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Species of the Genus *Ecnomus* (Trichoptera: Ecnomidae) from the People's Republic of China

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ABSTRACT

Twenty-two species of the genus *Ecnomus* McLachlan (Ecnomidae: Trichoptera) from the People's Republic of China are described or re-described, among which eighteen species are new to science. One additional species is considered a *nomen dubium*. A phylogeny of these 22 species is inferred from the adult male characters, using PAUP. Four monophyletic species groups are recognized within the genus. A phylogeny of the genera in the whole family is also inferred with PAUP from information in all life stages. *Ecnomus* and *Psychomyiellodes* Mosely are sister lineages. Their sister lineage is (*Austrotinodes* + *Ecnomina*) + *Parecnomina* + *Parecnomina resima*. A new genus probably is needed for *Parecnomina resima* Morse. [Keywords: new species, phylogeny, *Psychomyiellodes*, *Austrotinodes*, *Ecnomina*, *Parecnomina*]

INTRODUCTION

In recent years, the known species diversity in the genus *Ecnomus* McLachlan has increased very dramatically. According to Cartwright (1990), this genus had 130 species. Now the number of *Ecnomus* species has increased to 221 species (Table 5). The result of the cooperative expedition by Clemson University and Nanjing Agricultural University in the People's Republic of China in 1990 reveals that the genus is highly diverse in that country, as well.

One of the objectives of this study is to clarify the taxonomy of the species of the genus from China. Prior to this study, only four species were recorded from the People's Republic of China. We now recognize 22 species, including four previously described species and 18 new species. One additional species is considered a *nomen dubium* because the description is inadequate to permit identification and the repository of its type specimens is unknown.

The type genus *Ecnomus* was the only genus included in Ulmer's (1903) Hydropsychidae subfamily Ecnominae (now Ecnomidae). The Ecnomidae now includes five genera, *Austrotinodes* Schmid, *Ecnomina* Kimmins, *Ecnomus*, *Parecnomina* Kimmins, and *Psychomyiellodes*, whose relationships were briefly presented by Flint (1973). Despite the rapid increase in the number of known species and increased knowledge of females and larvae of most genera in recent years, no additional

phylogenetic work has been attempted for this family. Therefore, in this paper, we infer a phylogeny of the genera based on available information from all life-history stages and we infer a phylogeny of the Chinese species of *Ecnomus*.

MATERIALS AND METHODS

Specimens

Specimens were collected using a 15-watt BL ultraviolet light suspended before a sheet and over a funnel leading to a container of ethanol. Collectors included John C. MORSE (JCM), Lianfang YANG (LY), Youwen Joe LI (YJL), Chang-hai SUN (CS), Shida WANG (SW), Xiao-en CHEN (XC), and Xin KE (XK).

Collection sites were as follows, with site numbers as in Figure 1:

An-hui Province

1. Ding-xi-he, Song-cun, 33 km E. of Jing-xian, Jing-xian County (30.42 ° N, 118.24 ° E)
2. Feng-huan-cun, Feng-cun, She-xian County (29.53 ° N, 118.26 ° E)
3. Yao-cun, Yong-feng-he, Lang-xi-xian County (31.08 ° N, 119.10 ° E)

Fu-jian Province

4. Fu-zhou City (26.06 ° N, 119.17 ° E)

Jiang-xi Province

5. Ju-ji-cun, Yuan-tou-xi, 70 km NW. of Wu-yuan, Wu-yuan County (29.31 ° N, 117.46 ° E)
6. Qin-hua-he, 57 km N. of Wu-yuan, Wu-yuan County (29.30 ° N, 117.49 ° E)
7. Xi-qi-he, 59 km SE. of Gui-xi, Gui-xi-he, Gui-xi County (28.90 ° N, 117.15 ° E)
8. Xi-qi-he, 10 km S. of Gui-xi, Gui-xi County (28.05 ° N, 117.10 ° E)
9. Muo-dao-shi-cun, Chang-he, Bo-yang County (28.95 ° N, 116.60 ° E)
10. San-qing-shan, Shuang-xi-he, 80 km S. of Yu-shan, Yu-shan County (28.61 ° N, 118.15 ° E)

Jiang-su Province

11. Hong-ze, Jiang-su City (33.19 ° N, 118.83 ° E)

Hu-bei Province

12. 50 km NW. of Yin-cheng, tributary of Da-fu-shui, Jin-shan County (31.20 ° N, 113.40 ° E)
13. 45 km NW. of Yi-cheng, upstream of Da-fu-shui, Jin-shan County (31.19 ° N, 113.50 ° E)
14. 27 km N. of Ma-cheng, Tong-jiang-chong-he, Ma-cheng County (31.40 ° N, 115.00 ° E)
15. 1 km S. of Gui-shan Tea Farm, 15 km N. E. of Ma-cheng, Zheng-shui-he, Ma-cheng County (31.20 ° N, 115.13 ° E)
16. Da-fu-shui, Tian-dian-dam, Yin-cheng City (30.97 ° N, 113.52 ° E)
17. Dong-hu, Wu-chang (30.60 ° N, 113.30 ° E)

Si-chuan Province

18. 2 km W. of Jiang-you, Kang-shui-he (tributary of Fu-jiang), Jiang-you City (31.76 ° N, 104.69 ° E)
19. 19 km E. of Ping-wu, tributary of Fu-jiang, Ping-wu County (32.48 ° N, 104.36° E)
20. 17 km E. of Ping-wu, tributary of Fu-jiang, Ping-wu County (32.48 ° N, 104.36 ° E)
21. Yang-ma-he, 4 km N. of Xin-jin, Xin-jin County (30.40 ° N, 103.67 ° E)
22. Si-mian-shan, Dam of Da-hong-hai, Jiang-jin County (29.17 ° N, 106.15 ° E)
23. Si-mian-shan, Fei-long-he, Jiang-jin County (29.17 ° N, 108.22 ° E)
24. Center of Chang-jiang, Wan-xian County (30.52 ° N, 108.22 ° E)
25. 3 km W. of Jing-shui, E-mei Mountain, E-mei City (29.36 ° N, 103.31 ° E)

Yun-nan Province

26. Nan-dong, 8 km E. of Kai-yuan, Kai-yuan County (23.36 ° N, 103.25 ° E)
27. Nan-wen-he River, Nan-wen-he, Ma-li-po County (23.05 ° N, 104.58 ° E)
28. Xiang-shui-he River, Ba-bao-zhen, Guan-nan County (32.76 ° N, 105.44 ° E)

Specimen Repositories

The type specimens of newly described species in this paper are deposited in the Department of Entomology, Nan-jing Agricultural University (NAU), Nan-jing, People's Republic of China (all holotypes, some paratypes), and the Clemson University Arthropod Collection (CUAC), Department of Entomology, Clemson University, Clemson, South Carolina, U.S.A. (some paratypes). Voucher specimens of *Ecnomina* sp. female, *Austrotinodes irwini* Flint male and female, and *Parecnomina* sp. female are deposited in the United States National Museum of Natural History (USNM), Washington, D.C., U.S.A. A paratype of *Ecnomus foochowensis* Mosely is deposited in the Natural History Museum (NHM), London, United Kingdom.

Morphological Terminology

Terminology used for head and thoracic warts follows that of Ivanov (1990); for male genitalia, Nielsen (1957, 1978), Barnard and Clark (1986), and Cartwright (1990); and for female genitalia, Nielson (1980) and Cartwright (1990). Terminology for wing venation is that of Neboiss (1991), with the following abbreviations used in the text and illustrations:

- C = Costa
- Sc = Subcosta
- R = Radius
- M = Medius
- Cu = Cubitus
- A = Anal vein
- DC = discoidal cell
- MC = median cell
- TC = thyridial cell
- f. R₁ = fork of R1

- F1 = Fork 1 (fork of R₂₊₃)
 F2 = Fork 2 (fork of R₄₊₅)
 F3 = Fork 3 (fork of M₁₊₂)
 F4 = Fork 4 (fork of M₃₊₄)
 F5 = Fork 5 (fork of Cu₁₊₂)

Phylogenetic Methods

PAUP version 3.1 (Swofford 1993) was used for the phylogenetic analysis. All characters are unordered. For the tree to the genera, characters are reweighted according to their RC values after a first round "heuristic search". Weight of character C is reassigned as 250, character D as 111, character M as 250, other characters as 1000. For the trees to species, all characters have default weight = 1. "Exhaust Search" was used. All characters were optimized by accelerated transformation (ACCTRAN) and delayed transformation (DELTRAN).

Ecnomidae, Polycentropodidae, and Hydropsychidae are a monophyletic group, but the phylogenetic relationships among them are yet unresolved if in the context of all Hydropsychoidea families (Weaver and Malicky 1994). Therefore, the two latter families together served as outgroups for our analysis of the phylogeny of genera of Ecnomidae. In the analysis of the five world Ecnomidae genera, 13 characters are chosen (Tables 2 and 3).

For the analysis of Chinese *Ecnomus* species, *Parecnomina* served as the outgroup. This is despite the fact that our generic analysis revealed *Psychomyiellodes* as the sister lineage of *Ecnomus*. *Psychomyiellodes* is less useful as an outgroup because it has some autapomorphies that obscure character polarities for *Ecnomus* and because some of the relevant characters are unknown in *Psychomyiellodes*. In the analysis of the 22 Chinese species of *Ecnomus*, 26 characters were used (Tables 4 and 5).

RESULTS

Phylogeny of the Ecnomidae genera

The PAUP analysis of the data matrix of generic characters of family Ecnomidae and outgroups Hydropsychidae and Polycentropodidae (Tables 2 and 3) generated the following results: The first round "heuristic search" generated three cladograms. After reweighting the characters according to RC values, a single cladogram (Figure 2) remains (tree length = 10583, CI = 0.91, RI = 0.91, and RC = 0.82). The cladogram shows that family Ecnomidae (Branch 10) is a monophyletic group, as suggested by homologue #E. It is a sister group of Polycentropodidae (Branch 9), as suggested by homologues #B and D. Ecnomidae are divided into two branches: Branch 11 (*Ecnomus* + *Psychomyiellodes*) and Branch 12 ((*Ecnomina* + *Austrotinodes*) + *Parecnomina*). Monophyly for Branch 11 is suggested by homologues #G and L; monophyly for Branch 12 is suggested by homo-

logues #J and K. *Ecnomina* and *Austrotinodes* (Branch 13) are sister groups, as suggested by homologues #C, D, and F, although homologue #C is homoplastic, also occurring in *Ecnomus*, and homologue #D is a reversed character. The monophyly of the genus *Ecnomus* is supported only by the homoplasious character #C.

Homologue #K (female segments X-XI elongated) does not occur in *Parecnomina resima* Morse, 1974. This homologue occurs independently in many other lineages of Annulipalpia. Because it lacks this homologue, the species appears basally in Branch 12. [Note that we follow Schmid's (1980) hypothesis that female abdominal segment IX is not evident in most species of Annulipalpia.]

The cladogram is generally consistent with that of Flint (1973), except that he placed *Parecnomina* as the sister lineage of *Psychomyiellodes* and *Ecnomus* on the basis of plesiomorphies ("male genitalia primitive, forewing with R_2 and R_3 separate"). On the contrary, *Parecnomina* shares uniquely with *Ecnomina* and *Austrotinodes* fused bases of male inferior appendages (homologue #10) and elongate female segments X-XI (homologue #11; Gibbs 1973, Flint 1973, Cartwright 1990).

The vertex-wart pattern of Chinese *Ecnomus* species is very consistent (Fig. 4). It is very similar to that of *Plectrocnemia* (Polycentropodidae), suggesting that it is plesiomorphic in these otherwise distantly related genera. In other genera of Ecnomidae, the warts are more or less fused or are indistinct. Further examination of the vertex-wart pattern among Ecnomidae genera and species may give additional, valuable phylogenetic clues.

Phylogeny of the *Ecnomus* species from China

The PAUP analysis of the data matrix of characters for *Ecnomus* species from China and outgroup *Parecnomina* generated two cladograms of equal parsimony with treelength = 35, CI = 0.74, RI = 0.89, and RC = 0.66 and a strict consensus tree (Figure 3a). The only difference between the two fully resolved cladograms is in the kinship of *Ecnomus perpendicularis*, sp. n. (Figs. 3b and 3c). *Ecnomus perpendicularis* is a sister species of lineage *E. connatus* + *E. coalitus* (Branch 33) (the three species together forming Branch 45) in the first tree (Fig. 3b). But, *E. perpendicularis*, sp. n. and *E. cornutus*, sp. n. are sister species (Branch 45) in the second cladogram (Fig. 3c). This difference is a result of the contradiction of homologues #X and AI. We prefer the first tree (Figure 3c) because homologue #AI (a cone-shaped basolateral process of each paramere) is very peculiar in this genus, while homologue #X (a long basoventral projection of each superior appendage) appears in other species (e.g., *E. projectus*, sp. n., *E. orientalis*, sp. n., etc.) as a very short projection. The character distributions with ACCTRAN and DELTRAN optimizations are identical except for the distributions of homologues #X and AI. Figures 3 depict ACCTRAN distributions. With DELTRAN optimization, homologue #X will appear on Branches 3 and 33 in Figure 3c and not on Branches

2 and 32; homologue #AI appears on Branches 2 and 3 in Figure 3b and not on Branches 32 and 33.

Several homoplasies and uncertainties appear in the data and cladograms (Tables 4 and 5, Figs. 3). Character #P in Branch 27 reverses in Branch 30. Character #U in Branch 35 also occurs in Branch 16. Phallic parameres, character #V, are several small spurs in most species of *Parecnomina* (a pair of long spines in *Parecnomina resima*); they are cup-shaped sheaths in *Psychomyiellodes*; however, in *Ecnomina*, *Austrotinodes*, most *Paranyctiophylax* species (Polycentropodidae), some *Polycentropus* species (Polycentropodidae), and most primitive Trichoptera (Ross, 1956), they are long and slender. Character #W in Branch 40 also occurs in Branch 7. Character #Y in Branch 29 also occurs in Branch 18 and it reverses in Branches 3 and 6. Character #Z in Branch 42 reverses in Branch 20. Character #AB in Branch 26 reverses in Branch 7. The frontal warts, character #AE, are indistinct in *Parecnomina* (also indistinct in *Austrotinodes* and *Ecnomina* of Ecnomidae) but are a pair of small distinctive warts in the outgroup genus *Polycentropus* (Polycentropodidae).

SYSTEMATICS

As mentioned previously, *Parecnomina resima* Morse has short female segments X and XI; but long female segments X and XI is a homologue (#K) for the lineage *Ecnomina* + *Austrotinodes* + *Parecnomina sensu stricto* (i.e., the other species of *Parecnomina* for which the female is known). Furthermore, the pair of phallic parameres of *P. resima* are long processes and quite different from the several small spurs in other *Parecnomina* species. The larva of *P. resima* is very peculiar (Ferdy de Moor, 1996, personal communication). The *P. resima* adult characters above are plesiomorphies, but *P. resima* has homologues #A, B, D, E, J, and M, placing it at the base of the monophyletic group of *Ecnomina* + *Austrotinodes* + all other species of *Parecnomina*. Therefore, a new genus status is apparently appropriate for the species *Parecnomina resima* Morse. A description of this genus is outside the scope of this paper and will be provided elsewhere.

ECNOMUS McLachlan, 1864

Ecnomus McLachlan, 1864, pp. 26, 30. Type species: *Philopotamus tenellus* Rambur (monobasic).

Ecnomiella Mosely, 1935, pp. 221-222. Type species: *Ecnomiella bifurcata* Kimmins (original designation). Kimmins, 1957, 261 and footnote (as synonym of *Ecnomus*).

