Giordani Soika) (MCG).

Sula Is.: 1 ♀ "Sula Besi, Doherty, ex coll. Fruhstorfer" (MHNG).

#### ***Eumenes incola*** Giordani Soika (nrs. 12-17)

This species is structurally the most aberrant member of the group, being characterized by the short thorax, the shape of the gastral petiole (figs. 1m and 1n) and by the antennal hook (fig. 1o), the almost edentate mandibles, and the volsella of the male (fig. 2a).

Yet the colour pattern of the most richly marked subspecies of *E. incola* (*aruensis* from Kei and Aru Is.) is remarkably similar to that of *E. arcuatus arcuatus*, differing only in the following respects:

Labrum yellow; eye-emarginations black; two circular yellow spots on front between ocelli and inter-antennal mark (these three marks sometimes confluent); posterior angles of pronotum with large, triangular, yellow mark; posterior pair of spots on mesoscutum lacking; tegulae with yellow mark at posterior margin only; spots on propodeum separated by median, longitudinal,

black band (only in specimens with reduced markings a slight indication of a transverse black bar); gastral petiole without the basal pair of spots; spots at base of second gastral tergite subcircular, more clearly separated than in *E. arcuatus*, where these spots are transverse and form an interrupted band; second sternite without spots near the middle; apical bands of tergites 2-5 not interrupted medially and hardly sinuate. Wings with conspicuous golden shine. The markings on the legs are as in *E. arcuatus arcuatus*.

This pattern is modified in the different subspecies by an apparently independent reduction of the yellow markings on certain parts of the body. The darkest form (*zonites*) is black, with only the apical band of the gastral petiole pale yellow; the face may be either black, or marked with one or three minute spots near the antennal bases; in the male the first antennal segment is partly pale yellow.

It is remarkable that the Australian specimens are hardly different from those collected in the Aru and Kei Islands, whereas the populations of the mainland of New Guinea, and of Misool, show various degrees of reduction of the yellow pigment.

*Eumenes incola* is smaller than the other species of this group, measuring only 16-20 mm (h. + th. + t. 1 + 2).

#### 12. *Eumenes incola mauritsi*, new subspecies

♀ — Head and thorax marked with yellow as in the subsp. *incola*, but the spots on the propodeum smaller, with broad and rather deep incision on inner side; gaster black, except for a yellow band at the apex of the petiole. Legs black; fore femora and tibiae with yellow line.

Wings yellow, veins pale brownish, but the basal third slightly infuscated, with dark veins.

Named in honour of my friend Dr. Maurits A. Lieftinck, who collected three females of this interesting form at Sorong, North West New Guinea, in the period between 28 Aug. and 6 Sept. 1948 (type and paratype in ML, one paratype in MZB).

#### 13. *Eumenes incola octomaculatus*, new subspecies

♀ — Similar to subsp. *zonites*, but the head marked with yellow as described in the key on p. 8.

The type and only specimen known is a female from Fakal, Misool, collected by Dr. M. A. Lieftinck between 8 Sept. and 20 Oct. 1948 (ML).

#### 14. *Eumenes incola zonites*, new subspecies

♀ — Black; head with at most a small inter-antennal spot and small spots at the inner orbits pale yellow; apex of petiole with narrow yellow band.

♂ — Similar to the female; facial markings variable: the interantennal spots rather large (covering the whole supraclypeal area and produced between the antennae, here reaching the level of the lower side of the eye-emarginations) or more or less reduced, in the darkest specimen entirely absent; spots at inner and outer orbits small, rarely absent; first antennal segment anteriorly with a pale yellow mark of variable size. Under side of flagellum ferruginous at base, darker towards the apex. Volsella of genitalia: fig. 2 a.

Holotype: ♀, Hollandia, North New Guinea, Dec. 1936, W. Stüber, ex coll. van der Vecht (ML); all females recorded below are paratypes.

Northern New Guinea: 1 ♀ Pionier Bivak, Dec. 1920, leg. W. C. van Heurn (MZB); 10 ♀ 7 ♂ Paniai, Aug.-Sept. 1939, 2 ♀ 1 ♂ Arabu Bivak, KNAG Expedition (ML); 6 ♀ 2 ♂ Hollandia, Dec. 1936, leg. W. Stüber, ex coll. van der Vecht (ML); 5 ♀ 2 ♂ Hollandia, July 1938, 3 ♀ 1 ♂ Araucaria Camp, 700-800 m, March 1939, 1 ♀ Rattan Camp, 1200 m, 2 ♀ 2 ♂ Baliem Camp, 1600 m, Dec. 1938 (all collected by Dr. L. J. Toxopeus during the Third Archbold Expedition) (AMNY, MZB, ML); Cyclops Mountains, 1 ♀ Sabron, 1200 ft., 15 May 1936, 1 ♀ Mt. Lina, 3500 ft., March 1936, leg. L. E. Cheesman (BM).

#### 15. *Eumenes incola incola* Giordani Soika

*Eumenes (Delta) incola* Giordani Soika, 1935, Ann. Mus. Civ. Stor. Nat. Genova, vol. 57, p. 134, ♀, fig. 3 — Moroka, South East New Guinea, leg. Loria (2 ♀, type in MCG).

Besides the type I have seen a female of this subspecies from Papua, Mafulu, 4000 ft., Jan. 1934, leg. Miss L. E. Cheesman (BM).

#### 16. *Eumenes incola aruensis* Giordani Soika

*Eumenes incola* var. *aruensis* Giordani Soika, 1935, Ann. Mus. Civ. Stor. Nat. Genova, vol. 57, p. 137, ♀ — Wokan, Aru, leg. Beccari (1 ♀, MCG).

Aru Is.: 1 ♀ "Aru", leg. Wallace, "*E. arcuatus* ♂, det. Smith" on blue round label, coll. Saunders (OUM). 1 ♀ Pulau Kobror, 30 May 1938, P. Buwalda (ML).

Kei Is.: 2 ♀ "Ke", leg. Wallace (no. 58/124, BM).

#### 17. *Eumenes incola teleporus*, new subspecies

♀ — Very similar to *E. incola aruensis*. Labrum black. Gaster less extensively marked with yellow: the spots at the base of the second tergite smaller, the apical band of the petiole more or less widely interrupted; gastral tergites

2-4 with yellow apical band, 5 and 6 entirely black. Wings more strongly infuscated.

♂ — Labrum yellowish. Gastral tergites 2-5 with yellow apical band (the band on the fifth tergite interrupted in the middle). Otherwise as in the female.

Holotype: ♀, Queensland, Mackay, G. Turner, 1892-16 (BM); allotype: ♂, Queensland, Cairns, Kuranda, 4-02, 1909-188 (BM).

Queensland: 2 ♀ Mackay, 1909-188 (BM, ML), paratypes.

### ***Eumenes flavopictus* Blanchard (nrs. 18-33)**

The literature references to this polytypic species are given below under the subspecies. Up to the present *E. flavopictus* has been considered conspecific with *E. arcuatus* Fabr., but it is distinguished by a number of morphological characters, as follows:

♀ — Anterior margin of clypeus very shallowly emarginate (see fig. 4, nrs. 18-33), the emargination always less deep than in *E. arcuatus*. Mesepisternum densely, in the upper part (above the transverse suture) almost reticulately, punctate, the interspaces here everywhere much smaller than the punctures. Posterior area of propodeum densely punctate, rather sharply separated from the impunctate lateral areas, the transition being distinctly angular.

♂ — Basal part of volsella of genitalia densely clothed with long hairs (figs. 3a-e).

*Eumenes flavopictus*, as delimited in this paper, occurs throughout the south-eastern part of continental Asia, in the western half of the Indo-Australian archipelago (lacking in most of the Philippine Islands and in Celebes), and in the islands of the Sunda arc as far as Tenimber and perhaps also the Kei Islands.

The basic pattern of yellow markings consists of the following elements: a mark on the clypeus (in the ♀ often the entire clypeus yellow, the mark is absent in most females of melanistic forms, but usually present in the males), an inter-antennal mark, a line at the inner orbits (often reduced, but even in the darkest forms never entirely absent), a narrow line at the outer orbits, a band on the pronotum, four spots on the mesoscutum (in some brightly coloured forms connected to form two lyre-shaped markings), a small mark on the lateral areas of the scutellum, a vertical band on the mesepisternum, a band at the outer margin of the tegulae, a band on the postscutellum, two large marks on the posterior area of the propodeum (leaving a median, cross-shaped area black), three pairs of spots on the gastral petiole, a pair of transverse spots at the base of tergite 2, forming an interrupted band, narrowly interrupted bands at the apex of tergites 2-5, and widely interrupted bands

at the apex of sternites 2-5, a pair of small spots at the sides of sternite 2, near the middle; on the legs: marks on outer side of mid and hind coxae, a line at the under side of the fore femora, most of the fore tibiae (leaving a brown line on the inner side), and a line on the outer side of the mid and hind tibiae.

The subspecies are mainly distinguished by differences in the colour pattern, various parts of the body showing independent variation in the extent of the yellow markings; the wings are usually pale brownish hyaline with a yellowish tinge at the anterior margin of the fore wing, but in some subspecies they are almost uniformly dark brown. Undoubtedly there exist also small differences in the structure of various parts of the body, as is indicated by the drawings of the anterior clypeal margin of the female of various subspecies (fig. 4, nrs. 18-33) and the volsella of the genitalia of some males (fig. 3), but the variation in this respect is slight and can hardly be expressed in words.

#### 18. *Eumenes flavopictus flavopictus* Blanchard

*Eumenes flavopictus* Blanchard, 1841-9, in Ch. d'Orbigny, Dict. Univ. Hist. Nat., Planches, vol. 2, Ins., Hym., pl. 2 fig. 2<sup>1</sup>) — no locality given (type MP?). Saussure, 1852, Ét. fam. Vesp., vol. 1, p. 65, ♀, pl. IV figs. 3a, 3b (*flavopicta*; "Indes Orientales"; type examined, MP); 1855, l.c., vol. 3, p. 132 (description of male; *prasinus* and *flavopictus* are perhaps varieties of *arcuatus*). Smith, 1857, Cat. Hym. Brit. Mus., vol. 5, p. 22 (cat., *flavopicta*); 1871, Jl. Proc. Linn. Soc. Zool., vol. 11, p. 371 (cat., *flavo-picta*). Maindron, 1882, Ann. Soc. Ent. France, ser. 6, vol. 2, p. 272 (*flavopicta*; syn. of *E. arcuata*). Bingham, 1896, Proc. Zool. Soc. Lond., 1896, p. 448 (*flavopicta*; Ceylon); 1897, Fauna Brit. India, Hym., vol. 1, p. 345, ♀ ♂ (*flavopicta*) [in part only]. Rothney, 1903, Trans. R. Ent. Soc. Lond. 1903, p. 106 (*flavopicta*; Barrackpore, Bengal, common). Strand, 1910, Jahrb. Nass. Ver. Naturk., vol. 63, p. 49 (*flavopicta*; Ceylon). Dover & Rao, 1922, Jl. As. Soc.

1) Dalla Torre (1894) refers to: "Blanchard, Dict. hist. nat. Hymén. II, 1840; T. 11 F. 2", but this is evidently incorrect. The second volume of plates of the "Dictionnaire Universelle" shows the figure of *Eumenes flavopictus* on pl. 2 of the division "Insectes, Hyménoptères", not pl. 11. The error is probably caused by careless copying of the reference "pl. II" in Maindron's paper (1882). The date of publication of this figure is perhaps not 1840. According to Sherborn and Palmer (1903, Ann. Mag. Nat. Hist., ser. 7, vol. 3, p. 350) the text of the "Dictionnaire" was published in 1839-49, and the plates were issued with the text. Unfortunately these authors say nothing about the dates of publication of the various plates, and I have not yet succeeded in obtaining reliable information on this point. Perhaps Dalla Torre, who apparently has not seen d'Orbigny's "Dictionnaire", confused this reference with Blanchard's "Hist. Nat. Anim. Artic., Insectes", which was published in 1840, but in this work *Eumenes flavopictus* is neither discussed nor figured.

Bengal, new ser., vol. 18, p. 238 (*flavopicta*; India; Ceylon). Dover, 1925, *ibid.*, vol. 20 (1924), p. 296, fig. 6 (*flavopicta*; discussion; occurrence of all possible transitions between "var. *flavopicta*" and "typical *arcuata*").

*Eumenes arcuata* var. *flavopicta* Dalla Torre, 1894, Cat. Hym., vol. 9, p. 18 (cat.); 1904, Gen. Insect., vol. 19, p. 21 (cat.). Zavattari, 1911, Ann. Mus. Zool. Univ. Nap., new ser., vol. 3, no. 19, p. 2 (*flavopictus*; Ceylon). Dusmet, 1930, Bol. Soc. Ent. Esp., vol. 13, p. 102 (*flavopictus*; Khandala, India).

*Eumenes arcuatus* var. *praslinius* (Guérin) Bequaert, 1928, Ann. Mag. Nat. Hist., ser. 10, vol. 2, p. 169 (in key; syn.: *flavopictus* Blanch.) [not *E. praslinia* Guérin].

*Eumenes arcuata flavopicta* Zimmermann, 1931, Zeitschr. Morph. Oek. Tiere, vol. 22, p. 205, fig. 26 no. 1 (Ceylon) [erroneously recorded from Sumatra and Java].

This species was first published as a coloured figure, with the legend "*Eumenes flavopictus* Blanch." in d'Orbigny's "Dictionnaire". Apparently it is not mentioned in the text of this work. A description published by de Saussure in 1852 is based on Blanchard's type from "les Indes Orientales" in the Paris Museum.

Judging from this description, I presume that the type was collected in Ceylon, for it agrees well with a series of specimens from this island. However, I have seen too few specimens from the mainland to state this with certainty.

The nominate race of *Eumenes flavopictus* is distinguished by the extent as well as by the tinge of the yellow markings, the latter being intermediate between Ridgway's "Pinard" and "Empire", whereas the colour of the markings in the subsp. *continentalis* comes closer to "Baryta-yellow". The wings have a pronounced yellowish tinge and are only slightly infuscated at apex.

Ceylon: 2 ♀ "Ceylon", from Staudinger (ML); 1 ♂ Trincomali, coll. Schulthess (ETHZ); 20 ♀ 12 ♂, various localities in all provinces (see below), June-Dec. 1953, Dr. F. Keiser (NMB; ML); 3 ♀ "Ceylon", leg. Thwaites (OUM); 1 ♀ "Ceylon" (MCZ), 1 ♀ Kandy (MCZ), 1 ♀ Matale, 1899, W. Horn (MCZ); 1 ♀ "Ceylon", K. Bernhardt, July 1904 (BM); probably also: 2 ♀ "Ind. Or." (IRSNB), 2 ♀ "Ind. Or.", leg. Calkoen (ML). A ♀ from "N. E. Sumatra, 1926, G. Fairchild" (MCZ) is evidently incorrectly labelled.

India: 1 ♀ South India, Nilgiri Hills, Cherangodi, 3500 ft., Oct. 1950 (ML); 1 ♀ Mysore (OUM); 10 ♀ 3 ♂ K'wada and other localities in South India, coll. T. R. Bell (BM); 1 ♂ "Dekkan" (ML), 1 ♂ Sikkim (ML); 1 ♀ "Bengale, Macé", coll. Spinola (MT). — The distribution of this form in

continental Asia is insufficiently known. According to Rothney it goes as far eastward as Bengal. The possible intergradation with *continentalis* deserves further study.

Variation. — The specimens collected by Dr. Keiser in Ceylon show marked differences in the extent of the yellow markings. It seemed of interest to determine whether this is solely due to variations in the amount of yellow pigment in general, or whether different parts of the body may vary independently in this respect. To describe the colour pattern of each of the available specimens, the variable characters are indicated by A, B, etc., the extent of the yellow colour by 1 and 2 (more and less yellow, resp.), or by 1, 2, and 3, when intermediates (2) between brighter and darker forms occur. The following characters were found to be more or less variable:

- A. Yellow lines at inner and outer orbits coalescent on the vertex (1), narrowly interrupted at the level of the ocelli (2), or widely interrupted, the upper part of the inner orbits (above the eye-emarginations) being entirely black (3).
- B. Pronotum almost entirely yellow (1), with incomplete transverse black band (2), or with complete black band separating a small yellow mark in front of the tegulae from the broad band at the anterior margin (3).
- C. Mesoscutum with some small yellow spots (near anterior margin and in posterior angles) besides the yellow bands, which are coalescent at the base (1), without such spots, the yellow bands coalescent at the base (2), or the bands entirely separated (3).
- D. Tegulae yellow, with translucent (1), brownish (2), or blackish (3) spot.
- E. Propodeum posteriorly yellow with median black band (1), with a dark spot on each side in addition to the band (2), or with these spots connected with the median band to form a dark cross (3).
- F. Anterior pair of yellow spots of gastral petiole coalescent (1), separated (2) or absent (3).
- G. Anterior band of second gastral tergite entire (1) or narrowly interrupted (2).
- H. Second gastral sternite with two lateral spots near the middle (1) or without such spots (2).

