

## A TAXONOMIC REVISION OF *PHIMENES* GIORDANI SOIKA (HYMENOPTERA : VESPIDAE : EUMENINAE) OF INDIAN SUBCONTINENT

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### INTRODUCTION

In 1855, de Saussure erected the name *Phi* for division IV of the genus *Eumenes* Latrielle. The type species of this division is *Vespa arcuata* Fabricius, 1775, by the subsequent designation of Bequaert (1926). Since the name *Phi* is preoccupied by a subgenus of a New World polistine genus *Mischocyttarus*, Giordani Soika (1992) proposed a new name *Phimenes* for *Phi* de Saussure.

The genus *Phimenes* Giordani Soika is widely distributed in Australian and Oriental region. At present, 19 species and 38 subspecies are recorded from the world (Source: Global Names Index BETA website [http://gni.globalnames.org/data\\_sources](http://gni.globalnames.org/data_sources)) and this group requires a thorough revisionary work for assessing the exact species number. The species *Phimenes flavopictum* (Blanchard, 1845) is the only species distributed in the Indian subcontinent with its four subspecies namely *Phimenes flavopictum flavopictum* (Blanchard, 1845), *Phimenes flavopictum andamanicum* (Zimmermann, 1931), *Phimenes flavopictum continentale* (Zimmermann, 1931) and *Phimenes flavopictum nicobaricum* (Meade-Waldo, 1910). After a detailed study based on a large number of specimens collected from different localities of India and Sri Lanka, I proposed a new synonymy for the subspecies *Phimenes flavopictum continentale* (Zimmermann, 1931) under the nominate species *Phimenes flavopictum* (Blanchard, 1845) and the subspecies *Phimenes*

*flavopictum andamanicum* (Zimmermann, 1931) and *Phimenes flavopictum nicobaricum* (Meade-Waldo, 1910) are elevated into distinct species status namely *Phimenes andamanicum* (Zimmermann, 1931) and *Phimenes nicobaricum* (Meade-Waldo, 1910). Hence, three valid species, namely, *Phimenes flavopictum* (Blanchard), *P. andamanicum* (Zimmermann) and *P. nicobaricum* (Meade-Waldo) are present in the Indian subcontinent.

Since the earlier descriptions were not sufficient for the identification, detailed redescriptions with sufficient illustrations and photographs are provided here. The detailed synonymical references and a key to separate the Indian subcontinent species were also provided. During the present study it is found out that the species *Phimenes flavopictum* (Blanchard) is newly recorded from Delhi, Manipur, Mizoram, Nagaland and Tripura and *P. andamanicum* (Zimmermann) is newly recorded from Nicobar Islands.

### MATERIAL AND METHODS

This study is based on a large number of specimens present in the Hymenoptera Section of the Zoological Survey of India, Kolkata. All the specimens were properly curated, registered and deposited at the 'National Zoological Collections' of the Zoological Survey of India, Kolkata (NZSI).

*Abbreviations used for the Museums:* BMNH = British Museum of Natural History, London, England; MP = Museum National d'Histoire

Naturelle, Geneve, Paris, France; NZSI = 'National Zoological Collections' of Zoological Survey of India, Kolkata, India; ZMB = Zoologisches Museum der Humboldt Universitat, Berlin, Germany.

Abbreviations used for the terms: H = Head; M = Mesosoma; OOL = Ocellocular length; POL = Postocellar length; T1-T2 = Gastral tergites 1 and 2.

## RESULTS

### Genus *Phimenes* Giordani Soika

*Phimenes* Giordani Soika, 1992, *Lavori Soc. Ven. Sci. Nat.*, **17**: 41, 66, genus, replacement name for *Phi* de Saussure, 1855, *not* de Saussure, 1854. Type species: *Vespa arcuata* Fabricius, 1775, by subsequent designation of Bequaert, 1926, *Ann. S. Afr. Mus.*, **23**: 487, as type species of *Phi* de Saussure, 1855.

**Diagnosis:** Clypeus subpyriform; cephalic fovea absent; occipital carina strong, complete and narrowed ventrally; antenna farther from each other than from eyes; last antennal segment of male hooked apically; anterior face of pronotum almost smooth; pronotum with distinct pretegular carina; parategula exceeding tegulae posteriorly; axillary fossa not slit-like, much broader; metanotum at the same level of scutellum and propodeum, not raised; median groove of propodeum distinct, complete; midtibia with one spur; second sub marginal cell of forewing acute basally; petiole length 1.25x or more than 1.25x the length of mesosoma in lateral view; second gastral tergum without lamellae separated by apical thickening.

**Distribution:** Australian, Oriental.

#### 1. *Phimenes flavopictum* (Blanchard, 1845) (Figs. 1-20; photo 1)

*Eumenes* "*arcuata* Fabricius"; Donovan, 1804, *Epit. Nat. Hist. Ins. India*: pl. 57 ("54") fig. 3 (Madras?). Additional citations: Westwood, 1842, in Donovan, *Nat. Hist. Ins. India*, ed. **2**: 90, pl. 57 fig. 3; Smith, 1861, *J. Linn. Soc. (Zool.)*, **5**: 126 (*arcuatus*); Smith, 1865, *J. Linn. Soc. (Zool.)*, **11**: 372 (cat.) (*arcuatus*); Smith, 1871, l. c., vol. ii, p. 372 (cat. as 1861); Smith, 1878, *J. Asiat. Soc. Beng.*, **47**: 168 (*arcuatas*; Moulmein, Tenasserim); Bingham,

1897, *Fauna Brit. India, Hym.*, vol. 1, p. 346, (*arcuatus*); Rothney, 1903, *Trans. Entomol. Soc. Lond.*, **106** (*arcuata*; Barrackpore, Bengal); Bingham, 1905, *Fasc. Malay., Zool.*, **3**: 47 (Malaya; Burma); Dover and Rao, 1922, *J. Proc. Asiat. Soc. Beng. (n. s.)*, **18**: 238 (*arcuata*; Lebong, Moulmein, Burma; note on nest); Dover, 1925, *J. Proc. Asiat. Soc. Beng. (n. s.)*, **20**: 296, fig. 6 (*arcuata*; *flavopicta* is a colour var.); Dover, 1926, *China J. Sci. Arts*, **4**: 233 (Hong Kong); Dover, 1929, *Bull. Raffles Mus.*, **2**: 44 (*arcuata*; Malaya) [incorrectly recorded from Sarawak, Borneo, New Guinea]; Dover, 1931, *J. Fed. Malay St. Mus.*, **16**: 253 (*arcuata*; Malaya); Giordani Soika, 1935, *Ann. Mus. Civ. Stor. Nat. Genova*, **57** (1934): 133 (syn.: *formosanus* Zimm. and *continentalis* Zimm.).

*Eumenes flavopictus* Blanchard, 1841-49, in Ch. d'Orbigny, *Dict. Univ. Hist. Nat., Planches*, vol. **2**, Ins., Hym., pl. 2, fig. 21, Type locality Unknown (MP?). Additional citations: Saussure, 1852, *Et. Fam. Vesp.*, **1**: 65, , pl. IV, figs. 3a, 3b, (*flavopicta*), "Indes Orientales" (MP); de Saussure, 1855, l. c., **3**: 132, description of *Smith*, 1857, *Cat. Hym. Brit. Mus.*, **5**: 22 (cat., *flavopicta*); Smith, 1858, *J. Linn. Soc. (Zool.)*, **2**: 108 (*flavopicta*; Singapore); Smith, 1871, *J. Proc. Linn. Soc. Zool.*, **2**: 371 (cat., *flavo-picta*); Maindron, 1882, *Ann. Soc. Ent. France*, ser. 6, vol. **2**, p. 272 (*flavopicta*; syn. of *E. arcuata*); Bingham, 1888, *J. Bombay Nat. Hist. Soc.*, **3**: 187 (*flavopicta*, Burma); Bingham, 1896, *Proc. Zool. Soc. Lond.*, p. 448 (*flavopicta*; Ceylon); Bingham, 1897, *Fauna Brit. India, Hym.*, **1**: 345, *flavopicta*); Rothney, 1903, *Trans. R. Ent. Soc. Lond.*, p. 106 (*flavopicta*; Barrackpore, West Bengal, common); Stebbing, 1905, *J. Bombay Nat. Hist. Soc.*, **16**: 674 (*flavopicta*, Burma); Strand, 1910, *Jahrb. Nass. Ver. Naturk.*, **63**: 49 (*flavopicta*; Ceylon); Annandale, 1912, *Rec. Indian Mus.*, **7**: 39 (*flavopicta*; Parésnath, India, 4000-4400 ft); Dover & Rao, 1922, *J. As. Soc. Bengal, new ser.*, **18**: 238 (*flavopicta*; India; Ceylon); Dover, 1925 (1924), *ibid.*, **20**: 296, fig. 6 (*flavopicta*).

