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AEDEASTRIA, A NEW CICADA GENUS FROM NEW GUINEA, ITS PHYLOGENY AND BIOGEOGRAPHY (HOMOPTERA, TIBICINIDAE), PRECEDED BY A DISCUSSION ON THE TAXONOMY OF NEW GUINEAN TIBICINIDAE

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ABSTRACT

Characters in male genitalia suggest that several New Guinean and Australian genera of the family Tibicinidae form a monophyletic taxon, indicated here as the "*Baeturia* and related genera complex". A new genus, *Aedeastria*, forms part of this complex and is erected for two New Guinean species: *Aedeastria cobrops* n. sp. from Sorong (Cendrawasih) and *Aedeastria sepia* n. sp. from Cendrawasih, Roon Island and north New Guinea. The phylogenetic position of *Aedeastria* is discussed and some remarks are made on the biogeography of this genus in relation to the geologic origin of Cendrawasih.

INTRODUCTION

The discovery of a very remarkably inflated aedeagus in two undescribed cicada species, resembling some species of the genus *Baeturia* Stål, 1866, initiated a comparative study of aedeagi of several New Guinean and Australian groups of Tibicinidae. This study revealed that the New Guinean Tibicinidae can be divided into three major groups, on account of aedeagus shape: the Prasiini, the Cicadettini and a complex of genera grouped around *Baeturia*. The latter group is here recognized as such, for the first time.

The second part of this publication contains the descriptions of the two new species, mentioned above, for which the genus *Aedeastria* is erected. The material examined for these descriptions comes from the collections of the Museum Zoologicum Bogoriense, Bogor (MZB); the Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussel (KBIN); the British Museum (Natural History), London (BMNH) and the Bernice P. Bishop Museum, Honolulu (BPBM).

PART 1: NOTES ON THE HIGHER TAXONOMY OF NEW GUINEAN TIBICINIDAE

The current taxonomic revision of *Baeturia*, the largest genus among the New Guinean Tibicinidae, shows that this genus is not monophyletic (De Boer, 1986), though it comprises several monophyletic species groups (cf.

De Boer, 1982, 1986, 1989). Of these groups however, some seem more closely related to either *Gymnotympana* Stål or *Thaumastopsaltria* Kirkaldy, than to the other *Baeturia* species groups.

A first attempt to investigate the phylogenetic relationship between these genera and species groups revealed that nearly all species of *Baeturia*, *Gymnotympana* and *Thaumastopsaltria* share a similar aedeagus with the species of the Australian genera *Chlorocysta* Westwood, *Cystosoma* Westwood and *Venustria* Goding & Froggatt. This list of genera is probably not complete and certainly includes several groups of undescribed New Guinean species.

According to the most recent classifications (cf. Duffels & van der Laan, 1985), *Baeturia* and *Gymnotympana* form part of the tribe Gymnotympanini, *Thaumastopsaltria* and *Chlorocysta* belong to the Chlorocystini, while *Cystosoma* belongs to the Hemidictyini. *Venustria* was recently transferred from the Taphurini to the Chlorocystini (Moulds, 1990). Pending a further phylogenetic study of the Austro-Malayan Tibicinidae, I propose the name "*Baeturia* and related genera complex" for all these genera together, to avoid the use of the names of these tribes.

The "*Baeturia* and related genera complex" is characterized by an aedeagus consisting of a long S-curved tube, with two narrow wing-shaped lateral crests running along the greater part of its length. These crests normally have their greatest width at the basal curvature of the aedeagus. The aedeagus pore is either circular or oval. However, many variations on this aedeagus-shape occur. In some species of *Baeturia* for example, the aedeagus is very strongly curved, while the lateral crests form bluntly rounded lateral lobes at the basal curvature (see Myers, 1928; Boulard, 1979, De Boer, 1989).

The two other major groups of Tibicinidae in the New Guinean-Australian region, the Prasiini and the Cicadettini, have a very different aedeagus.

The aedeagus of the oriental Prasiini is generally longer, C-curved and bent downwards, and often provided with a single or paired dorsal appendage. Its pore margin is serrate, or incised, while the pore is flanked by two rounded or dentate, more or less projecting, lobes (De Jong & Duffels, 1981; De Jong, 1982, 1985, 1986, 1987).