The condition of these characters in the specimens of the Ceylon series, in the type (based on the description of de Saussure), and in some continental specimens is shown in the accompanying table.

The following points are of interest.

(1) Among the 20 females 5 specimens have a relatively dark head (nrs. 8, 10, 12, 13, 20); generally these specimens also have the pro- and meso-



Similarly no constant associations can be found when other characters are compared. We may therefore conclude that the extent of the yellow markings on different parts of the body appears to vary independently.

(2) Brightly coloured specimens (nrs. 2, 3, 11, 18) have been found in various localities, and occur together with relatively dark specimens.

(3) No seasonal influence on the degree of melanism can be observed.

(4) The males are constantly darker than the females.

(5) The few available continental specimens are less extensively marked with yellow than the Ceylon specimens.

### 19. *Eumenes flavopictus continentalis* Zimmermann

*Eumenes arcuata continentalis* Zimmermann, 1931, Zeitschr. Morph. Oek. Tiere, vol. 22, p. 203, fig. 3, ♀ ♂ — Sikkim (types in coll. Bingham, ZMB); India to Canton; Sumatra [erroneously recorded from Borneo]. Giordani Soika, 1934, Boll. Soc. Venez. Stor. Nat., vol. 1, p. 42 (not a separate variety); 1935, Ann. Mus. Stor. Nat. Genova, vol. 57, p. 133 (syn. of *E. arcuatus arcuatus*). Van der Vecht, 1937, Treubia, vol. 16, p. 268, fig. 3a (Sumatra; erroneously recorded from Borneo).

*Eumenes arcuatus* (Fabr.) Smith, 1861, Jl. Proc. Linn. Soc. Zool., vol. 5, p. 126 [Singapore and Siam records only]; 1871, l. c., vol. 11, p. 372 (cat.) [as 1861]. Bingham, 1897, Fauna Brit. India, Hym., vol. 1, p. 346, ♀ ♂ [in part only]. Rothney, 1903, Trans. Ent. Soc. Lond. 1903, p. 106 (Barrackpore, Bengal; rare). Bingham, 1905, Fasc. Malay., Zool., vol. 3, p. 47 (Malaya; Burma). Dover & Rao, 1922, Jl. As. Soc. Bengal, new series, vol. 18, p. 238 (*arcuata*; Lebong, 5000'; Moulmein, Burma; note on nest). Dover, 1925, l.c., vol. 22, p. 296, fig. 6 (*arcuata*; *flavopicta* is a colour variety; *nico-barica* M. W. a race); 1926, China Jl. Sci. & Arts, vol. 4, p. 233 (Hongkong); 1929, Bull. Raffles Mus., vol. 2, p. 44 (*arcuata*; Malaya) [incorrectly recorded from Sarawak, Borneo, and from New Guinea]; 1931, Jl. Fed. Mal. St. Mus., vol. 16, p. 253 (*arcuata*; Malaya). Giordani Soika, 1935, Ann. Mus. Civ. Stor. Nat. Genova, vol. 57, p. 133 (syn.: *formosanus* Zimm. and *continentalis* Zimm.).

*Eumenes flavopicta* (Blanch.) Smith, 1858, Jl. Proc. Linn. Soc. Zool., vol. 2, p. 108 (Singapore).

*Eumenes arcuatus* var. *flavopictus* (Blanch.) Schulthess, 1914, Zool. Jahrb. Syst., vol. 37, p. 263 (Sumatra).

♀ ♂ — Colour pattern very similar to that of *Eumenes arcuatus* (Fabr.) of New Guinea and North Australia (see p. 54), but the pronotum only very rarely with a minute spot in its posterior angles, the inter-antennal mark only

slightly widened above, and the second gastral tergite at most with small lateral spots near the middle. Anterior band of second gastral tergite slightly wider than the posterior band.

It is rather unfortunate that the type locality of this form is Sikkim, for this area lies at the northwestern end of the range of the subspecies, where the colour pattern shows a greater resemblance to that of *flavopictus* from Ceylon and India than at the southern end (Sumatra).

I have only recently become aware of this fact, when I received a female specimen from the typical series (labelled "Sikkim, coll. Bingham") from the Zoological Museum in Berlin.

This specimen differs in some respects from a series from Sumatra in the Leiden Museum, as follows: markings slightly darker yellow; inter-antennal mark a little wider above, below extended along the base of the clypeus, the space between antennal sockets and clypeus being yellow except for the two dark sutures; thoracic markings a little more extensive; arms of propodeal cross rounded, narrowed at base (rather neatly rectangular in Sumatran specimens); basal spots of petiole coalescent (in Sumatran specimens the petiolar spots never coalescent), the middle spots slightly larger, and the markings on the following tergites slightly more extensive.

At present I do not have sufficient material at hand to give an adequate description of the variation of the subspecies *continentalis*, as here defined, over its entire range. It is still necessary to determine whether the specimen from Sikkim, described above, can be regarded as representing exactly the population of the type locality, and it should be further investigated whether the colour pattern of this population does indeed change gradually — as the few available specimens seem to indicate — from the northern to the southern end of the range of the subspecies, i.e. from Sikkim to Sumatra.

The coloration of 18 females from various localities in Sumatra shows very little variation; the lateral spots near the middle of the second gastral sternite vary from small to hardly visible in nine specimens and are entirely lacking in the others. A female from Sebuk Island has the line on the hind tibiae reduced to a spot near the apex.

It should be noted that most of the continental specimens, recorded below, have been examined before a specimen from the type locality was obtained.

S i k k i m: 1 ♀ "Sikkim", coll. Schulthess (ETHZ); 1 ♀ "Sikkim, coll. Bingham", received from ZMB (ML); 1 ♀ "Sikkim", May 1894, leg. Bingham, coll. Rothney (OUM).

A s s a m: 1 ♀ 1 ♂ Khasia, coll. Rothney (OUM), in the ♀ the spots on the mesoscutum are almost confluent as in typical *E. flavopictus*; 2 ♂ Khasia, coll. Schulthess (ETHZ).

Burma: 2 ♀ Bhamò, June and Sept. 1886, L. Fea (MCG, ML); 2 ♀ 4 ♂ Schwego (or Shwegoo) Myra, 1 ♂ Schwego Myo, Oct. 1885, L. Fea (MCG); 2 ♀ 1 ♂ Carin Chebà, May-Dec. 1888, 1 ♀ do., Aug. 1888, L. Fea (MCG, 1 ♀ ML). S. Shan States: 1 ♀ Inle Lake, Thaungdo, 900 m, 10 Sept. 1934 (NRS), 1 ♂ Taunggyi, 1500 m, 1 Aug.-22 Sept. 1934 (NRS), 1 ♂ Pekkong, 900 m, 8 Oct. 1934 (ML); all leg. R. Malaise.

China: 2 ♀ 1 ♂ Canton, coll. Schulthess (ETHZ); 1 ♀ "Ngan Hoi", coll. Gribodo (MCG); 1 ♀ Nan-ning, Kowang-si, 1933, ex coll. van Dyke (CAS); 1 ♀ 1 ♂ Foochow, leg. Kellogg (MCZ).

Hainan I.: 1 ♀ 1 ♂ Dwa Bi, 26 July 1935, 1 ♂ Nodoa, 30 May 1935, 1 ♀ Fan Ta, 17 July 1935, all leg. L. Gressitt (MCZ).

Indo-China: 1 ♀ Central Tonkin, Chiem-Hoa, Aug.-Sept., coll. Schulthess (ETHZ); Cochinchina: 1 ♀ P. Condora, 14 Aug. 1924, 1 ♂ Phuquoc, 17 Sept. 1924, R. Vitalis de Salvaza (IRSNB); 2 ♀ Hanoi, April-May 1917, V. Demange (MCZ).

Siam: North Siam, 1 ♀ Chieng Mai, 19 Sept. 1935, Dajak Layang Gaddi (IRNSB); East Siam, 1 ♀ Lam Ton Lang, 5 June 1935, Dajak Layang Gaddi (IRSNB); 1 ♀ Bangkok, coll. Schulthess (ETHZ); 1 ♀ "Siam", Mouhot (OUM).

Tenasserim: 1 ♀ mountains between Meekalan and Kyeat, 500 m, March 1887, 1 ♂ Thagatà, April 1887, both leg. L. Fea (MCG); 1 ♂ "Tenas-serim", 1 ♀ Thaungyin, Febr. 1891, 1 ♂ Tavoy, Nov. 1889, all leg. Bingham, coll. Rothney (OUM).

Malaya: 1 ♀ P. Penang, 600 m, Febr. 1889, L. Loria & L. Fea (MCG); 1 ♀ 1 ♂ Perak, coll. Schulthess (ETHZ); 2 ♀ Penang (USNM); 1 ♀ "Sing" (= Singapore), leg. Wallace (OUM).

Sumatra: 1 ♀ "Sumatra", S. Müller (ML). 1 ♀ Tamiang (IRSNB). North Sumatra: 1 ♀ between Takengon and Bireuen, June 1937, C. T. & B. B. Brues (MCZ); 6 ♀ 1 ♂ Tandjong Morawa, Serdang, Dr. B. Hagen (ML); 1 ♀ Prapat, 900 m, 31 Dec. 1954, J. van der Vecht (ML); 1 ♀ "Siboga" (Sibolga), April 1886, E. Modigliani (MCG). Central Sumatra: 2 ♀ West Sumatra, van Lansberge (ML); 1 ♀ Sawahlunto, Miss Delprat (ML); 4 ♀ Padang (MZB, ML, MCZ); 1 ♂ Riouw Res., Indragiri, Mandian, April 1939, P. Buwalda (ML); 1 ♀ Lubuk Sikaping (MZB); 1 ♀ "Sandaran Agong" (Sanggaran Agung), Korinchi Lake, 2450 ft., May-June 1914 (BM). South Sumatra: 1 ♀ Sarolangun (MZB); 1 ♀ Benkulen Distr., 1912-19, C. J. Brooks (BM); 1 ♀ Bukit Item, June-July 1935, 1 ♀ Tandjong Sakti, May 1935, 1 ♀ Muara Tenam, Aug. 1935, all in Benkulen, leg. Mrs. M. E. Walsh (ML); 1 ♀ Kedaton near Tandjongkarang, 27 March 1937, J.

van der Vecht (ML); 1 ♂ Bergen Estate near Tandjongkarang, May 1953, A. Sollaart (ML).

Islands in Sunda Straits: 1 ♀ P. Legundi, 21 June 1955, 3 ♀ 4 ♂ P. Sebuku, June 1955, all leg. A. M. R. Wegner (MZB, ML); 1 ♀ P. Sebesi, Jan. 1922, 1 ♀ "Verlaten Eiland" (P. Sertung), Jan. 1933, 1 ♀ 1 ♂ Krakatau, Dec. 1933 and Jan. 1933, resp., all leg. K. W. Dammerman (ML).

Bangka I.: 1 ♀ "Banca", leg. Budding (ML); 3 ♀ Pangkalpinang, April 1930, J. van der Vecht (ML). — Abdominal bands a little narrower than in Sumatran specimens, but wider than in the Bornean race.

#### 20. *Eumenes flavopictus formosanus* Zimmermann

*Eumenes arcuata formosana* Zimmermann, 1931, Zeitschr. Morph. Oek. Tiere, vol. 22, p. 206, ♀ ♂, fig. 26 no. 5 — "Pilan, Formosa" [Pilam?] (holotype ♀ ZMB). Giordani Soika, 1934, Boll. Soc. Venez. Stor. Nat., vol. 1, p. 42 (*arcuatus* var. *formosanus*; not a separate variety); 1935, Ann. Mus. Civ. Stor. Nat. Genova, vol. 57, p. 133 (do.; syn. of *Eumenes arcuatus arcuatus*).

*Eumenes arcuata* Tosawa, 1934, Trans. Kansai Entom. Soc., Osaka, no. 5, p. 5 (in key), p. 15, plate fig. 4 (♂) (Formosa).

♀ ♂ — Colour pattern as in *continentalis*, but most of the yellow markings slightly reduced. In contrast to *engganensis*, the reduction of the yellow markings is apparent on the gaster as well as on head and thorax. Second gastral sternite without lateral yellow spots near the middle. Legs black; tibiae I reddish on inner side, and with yellow spot at base; femora I and coxae III in some specimens with minute yellow spot. Anterior petiolar spots lacking in the male.

The almost complete absence of yellow markings on the legs has been overlooked by Zimmermann.

Length (h. + th. + t. 1 + 2): ♀ 24-26 mm, ♂ 19-22 mm.

Formosa: 2 ♀ 1 ♂ Takao, Nov. 1907, H. Sauter (MCG); 1 ♂ Pilam, Febr. 1908, H. Sauter (MCG); 2 ♀ 1 ♂ Takao, 1 ♀ Taihanroku, 1 ♂ Kos-hun, 1 ♂ Kankau, all leg. H. Sauter, 1907-8 (ML); 1 ♀ Kuraru, 5 June 1930, C. Takeya ("Tosawa's paper no. 13") (MCZ); 5 ♀ 5 ♂ Kuraru, Febr. 1935, L. Gressitt (MCZ, 1 ♀ 1 ♂ ML); 1 ♀ Urai, 26 Febr. 1932, E. Gressitt (MCZ); 2 ♀ 1 ♂ Shonoryo, 11 June 1932, L. Gressitt (MCZ, 1 ♀ CAS).

Riu Kiu Is.: 1 ♀ Iriomote I., 1 July 1932, L. Gressitt (MCZ). — This female has the anterior third of the clypeus black; the inter-antennal mark is divided into two spots; the second gastral sternite has small medio-lateral spots.

21. ***Eumenes flavopictus andamanicus*** Zimmermann

*Eumenes arcuata andamanica* Zimmermann, 1931, Zeitschr. Morph. Oek. Tiere, vol. 22, p. 207, ♀, fig. 26 no. 6 — Andaman Is. (type ZMB). Giordani Soika, 1934, Mem. Soc. Ent. Ital., vol. 12 (1933), p. 224 (*arcuatus andamanicus*, description of ♂).

♀ — Head black, with a narrow line at the inner orbits (from clypeus to centre of eye-emargination) and a short and narrow line on the temples pale yellow; thorax black, with only a short yellowish line on the lateral expansions of the scutellum; gaster black, extensively marked with yellow: first pair of petiolar spots lacking, second pair elongate, third pair confluent, forming a pre-apical yellow band; second tergite yellow, narrowly black at the base and on the lateral and apical margins, and with a small black spot on each side near the middle (probably variable); following tergites with well developed bands, sixth tergite with a pair of spots; sternites black, second sternite with a pair of small lateral spots near the middle, sternites 2-5 each with a pair of small spots in the posterior angles. Legs black, fore tibiae brownish on inner side.

Wings slightly darker than in subsp. *continentalis*.

Note: Only one of Zimmermann's eight specimens had three pairs of spots on the gastral petiole, and large spots on the second sternite.

♂ — As the two males of *andamanicus* examined by me do not agree with the description published by Giordani Soika (1934), I give a new description.

Black; marked with pale yellow as follows: a median band on clypeus, leaving only a very narrow dark margin at base and apex, the band at apex as wide as the emargination, at base slightly narrower (G.S.: "clipeo con una larga fascia longitudinale sulla metà apicale..."); a narrow line at inner orbits, not quite reaching the centre of the eye emarginations; a short inter-antennal mark from base of clypeus to level of upper margin of antennal sockets, a short narrow line on the temples, an interrupted line on outer side of tibiae I, a narrow transverse line at extreme apex of tibiae II (G. S.: "... zampe completamente neri"); middle and posterior spots on gastral petiole (middle spots rather long, posterior ones hardly separated); in one male two very wide bands on the second gastral tergite, in the other specimen this tergite yellow, with only the base and the lateral and apical margins narrowly black, the transverse black band reduced to a small spot in the middle and one on each side; the usual curved bands on tergites 3-6; two small spots, close together, on tergite 7, and a pair of lateral spots at apical margin of tergites 2-7 (G.S.: "secondo tergite giallo con la base, uno stretto orlo apicale, ed una grande macchia romboidale sul mezzo, neri. I tergiti successivi, e tutti gli sterniti neri.").

Wings fusco-hyaline, as in subsp. *blanchardi* Saussure.