*Eumenes arcuata* var. *flavopicta* Dalla Torre, 1894, *Cat. Hym.*, **9**: 18 (cat.). Additional citations: Dalla Torre, 1904, *Gen. Insect.*, **19**: 21 (cat.); von Schulthess, 1914, *Zool. Jahrb. Syst.*, **37**: 263 (*arcuatus*

var. *flavopictus*, Sumatra); Zavattari, 1911, *Ann. Mus. Zool. Univ. Nap.*, new ser., vol. 3, no. 19, p.2 (*flavopictus*; Ceylon); Dusmet, 1930, *Bol. Soc. Ent. Esp.*, 13: 102 (*flavopictus*; Khandala, India).

*Eumenes arcuatus* var. *praslinius* (Guerin): Bequaert, 1928, *Ann. Mag. Nat. Hist.*, ser. 10, vol. 2, p. 169 (in key; syn.: *flavopictus* Blanch.).

*Eumenes arcuata flavopicta* Zimmermann, 1931, *Zeitschr. Morph. Oek. Tiere*, 22: 205, fig. 26, no. 1 (Ceylon; wrongly reported from Sumatra and Java).

*Eumemes arcuatus continentalis* Zimmermann, 1931, *Z. Morph. Ökol. Tiere*, 22: 205, 224, 226, fig. 26 no. 3, *arcuata continentalis* - "Sikhim"; India to Canton; Sumatra ( , ZMB) [erroneously recorded from Borneo]; Giordani Soika, 1934, *Boll. Soc. Venez. Stor. Nat.*, 1: 42 (not a separate var.); Giordani Soika, 1935, *Ann. Mus. Civ. Stor. Nat. Genova*, 57 (1934): 133 (syn. of *arcuatus arcuatus*); van der Vecht, 1937, *Treubia*, 16: 268, fig. 3a (Sumatra; erroneously recorded from Borneo); Dammerman, 1948, *Verh. K. ned. Akad. Wet.*, (2) 44: 364 (Krakatau).

*Eumenes flavopictus flavopictus* Blanchard: in van der Vecht, 1959, *Zool. Verh. Leiden*, 41: 32.

*Eumenes flavopictus continentalis* Zimmermann : in van der Vecht, 1959, *Zool. Verh. Leiden*, 41:15. Additional citation: Iwata, 1965, *Mushi* 38: 105, pl. 9 fig. 9 (anat. ovary), pl. 10 fig. 11 (egg). New synonymy.

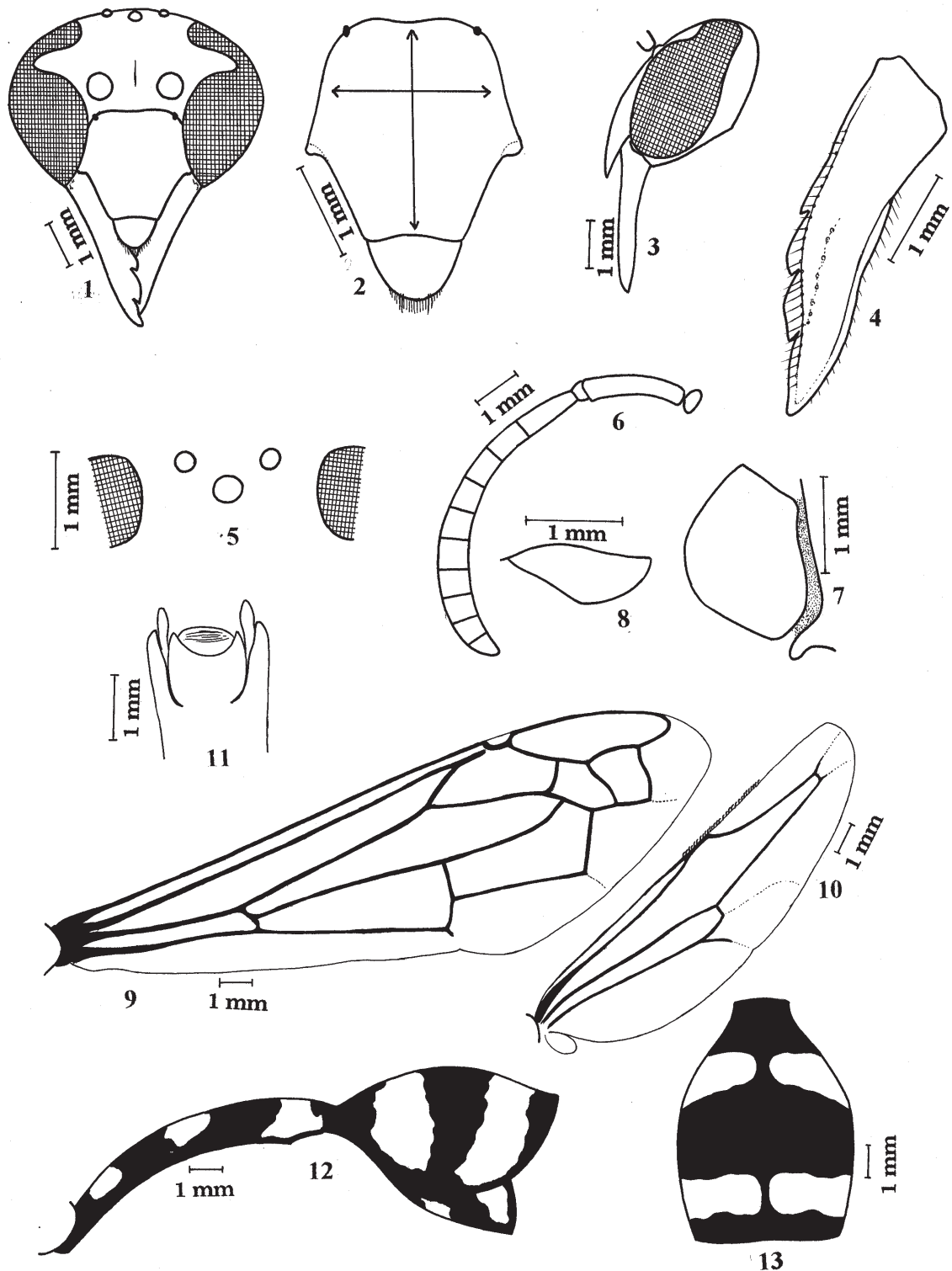
*Delta arcuata* (Fabricius): in Gupta, 2007, *Zool. Surv. India, Faunal Diversity Western Doon Shiwaliks*, p. 37 (recorded from Tiparpur in Dehradun).

Based on the detailed examination of specimens from various localities of Indian subcontinent, reached the conclusion that *Phimenes flavopictus continentalis* (Zimmermann, 1931) based on the type species from Sikkim is no more than a local colour variation of the nominate species *Phimenes flavopictum flavopictum* (Blanchard, 1845). Hence, herewith propose to synonymise *Phimenes flavopictus continentalis* (Zimmermann, 1931) under the nominate species

*Phimenes flavopictum flavopictum* (Blanchard, 1845).