The aedeagus of the Cicadettini is either short and rather straight, or longer and bent downwards, but always trifid, consisting of a central shaft, containing the ejaculatory duct and two, generally longer, outer appendages, the pseudoparameres (Dugdale, 1971). The aedeagus pore is generally circular. Within the New Guinean-Australian region, this aedeagus shape is found in *Cicadetta* Amyot (Myers, 1926; Moulds, 1988) and *Pauropsalta* Goding & Froggatt (Ewart, 1989) from Australia, *Toxopeusella* Kirkaldy from New Guinea, Maluku and Solomon Islands (Boulard, 1981) and all New Zealand cicada genera (Dugdale & Fleming, 1969; Dugdale, 1971). Cicadettini are further widely distributed outside this region. A similar trifid aedeagus can be found in several genera, not included in the Cicadettini. Dugdale & Fleming (1969) listed: *Diemeniana* Distant (Parnisini) and *Ueana* Distant (Taphurini). But *Auta* Distant (Taphurini), *Huechys* Amyot & Serville (Huechysini) and *Scieroptera* Stål (Huechysini) can be added to this list.

PART 2: *AEDEASTRIA*, A NEW GENUS FROM NEW GUINEA, ITS PHYLOGENY AND BIOGEOGRAPHY

PHYLOGENY

The genus *Aedeastria*, erected here for two New Guinean species, belongs to the "*Baeturia* and related genera complex." The aedeagus of *Aedeastria*, however, strongly deviates from the simple S-curved tube with wing-shaped lateral crests characteristic for the genera complex: the S-curvature of the aedeagus is hardly recognizable, because of its strong inflation, while the wing-shaped lateral crests, though very prominent, are upcurved and have their greatest width near the aedeagus apex. The

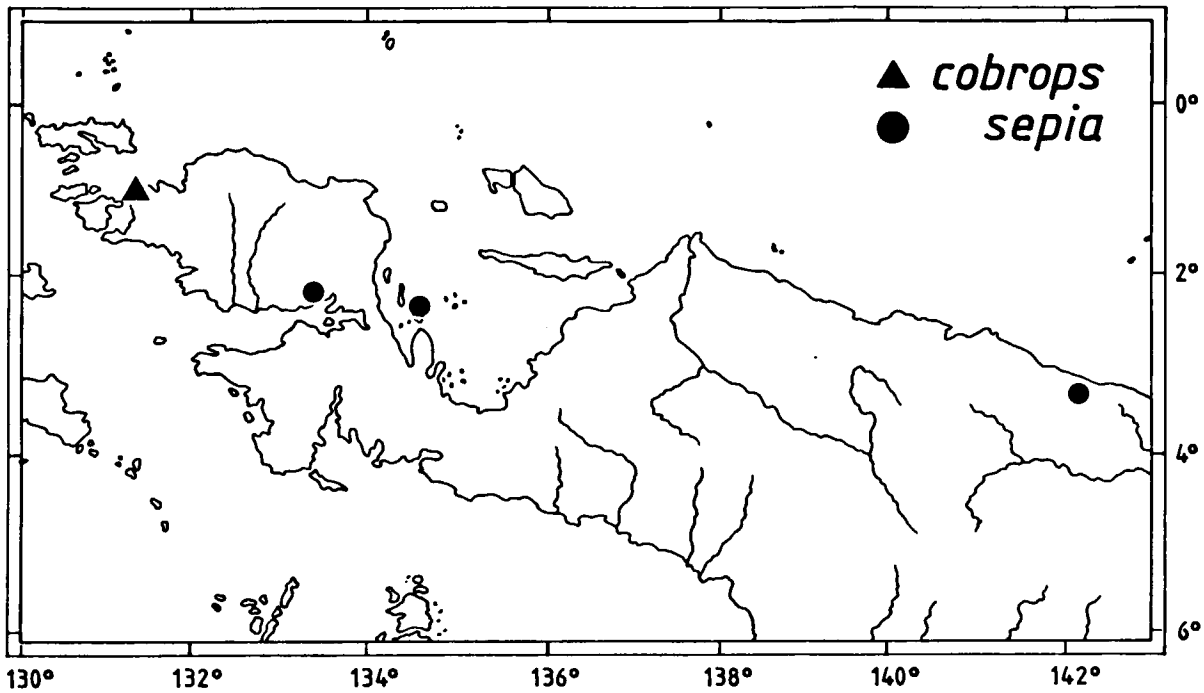


Fig. 1. Localities of *Aedeastria cobrops* and *Aedeastria sepia*.

aedeagus pore is circular. Appendages or pseudoparameres are lacking.