Length (h. + th. + t. 1 + 2): ♀ 25-27 mm, ♂ 20-22 mm.

This form is very similar to subsp. *blanchardi*, differing mainly in the more extensive yellow coloration of the second gastral tergite; it differs from subsp. *maidli* in the colour of the wings and the maculation of the gastral petiole.

Andaman Is.: 1 ♀ 1 ♂ "Andaman Is.", ex coll. Smith, 1879, coll. Saunders (♂: "*arcuatus andamanicus* Z., Giordani Soika det. 1934") (OUM); 1 ♂ "Andaman Isl., 77-27" (BM).

## 22. *Eumenes flavopictus nicobaricus* Meade-Waldo

*Eumenes nicobarica* Meade-Waldo, 1910, Ann. Mag. Nat. Hist., ser. 8, vol. 5, p. 41, "♂" [recte: ♀!] — Nicobar Is. (BM).

*Eumenes arcuata* race *nicobarica* Dover, 1925, Jl. As. Soc. Bengal, new ser., vol. 22, p. 296.

*Eumenes arcuatus* var. *nicobaricus* Bequaert, 1928, Ann. Mag. Nat. Hist., ser. 10, vol. 2, p. 168 (types in BM are ♀ ♀!), 169 (in key).

*Eumenes arcuata nicobarica* Zimmermann, 1931, Zeitschr. Morph. Oek. Tiere, vol. 22, p. 205, fig. 26 no. 2 (Nicobar Is.).

The following notes may serve as an addition to the original description.

♀ — Colour of yellow markings slightly darker than in Sumatran *continentalis* (pinard yellow and baryta yellow resp.). Markings of head and thorax as in *continentalis*, but the pre-ocular part of the clypeus with a black margin; gastral markings much more extensive; second gastral sternite with large lateral spots; apical spots on sternites 2-5 slightly larger than in *continentalis*, abruptly dilated on outer side. Legs black; apical half of femora I yellow beneath; tibiae I with yellow line on outer side; coxae II and III with yellow line on outer side.

Wings brown, intermediate between *continentalis* and *umbripennis*.

Length (h. + th. + t. 1 + 2): 23-25 mm.

Nicobar Is.: 3 ♀ "Nicobar, 76-30" (including the type) (BM). 1 ♀ "Nicobars, Bingham coll.", from ZMB (ML). The collection of Dr. Giordani Soika contains a female labelled "Novara-R. Shanghai" and "*flavopicta* var. *arcuata* (sic!) Kohl", but this specimen is undoubtedly mislabelled and probably comes from Sambelong, Nicobar Is., where the Novara Expedition collected early in 1858.

## 23. *Eumenes flavopictus simalurensis* Giordani Soika

*Eumenes arcuatus* var. *simalurensis* Giordani Soika, 1934, Mem. Soc. Ent. Ital., vol. 12 (1933), p. 222, ♀ ♂ — Sinabang, Simalur I., leg. E. Jacobson (holotype ♀ and allotype ♂ in USNM).

♀ — Black; head and thorax extensively marked with yellow; wings dark.

Head almost entirely yellow; occiput, antennal fossae and a small triangular spot around the anterior ocellus black. Labrum and mandibles brownish black; antennae black. Pronotum, mesoscutum, scutellum, and postscutellum yellow, narrowly margined with black; mesoscutum anteriorly with median black line. Tegulae yellow; mesepisternum black with large yellow mark on upper half, extending downwards over a short distance beyond the transverse suture; metapleura and lateral areas of propodeum black; dorsal area of propodeum yellow with narrow black median sulcus. Legs brown-black; fore femora with small yellow spot at apex of inner side, fore tibiae yellow on outer side. Wings very dark with strong violaceous reflections. Gaster black.

♂ — Yellow pigments less extensive than in the female. The black marks above the antennal insertions are produced above and just reach two linear extensions of the black spot around the anterior ocellus (fig. 5f). An elongate black spot around the posterior ocelli is connected anteriorly with the spot around the anterior ocellus, posteriorly with the black occiput. Mandibles brownish-black; antennae, including the apical segment, black.

Pronotum as in the female; mesoscutum with two broad yellow bands, as in richly marked specimens of the subsp. *flavopictus*; yellow spots on mesepisternum slightly smaller than in the female; dorsal area of propodeum with a small black dot on each side. Apical mark on fore femora larger than in the female; fore tibiae partly ferruginous; base and apex of mid tibiae with minute yellow spot; metatarsus of mid legs with yellow line on inner side. Wings and abdomen as in the female.

Simalur I.: 1 ♂ Sinabang, April 1913, E. Jacobson (USNM, allotype, no. 64232); 8 ♀ Sinabang, May-July 1913, E. Jacobson (ML, 1 ♀ coll. Giordani Soika); 2 ♀ Aer Dingin, July 1913, E. Jacobson (ML). According to Mr. Krombein the USNM possesses some additional females from the series collected by Jacobson.

#### 24. *Eumenes flavopictus umbripennis*, new subspecies

♀ — Markings of a slightly richer yellow than in *E. flavopictus continentalis*. Pattern of head and thorax as in that subspecies, but the inter-antennal mark slightly wider above, the markings on pronotum and mesopleura slightly more extensive (the black band separating these yellow areas hardly more than half as wide as the yellow band on the mesopleura), the posterior marks on the mesoscutum longer, the arms of the black cross on the propodeum much narrowed towards the middle.

Gastral petiole black (2 ♀) or with a pair of small spots at apex (4 ♀); bands on second tergite a little wider than in *continentalis*, the basal band

only very narrowly interrupted in the middle; second sternite without lateral spots near the middle, the apical spots on sternites 2-5 small.

Legs black; femora I with yellow mark on apical half to two-thirds (shorter than in *continentalis*), tibiae I yellow on outer side; mid tibiae in some specimens with rudimentary yellow spots.

Wings dark brown, with rather weak violaceous effulgence.

Length (h. + th. + t. 1 + 2): 24-26 mm.

Holotype: ♀, Mt. Sitoli, Nias, leg. Kleiweg de Zwaan (ML); the other specimens recorded below are paratypes.

N i a s: 1 ♀ Mt. Sitoli, leg. Modigliani (MCG); 1 ♀ "Nias", 1897-98, U. Raap (MCG); 1 ♀ Lelemboli, Aug. 1886, leg. Modigliani (coll. Giordani Soika); 3 ♀ (incl. the holotype) Mt. Sitoli, leg. Kleiweg de Zwaan (ML).

#### 25. *Eumenes flavopictus telonus*, new subspecies

♀ — Head and thorax black; a narrow line at inner orbits (from clypeus almost to centre of eye-emarginations), a very short and narrow line on temples, and apex of lateral areas of scutellum (often covered by the wing bases!), pale yellow. Gastral petiole with two small spots at apex; tergites 2-5 with yellow bands, almost exactly as in subsp. *blanchardi*; sternites 2-5 with small lateral spots at apex; second sternite with or without small lateral spots near the middle.

Legs black; tibiae I brown, ferruginous on inner side, outer side with small yellow marks at base and apex.

Wings fusco-hyaline, as in subspp. *continentalis* and *blanchardi*.

Length (h. + th. + t. 1 + 2): 24-25 mm.

Very similar to subsp. *blanchardi* from Java, Bali, etc., but the gastral petiole with only one pair of small spots.

B a t u I s.: 2 ♀ "Pulau Tello" (= Telo Island), Nov. 1924, leg. H. H. Karny (holotype), leg. C. Boden Kloss & N. Smedley (paratype) (ML).

#### 26. *Eumenes flavopictus maidli* Giordani Soika

*Eumenes arcuatus* var. *maidli* Giordani Soika, 1934, Mem. Soc. Ent. Ital., vol. 12 (1933), p. 223, ♀ — "Padang, 1899, Consul Schild." (type MV); 1935, Ann. Mus. Civ. Stor. Genova, vol. 57, p. 134 (footnote).

The following description is based on 8 ♀ from Siberut I. and 5 ♀ from Sipora I., Mentawai Is.

♀ — Colour of yellow markings similar to Ridgway's apricot yellow (Pl. IV, 19b). Head and thorax black, with only a narrow line at inner orbits (from clypeus to centre of eye-sinus) and a short and narrow line on temples

pale yellow; inter-antennal spots small (8 ♀) or absent (5 ♀). Gastral petiole with two conspicuous spots at apex (3 ♀), with small spots (7 ♀), or entirely black (3 ♀). Second gastral tergite almost entirely yellow; only the extreme base and an irregular band at lateral margins black (5 ♀), or moreover with a small longitudinal spot on the disk (6 ♀), with a transverse band of separate and ill-defined dark blotches (1 ♀) or with black transverse band which does not reach the lateral margins (1 ♀). Second gastral sternite with small lateral spots near the middle (4 ♀) or with only the apical spots (9 ♀). Bands on tergites 2-5 wider than in *continentalis*; lateral spots at apex of sternites 2-5 small.

Legs dark; fore tibiae rufous on inner side.

Wings dark brown, with weak coppery and violaceous effulgence.

Length (h. + th. + t. 1 + 2): mostly 23-24 mm, but a very small and a very large specimen measure 20 and 27 mm, respectively.

This form is known with certainty from two islands of the Mentawai-group; there are no appreciable differences between the available specimens from these islands. The locality label of the type is evidently incorrect; Giordani Soika had already realized this and wrote: "suppongo si tratti dell'omonima città dell'isola Karimata; certo è sommamente improbabile sia il Padang di Sumatra." It seems more probable, however, that "Consul Schild." lived at Padang in Sumatra and obtained his specimen from the Mentawai islands.

Siberut I: 8 ♀ Sept. 1924, H. H. Karny, C. Boden Kloss & N. Smedley (ML, MZB).

Sipora I: 5 ♀ Oct. 1924, H. H. Karny, C. Boden Kloss & N. Smedley (ML, MZB).

#### 27. *Eumenes flavopictus engganensis*, new subspecies

♀♂ — Differs from the Sumatran subspecies *continentalis* as follows: Yellow markings on head and thorax (including the legs) slightly reduced, on the abdomen more extensive. Inter-antennal yellow mark often divided by a transverse black line. Markings on mesoscutum small and far apart. Tegulae rarely with complete yellow band at outer margin, as a rule with yellow spot in anterior third only; in two females from Meok entirely black. Scutellar spots small (rarely absent), much smaller than the space between them. Propodeal black cross with broad arms. Gaster: first tergite with the usual three pairs of yellow spots (the basal spots absent in the ♂); bands of second tergite broad, converging towards the sides where they are close together, as a rule narrowly interrupted in the middle; sternite 2 with a pair of large lateral yellow spots in the middle (these spots small in one ♂), sternites 2-5

each with a pair of irregularly triangular spots in posterior lateral angles.

Legs: femora I black with yellow spot in apical fourth, II and III black; tibiae I yellow anteriorly, II with indistinct yellow line, III black.

Wings fusco-hyaline, as in *continentalis*.

Length (h. + th. + t. 1 + 2): ♀ 20-24 mm, ♂ 18-21 mm.

Holotype: ♀, Meok, Enggano, May-July 1936, J. K. de Jong (ML); all specimens recorded below are paratypes.

Enggano I.: 3 ♀ "Engano", coll. Gribodo (MCG, ML). 9 ♀ "Kifa-juc" (= Kifajuk, eastern part of the island), May 1891, 3 ♀ Bua-bua (central part), May-June 1891, E. Modigliani (MCG, ML). 21 ♀ 4 ♂ Meok, May-July 1936, J. K. de Jong (MZB, ML).

#### 28. *Eumenes flavopictus kalimantenus*, new subspecies

♀♂ — Very similar to subsp. *continentalis* from Sumatra, but distinguished by the reduction of some of the yellow markings. Upper half of eye-sinus partly black. Lateral margins of clypeus narrowly black. Posterior pair of spots on mesoscutum small. Transverse bands of second gastral tergite narrow; near the middle the distance between them about four times the width of each band, at the sides about twice their width, rarely less. Bands on tergites 3-5 also narrow, on 4 and 5 rather widely interrupted. Second gastral sternite without lateral spots near the middle; lateral spots at apical margin small. Yellow line on hind tibiae often reduced to a spot in apical third. In the male the width of the black lateral margins of the clypeus is rather variable; the basal pair of petiolar spots is absent, the median pair more or less reduced. In a ♂ from Sandakan (USNM) the middle pair of petiolar spots is hardly visible, the first band on tergite 2 is reduced to a pair of small, transverse spots, and the sixth gastral tergite is entirely black.

Wings as in subsp. *continentalis*.

Length (h. + th. + t. 1 + 2): ♀ 19-23 mm, ♂ 18-21 mm.

Holotype: ♀, Samarinda, Muara Kaman, East Borneo, Sept. 1950, A. M. R. Wegner (ML); all females recorded below are paratypes.

Borneo: North Borneo: 4 ♀ 1 ♂ Sandakan, C. F. Baker (USNM); 1 ♀ Bettotan, 1 ♂ Kudat, Aug.-Sept. 1927, Boden Kloss & Pendlebury (BM). Sarawak: 1 ♀ "Sarawak" (MCZ); 1 ♂ Sarawak, H. W. Smith (MCZ); 1 ♀ Kuching, May 1898 (MCZ); 1 ♀ Matang Road, 3 Oct. 1910 (MCZ); 1 ♀ Batu Lawi Exp., 16 May 1911 (MCZ); 1 ♀ "Sar", leg. Wallace (OUM); 1 ♀ "Sarawak", leg. Shelford, "1900-117" (BM), 1 ♀ Mt. Matang, 5 Dec. 1913, G. E. Bryant (BM) [in the last two ♀♀ the hind tibiae with complete yellow line]; 1 ♀ Kuching, 28 Nov. 1913, G. E. Bryant (BM) [yellow line of hind tibiae interrupted]; 1 ♂ River Kapah Trib. of River Tinjah, 8 Oct.

1932, Oxford Univ. Exp. (BM). West Borneo: 1 ♀ Pontianak, Febr. 1923, ex coll. Jurriaanse (ML); 1 ♀ Sambas, leg. J. Bosscha, 1891 (ML); 1 ♀ Pontianak, leg. Bollen (IRSNB). South Borneo: 1 ♀ Pemanten-Sampit, July 1953, M. A. Lieftinck (ML). South East Borneo: 1 ♀ Ketapan, June 1937, Mrs. M. E. Walsh (ML). East Borneo: 2 ♀ 1 ♂ Central East Borneo, Sept.-Nov. 1925, nrs. 135, 207, 209, H. C. Siebers (MZB, ML); 1 ♀ Mahakkam River, 1894, leg. Nieuwenhuis (ML); 1 ♀ 1 ♂ Kariorang, April 1937, Mrs. M. E. Walsh (ML); 1 ♀ 2 ♂ Samarinda, Muara Kaman, Sept. 1950, A. M. R. Wegner (MB, ML); 4 ♀ Balikpapan, Mentawir and Wain Rivers, Oct.-Nov. 1950, A. M. R. Wegner (MZB, ML); 3 ♀ Gunungsari, 95 m, 19-21 Aug. 1956, 7 ♀ 1 ♂ Tabang, Bengen River, 125 m, 31 Aug.-20 Oct. 1956, all A. M. R. Wegner (MZB, ML) [basal pair of petiolar spots lacking in 2 ♀ 1 ♂]; 6 ♀ Kembang Djangut, 23-30 Nov. 1956, A. M. R. Wegner (MZB, ML). 1 ♀ Berau, Jan.-Febr. 1926, E. Mjöberg (MCZ).

The Spinola collection in Turin contains 1 ♀ under the label "*arcuata* var., Java, coll. Serville" (MT), another instance of the incorrectness of many of Serville's locality labels.

Note. — One female from Kariorang is stylopized.

### 29. *Eumenes flavopictus aidrytus*, new subspecies

♀ — Black; a narrow line at inner orbits (from clypeus to centre of eye-emarginations), and a very short and narrow line on temples, pale yellow.

Apex of femora I and outer side of tibiae I reddish brown; tibiae II with irregular brownish streak or entirely brownish black.

Wings fusco-hyaline, as in *continentalis*.

Length (h. + th. + t. 1 + 2): 23-26 mm.

Holotype: ♀, Puerto Princesa, Palawan, 1 Sept. 1924, R. C. McGregor (USNM). — All specimens recorded below are paratypes.

**P a l a w a n:** 1 ♀ "Palawan", coll. Gribodo (MCG); 1 ♀ Palawan, 1898, Doherty, ex coll. Fruhstorfer (MHNG); 2 ♀ "Palawan" (MHNG, ML); 1 ♀ Puerto Princesa, 1 Dec. 1952, H. Townes (coll. Townes). 1 ♀, same data as holotype, from USNM (ML).