*Redescription*: Female: Body length (H+M+T1+T2) 24-26 mm; forewing length 17.5-19.5 mm. Black with the following yellow markings: clypeus, an interantennal mark, a line at the inner orbits, a narrow line at the outer orbits (in some specimens more extensive yellow markings; yellow lines at inner and outer orbits almost coalescent or narrowly or widely interrupted on the vertex, line at the outer orbit more widened and extends posteriorly); a transverse band on the pronotum (in brightly coloured forms yellow maculation more extended, sometimes a yellow spot at variable size present posteriorly near tegulae); 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 (in brightly coloured forms scutellum almost entirely except peripheral areas), marks behind axillary fossa near base of hind wing, a vertical band on the mesepisternum, a band on outer margin of tegulae, a band on the postscutellum, two large marks on posterior area of propodeum (leaving a median, cross shaped area black, in some brightly coloured forms yellow maculation more extensive except a longitudinal black marking medially and two minute black spots inside the yellow area); marks on outer side of mid and hind coxae, a line at the inner side of fore femora, most of the fore tibiae (leaving a brown line on the inner side), a line on the outer side of mid and hind tibiae; three pairs of spots on the gastral petiole (anterior pair sometimes coalescent or separated or absent, posterior pair also sometimes coalescent); 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, a pair of small spot at apex of 6<sup>th</sup> tergite and widely interrupted bands at the apex of sternites 2-5 (in some specimens a pair of spot on second sternite medio-laterally). Brown markings as follows: labrum brown; mandible blackish brown (in some specimens a very small yellow spot near base of mandible). Wings fusc-hyaline.

## PLATE I



**Plate 1:** *Phimenes flavopictum* (Blanchard) Female. 1. Head front view; 2. Clypeus; 3. Head lateral view; 4. Left mandible; 5. Ocellar area; 6. Antenna; 7. Tegula and parategula; 8. Propodealvalvula; 9. Forewing; 10. Hindwing; 11. Apical portion of ventral side of petiole; 12. Petiole and second gastral segment in lateral view; 13. Second gastral tergite dorsal view.

## PLATE II

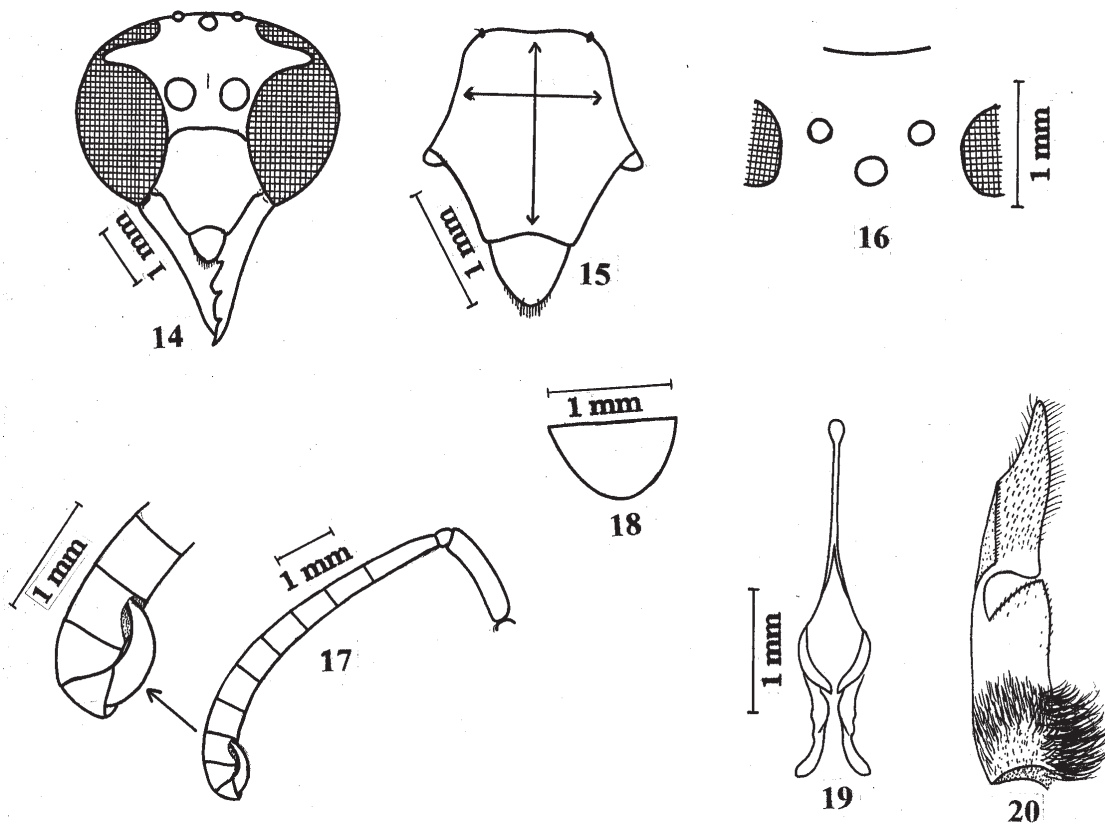


Plate II : *Phimenes flavopictum* (Blanchard) Male. 14. Head front view; 15. Clypeus; 16. Ocellar area; 17. Antenna; 18. Last gastral sternite; 19. Aedeagus dorsal view; 20. Volsella.

**Head:** Width in front view (Fig. 1) 1.30x as long as distance between front ocellus and clypeal margin medially; clypeus (Fig. 2) subpyriform, the apex widely truncate, raised at base and sides, anterior margin moderately emarginate (Fig. 1), width 0.86x its length medially, sparsely punctate, the punctures not well defined; mandible (Fig. 4) long and moderately stout with four distinct teeth on inner side; labrum (Fig. 2) rounded at apex; supraclypeal area smooth; frons and ocular sinus closely and strongly punctured, interspaces distinctly less than diameter of punctures; area in front of median ocellus smooth; vertex and temple with scattered minute punctures; occiput almost smooth with fine scattered minute punctures; cephalic fovea absent; POL (Fig. 5) 1.68x OOL; diameter of anterior ocellus slightly longer than the distance between anterior ocellus and posterior ocelli; interocular distance almost equal on vertex and at

clypeus (37:37.5); temple (Fig. 3) distinctly narrower (0.67x) than eye in profile (measured through its ocular sinus); occipital carina strong, complete and narrowed ventrally. Antenna farther from each other than from eyes (12:4); scape length 1.69x length of F1 (Fig. 6); F1 1.62x as long as F2, 3.25x as long as wide, flagellar segments slightly widening towards apex as in figure 6; apical antennal segment slightly longer than wide (23:21).

**Mesosoma:** Pronotum strongly and closely punctured except anterior face almost smooth, anterolateral angle with scattered punctures; mesoscutum, scutellum and metanotum strongly and closely punctured; propleuron smooth with minute scattered punctures; mesepisternum densely, in the upper part above the transverse suture almost reticulately punctuate, the interspaces much smaller than the punctures; anterior, posterior and lower sides of