The genus *Ecnomus* was established by McLachlan, associated with *Polycentropus* in his Section IV (now Hydropsychidae, Polycentropodidae, and Philopotamidae and their relatives), agreeing with it in the possession of 3, 4, 4 spurs on each of the fore-, mid-, and hind tibiae, respectively. He later (McLachlan 1878) placed this genus

in his Hydropsychidae section V (now Ecnomidae + Psychomyiidae), noting that the genus was undoubtedly associated with *Tinodes* because of the absence of a cross-vein between C and Sc and because the second joint of each maxillary palpus is longer than the first joint and shorter than the fourth. Ulmer (1903) erected a subfamily Ecnominae in Hydropsychidae for the genus. He later (Ulmer 1907) put this subfamily under family Polycentropodidae. In 1910, he transferred this subfamily into Psychomyiidae. Navás (1908) placed his tribe Ecnomini under Polycentropodidae (as Polycentropidae). Lepneva (1956) compared the morphology of adults, larvae and pupae of Psychomyiinae, Polycentropodinae and Ecnominae and elevated the latter group to family level. Kimmins (1957) provided further adult characters to separate Ecnomidae from Psychomyiidae (both of which he treated as subfamilies of Psychomyiidae). He also recognized *Ecnomiella* as a synonym of *Ecnomus* because R1 is forked (obscurely) in the forewing in *Ecnomiella* as in other *Ecnomus* species and the presence of only two foretibial spurs in *Ecnomiella* also occurs in some other *Ecnomus* species.

Adult

Body.—Length from front of head to tips of folded wings 6-10 mm. Body yellow to brown, and hairy.

Head.—(Figs. 4, 5, 6, 8, 9, 10, and 11) Without ocelli but with many warts on vertex and frons (Figs. 4, 5, and 6). Vertex-wart pattern similar to that of *Plectrocnemia* (Polycentropodidae; Neboiss 1991); most of vertex occupied by diamond-shaped area composed of seven warts, including single small frontal wart at anterior apex, two long antennal warts forming anterior sides of diamond, two long posterior ocellar warts forming posterior sides of diamond, and intervening space (sometimes nearly filled) with one pair of smaller preocular warts parallel to antennal warts; in addition, pair of posterior occipital warts large and triangular; pair of nearly transverse hypomedial warts in front of bases of antennae (Figs. 6 and 9), these warts in some species nearly filling frontal space (Fig. 11) and covered by dense hairs; some species with additional pair of small anterolateral warts below hypomedial warts (Figs. 5 and 6). Maxillary palpi 5-segmented; second segment slightly longer than first and shorter than third and fourth; third segment positioned apically on second; fifth segment longest, secondarily annulated and flexible. Labial palpi 3-segmented (Fig. 5), with first segment longer than second and shorter than annulated and flexible third.

Thorax.—(Fig. 4) Pronotum transverse, with two pairs of warts, medial and lateral. Mesonotum at midlength with pair of round scutal warts nearly touching in middle at longitudinal suture; mesoscutellum with pair of semi-circular scutellar warts separated by long, narrow mesal space. Legs with tibial spur formula: 2 or 3, 4, 4. All known Chinese species have tibial spur formula: 3, 4, 4.

Wings.—(Figs. 7 and 65) Forewings each with fork of R1, Forks 1, 2, 3, 4, and 5 and DC, MC, and TC; corneous nygmæ in F1 and TC. Few

species with fork of R1 very faded and Fork 1 absent. Fork 4 sessile. Hindwing (Figs. 7 and 65) with Forks 2 and 5 and without DC, MC, or TC; Fork 2 without nygma.

Male genitalia.—(Figs. 14, 15, and 16) Tergum IX concave anteriorly, lateral regions extended anteriorly and jointed with sternum IX by narrow articulations; in some species, tergum IX with pair of dorsal membranous projections from posterior margin; sternum IX very broad, with or without longitudinal median line, rectangular or concave (sometimes deeply concave) on both anterior and posterior margins, usually concave deeper on anterior margin than on posterior margin. Segment X small, withdrawn inside segment IX, broad or strip-like, anterolateral arms projecting ventrad or anterad; with pair of posterior ventral projections long in some species, short and broad in other species. Superior appendages long and slender or clavate or triangular with broad base, concave and with stout setae on mesal surface, each with small mesal or ventral projection at base. Inferior appendages each 1-segmented, independent at base from each other in ventral view. Dorsal surfaces of inferior appendages extended anteriorly to base of phallus, forming very large and broad basal plate to support phallus from beneath. Pair of sclerotized strips from lateral margin of tergum IX associated with phallobase dorsolaterally. Phallus with one of two types of basic structure: (1) Simple sclerotized tube, membranous only at apex, parameres absent (Figs. 20 and 29). (2) Mostly bulbous, acute at apex, membranous dorsally at least at base (Figs. 37 and 52); parameres very long, slender and directed caudad (Fig. 76) or short and directed dorsad (Fig. 42) or coin-shaped (Fig. 31), fused to each other at base (Fig. 84) or separated (Fig. 80); dorsobasal lobe associated with parameres (Fig. 76) or isolated (Fig. 45).

Female genitalia.—(Figs. 12 and 13). Abdominal segment VII with sclerotized tergum and sternum separated by pleural membranes, posterior margin of sternum VII straight or with mesal rectangular notch. Segment VIII with tergal plate covering top and sides of segment, sternum VIII with pair of broad ventral plates, on which many species have small "pockets" apparently matching shape of mesal projections of male inferior appendages (Cartwright 1990); irregular sclerite surrounding gonophore between ventral plates. Segment IX not evident (Schmid 1980). Segments IX and XI short: segment X with membranous ventral groove and sclerotized tergum with row of long setae arranged transversely across middle; segment XI vestigial, with only small lateral sclerite and three pairs of small apicolateral projections: upper and lower pairs of papillae and middle pair of cerci (Nielson 1980).

Larva

Head strongly depressed dorsoventrally, with lateral carinae. Left mandible square, without tuft of hairs on mesal side. Maxillary palpi each 4-segmented, maxillary palpifer finger-like. Labium with submentum broader posteriorly, anterior margin indistinct. Labial palpal segments each slender and rod-like with long sensillae. Ligula

narrow, slightly longer than labial palpi, much shorter than maxillary palpi. Trochantin of prothorax long and acute at apex. All three segments of thorax fully sclerotized dorsally. Abdomen with mid-lateral line of dense setae. Anal claws each with row of tiny teeth on ventral side (Lepneva, 1956, 1964; Ulmer, 1957; Marlier, 1962; Dean and Bunn, 1989).

Pupa

Apex of mandible straight, long, pointed. Last abdominal segment moderately long, with short rounded lobes farther from each other than breadth of one lobe; brush of dense long hairs on each lobe (Lepneva 1956; Ulmer 1957; Marlier 1962).

Biology

Larvae of the genus *Ecnomus* are predominantly predaceous, but they also feed on algae and detritus (Barnard, 1986). They construct silken retreats on solid substrates in permanent ponds and lakes and in areas of slow-flowing rivers and streams (Chessman, 1986).

Distribution

Through 1995, 203 species of the genus *Ecnomus* have been described globally. Adding the 18 new species in this study, this genus now has 221 species distributed mainly in the Afrotropical, Oriental, and Australasian Regions, with several in the East and West Palaearctic Regions (Table 5).

Etymology

Ecnomos is a Greek adjective (eknomos, on = "outlawed, unlawful, monstrous"), used here as a masculine noun. The reason for this name is uncertain; it is perhaps for the predaceous habits of larvae.

Checklist of Chinese species of *Ecnomus*

- Ecnomus acuminatus*, sp. n.
- Ecnomus bicolorus* Tian and Li, 1992
- Ecnomus coalitus*, sp. n.
- Ecnomus connatus*, sp. n.
- Ecnomus cornutus*, sp. n.
- Ecnomus ellipticus*, sp. n.
- Ecnomus foochowensis* Mosely, 1942
- Ecnomus gigantius*, sp. n.
- Ecnomus incisus*, sp. n.
- Ecnomus latus*, sp. n.
- Ecnomus longicaudatus*, sp. n.
- Ecnomus orientalis*, sp. n.
- Ecnomus parellipticus*, sp. n.
- Ecnomus perpendicularis*, sp. n.
- Ecnomus projectus*, sp. n.
- Ecnomus pungens*, sp. n.
- Ecnomus rectus*, sp. n.

Ecnomus sinensis Navás, 1923, *nomen dubium*
Ecnomus spatulatus, sp. n.
Ecnomus tenellus Rambur, 1842
Ecnomus truncatus, sp. n.
*Ecnomus uncatu*s, sp. n.
Ecnomus yamashironis Tsuda, 1942

According to the phylogenetic analysis above, the species of the genus *Ecnomus* can be classified into the following monophyletic groups (Fig. 3). The *Ecnomus tenellus* Group (Branch #41) is composed of *Ecnomus incisus*, sp. n.; *Ecnomus foochowensis* Mosely; *Ecnomus yamashironis* Tsuda; *Ecnomus bicolorus* Tian and Li, and *Ecnomus tenellus* Rambur, as suggested by the homologue #N (phallus with apex spoon-shaped and curved ventrad) and homologue #AK (the phallic parameres originating from close to the apex of the phallus). The *Ecnomus gigantius* Group (Branch #39) is constituted of *Ecnomus latus*, sp. n.; *Ecnomus rectus*, sp. n.; and *Ecnomus gigantius*, sp. n., as suggested by the coin-shaped parameres (homologue #AF). Homologues #U (superior appendages short and broad, ear-like) and #AL (apex of each inferior appendage sharp) suggest that *Ecnomus acuminatus*, sp. n.; *Ecnomus parellipticus*, sp. n.; *Ecnomus uncatu*s, sp. n.; *Ecnomus ellipticus*, sp. n.; and *Ecnomus truncatus*, sp. n. belong to the same monophyletic group, the *Ecnomus ellipticus* Group (Branch #35). The remaining Chinese species comprise the *Ecnomus connatus* Group (Branch #28), suggested by homologue #AC (impressed median line of sternum IX absent).

Ecnomus tenellus Group

Besides the homologues noted above, all species of the group have a plesiomorphic pair of long and slender ventral projections of segment X. Segment X with pair of long and slender projections extending anterad in some species (Figs. 14 and 15), even connected with the phallobase in *Ecnomus incisus*, sp. n. (Fig. 27); projecting anterolaterad in other species. Sternum IX has a conspicuous longitudinal, median impressed line.

***Ecnomus yamashironis* Tsuda, 1942**

Figs. 14-16

Ecnomus yamashironis, M. Tsuda. 1942. p. 267 - 268, f. 25-26. Type locality: Japan (Yamashina, Kyoto).

Ecnomus yamashironis Tsuda, L. Botosaneanu, 1970, p. 302 - 303, pl. 28, f. 3. Korea, doubtful identification.

Length with folded forewings.—4.7-5.1 mm (N = 5). Venation typical for genus, forewings each with Fork 1 and fork of R₁.

Male genitalia.—Segment X long and slender, anterolateral arms directed anterad, and posterior ventral projections each with lateral expansion about in mid length. Superior appendages each triangular

in lateral view, tapering to blunt apex. Inferior appendages each curved slightly dorsad in lateral view, with dorsomesal surface concave at middle. Sternum IX with conspicuous longitudinal median line and anterior margin of sternum with deep median incision. Phallus tubular, with ventral apex long and acute in lateral view.

Material examined.—4 males, 27 km N. of Ma-cheng, Tong-jia-chong River, Ma-cheng County, Hu-bei, 150 M elev., 12 July, 1990, collected by JCM and LY [NAU]. 1 male, Xi-qi River, 10 km S. of Gui-xi, Gui-xi County, Jiang-xi, 30 m elev., 4 June 1990, collected by LY and JCM and CS [CUAC].

Diagnosis.—The species is very similar to *Ecnomus bicolorus* Tian et Li, 1992 in the triangular superior appendages, the straight inferior appendages and laterally expanded ventral projections of segment X. However, in this species, there is no dorsal transverse projection of each inferior appendage in the middle, instead the appendage is concave in this region. From ventral view, the thicker base of each inferior appendage is shorter than in *E. bicolorus*.

Distribution.—The species is widely distributed in the East Palaearctic Biogeographic Region (Japan and Korea) and the Oriental Biogeographic Region (Hu-bei and Jiang-xi Provinces, China).

Phylogeny.—The species is a sister species of *Ecnomus bicolorus* Tian and Li, as suggested by the laterally expanded posterior ventral projections of segment X.

***Ecnomus bicolorus* Tian and Li, 1992**

Figs. 17-20

Ecnomus bicolorus Tian et Li, 1992, p. 28-29. Male. Type locality: Jiang-su, China.

Length with folded forewings.—4.7-5.1 mm (N = 5). Venation typical for the genus, forewings each with Fork 1 and fork of R1.

Male genitalia.—Anterior margin of sternum IX with deep triangular mesal incision and impressed line along meson. Posterior ventral projections of segment X slender, expanded laterally at middle, sharp at apex. Superior appendages reaching apices of inferior appendages, triangular, each much broader at base, tapering to apex, with small basoventral process and with mesal spines at middle and apex. Inferior appendages almost straight at mesal margins in ventral view, lateral margins slightly sinuous, each with short transverse dorsomesal projection at middle length; from lateral view, basal half twice as thick as apical part and concave longitudinally along dorsal margin. Phallus tube-like, with apex extended ventrally and with two small apical sclerites.

Diagnosis.—The species is very similar to *E. yamashironis* Tsuda in the triangular-shaped superior appendages and straight inferior appendages from lateral view. However, in this species, the basal thick part of each inferior appendage is more than one third of the whole length, whereas about one-fourth in *E. yamashironis*. There are no short transverse dorsomesal projections on the inferior appendages in the

latter species. The species also is very similar to *Ecnomus tenellus* (Rambur), 1842 in the triangular superior appendages and the short dorsal projection at middle length of each inferior appendage. However, in *E. bicolorus*, the apex of each inferior appendage is not curved, the ventral projections of segment X are expanded laterally at middle, and there is no dorsomesal projection at the apex of phallus as in *E. tenellus*.

Material examined.—5 males, Hong-ze County, Jiang-su, 24 September 1988, collected by CS. 3 males, Muo-dao-shi-cun, Chang-he, Buoyang County, Jiang-xi, 6 June 1990, 30 m elevation, collected by JCM and LY and CS [NAU]. 3 males, 50 km N.W. of Yin-cheng, Tributary of Da-fu-shui, Jin-shan County, Hu-bei, 17 July 1990, 90 m elevation, collected by JCM [CUAC].

Distribution.—This species is distributed in the Oriental Biogeographic Region of southeastern China, including Jiang-su, Jiang-xi, and Hu-bei Provinces.

Phylogeny.—The species is closely related to *E. yamashironis* Tsuda, as suggested by the lateral expansion of each ventral projection of segment X.

***Ecnomus tenellus* (Rambur) 1842**

Figs 4 - 7, 12 - 13, 22, 25 - 26

Philopotamus tenellus Rambur, 1842, p. 503, type locality: France.

Ecnomus tenellus (Rambur), McLachlan, 1864, p. 30.

Polycentropus concinnus Hagen, 1861, p. 5 (not Stephens, 1836), type locality: Britain. McLachlan, 1864, p. 30, as synonym of *E. tenellus*.

Ecnomus falcatus Mosely, 1932, p. 167-168, f. 7-9, type locality: India. Schmid, 1958, p. 94, as synonym of *E. tenellus*.

Ecnomus omiensis Tsuda, 1942, p. 268-269, f. 27, type locality: Japan. Schmid 1958, p. 94, as synonym of *E. tenellus*.

Length with folded forewings.—4.3-5.1 mm (N = 7). Forewings each with Fork 1 and fork of R₁.

Male genitalia.—(Figs. 22, 25 - 26): Sternum IX with triangular excision on anterior margin, posterior margin straight, with longitudinal median line along meson. Tergum X with posterior ventral projection straight, finger-shaped in lateral view, broad in dorsal view. Superior appendages broad, tapering to apex, each with tiny mesal process at base and several stout spines on mesal surface near middle and apex. Inferior appendages shorter than superior appendages, each with short dorsal process at middle, apex more slender and curved upward in lateral view, round and curved mesad in ventral view. Phallus tube-like, apex with small finger-like process at dorsal margin, ventral margin extended tongue-like.

Female genitalia.—(Figs. 12 - 13): Posterior margin of sternum VII with mesal rectangular notch. Segment X with transverse row of long setae. Ventral plates subquadrate, each with short diagonal ridge. Irregular sclerite surrounding gonophore between ventral plates. Sternum XI with median membranous fold, lateral ridges each with

cercus and two papillae.