**M i n d o r o:** 1 ♀ S. Luis, Calapan, 17 April 1954, H., M., & D. Townes (ML).

**L u z o n:** Los Baños, 2 ♀ leg. F. X. Williams (MCZ, 1 ♀ ML); 1 ♀ 22 Jan. 1917, J. O. Esquerria (MCZ); 1 ♀ 2 July 1927, Jose O. Cruz, ex coll. MCZ (ML); 1 ♀ 22 Aug. 1927, H. T. Ramos (MCZ); 1 ♀ 2 Nov. 1934, E. Casa (MCZ). — The specimen collected by E. Casa has four small yellow spots at the apex of the gastral petiole, two dorsal and two lateral.

This form appears to agree with *E. flavopictus* in all essential morpholog-

ical characters. The anterior margin of the clypeus is more than half as wide as the shortest distance between the eyes at the clypeus (16 : 29), shallowly emarginate; the lateral areas of the propodeum are rather sharply separated from the dorsal area and have only about 20 shallow and small, partly very fine and indistinct, punctures in their upper part. Greatest width of gastral petiole about equal to distance between eyes on vertex (28 : 27).

A final decision concerning the status of this form must be postponed until it becomes possible to study the male.

### 30. *Eumenes flavopictus blanchardi* Saussure

*Eumenes blanchardi* Saussure, 1852, Ét. Fam. Vesp., vol. 1, p. 66, ♀, pl. 12 fig. 2 — “Indes Orientales, Pondichéry” (Mus. Paris) [Mislabelled specimens, for this form does not occur in India]. Smith, 1857, Cat. Hym. Brit. Mus., vol. 5, p. 22 (cat.). Saussure, 1862, Stett. Ent. Ztg., vol. 23, p. 179 (probably variety of *E. arcuatus*). Smith, 1871, Jl. Proc. Linn. Soc. Zool., vol. 11, p. 372 (cat.; “India”). Bingham, 1897, Fauna Brit. India, Hym., vol. 1, p. 347 [repeats de Saussure’s erroneous locality record]. Cameron, 1905, Tijdschr. Ent., vol. 48, p. 75 (Java). Strand, 1910, Jahrb. Nass. Ver. Naturk., vol. 63, p. 50 (Batavia, Java). Koningsberger, 1912, Java Zool. Biol., p. 167 (Java).

*Eumenes arcuatus* var. *blanchardi* Maindron, 1882, Ann. Soc. Ent. France, ser. 6, vol. 2, p. 272 (cat., Ind. arch.). Dalla Torre, 1894, Cat. Hym., vol. 9, p. 18 (cat., *arcuata* var. *blanchardii*); 1904, Gen. Insect., vol. 19, p. 21 (cat., *arcuata* var. *blanchardi*). Zavattari, 1911, Ann. Mus. Zool. Univ. Nap., new ser., vol. 3, p. 2 (Java). Dover, 1925, Jl. As. Soc. Bengal, new ser., vol. 20 (1924), p. 296 (*arcuata* var. *blanchardi*; Java!, probably not in India). Bequaert, 1928, Ann. Mag. Nat. Hist., ser. 10, vol. 2, p. 169 (in key).

*Eumenes arcuata blanchardi* Zimmermann, 1931, Zeitschr. Morph. Oek. Tiere, vol. 22, p. 207, fig. 26 no. 7 (Java; Sumbawa) [erroneously recorded from Sumatra and the Saleyer Is.]. Van der Vecht, 1937, Treubia, vol. 16, p. 268, fig. 3a'. (Java; colour pattern compared with that of *Pareumenes* spp.).

♀ — Head and thorax black, with only the following parts pale yellow: a line at inner orbits, which in some specimens reaches the top of the eye-sinus, but which is usually shorter, a very short and narrow line at outer orbits, two minute spots behind the tegulae and two at the apex of the propodeum. Gaster: petiole with basal, middle and apical spots, the former often reduced or absent, the middle spots rather long, the apical spots with only a thin black line between them; second tergite with broad basal and narrower apical band,

both narrowed towards the middle and here as a rule narrowly interrupted; bands on tergites 3-5 distinctly curved, widest near the middle where they are narrowly interrupted; sternites 2-5 with widely separated spots in posterior lateral angles; spots near the middle of second sternite small or absent, rarely rather large. Legs black, tibiae I brownish red on inner side.

♂ — Clypeus as a rule with large median spot, the spot sometimes reduced, but rarely entirely absent. The figures 5g and 5h show the facial markings of an unusually dark male from Java and of a very richly marked male from Sumba. All possible transitions between these extremes appear to occur throughout the distribution range. — Sternites 3-6 pale brown.

Variation. — A female from Mt. Dogdog, 1500 m, West Java, has two small yellow spots on clypeus, two small inter-antennal spots, two small spots in middle of pronotum, and a line which runs from the apical yellow spot on the propodeum along the border between lateral and posterior faces, up to about  $\frac{2}{3}$  of the height of the propodeum.

J a v a: a common species in cultivated areas throughout the island, up to about 1500 m above sea-level (many specimens in MZB, ML, IRSNB); 1 ♀ 1 ♂ "Java, coll. Serville", "*arcuata* var.", coll. Spinola (MT); 1 ♀ "Indes", 2 ♀ "Java", coll. de Saussure (MHNG); 1 ♀ "Java", ex coll. Smith, no. 99-303 (BM); 1 ♀ "Java, 55-39" (BM); 2 ♀ Kagok, 1898, leg. Zehntner (MHNG); 1 ♂ "Buitenzorg" (Bogor), May 1878, G. B. Ferrari (MCG); 1 ♂ Lawang, E. Java, leg. Buysman, ex coll. Cameron, 1914-110 (BM); 1 ♀ Sukabumi, 1 ♀ Tjibodas (MCZ); 1 ♀ "J" (OUM).

P u l a u D a t a r: 1 ♀, Jan. 1901 (ML).

P u l a u P e n a i t a n: 1 ♀ Aug. 1951, leg. A. Hoogerwerf (MB).

K a n g e a n I s l a n d s: 1 ♀ Tembajangan, Febr. 1936, leg. Mrs. Walsh (ML); 1 ♀ Djokong, 1 ♀ Sapandjang, 1 ♂ Ardjasa, 3 ♂ Bujutan, Aug.-Sept. 1954, leg. A. Hoogerwerf (MB, ML).

K a r i m o n D j a w a I s l a n d s: 2 ♀ May 1926, leg. K. W. Dammerman; 2 ♀ Nov. 1930, M. A. Lieftinck (MZB, ML), 1 ♂ 26 Oct. 1955, A. Hoogerwerf (ML). — In the females the basal spots of the gastral petiole are absent, the middle spots are small; in the male the middle spots are hardly visible and the apical band is reduced to four spots. Second gastral sternite black.

B a l i: 1 ♀ Den Pasar, June 1935, leg. R. Awibowo; 1 ♂ Gitgit, June 1939, J. van der Vecht (ML); 1 ♀ 1 ♂ "Bali", coll. Gribodo (MCG).

L o m b o k: 2 ♀ "Lombok", coll. Gribodo (MCG); in one of these females the middle petiolar spots are longer than usual, and the bands on the second gastral tergite are coalescent laterally); 1 ♀ Sapit, 2000 ft., May-June 1896,

H. Fruhstorfer (MHNG); 2 ♀ Sambalun, 4000 ft., April 1896, H. Fruhstorfer (MCZ).

S u m b a w a: 3 ♀ Tabora, coll. Gribodo (MCG).

K o m o d o: 1 ♀ June 1953, leg. A. Hoogerwerf (ML).

F l o r e s: 1 ♀ Wolawaru, 1 ♂ between Ende and Wolawaru, Aug. 1950, J. van der Vecht (ML).

S u m b a: 1 ♀ Kananggar, East Sumba, May 1925, leg. K. W. Dammerman (ML); 24 ♀ 10 ♂ from several localities, 1949, leg. Swiss Sumba-Expedition (NMB, MZB, ML); 1 ♀ "Sumba", coll. Gribodo (MCG).

### 31. *Eumenes flavopictus baweanus*, new subspecies

♂ — This form appears to agree in structure (incl. the shape and pubescence of the genitalia) with *E. flavopictus* and has perhaps developed from the subsp. *blanchardi* by reduction of the gastral yellow markings. Inter-ocular distance on vertex greater than at clypeus (19 : 16); width of anterior margin only two fifths of length of clypeus (10 : 25). Gastral petiole rather gradually widening towards the end; relative widths at base, behind the spiracles and at apex 9 : 14 : 19; at apex as wide as the inter-ocular distance on the vertex.

Black; the following parts pale yellow (see also fig. 5 i): a broad median band on clypeus, a reversed T-shaped inter-antennal spot, a line at inner orbits (reaching the centre of the eye-sinus), a very short and narrow line on the temples, two very small spots at apex of gastral petiole; a spot on outer side at base of tibiae I, a narrow transverse line at apex of tibiae I and II, a line on outer side of metatarsi I and II. Last tarsal segment brownish in the middle. Antennal segments 11 and 12 with ill defined ferruginous spot at under side; last segment (hook) black.

Wings as in *E. flavopictus blanchardi*, fusco-hyaline with faint yellow tinge in anterior part of fore wing.

Length (h. + th. + t. 1 + 2): 19-20 mm.

Holotype: ♂, Bawean Island, 30 June 1954, A. Hoogerwerf (ML).

### 32. *Eumenes flavopictus timorensis*, new subspecies

♀ ♂ — Colour pattern only slightly different from that of subsp. *continentalis*, as follows: lateral margins of clypeus narrowly black; inter-antennal mark slightly more dilated above; posterior angles of pronotum with small yellow spot (4 ♀) or entirely black (4 ♀ 3 ♂); scutellar spots large, wider than long, anterior petiolar spots relatively large, rarely small (1 ♀) or absent (2 ♂); second gastral sternite with small lateral spots near the middle (6 ♀ 1 ♂) or with only the apical spots (2 ♀ 2 ♂). Legs slightly darker: yellow

line on outer side of tibiae II entire (2 ♀ 2 ♂), interrupted (2 ♀ 1 ♂), or reduced to one or two marks on basal half (4 ♀); hind tibiae black (7 ♀), with small yellow spot at base (1 ♀) or apex (1 ♂), or with yellow line (2 ♂).

Wings fusco-hyaline, as in *continentalis*.

Length (h. + th. + t. 1 + 2): 22-27 mm.

Holotype: 1 ♀ "Timor", leg. Wienecke (ML). — The other specimens recorded below are paratypes.

Timor: 6 ♀ 1 ♂ "Timor", leg. Wienecke (ML); 2 ♂ Nikiniki, June 1935, leg. Bühler & Meyer (NMB, ML); 1 ♀ "Timor", coll. Gribodo (MCG); 1 ♀ Kupang, 1 ♂ Soë (2000 ft.), 6-21 June 1929, J. M. Mackerras (CSIRO).

Wetar: 1 ♀ "Wetter", leg. C. Schädler, "acq. 1898" (ML).

### 33. *Eumenes flavopictus dammae* Dalla Torre

*Eumenes walkeri* Kirby, 1894, Ann. Mag. Nat. Hist., ser. 6, vol. 14, p. 108, ♂ — Damma Island (BM) [invalid homonym of *E. walkeri* Ritsema, 1874].

*Eumenes dammae* Dalla Torre, 1904, Gen. Insect., vol. 19, p. 22 (cat., new name).

*Eumenes arcuatus* var. *dammae* Bequaert, 1928, Ann. Mag. Nat. Hist., ser. 10, vol. 2, p. 168 (holotype examined), p. 169 (in key).

♀ — Colour of the yellow markings slightly different from that of the other subspecies, similar to Ridgway's maize- to buff-yellow (Pl. IV, 19f-d). Pattern of markings of head and thorax mainly as in Sumatran *continentalis*, but differing as follows: lateral margins of clypeus with irregular black band; space between antennal sockets and clypeus yellow or black; inter-antennal mark a little wider above; line on temples rather long (in one ♀ almost reaching the base of the mandibles); posterior angles of pronotum with small spot; scutellum with narrowly interrupted transverse band. Propodeum as in fig. 7 (33), or the arms of the cross slightly heavier, somewhat narrowed basally. Basal spots of gastral petiole distinct, coalescent or separated by thin line; middle and apical pairs of spots forming together one large yellow mark on posterior two thirds of petiole, the black areas reduced to a characteristic arrow-shaped mark in the middle, and an emargination of the yellow mark on each side of the petiole, at a short distance from the apex; ventral side of petiole black. Bands of second tergite wide, dilated towards the sides, and here coalescent; apical bands of tergites 3-5 relatively wide; sixth tergite with two spots; second sternite with two unusually large spots near the middle, apical band of this sternite narrowed towards the middle and here narrowly interrupted, the following band almost entire, but the bands on sternites 4 and 5 more widely interrupted.

Legs black; femora I with yellow mark on distal half (from a point slightly beyond the middle to the apex), tibiae I brown, yellowish anteriorly and on outer side, apical segment of tarsi I yellowish; coxae II and III with elongate mark on outer side, tibiae II partly reddish anteriorly.

Wings slightly brownish, with faint yellowish tinge, distinctly less infuscated than in *continentalis*.

♂ — Very similar to the ♀. Antennal segments 3-4 and 10-12 ferruginous at under side. Space between antennal sockets and clypeus yellow. Apical bands of sternites 2-6 all widely interrupted. Yellow lines on coxae II and III small or absent; femora I more or less brownish, tibiae II and metatarsi II with yellow line on outer side, apical segments of all tarsi partly brownish.

Length (h. + th. + t. 1 + 2): ♀ 26-27 mm, ♂ 22-24 mm.

D a m m a I.: 1 ♂ "Damma I., 92-44" (holotype, BM).

K e i I s.: 2 ♀ 4 ♂ "Asia Arch., Key Ins. 1900, Kühn" (1 ♀ 1 ♂ BM, 1 ♀ 2 ♂ coll. Giordani Soika, 1 ♂ ML).

The distribution of this interesting form deserves further study.

#### 34. *Eumenes eremnus*, new species

♀ — Clypeus as in *E. violaceipennis*, with the lateral angles of the anterior margin distinctly depressed and shiny, the emargination hardly shallower (1 : 10 to 1 : 12), but the puncturation slightly more distinct, the flattened disk having about 20 distinct punctures; width of anterior margin less than half the length of the clypeus (15 : 33). Inter-ocular distance on vertex equal to that at the clypeus or very slightly greater.

Puncturation of pro- and mesoscutum slightly sparser than in *E. sciarus*; the anterior portion of the mesoscutum with several flat interspaces, as a rule some of these as large as or even larger than the punctures. Lateral areas of propodeum sharply separated from the dorsal area, except in the dorsal fourth, where the transition is somewhat rounded off; the upper part of the lateral areas with only a few fine and shallow punctures, the number of punctures with distinctly visible flat bottom being no more than ten.

Gaster slender; petiole at apex narrower than the interocular distance on the vertex (24 : 26); relative widths at base, behind the spiracles and at apex 12 : 18 : 24, respectively; width of second segment slightly more than 2½ times the greatest width of the petiole.

Black, a line at inner orbits, ending near middle of lower side of eye-sinus, and a short and thin line on the temples, pale yellow; apex of dorsal area of propodeum on each side with yellow line of variable length (5 ♀), with minute spot (1 ♀), or entirely black (1 ♀). Tibiae I brownish anteriorly; apex of femora II and of tibiae II with faint yellowish or brownish mark.

Wings as in *E. sciarus*, dark brown with a bronzy shine and greenish and purplish reflections.

♂ — Very similar to the female. Pale yellow markings of face slightly different from those of *E. sciarus* ♂: the inter-antennal mark usually constricted near the middle, the transverse band on the supraclypeal area of peculiar shape (fig. 5j), the sutures between antennal sockets and clypeus rarely entirely dark; the clypeal mark not further from the base of the clypeus than from the apex. Antennal hook (apical segment) black. Apex of mid tibiae yellow anteriorly, the tibia often with pale yellow line on inner side; tibia I and metatarsus I with vague yellow line anteriorly. Genitalia: fig. 3f.

Length (h. + th. + t. 1 + 2): ♀ 21-24 mm, ♂ 19-21 mm.

This species can easily be confused with *E. sciarus*, with which it occurs together, at least in Flores and Sumba.

Holotype: ♀, Labuan Badjo, Flores, June 1937, J. K. de Jong (ML); all other specimens recorded below are paratypes.

Flores: 1 ♀ Labuan Badjo, June 1937, J. K. de Jong (MZB); 2 ♂ along road from Endeh to Wolawaru, Aug. 1950, J. van der Vecht (genitalia on slides 2.17.3.56 and 3.23.3.56; ML).