## PLATE III

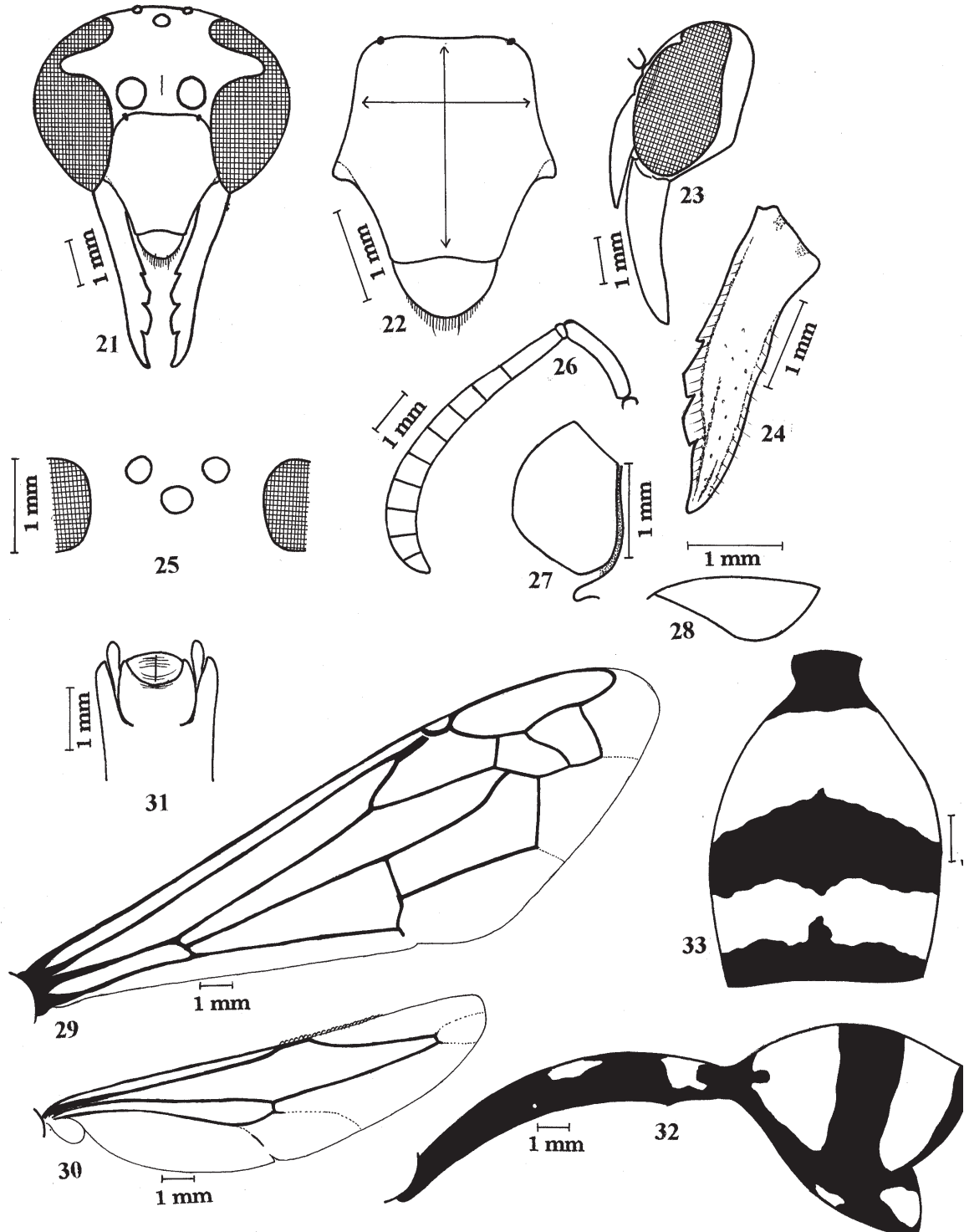


Plate III : *Phimenes andamanicum* (Zimmermann) Female. 21. Head front view; 22. Clypeus; 23. Head lateral view; 24. Left mandible; 25. Ocellar area; 26. Antenna; 27. Tegula and parategula; 28. Propodealvalvula; 29. Forewing; 30. Hindwing; 31. Apical portion of petiole; 32. Petiole and second gastral segment in lateral view; 33. Second gastral tergite dorsal view.

mesopleuron below transverse suture smooth; metapleuron almost smooth except few punctures in the middle of dorsal metapleuron; propodeal dorsum strongly punctured except at dorsolateral angle almost smooth; ventral area of propodeum strongly punctured except the inner concavity almost smooth; lateral areas of propodeum entirely smooth; median groove of propodeum distinct, punctured and complete; pronotum with distinct pretegular carina; median length of mesoscutum slightly longer than its maximum width (1.04x); pretegula (Fig. 7) exceeding tegulae posteriorly; axillary fossa not slit-like, much broader; metanotum at the same level of scutellum and propodeum, not raised; propodeal valvula as in figure 8. Midtibia with one spur. Forewing and hind wing as in figures 9 & 10; fore wing with prestigma 1.31x pterostigma, second submarginal cell acute basally.

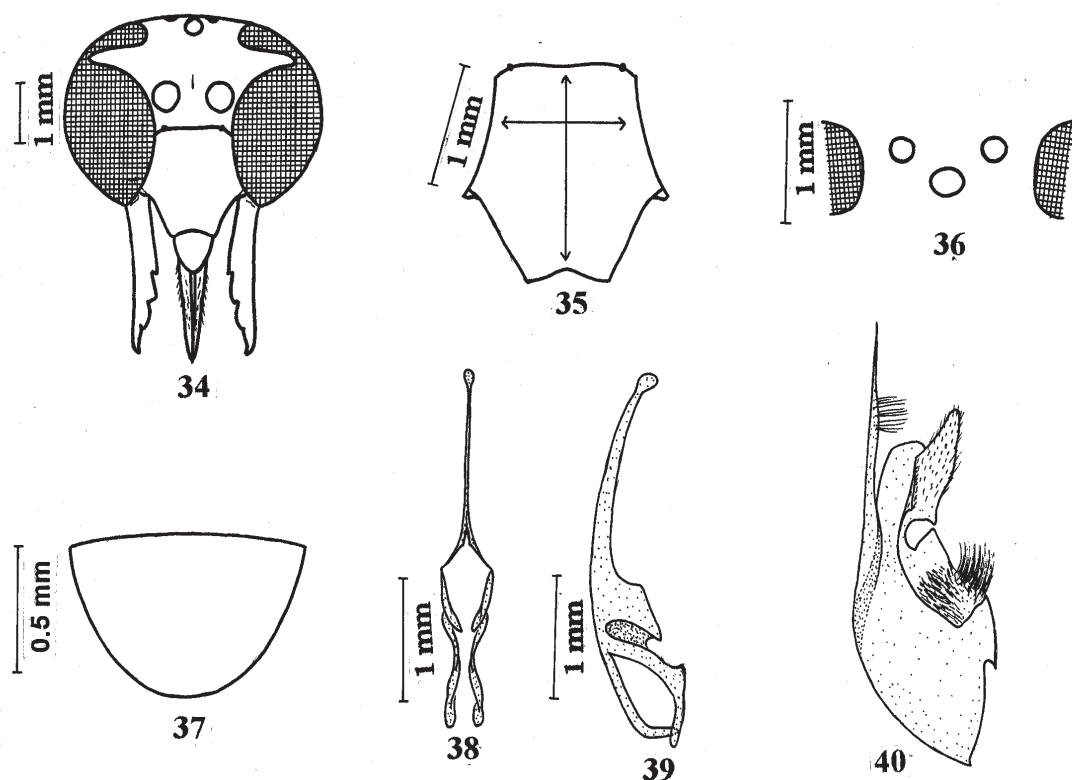
*Metasoma*: Petiole length 1.25x than mesosoma in lateral view, 1.37x second gastral tergite (Fig. 12); apex of petiole on ventral side as in figure 11; petiole and gaster almost smooth; second gastral tergum (Fig. 13) without lamellae separated by apical thickening, slightly curved inwards medially at apex, almost straight, 1.44x as long as broad; posterior apices of 3<sup>rd</sup>-5<sup>th</sup> tergites and 2<sup>nd</sup>-5<sup>th</sup> sternites distinctly curved inward at middle.