Material examined.— 1 male, Feng-huan-cun, Feng-cun, Xi-xian County, An-hui, 24 May 1990, 116 m elevation, collected by LY. 2 males, Yao-cun, Yong-feng-he, Lang-xi County, An-hui, 23 May 1990, collected by JCM and LY and CS. 1 male, San-qing-shan, Shuang-xi-he, 80 km S. of Yu-shan, Yu-shan County, Jiang-xi, 27-28 May 1990, 470 m elevation, collected by JCM and CS. 5 males, Muo-dao-shi-cun, Chang-he, Buo-yang County, Jiang-xi, 6 June 1990, 30 m elevation, collected by JCM and CS. 1 male, 19 km E. of Ping-wu, Ping-wu County, Si-chuan, 27 June 1990, 1090 m elevation, collected JCM. 3 males, Yang-ma-he, 4 km N. of Xin-jin, Xin-jin County, Si-chuan, 18 June 1990, 550 m elevation, collected by JCM and YJL. 5 males, Si-mian-shan, Dam of Da-hong-hai, Jiang-jin County, Si-chuan, 6 July 1990, 1000 m elevation, collected by JCM. 3 males, Si-mian-shan, Fei-long-he, Jiang-jin County, Si-chuan, 7 July 1990, 300 m elevation, collected by LY. 2 males, 3 km N. of Xin-jing, Yang-ma-he, 550 m elevation, Xi-jin County, Si-chuan, 18 June 1990, 550 m elevation, collected by LY and XC. 1 male, 2 km N. W. of Jiang-you, Kang-shui-he (tributary of Fu-jiang), Jiang-you County, Si-chuan, 28 June 1990, 600 m elevation, collected by LY, YJL, and XC. 1 male, Nan-dong, 8 km E. of Kai-yuan, Kai-yuan County, Yun-nan, 17 July 1990, 1450 m elevation, collected by YJL. 26 males, 45 km N. W. of Yi-cheng, upstream of Da-fu-shui, Jin-shan County, Hu-bei, 80 m elevation, 17 July 1990, collected by LY and SDW. 8 males, 27 km N. of Ma-cheng, Tong-jiang-chong-he, Ma-cheng County, Hu-bei, 12 July 1990, 150 m elevation, collected by JCM and LY [deposited in (NAU)]. 45 males, Da-fu-shui, Tian-dian-dam, Yin-cheng City, Hu-bei, 16 July 1990, 40 m elevation, collected by JCM and LY. 65 males, Dong-hu, Wu-han City, Hu-bei, 11 July 1990, collected by JCM and LY [deposited in (CUAC)].

Distribution.— The species is widely distributed over four Biogeographic Regions: Afrotropical, Oriental and East and West Palaearctic. In China: Guang-dong, An-hui, Jiang-xi, Jiang-su, Hu-bei, Si-chuan, Yun-nan, Ti-bet, and Tai-wan Provinces.

Diagnosis.— The species is similar to *E. yamashironi* Tsuda as mentioned previously and may be distinguished by the characters cited above.

Phylogeny.— The species is closely related to *E. bicolorus* Tian and Li, as suggested by the dorsal transverse process at the middle of each inferior appendage.

***Ecnomus fochowensis* Mosely, 1942**

Figs. 21, 23-24

Ecnomus fochowensis Mosely, 1942, p. 354-355, type locality: Fu-zhou (= "Fochow"), China.

Length with folded forewings.— 5.1 mm (N=1). Forewings each with Fork 1 and fork of R_1 .

Male genitalia.— Sternum IX with deep triangular incision on ante-

rior margin, shallow incision on posterior margin and longitudinal line along meson. Segment X projecting anterolaterad, posterior ventral projections of segment X ("upper-penis", Mosely 1942) each slender and directed posterad. Superior appendages very long, with fairly closely fringed inner margins and short teeth at apices; with minute branch tipped with a few hairs in the inner surface towards the base; in lateral view, of equal thickness throughout their length (Mosely 1942). Inferior appendages large, boot-shaped, heels directed distally, toes stout and directed upwards and each with dorsomesal transverse ridge at middle. Phallus short, its apex appearing from side as triangular shelf directed downwards.

Diagnosis.—The species is similar to *E. bicolorus* and *E. tenellus* in the presence of a transverse dorsomesal process on each inferior appendage. However, the boot-shaped inferior appendages of this species are peculiar in this genus.

Material examined.—Paratype, 1 male, Fu-zhou, China, 1936 - 1937, collected by M.S. Yang (Deposited in (NHM)).

Distribution.— The species has been found only in the type location in southeastern China, Fu-jian Province (Oriental Biogeographic Region).

Phylogeny.— The species is related to *E. bicolorus* and *E. tenellus* as suggested by the presence of a transverse dorsomesal process on each inferior appendage.

Ecnomus incisus sp. n.

Figs. 27-30, 32

Length with folded forewings.— 4.3 mm (N = 1). Forewings each with Fork 1 and fork of R_1 .

Male genitalia.— Sternum IX with anteromesal incision triangular and with median impressed line. Segment X anterior arms directed anteroventrad, connected with phallobase; posterior ventral projections of segment X short, each forked. Superior appendages each broad mesally at base, abruptly narrowed beyond base, mostly slender and straight, clavate apically; each with slender mesal projection and tiny lateral process at base. Inferior appendages slender, curved mesad, each expanded slightly and blunt at apex; from lateral view, basal 1/3 thick, concave dorsally at middle, curved upward about 45°. Phallus tube-like, apicoventral margin extended, spoon-like, with dorsal finger-like process.

Diagnosis.—The species is similar to *Ecnomus penjabi* Schmid, 1961 in its narrow and slender superior appendages expanded basally and the inferior appendages slightly expanded and blunt apically, curved mesad. However, three characters can be used to distinguish the two species. In the new species, the inferior appendages are thicker at the base and concave at the middle. The posterior ventral projections of segment X are forked in the new species while single in *E. penjabi*. The apex of the phallus is blunt in the new species while acute at *E. penjabi*.

Holotype.—Male, Center of Chang-jiang River, Wan-xian County,

Si-chuan, 9 July 1990, collected by JCM and LY [deposited in (NAU)].

Distribution.— The species has been found only in the type locality in central China, Oriental Biogeographic Region.

Phylogeny.— This species is probably a sister species of *E. penjabi*, as suggested by the mesally expanded base of each superior appendage.

Etymology.—Latin, *incisus* = "cut in, cut into," referring to the incision of each posterior ventral projection of segment X.

Ecnomus gigantius Group

The group is monophyletic, as suggested by the homologue of coin-shaped parameres. The group members also share other characters: The ventral projection of segment X is absent or short and broad; the phallus is bulbous basally, acute apically, mostly membranous dorsally; and the impressed median line of sternum IX is present.

Ecnomus latus sp. n.

Figs. 31, 33

Length with folded forewings.— 5.69 - 6.9 mm (N = 5). Forewings each with fork of R_1 and Fork 1.

Male genitalia.— Sternum IX with impressed median line, anterior margin with deep mesal incision; posterior margin of sternum IX far beyond posterior margin of tergum IX. Ventral projections of segment X short. Superior appendages shorter than inferior appendages, ovoid. Inferior appendage broader at base, each with large mesal thumb-like projection at middle, rounded and curved slightly inward at apex. Phallus mostly membranous, covered by two very broad round sclerites (= parameres) at middle; apex acute, curved first caudodorsad, then ventrad.

Diagnosis.— The species is similar to *Ecnomus gigantius*, sp. n. and *Ecnomus rectus*, sp. n. in the coin-shaped parameres. However, the parameres of this new species are much bigger and more darkly sclerotized than in the other two species. The finger-like mesal projection of each inferior appendage is absent in the other two species.

Holotype.—Male, Qin-hua-he, 57 km N. of Wu-yuan, Wu-yuan County, Jiang-xi, 25 May 1990, 250 m elevation, collected by JCM, LY and YJL. Paratypes: 1 male, same data as for holotype; 1 male, Xi-qi-he, 59 km S. E. of Gui-xi, Gui-xi County, Jiang-xi, 5 June 1990, 210 m elevation, collected by LY [deposited in (NAU)]; 2 males, Ding-xi-he, Song-cun, 33 km E. of Jin-xian, Jin-xian County, An-hui, 8 June 1990, 120 m elevation, collected by JCM, LY and CS [deposited in (CUAC)].

Distribution.— The species is distributed in the Oriental Biogeographic Region of southeastern China (Jiang-xi and An-hui Provinces).

Phylogeny.—The species is probably a sister species of the lineage of *Ecnomus gigantius*, sp.n. + *Ecnomus rectus*, sp.n. as suggested by the coin-shaped parameres on the phallus.

Etymology.—Latin, *latus*, = "broad," referring to the broad, round shape of the parameres.

***Ecnomus gigantius* sp. n.**
(Figs. 34-37)

Length with folded forewings.—7.3 -7.5 mm (N = 2). Forewings each with Fork 1 and fork of R₁.

Male genitalia.—Anterior margin of sternum IX nearly straight, posterior margin with broad and shallow triangular incision, median line present; sternum IX short, posterior margin slightly exceeding tergum IX. Superior appendages each long, slender at base and broader in apical half, compressed, lateral margin of apical part twisted laterad, round apically in lateral view, mesal surface with several stout spines. Inferior appendages short, about half length of superior appendages; in ventral view, each broadest at basal 1/3 -1/4 of length, slightly concave mesally before apex; in lateral view, concave at middle at dorsal margin and slightly curved dorsad to round apex. Phallus with apex slender, curved ventrad; without basal lobe; parameres coin-shaped, slightly sclerotized.

Diagnosis.—The species is the biggest of all Chinese species of the genus. The species is similar to *Ecnomus rectus*, sp. n., in the slightly sclerotized, coin-shaped parameres and short sternum IX. However, the inferior appendages of this species are much narrower than those of *E. rectus* and are each without the median tooth seen in *E. rectus*.

Holotype.—Male, Ding-xi-he, Song-cun, 33 km E. of Jin-xian, Jin-xian County, An-hui, 8 June 1990, 120 m elevation, collected by JCM, YJL and CS [deposited in (NAU)]. Paratypes: 1 male, Ju-ji-cun, Yuan-tou-xi, 70 km WN. of Wu-yuan, Wu-yuan County, Jiang-xi, 26 May 1990, 280 m elevation, collected by JCM, YJL, and CS [deposited in (CUAC)].

Distribution.—The species has been found only in the type locality of the Oriental Biogeographic Region of eastern China (An-hui and Jiang-xi Provinces).

Phylogeny.—The species is closely related to *E. rectus* as suggested by the homologue of a short sternum IX.

Etymology.—Latin, *gigantius* = "great," referring to the size of this species relative to the others of the genus.

***Ecnomus rectus* sp. n.**
Figs. 38-41

Length with folded forewings.—5.8 - 6.8 mm (N = 7). Forewings each with Fork 1 and fork of R₁.

Male genitalia.—Sternum IX short, but posterior margin far exceeding tergum IX; in ventral view, anterior portion about 1/3 as broad as posterior portion; both anterior and posterior margins with triangular excisions. Ventral projections of segment X absent. Superior appendages long and curved slightly dorsad, with broad projection arising

from base of mesal surface, each round at apex from lateral view. Inferior appendages short, about half length of superior appendages; depressed, each with submedial point and medial excision at midlength in ventral view; narrow and concave on dorsal margin at middle in lateral view. Phallus apex slender, straight from dorsal view; parameres small, slightly sclerotized, coin-like, their separation from each other imperceptible.

Diagnosis.—The species is very similar to *E. giantius* in that the parameres are small, slightly sclerotized, coin-like and the inferior appendages are short, narrow and concave on the dorsal margin at the middle in lateral view. However, in this new species, the inferior appendages each possess a mesal projection which is more than half as wide as long from ventral view and much broader than in *E. giantius*, sp. n.

Holotype.—male, Si-mian-shan, Fei-long-he, Jiang-jin County, Si-chuan, 7 July 1990, 300 m elevation, collected by LY [deposited in (NAU)]. Paratypes: 8 males, same data as holotype [deposited in (NAU) and (CUAC)].

Distribution.—The species has been found only in the type location in the Oriental Biogeographic Region, southwestern China (Si-chuan Province).

Phylogeny.—The species is closely related to *E. giantius*, sp. n. as suggested by the homologue of a short sternum IX.

Etymology.—Latin, *rectus* = "straight," referring to the nearly straight shape of the superior appendages.

Ecnomus ellipticus Group

The monophyly of this group is suggested by the following homologues: The apex of each inferior appendage is sharp and the superior appendages are short and ear-like. Superior appendages of *Ecnomus uncatus*, sp. n. are not so short; however, they are widened toward their apices, suggesting that these are autapomorphic derivatives of ear-like structures.

This group is a sister group of the *Ecnomus connatus* Group, as suggested by the homologue of the absence of a median line on sternum IX. The members of the group also share other characters, such as the following: The posterior ventral projections of segment X are short and broad; the phallus of the group is bulbous basally, acute apically, membranous dorsally; and a dorsobasal lobe of the phallus is present between the parameres or anterior to the parameres.

Ecnomus uncatatus sp. n.

Figs. 42-45

Length.—6.5 mm (N = 1). Each forewing with fork of R_1 and Fork 1.

Male genitalia.—Sternum IX anterior margin with small triangular excision, posterior margin broadly concave. Ventral projections of segment X short and broad from lateral view. Superior appendages compressed, long, gradually widened before apex, obliquely truncate dorsally at apex. Inferior appendages each with apex acute and curved dorsomesad, with thumb-shaped dorsolateral projection at middle; in ventral view, base of each inferior appendage much broader than in middle. Phallus with dorsobasal lobe between two parameres; parameres and dorsobasal lobe longitudinal, originating from middle of phallus, upright and tall; from lateral view, parameres broad at base and somewhat membranous; apex of phallus sharp and curved ventrad.

Diagnosis.—This species is very similar to *Ecnomus ellipticus*, sp. n. in the following characters: 1, The inferior appendages are sharp and curved dorsomesad, each depressed basally and with a thumb-shaped dorsolateral projection at the middle. 2, The phallic parameres and dorsobasal lobe are long, upright, originating from the middle of the phallus. However, the superior appendages of this species are slender, not ear-like as in *E. ellipticus*, sp. n. 3, The apex of the phallus is curved ventrad in this species (straight in *E. ellipticus*).

Holotype.—Male, Si-mian-shan, Fei-long-he, Jiang-jin County, Si-chuan, 7 July 1990, 300 m elevation, collected by LY [deposited in (NAU)].

Distribution.—The species has been found only in the type locality in the Oriental Biogeographic Region of southwestern China, Si-chuan Province.

Phylogeny.—The species is closely related to *Ecnomus ellipticus*, sp. n. as suggested by the homologue of a long dorsolateral projection of each inferior appendage.

Etymology.—Latin, *uncatus* = "hooked," referring to the shape of the inferior appendages.

Ecnomus ellipticus sp. n.

Figs. 46-48

Length with folded forewings.—5.5 - 5.8 mm (N = 7). Each forewing with fork of R_1 and Fork 1.

Male genitalia.—Ventral projections of segment X short and broad from lateral view. Superior appendages each short, elliptical in lateral view, with several spines distally on mesal surface. Inferior appendages each with apex acute and curved dorsomesad, with thumb-shaped dorsolateral projection at middle; bases of inferior appendages depressed dorsoventrally, in ventral view each broader basally than in middle. Phallus with dorsobasal lobe between two parameres; parameres and dorsobasal lobe long, upright, originating from middle

of phallus; from lateral view, parameres broad at base and somewhat membranous; apex of phallus sharp, straight.

Diagnosis.—This species is very similar to *E. uncatius* and may be distinguished from it by characters provided above in its description.

Holotype.—Male, Ding-xi-he, Song-cun, 33 km E. of Jin-xian, Jin-xian County, An-hui, 8 June 1990, 120 m elevation, collected by JCM, LY, and CS. Paratypes: 7 males, data same as holotype; 1 male, 17 km E. of Ping-wu, tributary of Fu-jiang, Ping-wu County, Si-chuan, 27 June 1990, 1050 m elevation, collected by LY and YJL [deposited in (NAU)]; 2 males, 1 km S. of Gui-shan Tea Farm, 15 km N. E. of Ma-cheng, Zheng-shui-he, Ma-cheng County, Hu-bei, 13 July 1990, 250 m elevation, collected by JCM and SW [deposited in (CUAC)].