Sumba: 1 ♀ Laora, 100 m, April 1925, K. W. Dammerman (MZB); 1 ♀ Mau Marru, 450 m, May 1925, K. W. Dammerman (both "*E. arcuatus curvatus* det. Schulthess") (MZB). 1 ♂ Waimangura, 436 m (genitalia on slide 23.3.56.5, ML), 1 ♂ Rua, sea-level (genitalia on slide 16.3.56.2, NMB); 1 ♀ 1 ♂ Pogobina, 500 m, 1 ♀ Langgaliru, 400-600 m, 2 ♀ Baing, 10-200 m, 1 ♀ Laluku, 100 m, 4 ♀ Mau Marru, 500 m, 1 ♀ Prai Jawang, 50 m, all leg. Swiss Exp. 1949 (NMB, MZB, ML, 1 ♀ MCZ).

### ***Eumenes arcuatus* (Fabricius) (nrs. 35-41)**

The polytypic species *E. arcuatus*, as defined in the present paper, is an inhabitant of the Moluccas, New Guinea and neighbouring islands, New Britain, and North Australia. If the Kei Islands harbour indeed a subspecies of *E. flavopictus* (see under subsp. *dammae* Dalla Torre), this is the only locality where the distribution areas of these two species overlap.

The following characters separate all subspecies of *E. arcuatus* from those of *E. flavopictus*:

♀ — Emargination of anterior margin of clypeus deeper (fig. 5, nrs. 35-41). Mesepisternum more sparsely punctate, the punctures partly arranged in irregular rows, but the impunctate spaces between these rows generally larger than the punctures; below the transverse suture the punctures even more remote. Posterior area of propodeum less sharply separated from the

lateral areas, the transition being rounded, except close to the apex where it is slightly angular. Pubescence of head and thorax longer and denser.

♂ — Basal part of volsella of genitalia densely clothed with short hairs (figs. 3 g and 3 h).

There are some slight differences in coloration between *Eumenes arcuatus arcuatus* and the very similarly looking *E. flavopictus continentalis*, but the basic elements of the colour pattern (see p. 31) appear to be exactly the same in the two species. It is therefore of interest to note that the pattern of the geographic variation of *E. arcuatus* is in some respects different from that of *E. flavopictus*. The races of the northern Moluccas have the yellow colour of the markings replaced by dull orange-red or brownish red, a case not without parallel as far as Vespidae are concerned, and a similar type of coloration is shown by the rather incompletely known subspecies of New Britain. In the subspecies occurring in Misool only the anterior band of the second gastral tergite shows a tendency to disappear, whereas in *E. flavopictus* the two bands never vary independently. On the other hand the pattern of the Buru subspecies of *E. arcuatus* presents a remarkable parallel to that of the Javan subspecies of *E. flavopictus* (see subsp. *blanchardi* Saussure).

### 35. *Eumenes arcuatus arcuatus* (Fabricius)

*Vespa arcuata* Fabricius, 1775, Syst. entom., p. 371 — Nova Hollandia, coll. Banks (type in BM); 1781, Spec. Insect., vol. 1, p. 467; 1787, Mant. Insect., vol. 1, p. 292. Gmelin, 1790, in Linné, Syst. Nat., Ed. 13, vol. 1, pt. 5, p. 2753. Olivier, 1791, Encycl. Méthod., vol. 6, p. 670. Fabricius, 1793, Entom. Syst., vol. 2, p. 276. Donovan, 1804, Epit. Nat. Hist. Insects India (1800-04), pl. 57 ("54" in Index) fig. 3 [erroneously recorded from Madras]. Jurine, 1807, Nouv. Méth. class. Hym., p. 171.

*Sphex arcuata* Christ, 1791, Naturgeschichte Insect., p. 312 [translation of original description].

*Eumenes arcuata* Fabricius, 1804, Syst. Piez., p. 287. Westwood, 1842, in Donovan, Nat. Hist. Insects India, 2nd edition, p. 90, pl. 57 fig. 3. Saussure, 1852, Ét. fam. Vesp., vol. 1, p. 63, ♀ (Triton Bay, journey of Dumont d'Urville; MP). Smith, 1857, Cat. Hym. Brit. Mus., vol. 5, p. 29 (cat.); 1859, Jl. Proc. Linn. Soc. Zool., vol. 3, p. 163 (Kei Is.); 1861, l.c., vol. 5, p. 126 (*arcuatus*; Dorey, New Guinea) [erroneously recorded from Batjan]. Saussure, 1862, Stett. Ent. Ztg., vol. 23, p. 179 (*arcuatus*; *flavopicta* Blanch., *blanchardi* Sauss., and probably *fulvipennis* Smith are varieties). Smith, 1864, Jl. Proc. Linn. Soc. Zool., vol. 7, p. 37 (*arcuatus*; Misool; Waigeu) [the specimens from Misool probably belonged to subsp. *transilis* m., see below]; 1865, l.c., vol. 8, p. 87 (*arcuatus*; Salawati); 1871, l.c., p. 372 (*arcuatus*; cat.)

[in part only]. Maindron, 1882, Ann. Soc. Ent. France, ser. 6, vol. 2, p. 272 (cat.; syn.: *fulvipennis* Smith and *flavopicta* Blanch.; varieties: *blanchardi* Sauss. and *praslinia* Guér.). Froggatt, 1892, Proc. Linn. Soc. N. S. Wales, ser. 2, vol. 7, p. 227 (cat.). Dalla Torre, 1894, Cat. Hym., vol. 9, p. 18 (cat.) [incorrectly: "*arcuata* (Fabr.) L."]; 1904, Gen. Insect., vol. 19, p. 21 (cat.). Cameron, 1906, Nova Guinea, vol. 5, Zool., Livr. 1, p. 65 (*arcuatus*; Manokwari, New Guinea). Zavattari, 1911, Ann. Mus. Zool. Univ. Napoli, new ser., vol. 3, no. 19, p. 2 (*arcuatus*; Australia). Buysson, 1911, Abh. Senckenb. Naturf. Ges., vol. 34, p. 230 (*arcuatus*; Aru Is.; Key Is.). Cameron, 1911, Nova Guinea, vol. 9, Zool., pt. 2, p. 194 (*arcuatus*; New Guinea). Meade-Waldo, 1912, Ann. Mag. Nat. Hist., ser. 8, vol. 9, p. 446 (*arcuatus*; New Guinea); 1915, Rept. Hym. in Brit. Ornith. Un. Exp., sep., p. 8 (as 1912). Bequaert, 1928, Bull. Brooklyn Ent. Soc., vol. 23, p. 61 (*arcuatus*; holotype examined); 1928, Ann. Mag. Nat. Hist., ser. 10, vol. 2, p. 169 (*arcuatus*; "typical form", in key). Giordani Soika, 1935, Ann. Mus. Civ. Stor. Nat. Genova, vol. 57, p. 133 (*arcuatus*; syn.: *formosanus* Zimm. and *continentalis* Zimm.) [in part only].

*Eumenes arcuata arcuata* Zimmermann, 1931, Zeitschr. Morph. Oek. Tiere, vol. 22, p. 205, fig. 26 no. 4 (Queensland; New Britain; New Guinea).

The colour pattern of this subspecies is remarkably similar to that of *E. flavopictus continentalis*, the main differences being as follows: inter-antennal mark triangularly dilated posteriorly (above); pronotum with yellow line or spot at posterior margin, just in front of the tegulae; second gastral sternite with two large, lateral, yellow spots near the middle.

The spots near the middle of the second sternite may be small or absent in the male. The spots on the mesoscutum are usually well separated, but they are confluent in one of the females from Hollandia. The spots at the base of the first gastral tergite are small or absent, the second pair of spots is usually slightly smaller than in *E. f. continentalis* (absent in some males from Queensland). Facial markings of male: fig. 5n.

The legs are black, with the following parts yellow: fore legs: outer side of femora, except at the extreme base ( $\frac{1}{5}$ ), tibiae (inner side brown), a line on the metatarsus, and the fifth tarsal segment; mid legs: a line on outer side of coxae, a short line at the apex of the femora, and the outer side of the tibiae; hind legs as the mid legs, but the line on the coxae wider, the femora entirely black, and the extreme base (about  $\frac{1}{4}$ ) of the tibiae black; in the male also the metatarsus of the mid legs yellow. In two females from Aindua River, New Guinea, the yellow line on the hind tibiae is narrowed in the basal half; in some females from Sorong the line on the hind tibiae is reduced to a spot on the apical fourth part.

New Guinea: 1 ♀ "Dory" (= Manukwari), "59-58" (BM); 1 ♀ Andai, 1 ♀ Sobie, coll. Gribodo (MCG); 9 ♀ Sorong, July-Sept. 1948, M. A. Lieftinck (MZB, ML); 1 ♀ Sorong, 10 Febr. 1957, G. F. Mees (ML); 1 ♀ Zoutbron, June 1910, P. N. van Kampen (ML); 1 ♀ Hollandia, March 1911, K. Gjellerup (ML); 1 ♀ Rouffaer River, Aug. 1926, 1 ♀ Hoofdbivak, 250 m, Sept. 1926, 1 ♀ 1 ♂ Exploratiebivak, 700 m, Oct. 1926, all collected by W. M. Docters van Leeuwen (MZB, ML); 8 ♀ 4 ♂ Hollandia, Dec. 1936 and March 1937, W. Stüber (ex coll. van der Vecht, ML); 17 ♀ 2 ♂ Hollandia, July 1938, 2 ♀ Bernhard Camp, 50 m, Aug. 1938, 2 ♀ Araucaria Camp, 800 m, March 1939 (all collected by Dr. L. J. Toxopeus during the third Archbold Expedition, MZB, ML); 6 ♀ Hollandia, 1936-8, 3 ♀ Bewani Mountains, Sept. 1937, Miss L. E. Cheesman (BM); Cyclops Mountains: 1 ♀ Mt. Lina, March 1936, 2 ♀ Sabron, 930 ft., April and May 1936, Miss L. E. Cheesman (BM). Papua: 2 ♀ Milne Bay, leg. R. G. Wind (MCZ); 1 ♀ KB Mission, Milne Bay, 19 March 1944, K. V. Krombein (coll. K. V. Krombein); 1 ♀ Mondo, River Augara, 3000 ft., Febr. 1934, 10 ♀ Kokoda, 1200 ft., April-June 1933, 2 ♀ Mafulu, 4000 ft., Jan. 1934, L. E. Cheesman (BM, ML). South New Guinea: 4 ♀ Utaqua River, Sept. 1912-March 1913, A. F. R. Wollaston (including 1 ♀ from Canoe Camp, Nov. 1912) (BM); 2 ♂ Muturi River, Maccluer Gulf, May 1941, 1 ♂ Siera River west of Uta, June 1941, 1 ♀ Aindua River, July 1941, all collected by E. Lindquist (MZB, ML); 2 ♀ Etna Bay, Aug.-Sept. 1939, KNAG Expedition (ML); 2 ♀ "Fiume Purari", Jan. 1894, L. Loria (MCG); 1 ♂ Yule I., May 1875, L. M. d'Albertis (MCG).

Biak: 3 ♀ Biak, Febr.-April 1952, L. D. Brongersma and W. J. Roosdorp (ML); 3 ♀ 2 ♂ Jan. 1945, 2 ♀, Nov. 1945, H. Blakemore (CAS).

Salawati: 1 ♀ "Salvatti", July 1875, O. Beccari (MCG).

Waigeu: 2 ♀ leg. Bernstein (ML); 1 ♀ leg. T. Barbour (MCZ); 1 ♀ Aug. 1948, M. A. Lieftinck (ML).

Kei Is.: 1 ♀ "Ké" (round label: "58/124") (BM); 1 ♀ "Ké" and "Key Isl.d" (round labels) "*Eumenes arcuata*" (blue label in Smith's handwriting), "Smith coll., pres. by Mrs. Farren-White, 99-303" (BM; both these specimens were collected by Wallace, probably when he stayed at Har (Nuhutjut) in the Kei Islands in 1857). — 1 ♀ "Key Is.", coll. Magretti (MCG). 1 ♀ "Key Is.", leg. Kühn, ex coll. C. F. Baker (USNM); 1 ♀ "Key Ins. 1900 Kühn" (coll. Giordani Soika); 1 ♀ "Iles Key", coll. le Moutl (MCZ).

Aru Is.: 5 ♀ 1 ♂ leg. Rosenberg (ML); 2 ♀ Dobo, Dec. 1932 and April 1933, Mrs. M. E. Walsh (MZB, ML).

Egum Is.: 6 ♀ "Egani Is., Yanarba, A. S. Meek" [correctly: Yanaba, A. S. Meek] (MCG, 1 ♀ ML).

Queensland: Cape York, 8 ♀ 10 ♂ Coen, May-June 1932, 1 ♀ Rocky Shrub, McIlwraith Range, 24 June 1932, all leg. Darlington, Harvard Exp. (MCZ, 1 ♀ 2 ♂ ML). 1 ♀ 1 ♂ Kuranda, 31 Oct. 1950, W. L. Brown [on label of ♀: "found commonly about epiphytes in tree tops — hard to capture"] (MCZ). 1 ♂ Palm Isl. to Cooktown, 21 April-13 May 1896, A. G. Mayer (MCZ). 1 ♂ "10 S Bowen", 27 Sept. 1950, E. F. Riek (CSIRO); 1 ♂ Meringa, 24 June 1925, A. N. Burns (CSIRO). 1 ♀ Mackay, April 1900 (ML); 1 ♀ Cooktown, from Staudinger (ML); 1 ♀ Halifax, 12 May 1919, F. X. Williams, ex coll. van der Vecht (ML); 2 ♀ Kuranda, P. Herbst coll., Dec. 1904 (CAS).

The Zoological Museum in Berlin sent me a female from "Neu Britannien, Gazelle Halbinsel", "coll. Bingham", which agrees with the specimens from New Guinea. The occurrence in this island appears to need confirmation.

### 36. *Eumenes arcuatus transilis*, new subspecies

♀ — Differs from *E. arcuatus arcuatus* as follows: Yellow markings of head and thorax showing a tendency to become slightly more extensive: the inter-antennal spot may be connected with the spot in the eye-sinus, the spots on mesoscutum sometimes confluent (an "entire" mark present in one paratype on the left side of the mesoscutum, in the other on the right side!); legs also slightly more extensively yellow: metatarsus II yellow, hind tibiae brown, yellow on outer side except at base. Abdominal petiole black, with small apical yellow spots (small middle spots present in one paratype); second abdominal tergite without basal spots or band (in one paratype some rudiments of basal spots are visible). Apical fascia of second tergite not different from that in subsp. *arcuatus*.

Misool: 2 ♀ Fakal (type and paratype, ML), 1 ♀ Waigama (paratype, MZB), Sept./Oct. 1948, M. A. Lieftinck. 1 ♀ "M" [= Misool, leg. Wallace] (OUM); this specimen has a minute spot on the left hand side of the gastral petiole, near the middle, whereas the apical band is reduced to four minute spots; the first band of the second gastral tergite is also reduced to four small spots.

### 37. *Eumenes arcuatus amboinensis*, new subspecies

*Eumenes Prasilina* [!] (Guér.) Smith, 1861, Jl. Proc. Linn. Soc. Zool., vol. 5, p. 126 (Amboina) [excl. specimens from North Moluccas and Kei Is.]; 1864, l.c., vol. 7, p. 37 (Ceram); 1871, l.c., vol. 11, p. 373 (cat.) [in part only].

*Eumenes arcuata prasilina* Zimmermann, 1931, Zeitschr. Morph. Oek. Tiere, vol. 22, p. 208, 224, 226 (Amboina).

♀ — Similar to *E. arcuatus arcuatus*, but the markings orange-yellow to orange (usually darkest on abdomen, but this may be due to discoloration); pubescence of head and thorax brownish (pale yellowish in subsp. *arcuatus*); markings on face slightly reduced: lateral margins of clypeus narrowly black, the space between each antennal insertion and the clypeus also black, the median mark thus being rather widely separated from the lines at the inner orbits; markings on mesoscutum usually confluent, forming two curved lines which are generally narrower than in *E. flavopictus flavopictus*; in some specimens these lines are narrowly interrupted; spots on scutellum large, often almost confluent; propodeum with well developed black cross; basal spots of gastral petiole hardly visible or absent, middle spots fairly large, apical spots confluent; second gastral sternite at most with small spots near the middle, the apical band narrowly interrupted (interruption less than  $\frac{1}{3}$  of the width of the sternite at apex), rarely complete (only narrowed in the middle). Orange yellow line on mid tibiae often interrupted, the line on the hind tibiae reduced to a spot on the apical third. Wings with pronounced orange-yellow tinge, apical half slightly infuscated.