*Male*: Body length (H+M+T1+T2) 16-20 mm; forewing length 13.5-14.5 mm. Head width in front view (Fig. 14) 1.30x distance between front ocellus and clypeal margin medially; median length of clypeus (Fig. 15) 1.26x its width; POL (Fig. 16) 2.60x OOL; Antenna as in figure 17; last antennal segment (Fig. 17) hooked apically, hook long, curved and pointed, in curved position it almost reaches the apex of ninth antennal segment; 3<sup>rd</sup>-6<sup>th</sup> gastral sternites with dense hairs; 7<sup>th</sup> sternite almost flat, rounded apically (Fig. 18) without dense hairs except at apical margin, apical margin with dense hairs; Genitalia as in figures 19 & 20; apical tip of aedeagus bulb-like; pubescence of base of volsella long and dense; digitus of volsella wider, densely pubescent at base, dorsally with distinct blunt angle;

parameral spine elongate with moderately large hairs. Other characters almost same as in female.

*Material examined*: **India**: Arunachal Pradesh, West Kameng dist., Bhalukpong, 1, 7.ix.1998, Coll. A. R. Lahiri & Party (NZSI Reg. No. 12631/H3); Assam, Tinsukia dist., Sadiya, Abor Expedition, 1, 28.xi.1911, Coll. Kemp (NZSI Reg. No. 12632/H3); Delhi, Janakpuri, 1, 21.xii.1975, Coll. Anita (NZSI Reg. No. 12633/H3); Jharkhand, Giridih dist., Parasnath Hills, 1, 12.iv.1909, Coll. Annandale (NZSI Reg. No. 12634/H3); Karnataka, Bengaluru, 2, date of collection unknown, Coll. Cameron (NZSI Reg. Nos. 12635/H3 & 12636/H3); Kerala, Thiruvananthapuram, 1, v.1888, Collector unknown (NZSI Reg. No. 12637/H3); Thiruvananthapuram dist., Nedumangad, 1, 14.xi.1908, Collector unknown (NZSI Reg. No. 12638/H3); Thrissur dist., Chalakkudi, 1, 14-30.ix.1914, Coll. F. H. Gravely (NZSI Reg. No. 12639/H3); Maharashtra, Satara dist., Mahabaleswar, 1, date of collection unknown, Coll. F. H. Gravely (NZSI Reg. No. 12640/H3); Bhimashankar Wildlife Sanctuary, 9, 3.v.1965, Coll. B. S. Lamba (NZSI Reg. Nos. 12641/H3 to 12649/H3); Kolhapur dist., Mahalewadi, 1, 14.i.1998, Coll. A. K. Hazra & Party (NZSI Reg. No. 12650/H3); Manipur, Imphal West dist., Kanchipur, 1, 8.x.1976, Coll. Tyagi (NZSI Reg. No. 12651/H3); Meghalaya, East Khasi Hills dist., Dawki, 1, 12.iv.1966, Coll. V. K. Gupta (NZSI Reg. No. 12652/H3); Ri-Bhoi dist., Nongpoh, 1, 16.x.1975, Coll. V. K. Gupta (NZSI Reg. No. 12653/H3); Jaintia Hills dist., Umkiang, Narpuh Reserve Forest, 1, 14.ix.1998, Collector unknown (NZSI Reg. No. 12654/H3); Mizoram, Lunglei dist., Hnahchang, 1, 13.xi.1995, Coll. P. H. Roy & Party (NZSI Reg. No. 12655/H3); Nagaland, Naga Hills, 2 & 1, date of collection unknown, Coll. Robertson (NZSI Reg. Nos. 12656/H3 to 12658/H3); Sikkim, 1, vii.1898, Coll. Dudgeon (NZSI Reg. No. 12659/H3); 2 & 5 (old specimens without further collection data), (NZSI Reg. Nos. 12660/H3 to 12666/H3); Tamil Nadu, Nilgiri Hills, 1, v.1904, Coll. W. Rowson (NZSI

## PLATE IV



Plater IV : *Phimenes andamanicum* (Zimmermann) Male. 34. Head front view; 35. Clypeus; 36. Ocellar area; 37. Last gastral sternite; 38. Aedeagus dorsal view; 39. Aedeagus lateral view; 40. Inner side of right paramere with volsella.

Reg. No. 12667/H3); Kanyakumari Wildlife Sanctuary, Alagiapandipur Range, 1, 11.vi.2007, Coll. S. Prabakaran & Party (NZSI Reg. No. 12332/H3); Tripura, West Tripura dist., Teliamura, 1, 18-20.v.1978, Coll. J. K. Jonathan & Party (NZSI Reg. No. 12668/H3); Uttarakhand, Nainital dist., Corbett National Park, Garjia, 1, 21.iv.1967, Coll. V. K. Gupta (NZSI Reg. No. 12669/H3); Almora dist., Dunagiri, 1, 12.x.1973, Coll. Girish (NZSI Reg. No. 12670/H3); Dehradun dist., Rishikesh, 1 & 1, 5.xi.1978, Coll. R. K. Varshney & Party (NZSI Reg. Nos. 12671/H3 & 12672/H3); West Bengal, Darjeeling dist., Singla, 12 & 5, iii.1913, Coll. Lord Carmichael (NZSI Reg. Nos. 398/H3 to 411/H3 and 418/H3). Sri Lanka: Central Province, Kandy dist., Paradeniya, 1, 21.v.1910, Coll. Unknown (NZSI Reg. No. 12694/H3); Kandy, 1, vi.1910, Coll. Unknown (NZSI Reg. No. 12695/H3).

*Distribution:* India: Arunachal Pradesh, Assam, Delhi (new record), Jharkhand, Karnataka, Kerala, Maharashtra, Manipur (new record), Meghalaya, Mizoram (new record), Nagaland (new record), Sikkim, Tamil Nadu, Tripura (new record), Uttarakhand, West Bengal.

*Elsewhere:* China, Hong Kong, Indonesia, Malaysia, Myanmar, Singapore, Sri Lanka, Thailand.

*Discussion:* *Phimenes flavopictum* (Blanchard) has been considered conspecific with *P. arcuatum* (Fabricius) for a long period of time and several earlier workers had misidentified it as *P. arcuatum*. But *P. flavopictum* distinctly differs from *P. arcuatum* in having: (1). Anterior margin of clypeus of female very shallowly emarginate (in *P. arcuatum*, the emargination of anterior margin of clypeus deeper); (2). Mesepisternum of female densely punctate with upper part above



transverse suture almost reticulately punctate and the interspaces much smaller than punctures (in *P. arcuatum*, mesepisternum more sparsely punctate, the punctures partly arranged in irregular rows, interspaces between these rows usually larger than the punctures, below the transverse suture the punctures even more sparse); (3). Posterior area of propodeum in female densely punctate, rather sharply separated from the impunctate lateral areas, the transition being distinctly angular (in *P. arcuatum* 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); (4). In female, pubescence of head and mesosoma not much longer and denser (in *P. arcuatum*, pubescence of head and mesosoma comparatively longer and denser); (5). Basal part of volsella in male genitalia densely clothed with long hairs (*P. arcuatum*, basal part of volsella in genitalia densely clothed with short hairs). The geographical distributions of these two species are also different. *Phimenes flavopictum* distributed throughout south-eastern part of continental Asia, in the Western half of the Indo-Australian archipelago (except in most of the Philippine Islands and in Celebes) and in the Islands of the Sunda arc up to Tenimber and perhaps also in the Kei Islands. But *Phimenes arcuatum* distributed in the Moluccas, New Guinea and neighbouring Islands, New Britain and north Australia and perhaps also in the Kei Islands (van der Vecht, 1959).

*Remarks:* New record for Delhi, Manipur, Mizoram, Nagaland, Tripura.

2. *Phimenes andamanicum* (Zimmermann, 1931) status nova  
(Figs. 21-40; Photo 2)

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

*Eumenes flavopictus andamanicus* Zimme-

rmann : in van der Vecht, 1959, *Zool. Verh. Leiden*, 41: 40, , fig. 4 (21). Additional citation: van der Vecht, 1961, *Evolution* 15: fig. 4A (p. 472, colour pattern), table 1 (distribution).