Distribution.—The new species has been found only in the type localities of the Oriental Biogeographic Region, southern China (An-hui, Si-chuan and Hu-bei Provinces).

Phylogeny.—The species is closely related to *Ecnomus uncatius* as suggested by the homologue of the thumb-shaped dorsolateral projection of each inferior appendage.

Etymology.—Greek, *elleiptikos* = "elliptic, defective," referring to the elliptical shape of each superior appendage (i.e., not a perfect circle).

***Ecnomus parellipticus* sp. n.**

Figs. 49-52

Length with forewing.—5.5 mm (N = 2). Each forewing with fork of R_1 and Fork 1.

Male genitalia.—Sternum IX anterior margin with small triangular excision, posterior margin broadly and shallowly excised, round in lateral view. Ventral projections of segment X short and broad from lateral view. Superior appendages short, elliptical in lateral view. Inferior appendages each with apex acute and curved dorsomesad and with short and triangular dorsolateral projection at middle; bases of inferior appendages slightly thicker than middle from ventral view. Dorsobasal lobe of phallus between parameres; parameres and dorsobasal lobe long, upright, originating from middle of phallus; from lateral view, parameres broad at base and somewhat membranous; apex of phallus sharp, directed ventrad.

Diagnosis.—The superior appendages of the species are similar to those of *E. ellipticus*. However, their inferior appendages are quite different: In this species, the dorsolateral process of each inferior appendage is much shorter and broader, not thumb-shaped as in *E. ellipticus*. From lateral view, the base of the inferior appendage is much more slender than in *E. ellipticus*.

Holotype.—Male, 2 km W. of Jiang-you, Kang-shui-he (tributary of Fu-jiang), Jiang-you County, Si-chuan, 28 June 1990, 600 m elevation, collected by JCM, YJL, and LY [deposited in (NAU)]. Paratype: 1 male, same data as holotype [deposited in (CUAC)].

Distribution.—The new species has been found only in the type

locality of the Oriental Biogeographic Region in southwestern China, Si-chuan Province.

Phylogeny.— The species is closely related to the lineage composed of *Ecnomus ellipticus*, sp. n. + *Ecnomus uncatus*, sp. n. as suggested by the presence of a homologous dorsolateral projection on each inferior appendage and the homologous dorsobasal lobe of the phallus between its two parameres.

Etymology.— Greek, para = "near, beside, beyond," and elleiptikos = "elliptic, defective," referring to the shape of the superior appendages, similar to those of *E. ellipticus*.

***Ecnomus truncatus* sp. n.**

Figs. 53-56

Length with forewing.— 7.3 mm (N = 2). Each forewing with fork of R1 and Fork 1.

Male genitalia.—Sternum IX with anterior part narrowed, anterior margin with small triangular excision, posterior margin straight, median line present. Ventral projections of segment X short, thick. Superior appendages each very broad and truncated at apex from lateral view. Inferior appendages nearly straight on ventral margin and slightly convex on dorsal margin in the middle from lateral view; apex sharp and recurved anteromesad. Phallus with apex acute and curved ventrad; dorsobasal lobe of phallus finger-like, upright and tall. Phallic parameres very small, longitudinal.

Diagnosis.—This is a very peculiar species in the genus for the expanded and truncated superior appendages and the very small phallic parameres.

Holotype.—Male, 3 km W. of Jing-shui, E-mei-shan, E-mei City, Si-chuan, 1 July 1990, collected by YJL and XC [deposited in (NAU)].

Distribution.— The species is found only in the type locality of Si-chuan Province, Southwest China, Oriental Biogeographic Region.

Phylogeny.— This species is closely related to the lineage of (*Ecnomus ellipticus* + *Ecnomus uncatus*) + *Ecnomus parellipticus* as suggested by the homologically recurved apex of each inferior appendage.

Etymology.— Latin, *truncatus* = "truncated," referring to the shape of the superior appendages.

***Ecnomus acuminatus* sp. n.**

Figs. 57 - 60

Length with folded forewing.— 6.5 - 6.6 mm (N = 4). Each forewing with fork of R1 and Fork 1.

Male genitalia.—Sternum IX with median line, anterior margin with narrow triangular incision, posterior margin with deeply rounded incision. Ventral projections of segment X short and thick. Superior appendages ear-like and round at apex from lateral view. Inferior appendages sharp at apex, with mesal concavity at middle and with small mesal projection beyond this concavity. Phallus sharp at apex,

protruding laterally suddenly at middle; from dorsal view, phallic parameres each originating from lateral edge of phallus at middle, directed first anterad, then recurved caudad, apically blunt; dorsobasal lobe broad, originating from middle of phallus beneath parameres, and forked at posterior apex.

Diagnosis.—The species is similar to *Ecnomus latus*, sp. n. in the presence of a mesal projection on each inferior appendage. However, the acute apices of the inferior appendages of this species can be used to distinguish it from *E. latus*.

Holotype.—Male, San-qing-shan, Shuang-xi-he, 80 km S. of Yu-shan, Yu-shan County, Jiang-xi, 27-28 May 1990, 470 m elevation, collected by JCM and CS [deposited in (NAU)]. Paratypes: 4 males, data same as holotype [deposited in (NAU) and (CUAC)].

Distribution.—The species has been found only at the type locality in southeastern China, Jiang-xi Province, Oriental Biogeographic Region.

Phylogeny.—The species belongs to the lineage of ((*E. ellipticus* + *E. uncatus*) + *E. parellipticus*) + *E. truncatus*. The monophyly of this group is supported by the following homologues: 1. Apex of each inferior appendage sharp. 2. Superior appendage short and ear-like.

Etymology.—Latin, *acuminatus* = "sharp", referring to the sharp apices of the inferior appendages.

Ecnomus connatus Group

The monophyly of this group is suggested by the absence of a median line on sternum IX. This group is a sister group of the *Ecnomus ellipticus* Group, as suggested by the homologous upright and tall configuration of the parameres. The members of the group also share the following characters: the parameres of the phallus originate from the base of the phallus; superior appendages are slender and long; the phallus is bulbous basally, acute apically, and membranous dorsally; the ventral projections of segment X are short and broad (except very long in *Ecnomus longicaudatus*, sp. n.); the dorsobasal lobe of the phallus is separated from the parameres or fused with them (if distinct, it is anterior to the parameres); and the phallic parameres are long, directed caudad, and fused basally or short and upright.

Ecnomus orientalis sp. n.

Figs. 61 - 64

Length with forewing.—5.2 mm (N = 1). Each forewing with fork R1, with Fork 1.

Male genitalia.—Sternum IX anterior margin with small triangular excision, posterior margin nearly straight, median line absent. Ventral projections of segment X each short and broadly triangular. Superior appendages each long and slender, more or less parallel-sided, slightly sinuous and apically round in lateral view, with small ventral projection at base. Inferior appendages each concave on dorsal margin at

middle, expanded and curved dorsad to apex from lateral view; broad at base, mesal margin sinuous in ventral view. Phallus with apex straight; dorsobasal lobe finger-like, directed dorsad; phallic parameres each widened at apex, directed dorsocaudad.

Diagnosis.—This species is somewhat similar to *Ecnomus tsudai* Kumanski, 1992 and *Ecnomus pseudostenellus* Ulmer, 1930 in the presence of a minute basoventral projection on each superior appendage and the orientation of the phallic dorsobasal lobe and parameres. However, in the new species, the dorsal margin of each inferior appendage is more concave than in the other two species.

Holotype.—Male, Ding-xi-he, Song-cun, 33 km E. of Jin-xian, Jin-xian, An-hui, 8 June 1990, 120 m elevation, collected by JCM and LY and CS [deposited in (NAU)].

Distribution.—The species is found only in the type locality in eastern China (An-hui Province), Oriental Biogeographic Region.

Phylogeny.—The species is the sister species to the lineage composed of all other species in this genus, as suggested by the homologue of median line of sternum IX absent.

Etymology.—Latin, *orientalis* = "oriental," referring to the type locality in eastern China.

Ecnomus pungens sp. n.

Figs. 65 - 68

Length with forewing.—4.5 mm (N = 1). Each forewing with fork of R1 inconspicuous and without Fork 1.

Male genitalia.—Sternum IX with anterior margin convex, posterior margin broadly and shallowly concave, without median line. Ventral projections of segment X fused as one, short and triangular from dorsal view. Superior appendages each long, compressed basally, in lateral view about four times as broad at base as in middle, apex slightly enlarged and rounded; parallel-sided and slender in dorsal view. Inferior appendage almost straight from lateral view, compressed; in ventral view, with large basal triangular area, basomesal corner acute. Phallus thick; dorsobasal lobe not fused with parameres, directed dorsad; phallic parameres directed dorsocaudad, stout and truncate from lateral view; phallic apex sharp and beak-like, directed caudad.

Diagnosis.—This species is very similar to *Ecnomus vahasaba* Schmid, 1958 and *Ecnomus projectus*, sp. n. in the absence of forewing Fork 1 and the presence of a dorsobasal lobe and short upright parameres on the male phallus. However, in this new species, the superior appendages lack minute basoventral processes which are present in *E. vahasaba* and *E. projectus*. The parameres are not curved and are broader than those in *E. projectus*, sp. n. The apices of the superior appendages are round and directed caudad, not truncated as in *E. vahasaba*. Also, the distal end of each inferior appendage of this species is not as oblique as in *E. vahasaba*. The ventral projections of segment X are fused as a small triangular lobe in the new species, but remain separated as a pair of

sharp triangular projections in *E. vahasaba* and *E. projectus*.

Holotype.—Male, Nan-wen-he, Nan-wen-he-xiang, Ma-li-po County, Yun-nan, 12 July 1990, 600 m elevation, collected by YJL and XK [deposited in (NAU)].

Distribution.—The species is found only in the type locality in Yun-nan Province, southwestern China, Oriental Biogeographic Region.

Phylogeny.—This species, *E. projectus*, and *E. vahasaba* constitute a monophyletic group supported by the homologous absence of Fork 1 from the forewing. There is insufficient information to resolve the trichotomy.

Etymology.—Latin, *pungens* = "penetrating," referring to the sharp, beak-like apex of the phallus.

***Ecnomus projectus* sp. n.**

Figs. 69 - 72

Length with folded forewings.—4.0-4.7 mm (N = 5). Each forewing with fork of R_1 , without Fork 1.

Male genitalia.—Sternum IX without median line, anterior margin with wide and shallow excision, posterior margin slightly concave, nearly straight. Ventral projections of segment X prominent, acute triangular. Superior appendages long and slender, each somewhat compressed and with a minute ventral projection at base, in lateral view with base about 1.5 times as wide as narrowest portion, rounded at apex, in dorsal view parallel-sided. Inferior appendages each compressed and concave mesally, slightly curved dorsad and with apicodorsal point; in ventral view, base twice as broad as apex, with blunt basomesal corner and with concave ventromesal margin. Phallus acute and straight at apex; its dorsobasal lobe separated from parameres; parameres each short, slender, upright, curved caudad at apex.

Diagnosis.—This species is very similar to *E. pungens* and *E. vahasaba* in the absence of Fork 1 from the forewings. However, the following characters can be used to distinguish this new species from *E. pungens* and *E. vahasaba*: (1) The phallic parameres of *E. projectus* are more slender and are curved caudad at the apex, unlike the thick and straight parameres of the other two species. (2) The apices of the inferior appendages are curved dorsad slightly, not straight in lateral view as in the other two species. (3) The anterior margin of sternum IX is slightly concave, not convex as in the other two species.

Holotype.—Male, Xi-qi-he, 10 km S. of Gui-xi, Gui-xi County, Jiang-xi, 4 June 1990, 30 m elevation, collected by LY and JCM and CS [deposited in (NAU)]. Paratypes: 20 males, same data as for holotype [deposited in (NAU) and (CUAC)].

Distribution.—The species is found only in the type location in Jiang-xi Province, southeastern China, Oriental Biogeographic Region.

Phylogeny.—Discussed with the immediately preceding species.

Etymology.—Latin, *projectus* = "thrown or pushed forth," referring

to the prominent, acute basoventral projections of segment X.

***Ecnomus spatulatus* sp. n.**

Figs. 8 - 9, 73 - 76)

Length with forewing.—5.2 mm (N = 1). Frons protruding, with normal hypomedial warts (Figs. 8 - 9). Each forewing with fork of R1 and with Fork 1.

Male genitalia (Figs. 73 - 76): Sternum IX without median line, anterior margin with triangular excision, posterior margin broadly concave. Ventral projections of segment X short, minute. Superior appendages long and slender, each slightly tapering to apex and without basoventral projection. Inferior appendages each somewhat spoon-shaped, with slender basal "handle" concave on dorsal and ventral margins in lateral view; apex compressed, mesal surface concave. Phallus with dorsobasal lobe distinct from parameres; parameres two-thirds as long as phallus, each thick at base, tapering to slender apex, slightly curved ventrad.

Diagnosis.— The species is somewhat like *Ecnomus perpendicularis*, sp. n. and *Ecnomus cornutus*, sp. n. in possessing long phallic parameres and an isolated basal lobe of the phallus. However, the spoon-shaped inferior appendages can be used to distinguish this new species from those two.

Holotype.—Male, Ding-xi-he, Song-cun, 33 km E. of Jin-xian, Jin-xian County, An-hui, 8 June 1990, 120 m elevation, collected by JCM and LY and YJL [deposited in (NAU)].

Distribution.— The species has been found only at the type locality in the Oriental Biogeographic Region of eastern China (An-hui Province).

Phylogeny.—The species is a sister species of the lineage constituted by *Ecnomus cornutus*, sp. n., *Ecnomus perpendicularis*, sp. n., *Ecnomus connatus*, sp. n. and *Ecnomus coalitus*, sp. n. as suggested by the following homologues: (1) adult frons protruding; (2) parameres long.

***Ecnomus longicaudatus* sp. n.**

Figs. 77 - 80

Length with folded forewing.—4.3 - 5.2 mm (N = 4). Each forewing with Fork 1 and fork of R1.

Male genitalia.—Sternum IX short, posterior margin slightly exceeding tergum IX, without median line, anterior margin straight, posterior margin shallowly concave. Ventral projections of segment X slender and acute, about half length of superior appendages, directed ventrocaudad. Superior appendages each long, triangular from lateral view, broad at base, with basal ventral point, tapering to rounded apex. Inferior appendages about half length of superior appendages, compressed; each concave dorsally at base, with sharp dorsal point at middle; apex sharp from ventral view. Phallus compressed at middle; basodorsal lobe absent; phallic parameres appearing as short strips,

depressed on top of phallus, obliquely truncated at apex, directed caudad.

Diagnosis.—This species resembles *Ecnomus singkarakensis* Ulmer, 1951 and *Ecnomus promat* Malicky and Chantaramongkol, 1993 in their long and slender basoventral projections of segment X. However, in those species, there are no parameres. The species is similar to *E. rectus* and *E. gigantius* in the short sternum IX. However, the ventral projection of segment X is much longer than in those two species.

Holotype.—Male, Ba-bao-zhen, Xiang-shui-he River, Guang-nan County, Yun-nan, 16 July 1990, collected by YJL [deposited in (NAU)]. Paratypes: 3 males, same data as holotype [deposited in (NAU) and (CUAC)].

Distribution.—The species is found only in the type locality in the Oriental Biogeographic Region, southwestern China (Yun-nan Province).

Phylogeny.—The species is probably closely related to the lineage composed of *Ecnomus cornutus*, sp. n., *Ecnomus perpendicularis*, sp. n., *Ecnomus connatus*, sp. n. and *Ecnomus coalitus*, sp. n. and *Ecnomus spatulatus*, sp. n. as suggested by the homologously depressed parameres directed caudad.

Etymology.—Latin, *longus* = "long," and *caudatus* = "with a tail," referring to the long ventral projections of segment X.

Ecnomus coalitus sp. n.

Figs. 81 - 84

Length with folded forewings.—5.5 - 5.8 mm (N = 3). Frons protruding, with very large hypomedial warts. Each forewing with fork of R1 and Fork 1.