♂ — Supraclypeal area entirely orange-yellow. Legs slightly more extensively yellow than in the female, the hind legs with yellow line on the apical three fourths of the tibiae.

In both sexes the posterior angles of the pronotum have a distinct orange-yellow line.

Length (h. + th. + t. 1 + 2): ♀ 22-25 mm, ♂ 21-24 mm.

Holotype: ♀, Amboina, 27 Aug. 1918 (ML); the other females recorded below from Amboina and Saparua are paratypes.

Amboina: 1 ♀ "Amboina", "59-25" (or 23?), 2 ♀ "Amb.", "83-35" (BM); 1 ♀ (without head) "*Eumenes arcuatus* fab amboine" in Guérin's handwriting, ex coll. Guérin, coll. Gribodo (MCG); 2 ♀ 2 ♂ "Amboina", coll. Gribodo (MCG; 1 ♂ ML); 1 ♀ Amboina, 1873, O. Beccari (MCG), 2 ♀ do., Dec. 1874, O. Beccari (MCG; 1 ♀ ML); 1 ♀ Amboina, leg. Forsten (ML), 1 ♀ do., Aug. 1915 (ML), 1 ♀ Latuhalat, 9 June 1938, L. J. Toxopeus (MA). A female from "Moluques, Ile de Sula", 1876, ex coll. J. Tosquinet (IRSNB) is probably incorrectly labelled. 1 ♀ Amboina, Aug. 1901, leg. Rouyer (MCZ, "*E. arcuatus* var. *flavopictus*", det. Bequaert); 1 ♀ "Amb", leg. Wallace (OUM, "*E. praslina*", det. Smith).

Saparua: 2 ♀ 1 ♂ 22-28 Oct. 1949, M. A. Lieftinck (ML).

Ceram: 1 ♀ "55-8" (BM); 1 ♀ "Ceram" (in poor condition) (ML); 1 ♂ Wahaai, leg. T. Barbour (MCZ).

The specimens from Ceram are provisionally placed under this subspecies. The female in the Leiden Museum differs in having rather large yellow spots

on the middle of the second gastral sternite, and the apical bands of the sternites 2-5 are all entire. Another female with these characters in the same Museum is labelled "Rosenberg, Aru", but this is certainly incorrect. The male collected by Barbour has the antennal hook orange (darker at the base), the spots near the middle of the second gastral sternite are lacking, but the ventral bands are entire as in the females.

### 38. *Eumenes arcuatus buruanus*, new subspecies

♀ — Head black; inner orbits with short brownish line which does not reach the middle of the lower side of the eye-emargination; supraclypeal area with small brownish spot; outer orbits with narrow and indistinct brownish line; thorax black (in some specimens with minute vestigial spots in the middle of the pronotum and on the apical angles of the propodeum); gaster with brownish-orange markings: petiole with interrupted apical band (in one specimen also with indistinct spots near the middle), gastral tergites 2-5 with the usual transverse bands, sternites 2-5 with small spots in the posterior angles. Legs black. Wings with distinct yellowish tinge, moderately infuscated.

Length (h. + th. + t. 1 + 2): ♀ 21-23 mm.

Holotype: ♀, Buru, Station 15, 1922, L. J. Toxopeus (ML).

Buru: 8 ♀ Stations 1, 4, 5, 9, and 15, June-Sept. 1921, L. J. Toxopeus (paratypes, MA, ML).

I believe that a female labelled "Ternate, T. Barbour" (MCZ) was also collected in Buru; all other specimens collected in Ternate belong to the widely different subsp. *lyratus*.

### 39. *Eumenes arcuatus lyratus*, new subspecies

*Eumenes Praslina* [!] (Guér.) Smith, 1861, Jl. Proc. Linn. Soc. Zool., vol. 5, p. 126 (Gilolo [= Djailolo]; Kaisaa [= Kaioa]) [erroneously recorded from Kei and Amboina] (a variety of *E. arcuatus*); 1862, l. c., vol. 6, p. 57 (Ternate); 1865, l. c., vol. 8, p. 87 (Morty [= Morotai]); 1871, l. c., vol. 11, p. 373 (cat.) [in part only].

?*Eumenes arcuatus* var. *prasilinus* Zavattari, 1911, Ann. Mus. Zool. Univ. Napoli, new ser., vol. 3, no. 19, p. 2 (Moluccas).

♀ — Markings orange-brown, close to Ridgway's "amber brown" (Pl. III k); the pattern similar to that of *E. arcuatus amboinensis*, but more extensive on the propodeum and the gaster. Clypeus entirely orange-brown or with very narrow dark lateral margins; inter-antennal mark usually distinctly separated from the lines at the inner orbits; these lines are fairly wide, but do not fill the eye-emarginations entirely, the upper margin being partly black; first antennal segment either entirely black or with brownish line of

variable size anteriorly; scutellar spots large, separated by a narrow black line, or confluent; transverse black bar of propodeum reduced or absent; basal spots of gastral petiole indistinct or absent, the middle pair large and confluent, separated from the apical band by a black space which is about as wide as this band; transverse bands of gastral tergite 2 rather wide and usually entire, rarely narrowly interrupted in the middle. Second gastral sternite with a pair of lateral spots near the middle (size variable, usually small, rarely large, in 2 females absent); its apical band entire or narrowly interrupted, in the latter case the black median part narrower than each of the lateral markings. Legs amber brown, coxae and trochanters mainly fuscous, fore and mid tarsi partly, hind tarsi entirely blackish.

Wings with pronounced yellow tinge, hardly infuscated at outer margin.

♂ — Similar to the female; supraclypeal area entirely orange-brown (fig. 50), first antennal segment with orange line anteriorly; gastral sternite 2 without lateral spots near the middle. Volsella of genitalia: fig. 3 h.

Length (h. + th. + t. 1 + 2): ♀ 24-27 mm, ♂ 21-23 mm.

Holotype: ♀, Halmahera, Tugauer-Tasoa, 150 m, 20-24 Sept. 1951, local collector (ML); all females recorded below are paratypes.

Morotai: 1 ♀, leg. Bernstein (ML); 1 ♀ "M" [= Morotai, leg. A. R. Wallace] (OUM; "*E. praslina* det. F. Smith"). 1 ♀ 1 ♂ Morotai, 1944, Ernest Reimscheissel (USNM).

Halmahera: 1 ♀ 2 ♂ "Gil" and "Gilolo" [= Djailolo, leg. A. R. Wallace] (1 ♀ 1 ♂ ex coll. Smith, BM; 1 ♂ OUM); 2 ♀ 1 ♂ South Halmahera, leg. Bernstein (ML); 1 ♀ coll. Gribodo (MCG); 1 ♀ North Halmahera, leg. Bernstein (from ML, March 1863, OUM); 3 ♀ Dodinga, sea level, 2-4 Nov. 1951, local collector (MZB, ML); 1 ♀ Akilamo, 50-100 m, 9-12 Sept. 1951, local collector (ML).

Ternate: 1 ♀ 1 ♂ "Ternate" [leg. A. R. Wallace], "60-113" (BM); 1 ♀ coll. Gribodo (MCG); 2 ♀ leg. Bernstein, 3 ♀ 1 ♂ leg. Forsten (ML); 1 ♂ leg. T. Barbour (MCZ).

Kaioa: 1 ♀ "Kai" ["Kaisaa" in Smith's paper = Kaioa, leg. A. R. Wallace] (OUM; "*E. praslina* det. F. Smith").

Batjan: 1 ♀ "Bac", 1 ♂ "Bachian", "99-303", leg. A. R. Wallace, ex coll. Smith (BM). 3 ♀, Aug.-Sept., ex coll. H. Fruhstorfer, coll. A. von Schulthess (ETHZ; *E. praslinius* det. Schulthess). 3 ♀ Salawaku River, 3 ♀ 2 ♂ Wajaua, June-July 1953, A. M. R. Wegner (MZB, ML).

Gebeh: 3 ♀ leg. Bernstein (ML).

Furthermore I have seen: 1 ♀ with label "*E. Praslina* Guér. Amboina, D. Mocsary", coll Gribodo (MCG), and 1 ♀ 1 ♂ with label "Brazil, Mocsary" [!] (MCG).

40. ***Eumenes arcuatus obiensis***, new subspecies

♀♂ — Very closely allied to *lyratus*, but the orange-brown markings a little brighter (more like Ridgway's "xanthine orange", Pl. III i) and partly a little less extensive. Propodeum always with the median black mark shaped like a cross. Lateral spots at apical margin of second gastral sternite much smaller than the black space separating them.

Holotype: ♀, Obi Lake, 160-260 m, Obi Island, July-Nov. 1953, A. M. R. Wegner (ML); the specimens recorded below are paratypes.

Obi: 2 ♀, leg. Bernstein (ML); 1 ♀ Wajaloar (0-50 m), 1 ♂ Laiwui (0-200 m), 1 ♂ Lake River (0-50 m), 1 ♀ Anggai (0-50 m), 8 ♀ 6 ♂ Obi Lake (160-260 m), July-Nov. 1953, A. M. R. Wegner (MZB, ML; 1 ♂ genitalia on slide no. 1.17.3.56).

41. ***Eumenes arcuatus prasinus*** Guérin

*Eumenes Prasinia* Guérin, 1831, in Duperrey, Voyage Coquille, Zool., vol. 2, pt. 2, div. 1, pl. 9 fig. 7 — Port Praslin, New Ireland; 1838, l. c., text, p. 267 (description) (badly damaged holotype at present in coll. Gribodo, MCG). Saussure, 1852, Ét. Fam. Vesp., vol. 1, p. 64 (type redescribed). Smith, 1857, Cat. Hym. Brit. Mus., vol. 5, p. 29 (cat., "*Praslina*"); 1871, Jl. Proc. Linn. Soc. Zool., vol. 11, p. 373 (cat., "*praslina*") [erroneously recorded from several localities in the Moluccas]. Strand, 1910, Jahrb. Nass. Ver. Naturk., vol. 63, p. 50 [erroneously recorded from Batavia, Java]. Bequaert, 1926, Ent. Mitt., Berlin, vol. 15, p. 192 (a variety of *E. arcuata*, probably = *flavopicta*).

*Eumenes arcuata* var. *prasinia* Maindron, 1882, Ann. Soc. Ent. France, ser. 6, vol. 2, p. 272 [erroneously recorded from New Guinea]. Dalla Torre, 1894, Cat. Hym., vol. 9, p. 18 (cat.); 1904, Gen. Insect., vol. 19, p. 21 (cat.). Giordani Soika, 1935, Ann. Mus. Civ. Stor. Nat. Genova, vol. 57, p. 133 (*arcuatus* var. *prasinus*; holotype examined; not *prasinus* Bequaert, 1928, which is *flavopictus* Blanch.).

The name *prasinus* has been applied incorrectly to specimens of *lyratus* from the North Moluccas (Smith, 1861, 1862, 1865, 1871), and to specimens of *amboinensis* from the South Moluccas (Smith, 1861, 1864, 1871; Zimmermann, 1931). The specimen(s) recorded by Zavattari (1911) from the Moluccas certainly belong to one of these forms, and not to *prasinus*. Bequaert (1928) confused *prasinus* with *flavopictus*.

Type — The type specimen, a ♀ with label "*Eumenes Prasinus* Guér. Voy. Coq. P. Praslin" in Guérin's handwriting, is seriously damaged. The following parts are missing: labrum, antennae (except segments 1 and 2 of

right antenna), right eye, gastral segments 2-6, and part of the legs. The mesoscutum has a large hole, but it is just complete enough to show the shape of the orange markings.

♀ — The following notes were made in Genoa, where I compared the type with a female of *lyratus* from Batjan: Inter-antennal mark larger (distance from anterior ocellus less than the diameter of the latter); pronotum almost entirely orange-red, with only a small black mark in the anterior, lower, angle of the sides, and a longitudinal black mark at posterior lateral margin; markings on mesopleura slightly more extensive. Marks on mesoscutum interrupted, the interruption about equal to one tenth of the greatest width of the mesoscutum. Tegulae black with two small orange spots, one in front and one at a short distance from the posterior margin. The scutellar spots, measured in longitudinal direction, cover slightly more than half the length of the scutellum; they are separated by a black space measuring one third of the length of the scutellum; markings on lateral areas of scutellum also slightly less extensive than in *lyratus*. Posterior surface of propodeum almost entirely orange-red, the median black band being relatively narrow: it varies somewhat in width, but except at the extreme base it is nowhere wider than the base of the gastral petiole (width of median line = 11-15, of base of petiole = 16). Gastral petiole: first pair of spots practically absent, second pair long, separated by dark line which measures about one fourth of the width of the petiole at this level; apical spots coalescent, forming a band which is emarginate in the middle anteriorly. Bands of second gastral tergite wide, not interrupted; second gastral sternite with large lateral spots near the middle and small spots at the apical margin, the apical band being widely interrupted.

Legs as in the subsp. *lyratus*; metatarsi of fore and mid legs and fifth tarsal segment of all legs at least partly orange-brown.

The colour of the markings is the same as in the subsp. *obiensis* and comes close to Ridgway's "xanthine orange", Pl. III i.

The subsp. *praslinius* is remarkably similar to the forms of the Northern Moluccas, which up to the present had been confused with it; the populations of both these island groups differ in slight modifications of the usual *arcuatus* pattern, but they agree in the peculiar colour of the markings and in the absence of black pigments on the femora and tibiae, two characters which are unique in this *Eumenes* group.

Apparently *E. arcuatus praslinius* is restricted to the Bismarck Archipelago, but its distribution is very incompletely known.

Besides the type I have seen one ♀ with label "Bismarck Archipel, coll.

Magretti" (MCG), and one ♀ from "Neu Britannien, Ralum [= Kokopo], F. Dahl" (ZMB). — Both specimens agree well with the type.

The following four species (nrs. 42-44, 45, 46, and 47) are provisionally regarded as members of a superspecies, and are indicated as such on the map, fig. 7. It should be noted, however, that the two forms from the South Moluccas are very imperfectly known; they may eventually prove to be more closely related to *E. arcuatus* than to *E. fulvipennis*.

#### 42. *Eumenes fulvipennis fulvipennis* Smith <sup>1)</sup>

*Eumenes fulvipennis* Smith, 1857, Cat. Hym. Brit. Mus., vol. 5, p. 24, ♀♂ — Celebes, coll. Mrs. I. Pfeiffer (types in BM); 1859, Jl. Proc. Linn. Soc. Zool., vol. 3, p. 20 (Celebes, leg. Wallace). Saussure, 1862, Stett. Ent. Ztg., vol. 23, p. 179 (probably a var. of *E. arcuatus*). Smith, 1865, Jl. Proc. Linn. Soc. Zool., vol. 8, p. 87 (Sula Is., leg. Wallace); 1871, l. c., vol. 11, p. 372 (cat.). Maindron, 1882, Ann. Soc. Ent. France, ser. 6, vol. 2, p. 272 (syn. of *E. arcuata*). Dalla Torre, 1894, Cat. Hym., vol. 9, p. 18 (cat., syn. of *E. arcuata*); 1904, Gen. Insect., vol. 19, p. 21 (as 1894).

*Eumenes arcuatus* var., Saussure, 1862, Stett. Ent. Ztg., vol. 23, p. 179 (Gorontalo, Celebes).

*Eumenes arcuatus* var. *fulvipennis* Zavattari, 1911, Ann. Mus. Zool. Univ. Napoli, new ser., vol. 3, p. 2 (Manado, Celebes; not identical with *E. arcuatus*; not a separate species, but a good variety). Bequaert, 1928, Ann. Mag. Nat. Hist., ser. 10, vol. 2, p. 168 (types examined); p. 169 (in key).

*Eumenes arcuata fulvipennis* Zimmermann, 1931, Zeitschr. Morph. Oek. Tiere, vol. 22, p. 207, fig. 26 no. 8 (S. Celebes). Giordani Soika, 1935, Ann. Mus. Civ. Stor. Nat. Genova, vol. 57, p. 134 (*arcuatus fulvipennis*; considered identical with varr. *saleyrensis* Zimm. and *niasanus* Zimm., and with *E. perplexus* Smith).

♀ — Clypeus convex, with flattened disk; anterior margin rather deeply emarginate (1 : 6 to 1 : 8), the lateral angles slightly depressed and somewhat more shiny than the disk; puncturation distinct, coarsest in the middle of the basal third, the flattened disk with at least 25 distinct punctures.