The colour form *Phimenes flavopictus andamanicus* (Zimmermann, 1931) is endemic to Andaman & Nicobar Islands and remain a distinct colour form, distinctly differ from all other colour forms of *Phimenes flavopictum* (Blanchard, 1845). Hence, herewith propose to elevate this colour form to a specific rank as *Phimenes andamanicum* (Zimmermann, 1931).

*Redescription:* Female: Body length (H+M+T1+T2) 24-27 mm; forewing length 20-20.5 mm. Head black, with a narrow line at inner orbit from clypeus to centre of eye emargination and a short and narrow line on the temple pale yellow (in one specimen two small yellow spots present near middle of clypeus and another one spot at supraclypeal area; in another specimen a very small yellow spot at middle of frons posteriorly at the level antennal scrobe); antenna black, apical segments brownish on ventral side; labrum blackish brown; mandible black to blackish brown; mesosoma black (in one specimen a very small yellow spot on metanotum posteromedially; in another specimen a yellow stripe at angle between posterior and lateral sides of propodeum at its posterior half); metasoma black, extensively marked with yellow: first pair of petiolar spots lacking (in some specimens first pair of petiolar spots vaguely present), second pair elongate, third pair confluent, forming a preapical yellow band (in some specimens third pair not confluent and forms either two, four or six distinct yellow spots of variable size); 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 (in some specimens black maculation highly variable especially on posterolateral margin and at middle; at middle it forms bands in some specimens or almost absent in some other specimens); following tergites with well-developed spots, not fused in the middle, sixth tergite with a pair of spots (size of the spot

## PLATE V

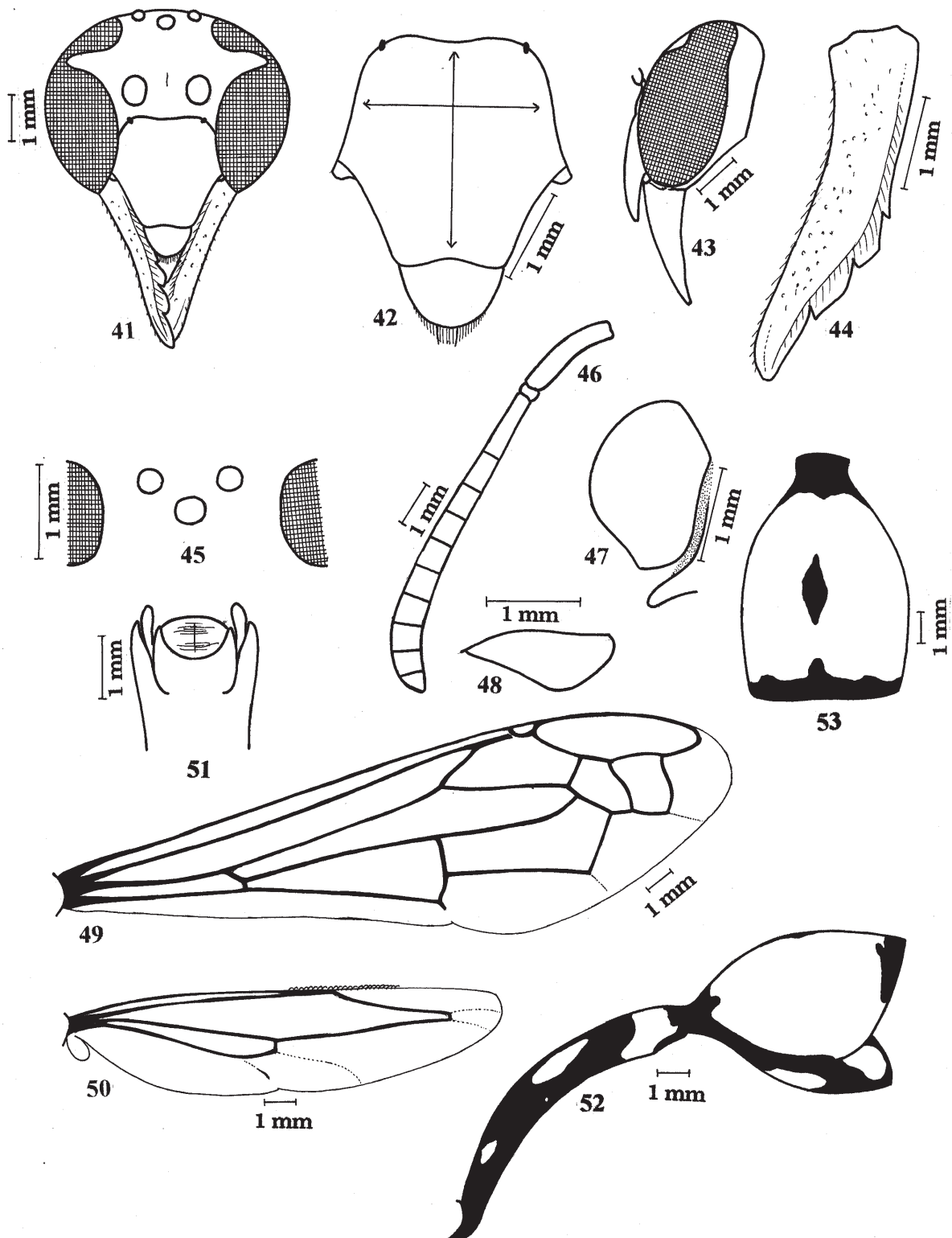


Plate V : *Phimenes nicobaricum* (Meade-Waldo) Female. 41. Head front view; 42. Clypeus; 43. Head lateral view; 44. Right mandible; 45. Ocellar area; 46. Antenna; 47. Tegula and parategula; 48. Propodealvalvula; 49. Forewing; 50. Hindwing; 51. Apical portion of ventral side of petiole; 52. Petiole and second gastral segment in lateral view; 53. Second gastral tergite dorsal view.

variable); sternites black, second sternite with a pair of small lateral spots near the middle (absent in some specimens), sternites 2-5 each with a pair of small spots in the posterolateral angles. Legs black to brownish black. Wings fusco-hyaline.

*Head:* Width in front view (Fig. 21) 1.24x as long as distance between front ocellus and clypeal margin medially; clypeus (Fig. 22) subpyriform, the apex widely truncate, raised at base and sides, anterior margin moderately emarginate, width 0.83x its length medially, sparsely punctate, the punctures not well defined; mandible (Fig. 24) long and moderately stout with four distinct teeth on inner side; labrum (Fig. 22) rounded at apex; supra-clypeal area smooth; frons and ocular sinus closely and strongly punctured, interspaces distinctly less than diameter of punctures; area in front of median ocellus smooth; vertex and temple with scattered minute punctures; occiput almost smooth with fine scattered minute punctures; cephalic fovea absent; POL (Fig. 25) 1.37x OOL; diameter of anterior ocellus slightly longer than the distance between anterior ocellus and posterior ocelli; interocular distance almost equal on vertex than at clypeus (39:40); temple (Fig. 23) distinctly narrower (0.70x) than eye in profile (measured through its ocular sinus); occipital carina strong, complete and narrowed ventrally. Antenna farther from each other than from eyes (15:4); scape length 1.43x length of F1 (Fig. 26); F1 2x as long as F2, 3.75x as long as wide, flagellar segments slightly widening towards apex as figure 26; apical antennal segment slightly longer than wide (23:20).

*Mesosoma:* Pronotum strongly and closely punctured except anterior face almost smooth, anterolateral angle with scattered punctures; mesoscutum, scutellum and metanotum strongly and closely punctured; propleuron smooth with minute scattered punctures; mesepisternum densely, in the upper part above the transverse suture almost reticulately punctuate, the interspaces much smaller than the punctures; anterior, posterior and lower sides of mesopleuron below transverse suture smooth; metapleuron almost smooth except few punctures in the middle of dorsal metapleuron;

propodeal dorsum strongly punctured except at dorsolateral angle almost smooth; ventral area of propodeum strongly punctured except the inner concavity almost smooth; lateral areas of propodeum entirely smooth; median groove of propodeum distinct, punctured and complete; pronotum with distinct pretegular carina; median length of mesoscutum longer than its maximum width (1.13x); pretegula (Fig. 27) exceeding tegulae posteriorly; axillary fossa not slit-like, much broader; metanotum at the same level of scutellum and propodeum, not raised; propodeal valvula as in figure 28. Midtibia with one spur. Forewing and hind wing as in figures 29 & 30; fore wing with prestigma 1.33x pterostigma, second submarginal cell acute basally.