Male genitalia.—Sternum IX without median line; anterior margin with shallow and broad triangular excision; posterior margin with shallow and broad concavity. Segment X with middle projection acute in lateral view, convex in dorsal view, and with ventral projection short, broad. Superior appendages slender, each with long basoventral projection, tapering slightly to rounded apex. Inferior appendages more than half as long as superior appendages, slightly expanded at apex from lateral view; in ventral view, concave mesally in apical half, lateral margins parallel basally. Phallic dorsobasal lobe fused with parameres; parameres fused basally, divergent from base, slender, reaching to apex of phallus.

Diagnosis.—This new species is similar to *Ecnomus connatus*, sp. n. in the long phallic parameres fused with the dorsobasal lobe, the presence of a middle process of segment X, and a long basoventral projection on each superior appendage. However, in this species, from ventral view, the mesal and lateral margins of each inferior appendage are parallel in ventral view, the basomesal corner is obtuse; the mesal subapical tooth of each inferior appendage is absent; and the anterior margin of sternum IX is slightly excised.

Holotype.—Male, 2 km N. W. of Jiang-you, Kang-shui-he (tributary

of Fu-jiang), Jiang-you County, Si-chuan, 28 June 1990, 600 m elevation, collected by JCM and LY and YJL and XC [deposited in (NAU)]. Paratypes: 2 males, same data as holotype [deposited in (CUAC)].

Distribution.— The species has been found only at the type locality in the Oriental Biogeographic Region, southwestern China (Si-chuan Province).

Phylogeny.— The species is a sister species of *E. connatus*, as suggested by the homologous presence of a middle projection of segment X. The unusually large hypomedial warts (occupying most of the frons) is a homologue of *E. connatus* + *E. coalitus* + *E. cornutus* + *E. perpendicularis*, a monophyletic lineage.

Etymology.— Latin, *coalitus* = "grown together, united," referring to the fused bases of the phallic parameres.

***Ecnomus connatus* sp. n.**

Figs. 10, 11, 85 - 88

Length with folded forewings.—5.8 mm (N = 2). Frons protruding, with very large hypomedial warts (Figs. 10, 11). Each forewing with fork of R1 and with Fork 1.

Male genitalia.—(Figs. 85 - 88). Sternum IX without median line; anterior margin slightly concave, nearly straight; posterior margin sinuous, darkened. Segment X with middle projection acute in lateral view and ventral projections short and broad. Superior appendages each slender, tapering slightly to rounded apex, with long ventral projection at base. Inferior appendages less than half as long as superior appendages; in ventral view, each with sharp triangular basomesal corner and mesal subapical tooth; in lateral view, apex round and slightly expanded dorsally. Phallic parameres fused with dorsobasal process and with each other basally and divergent from base, slender, reaching apex of phallus.

Holotype.—Male, Ding-xi-he, Song-cun, 33 km E. of Jin-xian, Jin-xian County, An-hui, 8 June 1990, 120 m elevation, collected by JCM, LY and YJL [deposited in (NAU)].

Diagnosis.—This new species is similar to *E. coalitus* in the long phallic parameres fused with each other and with the dorsobasal lobe, the presence of a middle process of segment X, and the long basoventral projections of the superior appendages. However, their difference is obvious: from ventral view, the inferior appendages each have an acute basomesal corner (obtuse in *E. coalitus*); the basomesal margin is oblique (straight, parallel with lateral margin in *E. coalitus*); and the subapical mesal margin bears a tooth (toothless in *E. coalitus*).

Distribution.— The species has been found only in the type locality in the Oriental Biogeographic Region, eastern China (An-hui Province).

Phylogeny.—The species is a sister species of *E. coalitus*, as suggested by the homologous presence of a middle projection of segment X.

Etymology.—Latin, *connatus* = "fused," referring to the fused bases of the phallic parameres.

Ecnomus perpendicularis sp. n.

Figs. 89 - 92

Length with folded forewings.—5.5 - 6.6 mm (N = 2). Frons protruding, with very large hypomedial warts. Each forewing with fork of R1 and with Fork 1.

Male genitalia.—Sternum IX long, without median line, anterior margin with triangular incision, posterior margin shallowly concave. Ventral projections of segment X short and broad. Superior appendages slender and long, with basoventral projection finger-like, blunt at apex. Inferior appendages L-shaped from ventral view, each with small subapical tooth on mesal margin. Phallus with tall, upright dorsobasal lobe connected with phallic parameres; parameres fused, deeply impressed in middle, and with pair of lateral, horn-like projections basally; long, contiguous, reaching apex of phallus.

Diagnosis.— This new species is very similar to *E. cornutus* in the presence of horn-like basolateral projections on the phallic parameres. However, in *E. perpendicularis*, the inferior appendages are L-shaped (gradually curved in *E. cornutus*) and the anterior margin of sternum IX is incised (nearly straight in *E. cornutus*).

Holotype.— Male, Si-mian-shan, Fei-long-he, Jiang-jin County, Si-chuan, 7 July 1990, 300 m elevation, collected by LY [deposited in (NAU)]. Paratype: 1 male, same data as holotype [deposited in (CUAC)].

Distribution.— The species has been found only in the type locality of the Oriental Biogeographic Region, central China (eastern Si-chuan Province).

Phylogeny.— The phylogenetic relationships of the species with *E. cornutus* and the lineage *E. connatus* + *E. coalitus* are uncertain yet.

Etymology.— Latin, *perpendicularis* = "upright, at right angles," referring to the L-shaped inferior appendages.

Ecnomus cornutus sp. n.

Figs. 93 - 96

Length with folded forewings.—6.2-6.6 mm (N = 3). Frons protruding, with very large hypomedial warts. Each forewing with fork of R1 and Fork 1.

Male genitalia.— Sternum IX without median line, anterior margin nearly straight; posterior margin broadly and shallowly concave. Ventral projections of segment X short and broad. Superior appendages each long and slender, slightly broader and with small ventral projection at base, round at apex. Inferior appendages each concave at middle in ventral view, with apex slightly expanded. Phallus with tall, erect dorsobasal process connected with parameres; parameres fused basally, each with horn-like lateral process at base, with deep impression in middle of processes.

Diagnosis.— The species is similar to *E. perpendicularis* in the phallus with basolateral horns and deeply depressed parameres. However,

the inferior appendages of this species are evenly curved mesad (bent at base in *E. perpendicularis*) and the anterior margin of sternum IX is nearly straight (incised in *E. perpendicularis*).

Holotype.—Male, Ding-xi-he, Song-cun, 33 km E. of Jin-xian, Jin-xian County, An-hui, 8 June 1990, 120 m elevation, collected by JCM and LY and CS [deposited in (NAU)]. 4 males, same data as holotype [deposited in (CUAC) and (NAU)].

Distribution.— The species has been found only at the type locality in eastern China (An-hui Province), Oriental Biogeographic Region.

Phylogeny.— The phylogenetic relationships of the species with *E. cornutus* and the lineage *E. connatus* + *E. coalitus* are uncertain yet.

Etymology.— Latin, *cornutus* = "horned," referring to the basolateral horns of the parameres.

Key to male adults of Chinese *Ecnomus* species

- 1 Phallus simple tube, phallic parameres absent (Fig. 14) (*Ecnomus tenellus* Group) 2
- 1' Phallus bulbous at base, acute at apex, phallic parameres present (Figs. 34, 37) 6
- 2(1) Superior appendages triangular, tapering gradually to apex in lateral view (Fig. 14) 3
- 2' Superior appendages equal in thickness (Fig. 21) or abruptly narrowed basally (Fig. 27) in lateral view 5
- 3(2) Inferior appendages tapering, curved dorsad about 90° (Fig. 22) *Ecnomus tenellus* Rambur.
- 3' Inferior appendages nearly straight (Fig. 17) 4
- 4(3') Inferior appendage each mesal surface with transverse projection (Figs. 17, 19) *Ecnomus bicolorus* Tian and Li.
- 4' Inferior appendage each mesal surface concave, without projection (Fig. 16) *Ecnomus yamashironis* Tsuda.
- 5(2') Inferior appendages boot-shaped, each with "toe" directed dorsad (Fig. 21) *Ecnomus foochowensis* Mosely
- 5' Inferior appendages not boot-shaped, their apices not so abruptly curved dorsad (Fig. 27) *Ecnomus incisus*, sp. n.
- 6(1') Phallic paramere coin-shaped (Fig. 31), sometimes somewhat membranous (Fig. 37) (*Ecnomus gigantius* Group) 7
- 6' Phallic paramere long (Figs. 42, 80) or short (Fig. 60), never coin-shaped 9
- 7(5) Inferior appendages each with mesal finger-like projection (Fig. 31) *Ecnomus latus*, sp. n.
- 7' Inferior appendages without mesal finger-like projections (Fig. 36) 8
- 8(6') Superior appendages narrower basally than apically (Fig. 34); inferior appendages each less than 1/3 as wide as long in ventral view (Fig. 36) *Ecnomus gigantius*, sp. n.
- 8' Superior appendages equally broad throughout (Fig. 40); inferior appendages more than 1/2 as wide as long in ventral view (Fig. 38) *Ecnomus rectus*, sp. n.
- 9(6') Superior appendages constricted basally, expanded to ear-like apices

- (Fig. 46); apices of inferior appendages sharp (Fig. 46); sternum IX with median line (Fig. 48) (*Ecnomus ellipticus* Group) 10
- 9' Superior appendages not constricted basally (Fig. 85); apices of inferior appendages not sharp (Fig. 85); sternum IX without median line (Fig. 87) (*Ecnomus connatus* Group) 14
- 10(9) Inferior appendages curved dorsomesad (Figs. 42, 43) 11
- 10' Inferior appendages directed dorsocaudad (Figs. 57, 59)
..... *Ecnomus acuminatus*, sp. n.
- 11(10) Inferior appendages each with dorsolateral margin convex, without projection (Fig. 53) *Ecnomus truncatus*, sp. n.
- 11' Inferior appendages each with projection on dorsolateral margin (Figs. 42, 49) 12
- 12(11') Inferior appendages each with thumb-like dorsolateral projection (Figs. 42, 46) 13
- 12' Inferior appendages each with triangular dorsolateral projection (Fig. 49) *Ecnomus parellipticus*, sp. n.
- 13(12) Superior appendages each three times longer than wide (Fig. 42)
..... *Ecnomus uncatu*s, sp. n.
- 13' Superior appendages each less than two times longer than wide (Fig. 46) *Ecnomus ellipticus*, sp. n.
- 14(9') Phallic parameres less than half as long as phallus (Figs. 77, 80) ... 15
- 14' Phallic parameres almost as long as phallus (Figs. 89, 92) 18
- 15(14) Segment X ventral projections long and slender, reaching phallus (Fig. 77) *Ecnomus longicaudatus*, sp. n.
- 15' Segment X ventral projections short, far from phallus (Fig. 61) 16
- 16(15') Fork 1 of each anterior wing present (as in Fig. 7)
..... *Ecnomus orientalis*, sp. n.
- 16' Fork 1 of each anterior wing absent 17
- 17(16') Inferior appendage each with basomesal corner acute (Fig. 68); sternum IX with anterior margin of convex (Fig. 68)
..... *Ecnomus pungens*, sp. n.
- 17' Inferior appendage each with basomesal corner obtuse (Fig. 71), segment IX with anterior margin of slightly concave (Fig. 71)
..... *Ecnomus projectus*, sp. n.
- 18(14') Superior appendages each with basoventral projection (Fig. 89); inferior appendages about as slender basally as apically (Fig. 89) 19
- 18' Superior appendages without basoventral projections (Fig. 73); inferior appendages each slender at base and broadly compressed apically (Fig. 73) *Ecnomus spatulatus*, sp. n.
- 19(18) Inferior appendages each perpendicularly curved at base in ventral view (Fig. 91) *Ecnomus perpendicularis*, sp. n.
- 19' Inferior appendages straight or evenly curved at base (Figs. 83) ... 20
- 20(19') Parameres of phallus each with basolateral process (Figs. 96)
..... *Ecnomus cornutus*, sp. n.
- 20' Parameres of phallus without basolateral processes (Fig. 88) 21
- 21(20') Inferior appendages in ventral view each with basomesal corner acute and with subapicomeresal tooth (Fig. 87) *Ecnomus connatus*, sp. n.

- 21' Inferior appendages in ventral view each with basomesal corner obtuse and without subapicomesal tooth (Fig.83). *Ecnomus coalitus*, sp. n.

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Table 1. Distribution of the species of *Ecnomus* in the world's major biogeographical regions.

Afrotropical	67
Oriental	100
E. Palearctic	6
W. Palearctic	5
Nearctic	0
Neotropical	0
Australasian	44
Total	221

Table 2. Character list for Ecnomidae genera, polarized using Hydropsychidae and Polycentropodidae as outgroups. Character numbers are as in Table 2 and Figures 2 and 3a. 0 = plesiomorphy, 1 = homologue.

-
- A. Female sternum VIII normal = 0; sternum VIII divided into pair of lateral lobes = 1 (Weaver and Malicky 1994).
 - B. Male genitalia inferior appendages each 2-segmented = 0; inferior appendages each 1-segmented = 1 (homoplasy with Dipseudopsidae, Weaver and Malicky 1994).
 - C. Larval head without lateral edge = 0; head flattened dorsoventrally, with lateral edge = 1 (Weaver and Malicky 1994, Flint 1973, Scott 1974, Cartwright and Dean 1982).
 - D. Larva without abdominal lateral fringe = 0; lateral fringe dense = 1 (Wiggins 1996, Weaver and Malicky 1994, Flint 1973, Scott 1974).
 - E. Adult anterior wing R_1 Fork absent = 0; R_1 Fork present = 1.
 - F. Adult anterior wing Fork 1 present = 0; Fork 1 absent = 1 (Flint 1973).
 - G. Adult posterior wing Fork 3 present = 0; Fork 3 absent = 1 (Flint 1973).
 - H. Male metathoracic inner tibial spur normal = 0; inner tibial spur abnormal, with subapical claw = 1 (Kimmins 1957).
 - I. Male phallus without sheath-cup = 0; phallus with sheath-cup = 1 (Kimmins 1957).
 - J. Male inferior appendages separate = 0; inferior appendages more or less fused at base = 1.
 - K. Female segments X and XI short = 0; segments X and XI elongated = 1 (Cartwright 1990, Gibbs 1973, Flint, 1973).
 - L. Adult posterior wing with DC closed = 0; posterior wing with DC open = 1 (Cartwright 1990, Kimmins 1957)
 - M. Larval meso- and meta - nota membranous = 0; larval meso- and meta - nota sclerotized = 1.
-

Wiggins, G. B. 1996. Larvae of the North American Caddisfly Genera (Trichoptera). 2nd edition. University of Toronto Press. Buffalo. 457 pages.

Weaver III J. S. and H. Malicky. 1994. The genus *Dipseudopsis* Walker from Asia (Trichoptera: Dipseudopsidae). Tijdschrift voor Entomologie 137: 95-142, Figs. 1 - 55.

Table 3. Character states of Ecnomidae genera, polarized by using Hydropsychidae and Polycentropodidae as outgroups. Character numbers are as for Table 1 and Figures 2 and 3a. 0 = plesiomorphy, 1 = homologue.