Front of head, pronotum, mesoscutum, scutellum, mesopleura, postscutellum, and dorsal area of propodeum densely and rather coarsely punctate; flat

1) The insect recorded as *Eumenes fulvipennis* Smith from Luzon, Philippine Islands, by Ashmead (1904, Jl. New York Ent. Soc., vol. 12, p. 8, as *fuleipennis*!), from Manila) and by Williams (1919, Bull. Hawaii Sugar Pl. Ass., Ent. Ser., vol. 14, p. 156) is not this species, but probably the Philippine race of *Eumenes pyriformis* (Fabr.).

interspaces are visible at lateral angles of pronotum, on lower half of mesopleura, on disk of mesoscutum posteriorly, on scutellum and postscutellum, and at base of propodeum; on dorsal face of pronotum and on upper part of mesopleura the narrow interspaces tend to run into transverse striae. Upper part of metapleura with a few distinct punctures.

The most characteristic feature of the propodeum is that its dorsal area is not sharply separated from the lateral areas; the puncturation of the former extends over the rounded transitional space and gradually becomes sparser and finer anteriorly, the lateral areas showing only a few scattered punctures where they meet with the metapleura.

Black; the following parts pale yellow: a narrow line at inner orbits, from clypeus to near the middle of the lower side of the eye-emarginations, a small inter-antennal spot (often absent), a short and narrow line on the temples, a short transverse line in the middle of the pronotum (often reduced or absent), two minute spots on apical angles of propodeum (sometimes absent), and basal and median pairs of spots on first gastral tergite. In about 20% of my specimens the apex of the gastral petiole has a pair of small lateral spots. Wings yellowish-hyaline with a rusty tinge, the base not darkened, but the apical third often slightly brownish.

The body is covered with an extremely fine and short blackish tomentum, which gives it a dull appearance; the erect pubescence of the punctate parts of head and thorax is brownish.

♂ — Similar to the female, but the yellow markings more extensive (fig. 5k): clypeus with median longitudinal yellow band; supra-clypeal area with reversed T-shaped mark; mid tibiae with pale yellow spot at tip, metatarsus II yellowish, brown at tip; all fifth tarsal segments pale yellowish. Gastral petiole often with apical spots. Antennal hook dark brown to black, somewhat ferruginous at under side. Volsella of genitalia: fig. 2 f. Antennal segments 9-13: fig. 1 h.

Length (h. + th. + t. 1 + 2): ♀ 20-23 mm, ♂ 19-21 mm.

Celebes: 1 ♂ "Celebes, 55-22", 1 ♀ 1 ♂ "Celebes, 57-101", leg. Wallace (BM). 4 ♀ "Celebes", coll. Gribodo (MCG); 1 ♀ "Celebes" (OUM), 1 ♂ "Celebes" (MCZ).

North Celebes: 1 ♀ "Tond." (= Tondano), "ex coll. Smith, 99-303" (BM). 1 ♀ 10 ♂ Toli-toli, Nov.-Dec. 1895, H. Fruhstorfer (ETHZ); 3 ♀ 10 ♂ do. (IRSNB). 1 ♀ "Minahasa", coll. Gribodo (MCG). 3 ♀ 2 ♂ Gorontalo, 1 ♂ Pagowat, 3 ♂ Tulabollo, leg. Rosenberg (ML). 1 ♂ Tondano, leg. Forsten (ML); 1 ♀ do., 1935, C. van Braekel (ML). 1 ♀ Tomohon, leg. Berends ten Kate (ML); 3 ♂ do., Sept. 1941, F. Dupont (ML). 1 ♂ Menado, June 1925, S. Leefmans (MA); 1 ♀ do., 8 Nov. 1937, J. S. Phillips

(ML); 2 ♂ do., May-June 1949, C. J. H. Franssen (ML). 3 ♀ 1 ♂ Kinamang, Nov. 1941, F. Dupont (ML). 1 ♀ Tateli, Aug. 1949, C. J. H. Franssen (ML). 1 ♀ Tantalete, July 1949, C. J. H. Franssen (ML). 1 ♂ Kelabat, 500 m, July 1941, F. Dupont (ML); 1 ♀ Insula Lutugan, Dec. 1895, H. Fruhstorfer, "Fr. v. d. Poll, Pres. 1911", coll. G. A. J. Rothney (OUM).

Central Celebes: 11 ♀ 15 ♂ Palu, Dec. 1936, local collector (ML). 1 ♂ Gurupalu, 18 March 1917, W. Kaudern (ML).

East Celebes: 1 ♀ Masamba, Luwu, April 1941, L. L. A. Maurenbrecher (ML).

South East Celebes: 1 ♂ Kendari, April 1874, O. Beccari (MCG).

South Celebes: 1 ♀ Samanga, Nov. 1895, H. Fruhstorfer (ETHZ). 1 ♂ Makassar, coll. Gribodo (MCG); 2 ♂ do., 5 March 1949, C. J. H. Franssen (ML). 2 ♀ "Pic Bonthain", coll. Gribodo (MCG). 1 ♀ Malino, 4000', Jan. 1936, L. E. Cheesman, no. 1936-271 (BM). 1 ♂ Bantimurung, 1 June 1948, J. van der Vecht (ML). 1 ♀ Malakadji, June 1949, C. J. H. Franssen (ML); 2 ♀ "Mak" [= Makassar, leg. A. R. Wallace] (1 ♀ "flower shrubs") (OUM); 1 ♂ Malino, Aug. 1937, C. T. and B. B. Brues (MCZ).

Buton Is.: 1 ♀ 2 ♂ Butonbaligo (ML).

Sula Is.: 1 ♀ "Sul", leg. A. R. Wallace (OUM); this specimen looks somewhat more slender than those from Celebes; the petiole is slender, gradually widening from base to apex (relative widths at apex, behind the spiracles and at the apex = 12 : 16 : 25); the yellow line at the inner orbits is interrupted at the level of the antennal sockets. The population inhabiting these islands deserves further study.

The Leiden Museum possesses 1 ♀ from "Banda Isl., Rosenberg", but this specimen is probably incorrectly labelled.

#### 43. *Eumenes fulvipennis saleyerensis* Zimmermann

*Eumenes arcuata saleyerensis* Zimmermann, 1931, Zeitschr. Morph. Oek. Tiere, vol. 22, p. 207, ♀ — Saleyer [or Salajar] Is., coll. Bingham (ZMB).

*Eumenes arcuatus* var. *saleyerensis* Giordani Soika, 1935, Ann. Mus. Stor. Nat. Genova, vol. 57, p. 134 (considered identical with "var. *fulvipennis* Smith").

♀ — "Resembles *arcuata fulvipennis*, being also entirely black with distinct basal spots on petiole, but the median spots only faintly indicated". [Translation of original diagnosis].

I have not yet seen any specimens from the Saleyer Islands, but it seems doubtful whether this form will prove to be constantly different from *fulvipennis* of the mainland of Celebes. According to the table on pp. 224-225, Zimmermann has seen only two specimens, one with two pairs of spots on the petiole, and one with one pair.

44. ***Eumenes fulvipennis niasanus*** Zimmermann

*Eumenes arcuata niasana* Zimmermann, 1931, Zeitschr. Morph. Oek. Tiere, vol. 22, p. 207, fig. 26 no. 9, ♀♂ — “Nias” (holotype ♀ in coll. Bingham, ZMB).

*Eumenes (Delta) arcuatus* var. *niasanus* Giordani Soika, 1935, Ann. Mus. Civ. Stor. Nat. Genova, vol. 57, p. 134 (considered not separable from “var. *fulvipennis* Sm.” from Celebes, Amboina and Mindanao) [*fulvipennis* (Sm.) Giord. Ska. includes *rumphii* m. and *squalidus* m.].

The holotype was kindly sent to me for examination by the Zoological Museum, Berlin. It agrees in all respects with *fulvipennis* Smith, but the gastral petiole is entirely black. The densely punctate pronotum and the yellowish wing base separate this form from *squalidus* m. Some relative measurements: Anterior margin of clypeus distinctly emarginate (1 : 8); distance between eyes at vertex = 25, greatest width of gastral petiole = 22, of second gastral segment = 66.

There can be little doubt that the locality label of the typical series is incorrect. Probably the insect will prove to be at home in one of the smaller islands around Celebes.

According to Zimmermann, the female may have the middle pair of petiolar spots, whereas in the male these spots are present together with faint traces of the basal spots. Furthermore the male has the middle of the clypeus yellow.

45. ***Eumenes squalidus***, new species

♀♂ — Very similar to *Eumenes fulvipennis* Smith, but the head and thorax less densely punctate, the wings fuscous at base, and the gastral petiole more strongly curved and swollen, and entirely black. On pronotum and mesopleura the interspaces are mostly larger than the punctures; propodeum with the junction of dorsal and lateral areas rounded as in *E. fulvipennis*, but the puncturation much less dense, the dorsal area with several interspaces which are at least as large as the punctures. Gastral petiole unusually swollen in apical half (figs. 1 d and 1e), its greatest height nearly twice that of the neck of the second segment in the female (23 : 12, against 19 : 12 in *E. fulvipennis* ♀), and equal to twice that of the neck of the second segment in the male; relative widths at base, behind the spiracles, and at apex, 13 : 21 : 27 in the female, 12 : 22 : 25 in the male.

In the only available male the antennal hook and the volsella of the genitalia (fig. 2 g) are hardly different from those of *E. fulvipennis*, but the clypeus is entirely black (fig. 5 l).

Length (h. + th. + t. 1 + 2): ♀ 20-23 mm, ♂ 20-21 mm.

Holotype: ♀, Dapitan, Mindanao, (C. F.) Baker (USNM); the specimens recorded below are paratypes.

M i n d a n a o: 1 ♀ Dapitan, Baker (ML); 1 ♀ Iligan, 1 ♂ Davao, Baker (USNM); 1 ♀ "Mindanao" (coll. Giordani Soika); 7 ♀ Calian, Davao Prov., 28 May, C. S. Clagg (4 ♀ MCZ, 1 ♀ BM, 2 ♀ ML).

#### 46. *Eumenes perplexus* Smith

*Eumenes perplexus* Smith, 1864, Jl. Proc. Linn. Soc. Zool., vol. 7, p. 39, ♀ — Buru, leg. Wallace ("probably a black variety of *E. arcuatus*") (OUM); 1871, l. c., vol. 11, p. 373 (cat.). Maindron, 1882, Ann. Soc. Ent. France, ser. 6, vol. 2, p. 275 (cat.). Dalla Torre, 1894, Cat. Hym., vol. 9, p. 28 (cat., *perplexa*) [erroneously recorded from "Afr.: Bourbon"]; 1904, Gen. Insect., vol. 19, p. 24 (cat., as 1894). Giordani Soika, 1935, Ann. Mus. Civ. Stor. Nat. Genova, vol. 57, p. 134 (considered identical with *E. arcuatus* var. *fulvipennis* Smith).

♀ — Closely allied to *Eumenes fulvipennis* Smith. Clypeus distinctly emarginate anteriorly (1 : 8.3), rather convex, as in *E. fulvipennis*, the anterior margin depressed and slightly more shiny than the convex part, wider at the sides than in the middle, but nowhere distinctly defined; the flattened disk with about 25 distinct punctures. Mesepisternum with several flat interspaces, of which, however, only a few are larger than the punctures. The impunctate lateral areas of the propodeum rather sharply separated from the punctate dorsal (posterior) area, but the transition rounded, not angular.

Black; inner orbits with yellow line which hardly reaches the eye-emarginations, a very short and narrow yellow line on the temples; gastral petiole with only the middle and the apical pairs of spots.

Wings yellow, with ferruginous veins; base not infuscated as in *E. squalidus*; the apical margin slightly smoky.

♂ — Thorax distinctly more sparsely punctate than in *E. fulvipennis*, especially the punctures on the upper part of the mesepisternum well separated, the interspaces flat, almost as large as the punctures, without any tendency to run into striae. Lateral areas of propodeum with only a few fine punctures in upper part. Antennal hook as in *E. fulvipennis* (see fig. 1 h).

Volsella of genitalia: fig. 2 h; the hairs on the basal part shorter than in *E. fulvipennis*.

Black: the following parts pale yellow: facial markings as in *E. fulvipennis*, but the clypeal mark wider anteriorly, the inter-antennal mark slightly projecting above the level of the upper margin of the antennal sockets, the sutures between antennae and clypeus black; a narrow line on the temples, a narrow line at anterior margin of pronotum, narrowly interrupted in the middle and on each side, a pair of small spots at apex of propodeum; the middle and apical pairs of petiolar spots, the basal pair small (1 ♂) or absent (1 ♂).

Buru: 1 ♀ "Bou" [= Bourou], leg. A. R. Wallace (type, OUM); 2 ♂ "Buru", coll. Gribodo (MCG, ML).

47. **Eumenes rumphii**, new species

♂ — Agrees in size and wing colour with *E. fulvipennis fulvipennis* Smith, but can be distinguished by the sparser puncturation, the shape of the antennal hook and of the genitalia, and by the slightly different colour pattern.

Inter-ocular distance on the vertex larger than that at the clypeus (20 : 16; in *fulvipennis* approximately 22 : 16); front above the antennae densely punctate, in the eye-emarginations with some distinct flat interspaces; antennal hook thicker than in any other species of this group (fig. 1 i). Dorsal areas of pronotum slightly concave, sparsely covered with fairly large, but superficial, punctures, the interspaces much larger than the punctures; mesopleura, scutellum, postscutellum, and dorsal area of propodeum (except at base) with locally slightly denser puncturation; mesoscutum equally sparsely, but more finely punctate; metapleura and lateral areas of propodeum impunctate; base of dorsal area with some scattered punctures.

Gastral petiole not unusually swollen, rather regularly increasing in width from base to apex; relative widths at base, behind the spiracles, and at apex: 11 : 16 : 23; the spiracles slightly more projecting than in *fulvipennis* (seen in dorso-lateral view); greatest width of petiole exceeding the inter-ocular distance on the vertex (23 : 20).

Pubescence of volsella of genitalia much sparser than in *fulvipennis* (compare figs. 2 i and f).

Black; facial markings more extensive than in *fulvipennis* (compare figs. 5 m and 5 k); temples with the usual short and narrow, pale yellow line; pronotum with a rather conspicuous yellow mark at anterior margin of the horizontal area, occupying nearly the middle third if the thorax is seen from above; mesopleura with two small and irregular yellow spots (one under pronotal tubercle, one near posterior margin; undoubtedly a variable character!). Propodeum and gaster entirely black. Antennal segments 10-12 partly ferruginous at under side. Mid tibiae with small and vague brownish spot at extreme apex. Wings as in *E. fulvipennis*; the outer third to half slightly more distinctly infuscated.

Length (h. + th. + t. 1 + 2) : 21-22 mm.

Holotype: ♂, "Amboina, coll. Gribodo" (MCG).

48. **Eumenes solomonis**, new species

♀ — In structure very similar to *E. arcuatus*, but the body smaller and more slender, head and thorax more coarsely punctate, and the anterior

margin of the clypeus very shallowly emarginate (1 : 12). Clypeus moderately convex, slightly depressed anteriorly. Humeral angles of pronotum more distinctly pronounced than in *E. arcuatus*.

Clypeus with some small, scattered, and rather superficial, punctures. Frons and vertex, pronotum, mesoscutum, mesepisternum, scutellum, postscutellum, and dorsal (posterior) area of propodeum coarsely and densely punctate, the punctures well defined, generally wider than deep, and mostly larger than the interspaces; there are, however, some larger interspaces on the middle of the posterior part of the mesoscutum, on the scutellum, at the apex of the postscutellum, and on the propodeum. Upper part of metapleura with 15-20 distinct punctures (smaller than those on mesepisternum). Lateral areas of propodeum not sharply separated from the dorsal (posterior) area, with some punctures near the transition.

Black; clypeus black or with yellow spot in the centre (size variable, in one specimen from Guadalcanal almost half as long as the clypeus); the following parts yellow: a small inter-antennal spot, a line at the inner orbits, from clypeus to near the middle of the lower side of the eye-emargination, a narrow line on the temples, a narrow band on the pronotum, abruptly dilated near the middle, the outer margin of the tegulae, a large mark on the upper part of the mesepisternum, a transverse band on the postscutellum, two V-shaped spots on the lower half of the posterior area of the propodeum, two spots in the middle and two at the apex of the gastral petiole (the former often much reduced, sometimes absent), two widely interrupted bands on the second tergite, a narrow apical band, abbreviated laterally and interrupted medially, on tergites 3 and 4; a very small spot in each lateral posterior angle of the second gastral sternite (in some specimens also the third sternite with such spots, which are then even smaller than those on the preceding sternite).

Wings moderately infuscated, darker than in *E. flavopictus blanchardi*.