*Metasoma:* Petiole length 1.36x than mesosoma in lateral view, 1.42x second gastral tergite (Fig. 32); apex of petiole on ventral side as in figure 31; petiole and gaster almost smooth; second gastral tergum (Fig. 33) without lamellae separated by apical thickening, slightly curved inwards medially at apex, almost straight, 1.40x as long as broad; posterior apices of 3<sup>rd</sup>-5<sup>th</sup> tergites and 2<sup>nd</sup>-5<sup>th</sup> sternites distinctly curved inward at middle.

*Male:* Body Length (H+M+T1+T2) 20-22 mm. Forewing length 14.5 mm. Colour almost same as that of female except the following yellow markings: a broad U-shaped yellow marking at the middle of clypeus, a short interantennal mark from base of clypeus to level of upper margin of antennal sockets. Head width in front view (Fig. 34) 1.25x distance between front ocellus and clypeal margin medially; median length of clypeus (Fig. 35) 1.30x its width; POL (Fig. 36) 2.3x OOL; 3<sup>rd</sup>-6<sup>th</sup> gastral sternites with dense hairs; 7<sup>th</sup> sternite almost flat, rounded apically (Fig. 37) without dense hairs except at apical margin, apical margin with dense hairs; Genitalia as in figures 38, 39 & 40; apical tip of aedeagus bulb-like; pubescence of base of volsella long and dense; digitus of volsella wider, densely pubescent at base, dorsally with distinct blunt angle; parameral spine elongate with moderately large hairs as in figure 40. Other characters almost same as in female.

*Material examined:* India: Andaman & Nicobar Islands: Andaman Islands, Hope Town, 1 ♂, 27.viii.1928, Coll. R. B. S. Sewell (NZSI Reg. No. 12673/H3); North Bay Island, 2 ♂ & 1 ♀, 29.viii.1928, Coll. R. B. S. Sewell (NZSI Reg. Nos. 12674/H3 to 12676/H3); Long Island, 1 ♀, vii.1931, Coll. R. Hodgart (NZSI Reg. No. 12677/H3); Port Blair, Delanipur, 1 ♂, 11.vii.1980, Coll. V. Arumugam (NZSI Reg. No. 12678/H3); **Nicobar Islands**, South Bay, 1 ♂, 27.vi.1984, Coll. S. S. Saha & Party (NZSI Reg. No. 12679/H3); Swaroop Nallah, 3 ♀, 20.vii.1984, Coll. S. S. Saha & Party (NZSI Reg. Nos. 12680/H3 to 12682/H3); South Nicobar, 1 ♀, 31.vii.1984, Coll. S. S. Saha & Party (NZSI Reg. No. 12683/H3); Cheema Nallah, 1 ♀, 3.viii.1984, Coll. S. S. Saha & Party (NZSI Reg. No. 12684/H3); South Bay, 1 ♂, 19.viii.1984, Coll. S. S. Saha & Party (NZSI Reg. No. 12685/H3).

*Distribution:* India: Andaman & Nicobar Islands: Andaman Islands, Nicobar Islands (new record).

*Remarks:* New record for Nicobar Islands.

3. *Phimenes nicobaricum* (Meade-Waldo, 1910)  
status nova  
(Figs. 41-60; Photo 3)

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

*Eumenes arcuata* race *nicobarica* Dover, 1925, *J. 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, 169.

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

*Eumenes flavopictus nicobaricus* Meade-Waldo: in van der Vecht, 1959, *Zool. Verh. Leiden*, 41: 41: 15 (key), 41, fig. 4 (22), 7 (22). Additional citation: van der Vecht, 1961, *Evolution* 15: fig. 4B (p. 472, colour pattern), table 1 (distribution).

Meade-Waldo in 1910 originally described this species as *Eumenes nicobarica*. But most of the

later workers considered it as a colour form of *flavopictum*. The colour form is endemic to Andaman & Nicobar Islands and remains a distinct colour form, distinctly differ from all other colour forms of *Phimenes flavopictum* (Blanchard). Hence, herewith propose to elevate this colour form to a specific rank as *Phimenes nicobaricum* (Meade-Waldo, 1910)

*Redescription:* Female: Body length (H+M+T1+T2) 23-25 mm; forewing length 19-20 mm. Black with the following yellow markings: clypeus except at anterior and lateral borders, an interantennal mark, a line at the inner orbits; a narrow line at the outer orbits; a transverse band on the pronotum (sometimes interrupted in the middle); four spots on the mesoscutum, a small mark on the lateral areas of the scutellum, marks behind axillary fossa near base of hind wing, a vertical band on the mesepisternum, a band on outer margin of tegulae, a band on the postscutellum, two large marks on posterior area of propodeum (leaving a median, cross shaped area black); apical half of fore femora beneath, fore tibiae on outer side, mid and hind coxa on outer side (sometimes reduced or absent), sometimes a line on the outer side of mid and hind tibiae; three pairs of spots on the gastral petiole (anterior pair sometimes absent); second tergite almost entirely except at base, three by fourth of lateral sides, at apex and a small spot dorsomedially; narrowly interrupted bands at the apex of tergites 3-5, a pair of small spot at apex of 6<sup>th</sup> tergites, and widely interrupted bands at the apex of sternites 2-5 (in some specimens a pair of spot on second sternite mediolaterally). Brown markings as follows: labrum brown; mandible blackish brown. Wings fusco-hyaline.

*Head:* Width in front view (Fig. 41) 1.24x as long as distance between front ocellus and clypeal margin medially; clypeus (Fig. 42) subpyriform, the apex widely truncate, raised at base and sides, anterior margin moderately emarginate, width 0.95x its length medially, sparsely punctate, the punctures not well defined; mandible (Fig. 44) long and moderately stout with four distinct teeth on inner side; labrum (Fig. 42) rounded at apex; supraclypeal area smooth; frons and ocular sinus