Taxa	Characters												
	A	B	C	D	E	F	G	H	I	J	K	L	M
Hydropsychidae	1	0	0	0	0	0	0	0	0	0	0	0	1
Polycentropodidae	1	1	0	1	0	0	0	0	0	0	0	0	0
<i>Ecnomus</i>	1	1	1	1	1	0	1	0	0	0	0	1	1
<i>Psychomyiellodes</i>	?	1	0	0	1	0	1	1	1	0	?	1	1
<i>Ecnomina</i>	1	1	1	0	1	1	0	0	0	1	1	0	1
<i>Parecnomina</i>	1	1	0	1	1	0	0	0	0	1	1	0	0
<i>Austrotinodes</i>	1	1	1	0	1	1	0	0	0	1	1	0	1
<i>Parecnomina resima</i>	1	1	0	1	1	0	0	0	0	1	0	0	0

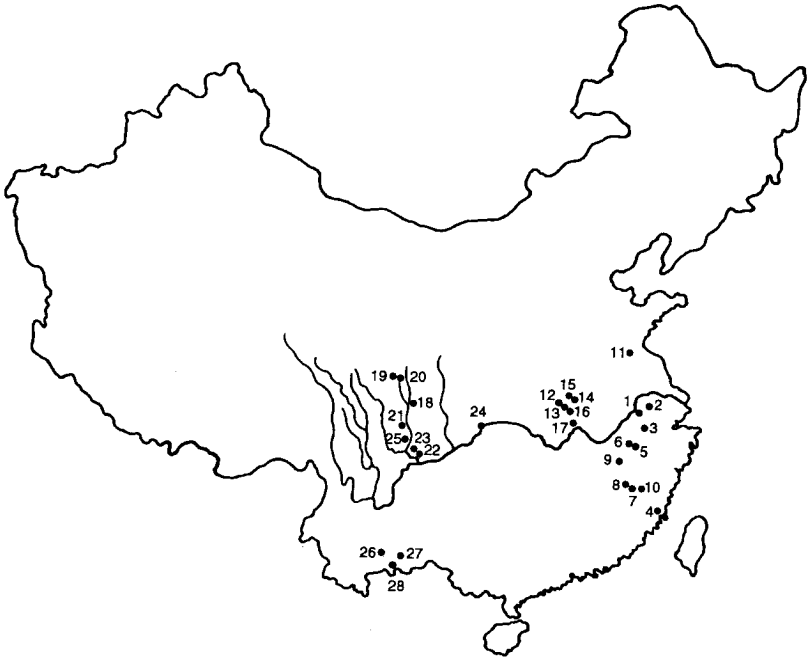
Table 4. Character list for males of *Ecnomus* species from China, polarized using *Parecnomina* as the outgroup. Character numbers are as in Table 4 and Figures 3a, 3b and 3c. 0 = plesiomorphy, 1 = homologue.

- N. Phallus with tubular apex = 0; phallus with apex ventrally curved and spoon-shaped = 1.
- O. Phallus of equal thickness and sclerotized throughout its length = 0; phallus bulbous at base, acute at apex, membranous dorsally = 1.
- P. Phallic parameres directed caudad = 0; phallic parameres upright, tall = 1.
- Q. Phallic parameres not fused at base = 0; phallic parameres fused at base = 1.
- R. Forewing with Fork 1 = 0; forewing without Fork 1 = 1.
- S. Inferior appendages each with tip not recurved = 0; inferior appendages each with tip recurved mesad = 1.
- T. Inferior appendage each with dorsolateral projection short = 0; inferior appendage each with dorsolateral projection very long = 1.
- U. Superior appendages long and slender = 0; superior appendages rather short and fan-like = 1.
- V. Phallic parameres short = 0; Phallic parameres long = 1.
- W. Sternum IX long, distal margin far exceeding base of superior appendages = 0; sternum IX short, distal margin close to bases of superior appendages = 1.
- X. Superior appendages each with basoventral projection absent or short = 0; superior appendages each with basoventral projection very long = 1.
- Y. Sternum IX with anterior margin deeply concave mesally = 0; Sternum IX with anterior margin not concave = 1.

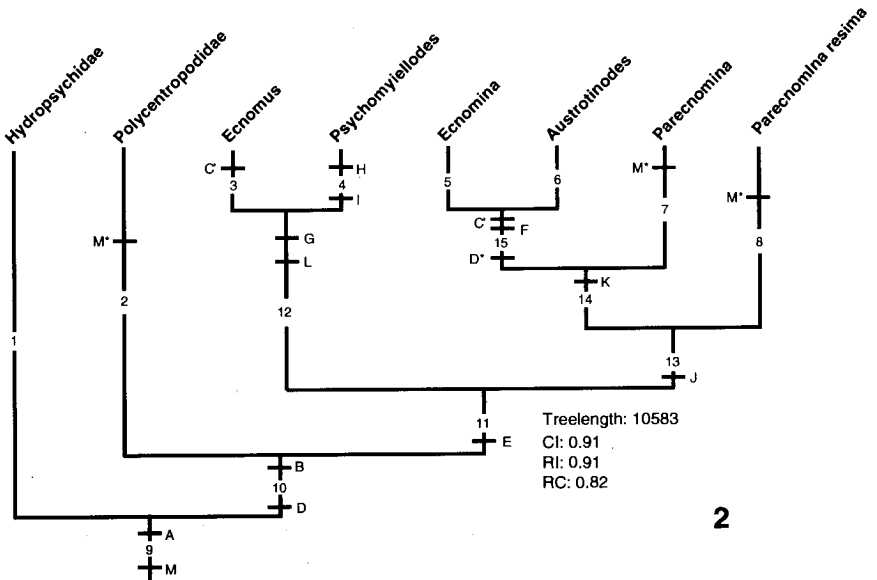
- Z. Inferior appendages each without small transverse dorsal projection = 0; inferior appendages each with small transverse dorsal projection = 1.
- AA. Superior appendages long and slender = 0; superior appendages triangular, with broad base = 1.
- AB. Segment X with ventral projection long and slender = 0; segment X with ventral projection broad and short = 1.
- AC. Sternum X with median line = 0; sternum X without median line = 1.
- AD. Frons not protruding = 0; frons protruding = 1.
- AE. Frons with small warts = 0; frons with large warts = 1.
- AF. Phallic parameres not coin-shaped = 0; phallic parameres coin-shaped = 1.
- AG. Phallus with dorsobasal lobe at bases of parameres = 0; phallus with dorsobasal lobe between parameres = 1.
- AH. Inferior appendages each with dorsolateral projection = 0; inferior appendages each without dorsolateral projection = 1.
- AI. Phallic parameres each without basolateral process = 0; phallic parameres each with basolateral process = 1.
- AJ. Segment X with ventral projection = 0; segment X with both ventral and middle projections = 1.
- AK. Phallic parameres originating from base of phallus = 0; phallic parameres originating from close to apex of phallus = 1.
- AL. Inferior appendages each blunt at apex = 0; inferior appendages each acute at apex = 1.
- AM. Segment X ventral projections without subapical expansions = 0; segment X ventral projection with subapical expansion = 1.

Table 5. Characters for males of *Ecnomus* species from the People's Republic of China, polarized using *Parecnomina* as the outgroup. Character numbers are as in Table 3 and Figures 3a, 3b and 3c. 0 = plesiomorphy, 1 = homologue.

Taxa	Characters						
	EGLNO	PQRST	UVWXY	ZABCD	AAAA	AAAAA	AAAA
<i>Parecnomina</i>	10000	00000	01000	00000	?	00000	0?00
<i>cornutus</i>	11101	01000	00001	00111	10001	0000	
<i>perpendicularis</i>	11101	01000	00010	00111	10001	0000	
<i>connatus</i>	11101	01000	00011	00111	10000	1000	
<i>coalitus</i>	11101	01000	00011	00111	10000	1000	
<i>spatulatus</i>	11101	00000	00000	00111	00000	0000	
<i>longicaudatus</i>	11101	00000	01101	00010	00000	0000	
<i>orientalis</i>	11101	10000	01000	00110	00000	0000	
<i>pungens</i>	11101	10100	01001	00110	00000	0000	
<i>projectus</i>	11101	10100	01001	00110	00000	0000	
<i>acuminatus</i>	11101	10000	11000	00100	00000	0010	
<i>latus</i>	11101	00000	01000	00100	01000	0000	
<i>rectus</i>	11101	00000	01100	00100	01000	0000	
<i>gigantius</i>	11101	00000	01101	00100	01000	0000	
<i>parellipticus</i>	11101	10010	11000	00100	00110	0010	
<i>ellipticus</i>	11101	10011	11000	00100	00110	0010	
<i>uncatus</i>	11101	10011	11000	00100	00110	0010	
<i>truncatus</i>	11101	10010	11000	00100	00000	0010	
<i>yamashironis</i>	11110	00000	01000	01000	00000	0101	
<i>foochowensis</i>	11110	00000	01000	10000	00000	0100	
<i>bicolorus</i>	11110	00000	01000	11000	00000	0101	
<i>tenellus</i>	11110	00000	01000	11000	00000	0100	
<i>incisus</i>	11110	00000	01000	00000	00000	0100	



1



2

Fig. 1. Map of collection sites in China, with Chang - jiang River (Yang - tze) indicated. Fig. 2. Cladogram of family Ecnomidae (Arabic number = branch number, † = character number, * = reversion, ' = homoplasy).

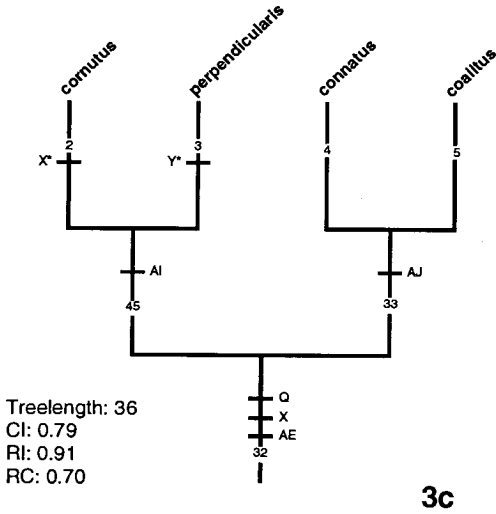
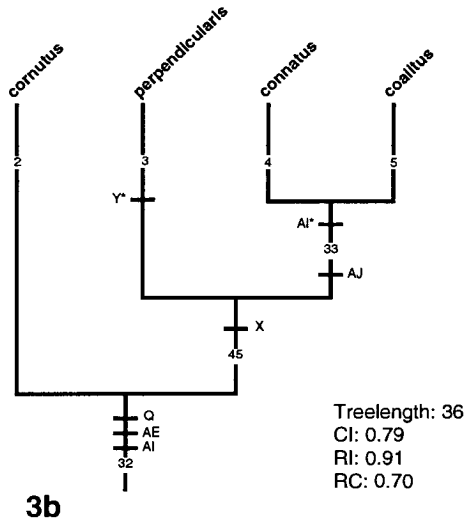
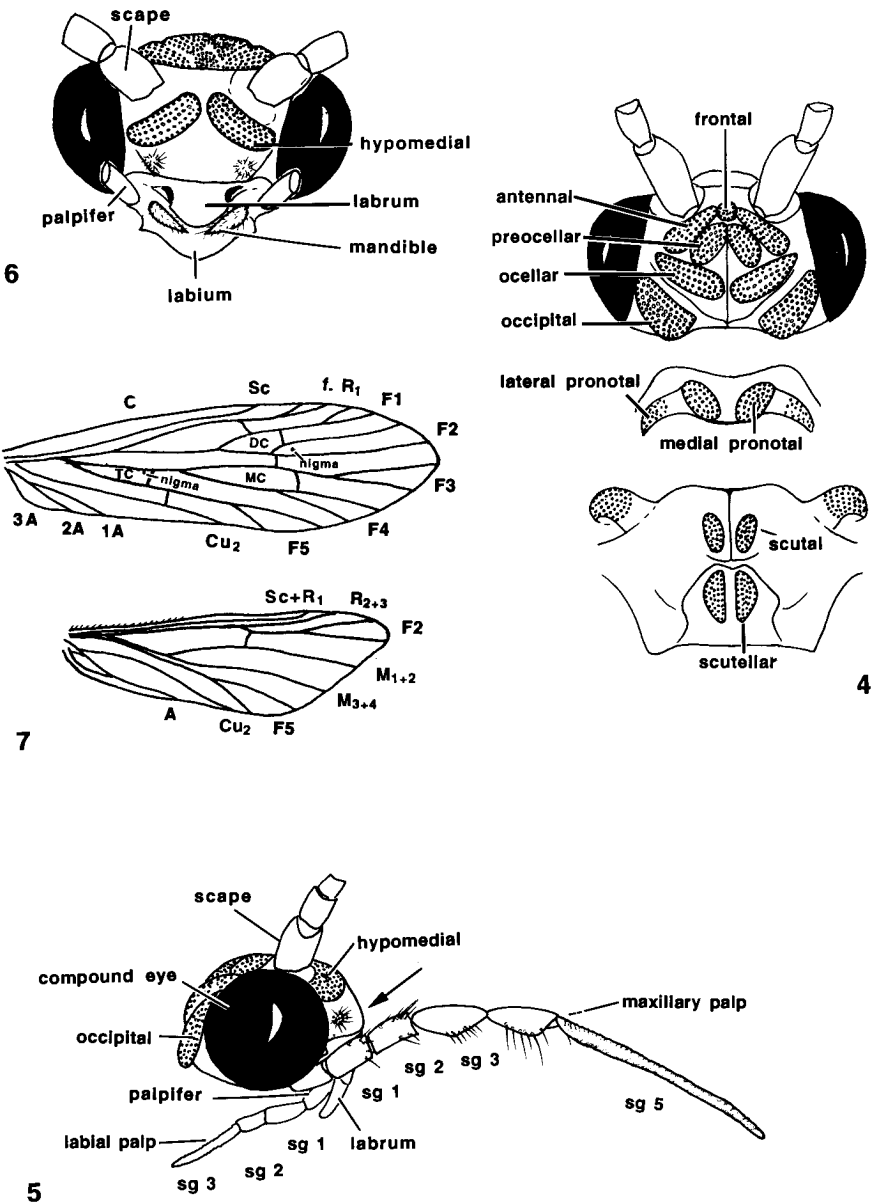
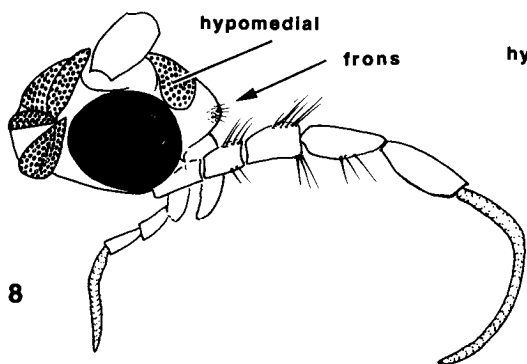


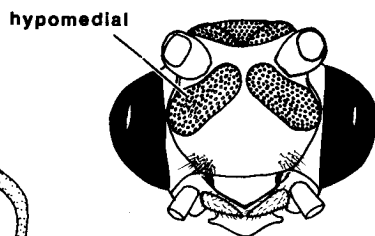
Fig. 3 b-c. Two alternative cladograms for Branch #32) (Arabic number = branch number, ‡ = character number, * = reversion, ' = homoplasy).



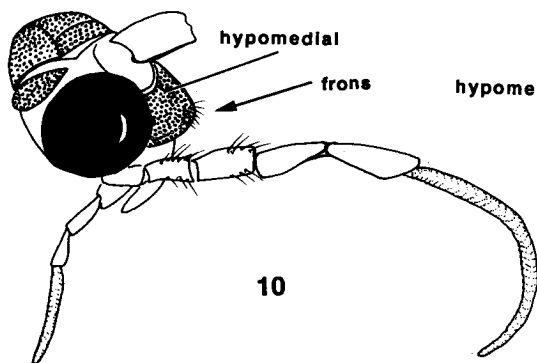
Figs. 4-6. *Ecnomus tenellus* Rambur adult: 4, head, fore and meso-thorax (apical part of antennae omitted), dorsal; 5, head, lateral (apical part of antennae omitted); 6, head (labial palpi and apical part of antennae, maxillary palpi omitted), fron. Fig. 7. Venation of *Ecnomus latus*, new species.