♂ — Clypeus more deeply emarginate than in the female (1 : 6), and slightly more coarsely punctate, with median yellow mark which is rounded at the base and emarginate at the apex (fig. 5 p); inter-antennal mark as in fig. 5 p, the upper spot is reduced or absent in some specimens; tegulae variable, in one male from Guadalcanal with complete yellow outer margin, in two others from this island entirely black, in two males from Tulagi with more or less interrupted yellow band. The male collected by Froggatt has three pairs of spots on the gastral petiole, but in the others the basal spots are lacking, whereas the second pair is reduced or absent. In two males from Guadalcanal the bands on gastral tergites 3 and 4 are present, but in the allotype and the other specimens they are lacking. Fore femora and tibiae

and apex of mid tibiae with vestigial yellow spots or entirely dark. Volsella of genitalia: fig. 2 e.

Length (h. + th. + t. 1 + 2): ♀ 20-22 mm, ♂ 19-20 mm.

Holotype: ♀, Solomon Is., Tulagi, Ridge, collecting mud, 27 Aug. 1933, no. 537, H. T. Pagden (BM); allotype: ♂, Tulagi, on flowers, 29 July 1933, no. 366, H. T. Pagden (BM). The females recorded below are paratypes.

Nggela: 1 ♀ jungle near Halaita, 20 March 1934, no. 1157, H. T. Pagden (ML).

Tulagi: 1 ♂, 13 Aug. 1933, no. 465, H. T. Pagden (ML); 1 ♀ Ridge, collecting mud, 31 March 1934, no. 1172, H. T. Pagden (ML); 1 ♀ Ridge, 26 Dec. 1934, no. 1763, H. T. Pagden (BM); 1 ♀ Ridge, 26 Jan. 1935, no. 1779, H. T. Pagden (ML). 1 ♀ Florida, W. M. Mann (MCZ).

Guadalcanal: 1 ♀, irrigated taro area, 4 Sept. 1934, no. 1574, H. T. Pagden (BM). 1 ♀, Tenaru, 19 Oct. 1943, J. G. Franclemont (coll. K. V. Krombein). 1 ♀ 2 ♂ "Guadalcanal", 1944, Ernest Reimscheissel (USNM); 1 ♀ without locality label, but probably also from this island, leg. D. Elden Beck (USNM). 4 ♀ 1 ♂ Tapenanje, 10-23 Dec. 1953, J. D. Bradley (Rennel I. Exp. BM 1954-222) (BM, 2 ♀ ML).

I have seen two females (CSIRO) and one male (BM) labelled "Solomon Is., July-Aug. 1909, W. W. Froggatt", which are slightly more extensively yellow than the specimens recorded above: the clypeal mark is wider, the supra-clypeal area of the ♀ has a larger yellow spot, in the ♂ it is entirely yellow, with its median process reaching well beyond the level of the upper margin of the antennal insertions; pronotal band dilated laterally; mark on mesepisternum extending over the lower part, beyond the transverse suture; scutellum with two spots (small in the ♂), petiole with three pairs of spots. These specimens may have been collected in an island in the neighbourhood of those mentioned above.

The Gribodo collection (MCG) contains 1 ♀ labelled "Bougainville".

#### 49. *Eumenes solomonis malaitensis*, new subspecies

♀ — Structurally identical with the preceding form, but the body black with the exception of two minute spots at the apex of the gastral petiole, and the wings distinctly more strongly infuscated.

Holotype: ♀, Solomon Is., Malaita, Auki, W. M. Mann (MCZ).

#### 50. *Eumenes pagdeni*, new species

This species is distinguished by the shiny surface of the thorax, which is only very slightly pubescent, and which has a characteristic puncturation.

♀ — Anterior margin of clypeus deeply emarginate (fig. 4, no. 50). Junction of dorsal and lateral areas of propodeum rounded; dorsal area, as seen from above and behind, very slightly constricted before the apex. Gastral petiole gradually widening from the base to the apex; the relative widths at the base, behind the spiracles and at the apex = 12 : 18 : 25; the spiracles distinctly projecting.

Puncturation distinctly coarser than in *E. arcuatus*, but especially on the thorax the interspaces much larger. Clypeus dull, alutaceous, with irregular and superficial punctures which are much smaller than the interspaces; frons densely punctate, as in *E. arcuatus*; punctures on pronotum partly arranged in rows, several interspaces larger than the punctures; puncturation of mesoscutum, scutellum (except for the almost impunctate posterior margin), and postscutellum similar, but in the centre of the mesoscutum the punctures even more remote, with some impunctate areas measuring 2-4 times the diameter of one puncture; punctures of episternum slightly smaller than on the pronotum, and more remote, particularly below the transverse suture, where most interspaces are 2-3 times larger than the punctures. Metapleura and lateral areas of propodeum impunctate, the latter with only a few minute and scattered punctures near the upper margin, the dorsal area coarsely and densely punctate, more sparsely at the apex and laterally at the base.

Black; labrum reddish, mandibles brown with dark base; flagellum of antennae ferruginous beneath at base and apex; the following parts yellow: an inverted V-shaped mark on the clypeus, a short line at the inner orbits (just reaching the lower side of the eye-emarginations), two small inter-antennal spots; a narrow line at the outer orbits, some minute vestigial spots at the anterior margin of the pronotum, the two anterior spots of the mesoscutum (the tegulae black in all specimens!), a mark on the upper part of the mesepisternum, a minute line on the ridge of the lateral areas of the scutellum, a line on each side of the outer margin of the dorsal area of the propodeum, dilated and curved inwards at the base, where the lines are separated by a distance slightly smaller than the width of the disk of the postscutellum; two small spots near the middle and two at the apex of the gastral petiole; the usual transverse bands on the following tergites, but these bands slightly reduced as compared with *E. arcuatus*, and more orange yellow; segments 5 and 6 entirely black; second sternite with two small lateral spots near the middle and two at the apex, sternites 3 and 4 with small lateral spots at apex. Legs dull red; coxae and trochanters mainly blackish, tarsi brownish, fore tibiae yellow on outer side, fore femora and mid tibiae with small yellow spot at apex, knees slightly infuscated. Wings subhyaline with faint yellowish tinge.

Length (h. + th. + t. 1 + 2): ♀ 20-22 mm.

This specimen is an inhabitant of the Solomon Islands, where it is apparently less common than *E. solomonis*.

Holotype: ♀, Solomon Is., Nggele, jungle near Halaita, 20 March 1934, H. T. Pagden, no. 1156 (coll. Pagden, BM); the specimens recorded below are paratypes.

Tulagi: 1 ♀ Ridge, collecting mud, 30 Sept. 1934, H. T. Pagden, no. 1638 (ML) (lines on propodeum broken up into two marks on left side and three marks on right side; gastral petiole slightly deformed).

Guadalcanal: 1 ♀ Tenaru, 25 Oct. 1943, J. G. Franclemont (coll. K. V. Krombein) (clypeus yellow with narrow black margin; inter-antennal marks confluent; lines at inner orbits and markings on pronotum and propodeum slightly more extensive than in the type; fifth gastral tergite with two minute and vague spots); 1 ♀ "Guadalcanal & Florida Is.", 1 March 1945, J. R. Stuntz (CAS) (very similar to the type).

#### 51. *Eumenes transmarinus*, new species

The single available female represents a form which is closely allied to *E. arcuatus*, but which is probably specifically distinct.

♀ — Anterior margin of clypeus deeply emarginate (fig. 4, no. 51). Gaster petiole gradually widening from base to apex; the relative widths at the base, behind the spiracles and at the apex = 13 : 20 : 27; spiracles not projecting.

Puncturation almost as in *E. arcuatus*, but the interspaces on the pronotum and in the centre of the mesoscutum slightly larger.

Body, especially the thorax, only slightly pubescent, much more shiny than in *E. arcuatus*.

Colour pattern similar to that of *E. arcuatus*, but differing as follows: upper lateral angles of inter-antennal mark rounded; mesoscutum with only the anterior pair of spots; tegulae with narrow, widely interrupted, yellow band at outer margin; spots on scutellum small; dorsal (posterior) area of propodeum yellow with median black band, the transverse dark band only faintly developed; basal pair of petiolar spots absent (the petiole here slightly brownish); bands on gastral tergites 2-5 wider, the bands on the second tergite hardly interrupted in the middle, separated by a black band which in the middle is about as wide as the yellow bands, laterally much narrower; markings on sternites also slightly larger, but the apical bands nevertheless widely interrupted. Hind tibiae with yellow mark on apical half only. Wings slightly more infuscated and less distinctly yellowish.

Holotype: ♀, N. W. Australia, de Freycinet I., 90-80 (BM).

Fig. 6. Map showing the distribution and diagrams of the colour pattern of the *Eumenes* species of the *curvatus* group and of the subspecies of *E. incola* Giordani Soika. — The wing colour is shown by various degrees of shading; undotted or sparsely dotted areas may have a yellow tinge.

1. *indosinensis* n. sp. — Tenasserim; Laos.
2. *viridipennis* n. sp. — Durian I., Riouw Archipelago.
3. *violaceipennis* n. sp. — W. Java; Bali.
4. *sciarus* n. sp. — Sumbawa; Komodo; Flores; Sumba.
5. *wieneckeii* n. sp. — Timor.
7. *curvatus curvatus* Saussure — Philippine Is.
8. — *talaudensis* n. subsp. — Talaud Is.
9. — *sangirensis* n. subsp. — Sangir Is.
12. *incola mauritsi* n. subsp. — Vogelkop, New Guinea.
13. — *octomaculatus* n. subsp. — Misool I.
14. — *zonites* n. subsp. — North New Guinea.
15. — *incola* Giordani Soika — South East New Guinea.
16. — *aruensis* Giordani Soika — Aru Is.
17. — *teleporus* n. subsp. — Queensland.

The nrs. 6 (*inflexus* Saussure, black with brownish wings — habitat unknown), 10 (*zimmermanni* Giordani Soika, black with dark brown wings — Palawan, Philippine Is.), and 11 (*zamenis* n. sp., black with the wings russet-yellow with dark base — Celebes and Sula Is.) are not represented on this map.

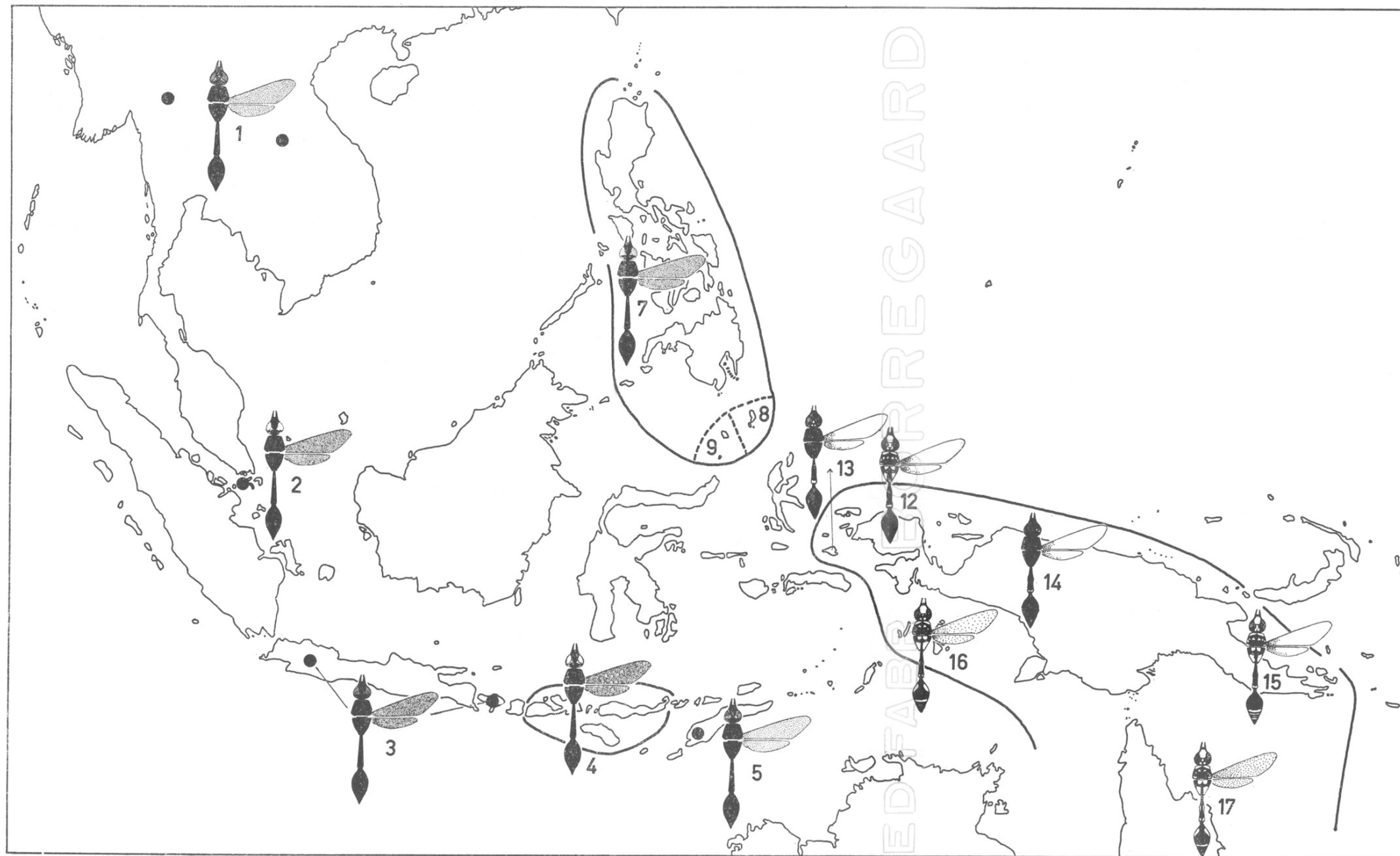


Fig. 7. Map showing the distribution and diagrams of the colour pattern of the subspecies of *Eumenes flavopictus* Blanchard and *E. arcuatus* (Fabricius) and of some allied species. Orange-brown markings are indicated by dotted areas (nrs. 38-41); the wing colour is shown by various degrees of shading, the absence of dots indicating that the wings have partly or entirely a more or less pronounced yellowish tinge.

18. *flavopictus flavopictus* Blanchard — India; Ceylon.
  19. — *continentalis* Zimmermann — from India to South China and Sumatra.
  20. — *formosanus* Zimmermann — Formosa.
  21. — *andamanicus* Zimmermann — Andaman Is.
  22. — *nicobaricus* Meade-Waldo — Nicobar Is.
  23. — *simalurensis* Giordani Soika — Simalur I.
  24. — *umbripennis* n. subsp. — Nias.
  25. — *telonus* n. subsp. — Batu Is.
  26. — *maidli* Giordani Soika — Siberut I. and Sipora I.
  27. — *engganensis* n. subsp. — Enggano I.
  28. — *kalimantenus* n. subsp. — Borneo.
  29. — *aidrytus* n. subsp. — Palawan-Luzon, Philippine Is.
  30. — *blanchardi* Saussure — Java-Flores and Sumba.
  31. — *baweanus* n. subsp. — Bawean I.
  32. — *timorensis* n. subsp. — Timor and Wetar I.
  33. — *dammae* Dalla Torre — Damma I.; ? Kei Is.
  34. *eremnus* n. sp. — Flores and Sumba.
  35. *arcuatus arcuatus* (Fabricius) — New Guinea, Kei and Aru Is., Queensland.
  36. — *transilis* n. subsp. — Misool.
  37. — *amboinensis* n. subsp. — Amboina; Saparua; Ceram.
  38. — *buruanus* n. subsp. — Buru.
  39. — *lyratus* n. subsp. — Northern Moluccas, excl. Obi I.
  40. — *obiensis* n. subsp. — Obi I.
  41. — *praslinius* Guérin — Bismarck Archipelago.
  42. *fulvipennis fulvipennis* Smith — Celebes and Buton; ? Sula Is.
  45. *squalidus* n. sp. — Mindanao.
  46. *perplexus* Smith — Buru.
  47. *rumphii* n. sp. — Amboina.
  48. *solomonis* n. sp. — Nggela; Tulagi; Guadalcanal; ? Bougainville.
  49. *solomonis malaitensis* n. subsp. — Malaita I.
  50. *pagdeni* n. sp. — Nggela; Tulagi; Guadalcanal.
- No diagrams: no. 31 (female unknown, probably similar to 29); no. 47 (female unknown, probably similar to 42, but petiole black).
- Not represented: no. 43 (*fulvipennis saleyerensis* Zimmermann, perhaps not different from 42); no. 44 (*fulvipennis niasanus* Zimmermann, probably based on incorrectly labeled specimen); no. 51 (*transmarinus* n. sp., Freycinet I., N. Australia).