## PLATE VI

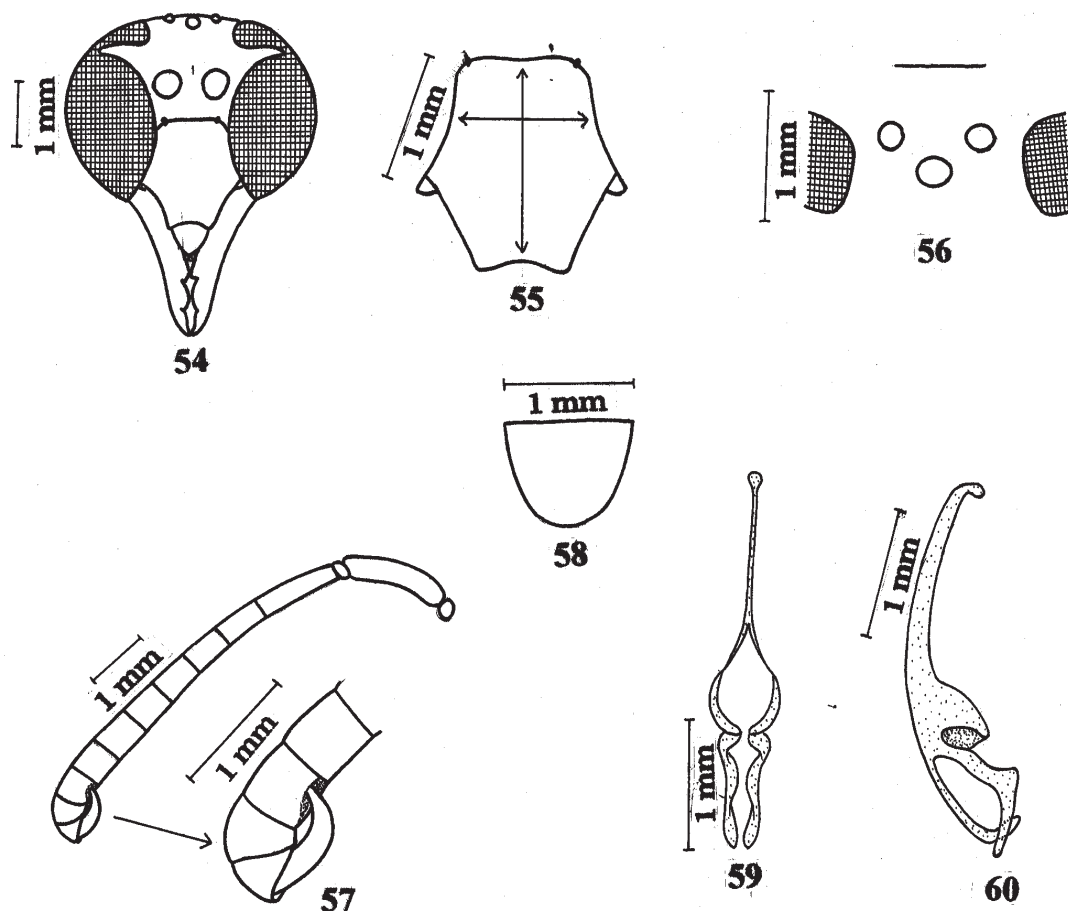


Plate : VI *Phimenes nicobaricum* (Meade-Waldo) Male. 54. Head front view; 55. Clypeus; 56. Ocellar area; 57. Antenna; 58. Last gastral sternite; 59. Aedeagus dorsal view; 60. Aedeagus lateral view.

closely and strongly punctured, interspaces distinctly less than diameter of punctures; area in front of median ocellus smooth; vertex and temple with scattered minute punctures; occiput almost smooth with fine scattered minute punctures; cephalic fovea absent; POL (Fig. 45) 1.50x OOL; diameter of anterior ocellus slightly longer than the distance between anterior ocellus and posterior ocelli; interocular distance almost equal on vertex than at clypeus (39:42); temple (Fig. 43) distinctly narrower (0.80x) than eye in profile (measured through its ocular sinus); occipital carina strong, complete and narrowed ventrally. Antenna farther from each other than from eyes (13:4.5); scape length 1.47x length of F1 (Fig. 46); F1 1.88x as long as F2, 3.75x as long as wide, flagellar segments slightly widening towards apex as figure 46; apical antennal segment slightly longer than wide (25.5:21).

*Mesosoma*: Pronotum strongly and closely punctured except anterior face almost smooth, anterolateral angle with scattered punctures; mesoscutum, scutellum and metanotum strongly and closely punctured; propleuron smooth with minute scattered punctures; mesepisternum densely, in the upper part above the transverse suture almost reticulately punctate, the interspaces much smaller than the punctures; anterior, posterior and lower sides of mesopleuron below transverse suture smooth; metapleuron almost smooth except few punctures in the middle of dorsal metapleuron; propodeal dorsum strongly punctured except at dorsolateral angle almost smooth; ventral area of propodeum strongly punctured except the inner concavity almost smooth; lateral areas of propodeum entirely smooth; median groove of propodeum distinct, punctured and complete;

pronotum with distinct pretegular carina; median length of mesoscutum longer than its maximum width (1.11x); pretegula (Fig. 47) exceeding tegulae posteriorly; axillary fossa not slit-like, much broader; metanotum at the same level of scutellum and propodeum, not raised; propodealvalvula as in figure 48. Midtibia with one spur. Forewing and hind wing as in figures 49 & 50; fore wing with prestigma 1.15x pterostigma, second submarginal cell acute basally.

*Metasoma*: Petiole length 1.58x than mesosoma in lateral view, 1.63x second gastral tergite (Fig. 52); apex of petiole on ventral side as in figure 51; petiole and gaster almost smooth; second gastral tergum (Fig. 53) without lamellae separated by apical thickening, slightly curved inwards medially at apex, almost straight, 1.45x as long as broad; posterior apices of 3<sup>rd</sup>-5<sup>th</sup> tergites and 2<sup>nd</sup>-5<sup>th</sup> sternites distinctly curved inward at middle.

*Male*: Body length (H+M+T1+T2) 18-18.5 mm. Forewing length 14.5 mm. Head width in front view (Fig. 54) 1.26x distance between front ocellus and clypeal margin medially; median length of clypeus (Fig. 55) 1.35x its width; POL (Fig. 56) 2.50x OOL; Antenna as in figure 57; last antennal segment hooked apically, hook long, curved and pointed, in curved position it almost reaches the apex of ninth antennal segment; 3<sup>rd</sup>-6<sup>th</sup> gastral sternites with dense hairs; 7<sup>th</sup> sternite almost flat, rounded apically (Fig. 58) without dense hairs except at apical margin, apical margin with dense hairs; Genitalia as in figures 59 & 60; apical tip of aedeagus bulb-like; pubescence of base of volsella long and dense; digitus of volsella wider, densely pubescent at base, dorsally with distinct blunt angle; parameral spine elongate with moderately large hairs. Other characters almost same as in female.

*Material examined*: India: Andaman & Nicobar Islands, Nicobar Islands, Nancowry Island, Champin, 2 ♂ & 1 ♀, 10.ii.1993, Coll. D. V. Rao & Party (NZSI Reg. Nos. 12687/H3 to 12689/H3); Katchal Island, 1 ♂, 14.ii.1993, Coll. D. V. Rao & Party (NZSI Reg. No. 12690/H3); Great Nicobar, Trinket Island, 1 ♂, 17.ii.1993, Coll. D. V. Rao &

Party (NZSI Reg. No. 12691/H3); 1 ♀, Nicobar (old specimen without further collection data) (NZSI Reg. No. 12686/H3).

*Distribution*: India: Andaman & Nicobar Islands: Nicobar Islands.

#### Key to species of *Phimenes* Giordani Soika of Indian subcontinent

1. Mesosoma almost entirely black (rarely a very small yellow spot posteromedially on metanotum and sometimes a vague yellow stripe at angle between posterior and lateral sides of propodeum at its posterior half).....*P. andamanicum* (Zimmermann)
- Mesosoma black with strong yellow maculations. ....2
2. Second gastral tergite black with a pair of transverse yellow spots at the base forming an interrupted band and narrowly interrupted bands at the apex (Fig. 13). ....*P. flavopictum* (Blanchard)
- Second tergite almost entirely yellow except at base, three by fourth of lateral sides, at apex and a small spot dorsomedially black (Fig. 53). ....*P. nicobaricum* (Meade-Waldo)

#### SUMMARY

The genus *Phimenes* Giordani Soika is taxonomically revised from Indian subcontinent. The subspecies *Phimenes flavopictum continentalis* (Zimmermann, 1931) is synonymised under the nominate species. The other two subspecies namely *Phimenes flavopictum andamanicum* (Zimmermann, 1931) and *Phimenes flavopictum nicobaricum* (Meade-Waldo, 1910) are elevated into distinct species rank namely *Phimenes andamanicum* (Zimmermann) and *Phimenes nicobaricum* (Meade-Waldo). All these three species are redescribed here. The species *Phimenes flavopictum* (Blanchard) is newly recorded for Delhi, Manipur, Mizoram, Nagaland and Tripura. The species *Phimenes andamanicum* (Zimmermann) is a new record for Nicobar Islands. A key to species of *Phimenes* Giordani Soika of Indian subcontinent is also provided.

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Photo 1. : *Phimenes flavopictum* (Blanchard) Female.



Photo 2. : *Phimenes andamanicum* (Zimmermann) Female.



Photo 3. : *Phimenes nicobaricum* (Meade-Waldo) Female.