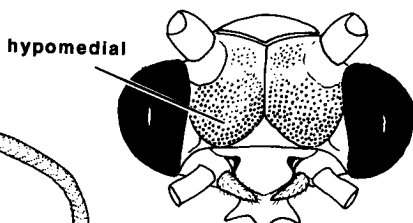
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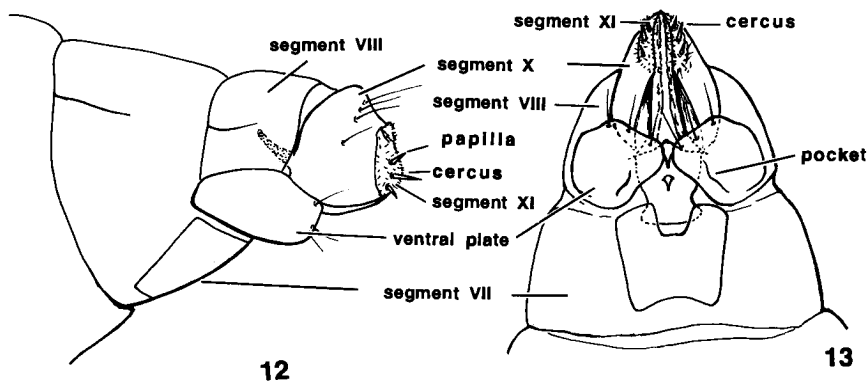
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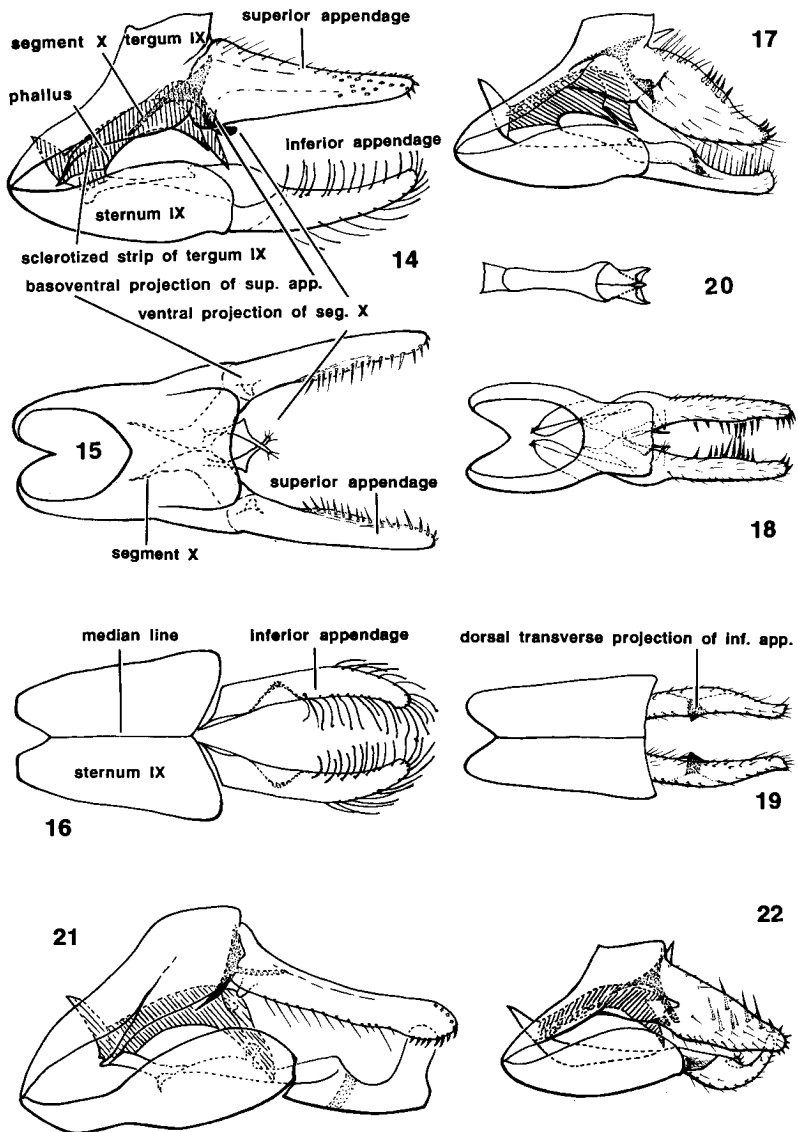
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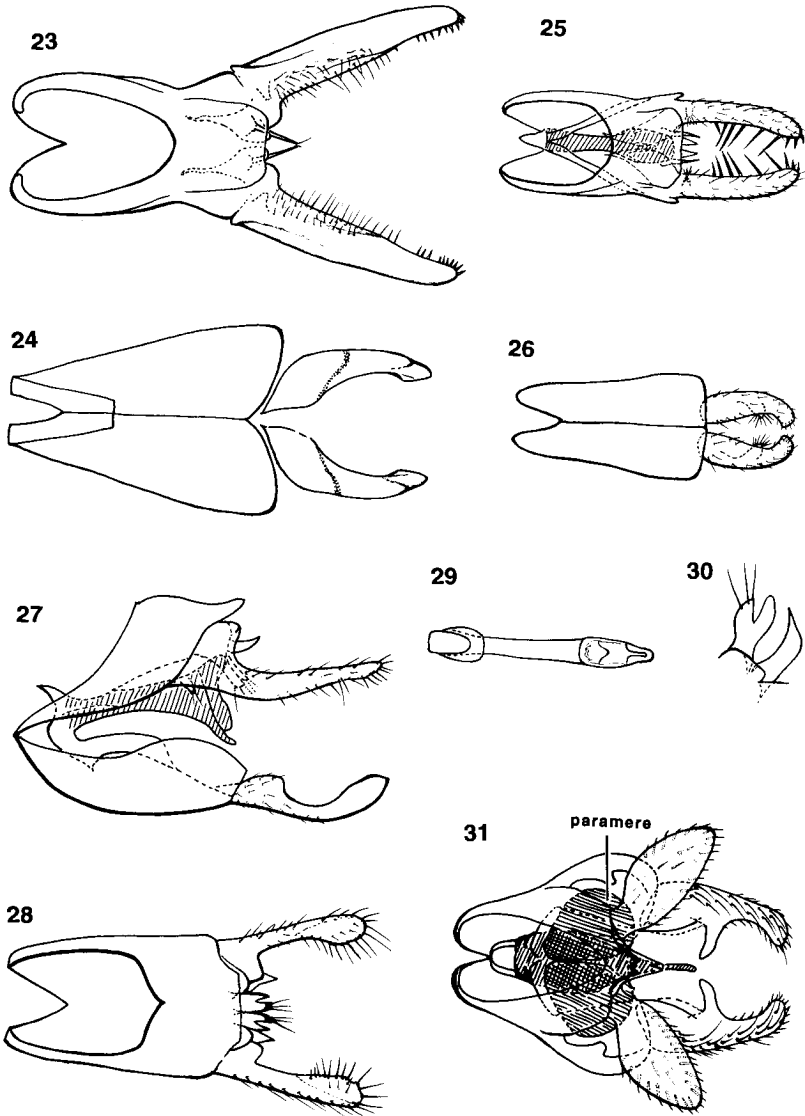
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Figs. 8-9. Head of *Ecnomus spatulatus*, new species: 8, head, lateral (apical part of antennae omitted); 9, head (apical part of antennae, maxillary and labial palpi omitted), front. Figs. 10-11. Head of *Ecnomus connatus*, new species: 10, head, lateral (apical part of antennae omitted); 11, head (labial palpi and apical part of antennae, maxillary palpi omitted), front. Figs. 12-13. Female genitalia of *Ecnomus tenellus* Rambur: 12, lateral; 13, ventral.



Figs. 14 - 16. Male genitalia of *Ecnomus yamashironis* Tsuda : 14, lateral; 15, dorsal; 16, ventral. **Figs. 17 - 20.** Male genitalia of *Ecnomus bicolorus* Tian et Li: 17, lateral; 18, dorsal; 19, ventral; 20, phallus, dorsal. **Fig. 21.** Male genitalia of *Ecnomus foochowensis* Mosely, lateral. **Fig. 22.** Male genitalia of *Ecnomus tenellus* Rambur, lateral.



Figs. 23 - 24. Male genitalia of *Ecnomus fochowensis* Mosely: 23, dorsal; 24, ventral. Figs. 25 - 26. Male genitalia of *Ecnomus tenellus* Rambur: 25, dorsal; 26, ventral. Figs. 27 - 30. Male genitalia of *Ecnomus incisus*, new species: 27, lateral; 28, dorsal; 29, phallus, dorsal; 30, basomesal process of superior appendage and ventral projection of segment X, dorsal. Fi. 31, male genitalia of *Ecnomus latus*, new species, dorsal.

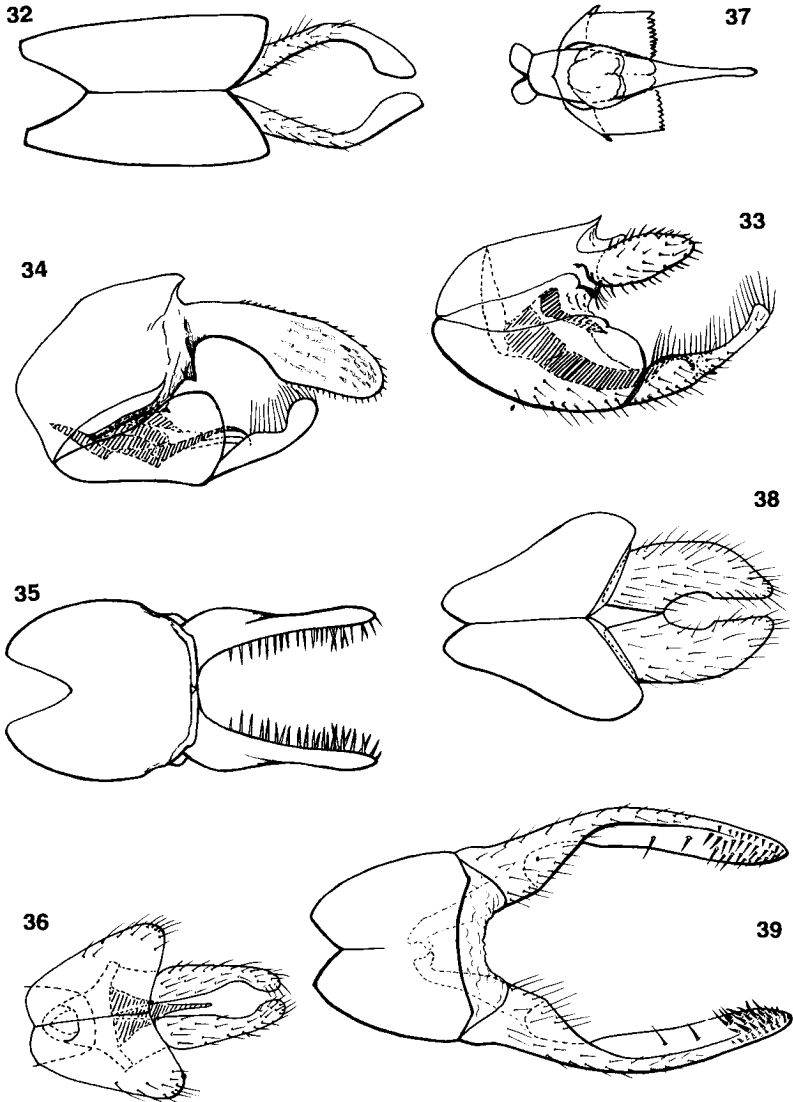
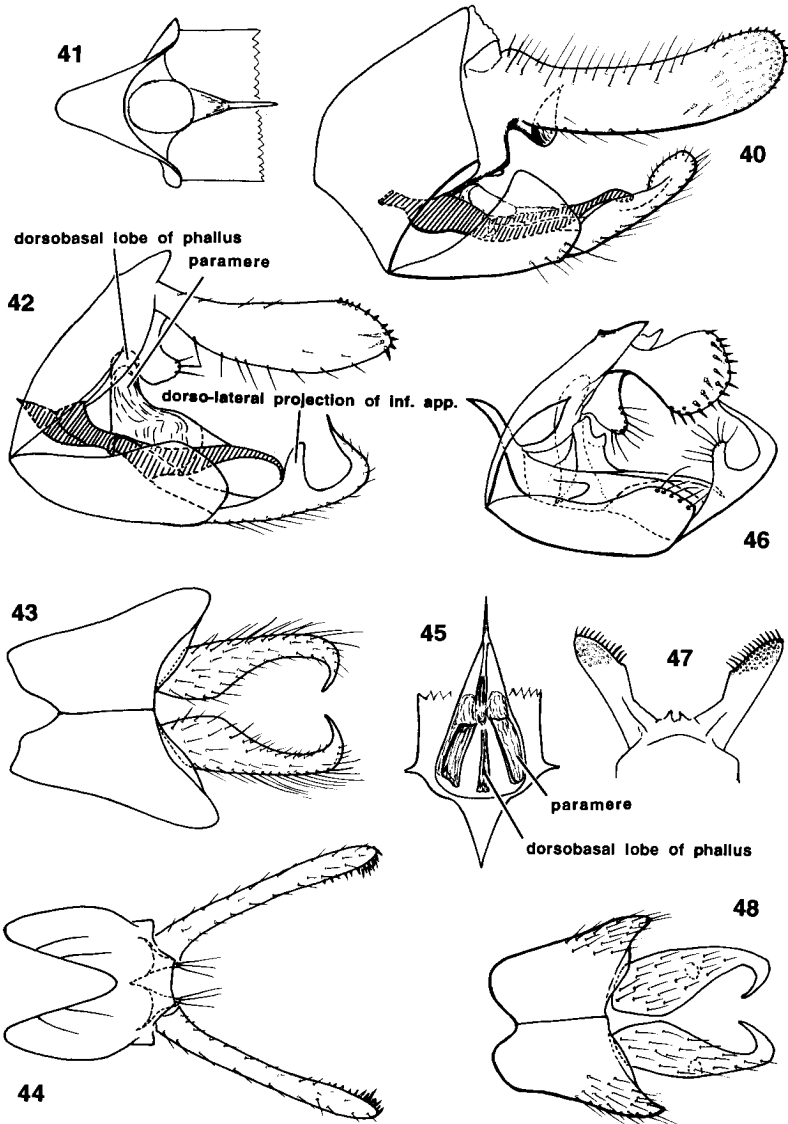
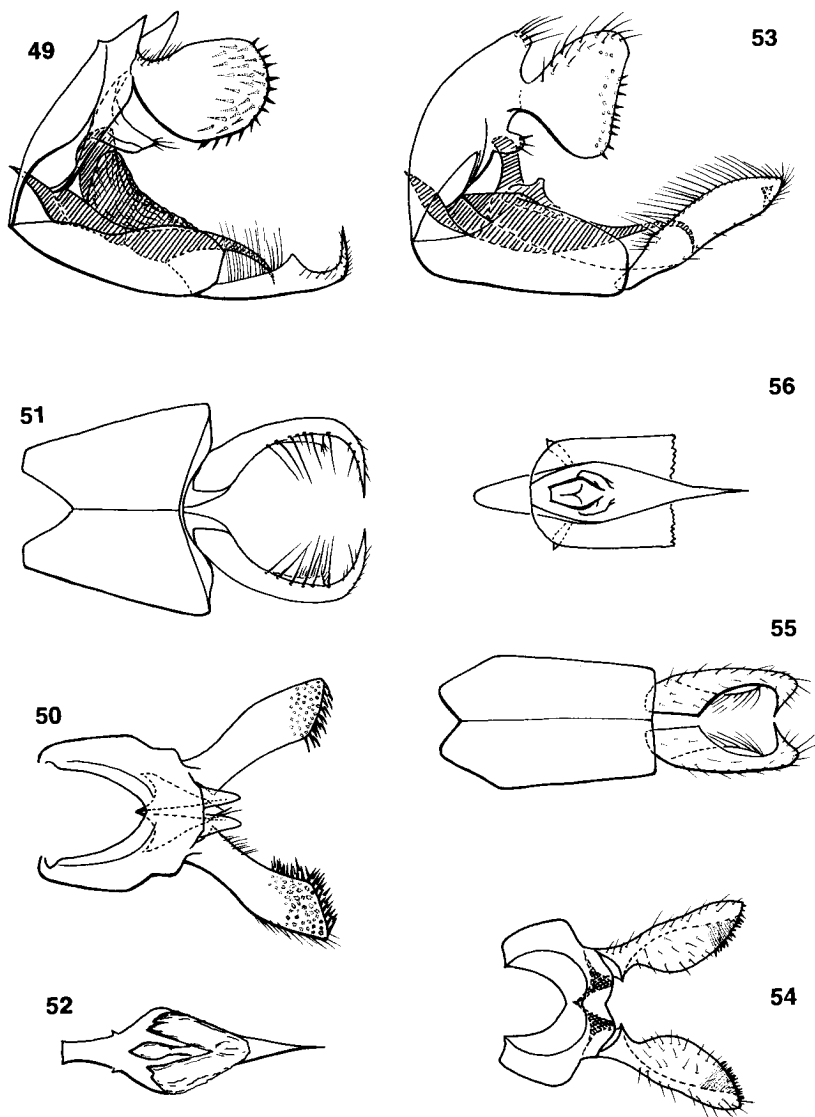


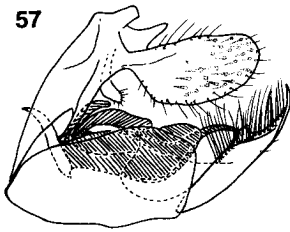
Fig. 32. Male genitalia of *Ecnomus incisus*, new species, ventral. Fig. 33. Male genitalia of *Ecnomus latus*, new species, lateral. Figs. 34 - 37. Male genitalia of *Ecnomus gigantius*, new species: 34, lateral; 35, dorsal; 36, ventral; 37, phallus, dorsal. Figs. 38 - 39. Male genitalia of *Ecnomus rectus*, new species: 38, ventral; 39, dorsal.



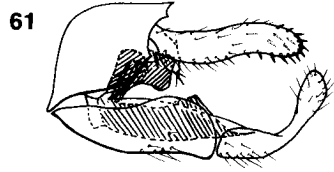
Figs. 40 - 41. Male genitalia of *Ecnomus rectus*, new species: 40, lateral; 41, phallus, dorsal; Figs. 42 - 45. male genitalia of *Ecnomus uncatatus*, new species: 42, lateral; 43, dorsal; 44, ventral; 45, phallus, dorsal. Figs. 46 - 48. Male genitalia of *Ecnomus ellipticus*, new species: 46, lateral; 47, dorsal; 48, ventral.



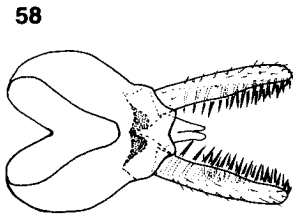
Figs. 49 - 52. Male genitalia of *Ecnomus parellipticus*, new species: 49, lateral; 50, dorsal; 51, ventral; 52, phallus, dorsal. **Figs. 53 - 56.** Male genitalia of *Ecnomus truncatus*, new species: 53, lateral. 54, dorsal; 55, ventral; 56, phallus, dorsal.



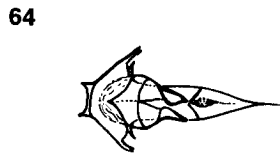
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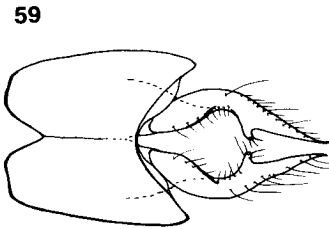
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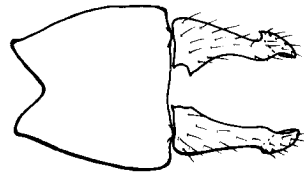
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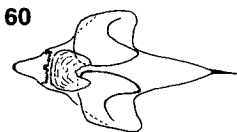
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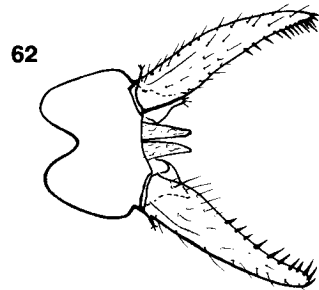
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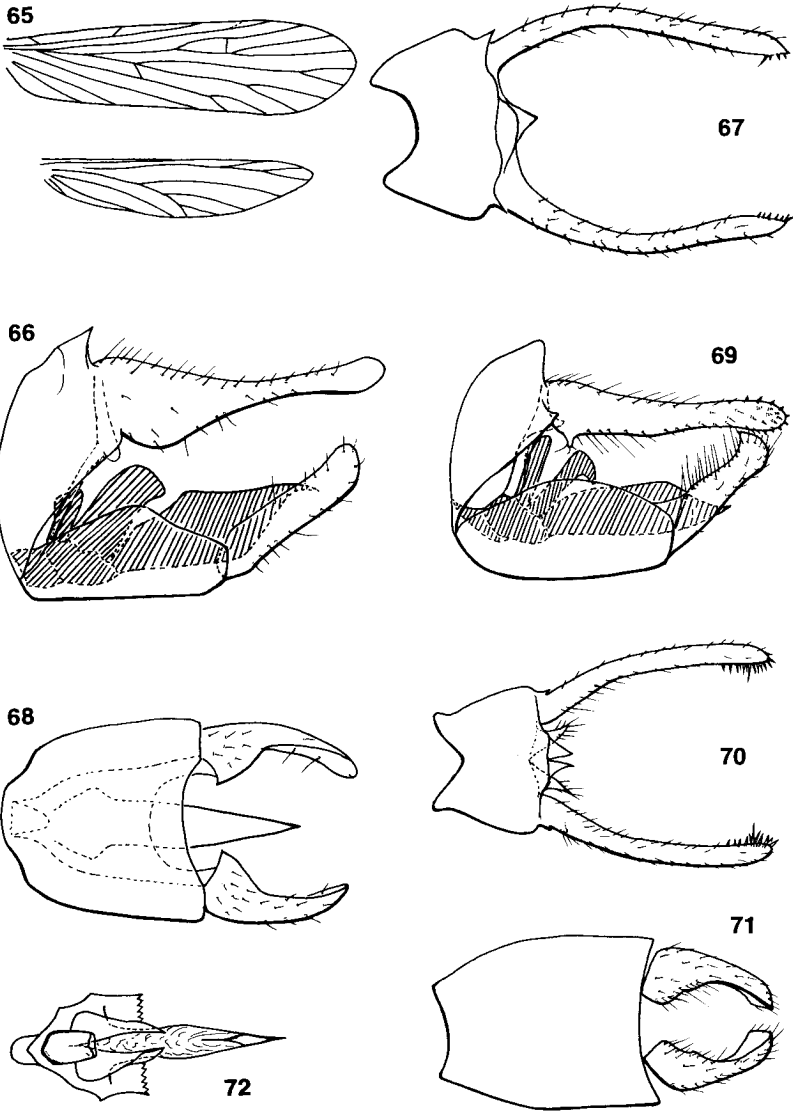


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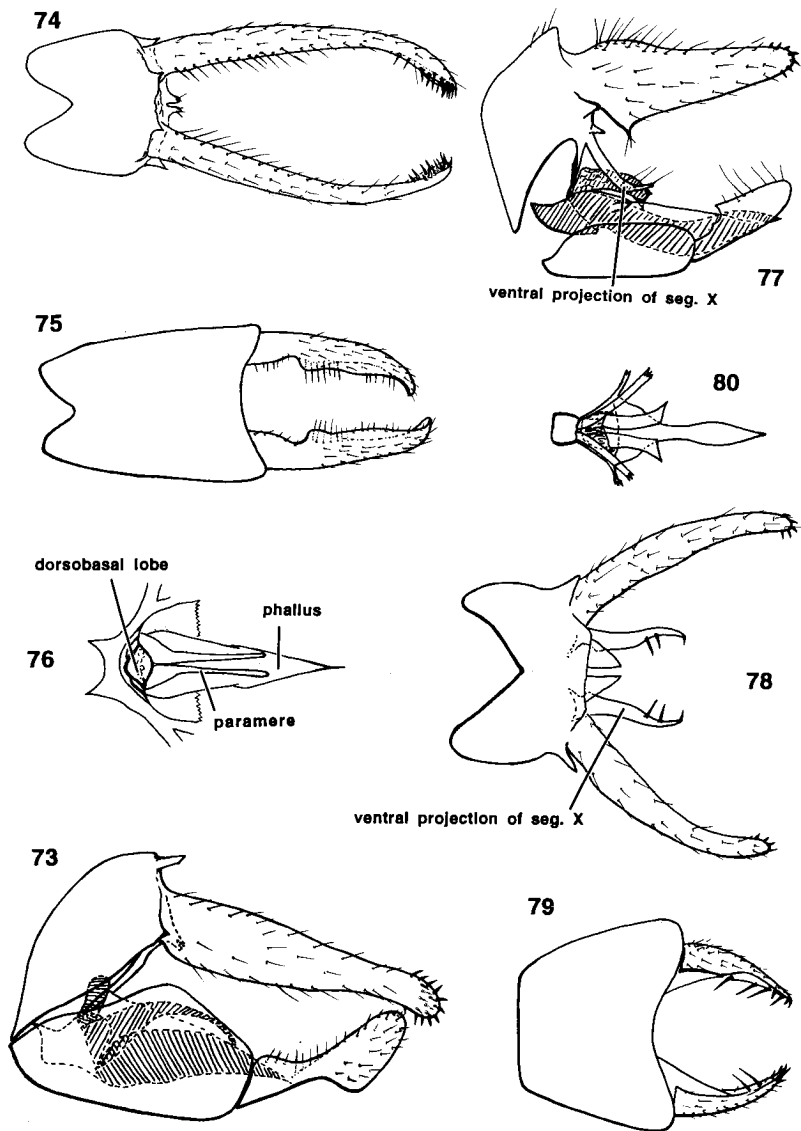


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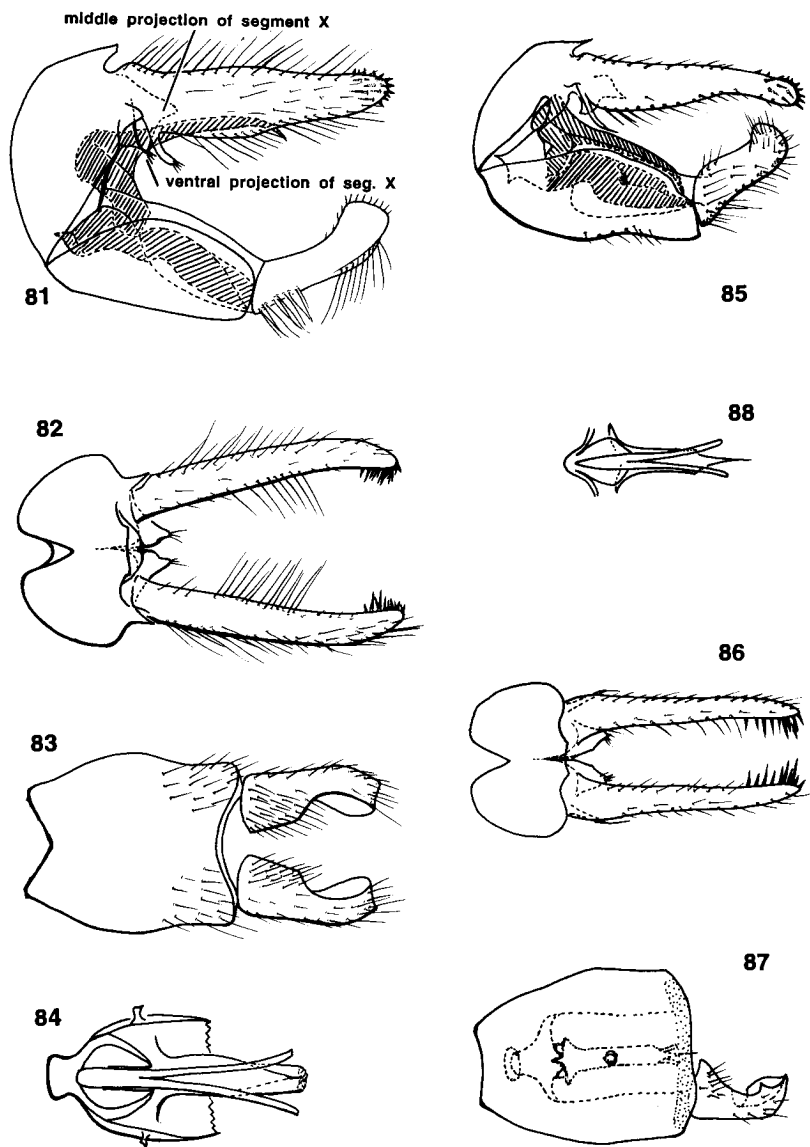
Figs. 57 - 60. Male genitalia of *Ecnomus acuminatus*, new species: 57, lateral; 58, dorsal; 59, ventral; 60, phallus, dorsal. **Figs. 61 - 64.** Male genitalia of *Ecnomus orientalis*, new species: 61, lateral; 62, dorsal; 63, ventral; 64, phallus, dorsal.



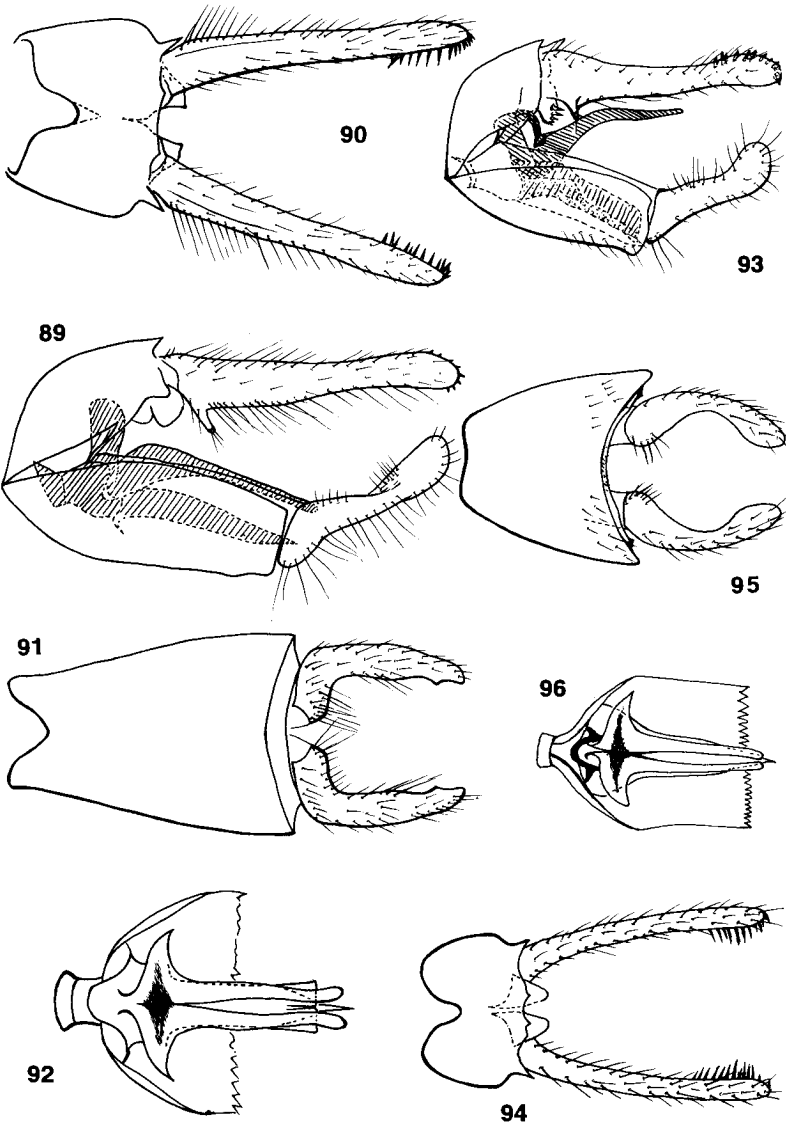
Figs. 65 - 68. *Ecnomus pungens*, new species: 65, fore and hind wing venation; 66, male genitalia, lateral; 67, male genitalia, dorsal; 68, male genitalia, ventral. **Figs. 69 - 72.** Male genitalia of *Ecnomus projectus*, new species: 69, lateral; 70, dorsal; 71, ventral; 72, phallus, dorsal.



Figs. 73 - 76. Male genitalia of *Ecnomus spatulatus*, new species: 73, lateral; 74, dorsal; 75, ventral; 76, phallus, dorsal. Figs. 77 - 80. Male genitalia of *Ecnomus longicaudatus*, new species: 77, Lateral, 78, dorsal; 79, ventral; 80, phallus, dorsal.



Figs. 81 - 84. Male genitalia of *Ecnomus coalitus*, new species: 81, lateral; 82, dorsal; 83, ventral; 84, phallus, dorsal. **Figs. 85 - 88.** Male genitalia of *Ecnomus connatus*, new species: 85, lateral; 86, dorsal; 87, ventral; 88, phallus, dorsal.



Figs. 89 - 92. Male genitalia of *Ecnomus perpendicularis*, new species: 89, lateral; 90, dorsal; 91, ventral; 92, phallus, dorsal. **Figs. 93 - 96.** Male genitalia of *Ecnomus cornutus*, new species: 93, lateral; 94, dorsal; 95, ventral; 96, phallus, dorsal.