Aedeastria is characterized by three apomorphies: (1) a strongly inflated aedeagus, reaching far beyond pygofer and claspers, showing a pattern of concentric semicircular ridges on its underside, (2) the absence of the caudodorsal beak of the male pygofer, and (3) broad and slightly bicuspidate, outward curved, clasper apices.

BIOGEOGRAPHY

Though the geographic data of *Aedeastria* are sparse, it is striking that all specimens come from the northern parts of New Guinea (fig. 1), the parts derived from the historic Outer Melanesian Arc (for reviews on the geological history of New Guinea see Hamilton, 1979; Holloway, 1979, 1984; Coleman, 1980 and Crook, 1981). *A. cobrops* n. sp., only known from Sorong, is almost certainly an endemic of Cendrawasih (= Vogelkop peninsula of New Guinea). *A. sepia* n. sp. is recorded from one locality on Cendrawasih, from Roon Island in the Geelvink Bay and from Torricelli Mts., part of the northcoast mountain range of New Guinea. Though considerable differences exist between the specimens of *A. sepia* from these three localities, it is interesting to note, that the one Cendrawasih specimen is the most deviating.

As to Cendrawasih, this distribution pattern is very interesting, since this peninsula probably took a somewhat isolated position within the Outer Melanesian Arc. Cendrawasih is supposed to have rotated clockwise, probably in the Neogene, from a position near the edge of the Australian continental plate (Hamilton, 1979).

This isolated position is reflected in the distribution patterns of several other monophyletic groups of cicadas. Cendrawasih (and adjacent islands) forms an area of endemism for the cicada genera *Rhadinopyga* Duffels (Duffels, 1985) and *Arfaka* Distant (De Jong, pers. comm.). But isolation of the Vogelkop is also suggested by the fact that some otherwise widely distributed taxa are absent in

this area: *Diceropyga* Stål, which is the sister group of *Rhadinopyga* (Duffels, 1977, 1985), and the *Baeturia bloetei* group (De Boer, 1989) are represented in Maluku and New Guinea, skipping the Vogelkop.

TAXONOMY

Aedeastria n. gen.
Type species: *A. cobrops* n. sp.

Description. — Body unicoloured ochraceous. Postclypeus broad and weakly produced. Anterior margin of postclypeus (dorsal view) continuous with anterior margins of vertex lobes. Head 2.5-2.8 × as wide as long, length of head 0.7-0.8 × distance between eyes. Distance between lateral ocelli 1.8-2.4 × width of frontal ocellus. Furrows in head very prominent. Head considerably narrower than pronotum and mesonotum. Pronotum abruptly bent down at anterior margins of its lateral lobes. Tegmina and wings hyaline, veins ochraceous. Tegmina with eight, wings with six apical areas. Hyaline border along hind margin of tegmen very narrow, distinctly broader in wing. Tympanum with 7-9 parallel sclerotized ridges spanning tymbal. Male operculum very short, not covering tymbal cavity, its medial margin not reaching to meracanthus. Male pygofer lacking a caudodorsal beak. Claspers with truncate, or slightly bicuspidate, outward curved apices. Aedeagus robust, reaching far beyond pygofer and claspers, strongly inflated, and towards apex, with wing-shaped lateral crests. Ventral side of aedeagus characterized by vague pattern of concentric ridges.

Etymology: *Aedeastria* is derived from the words "aedaegus" and "strio" (Latin, grooved or furrowed) and refers to the pattern of concentric ridges on ventral side of the aedeagus.

Description of the species

Aedeastria cobrops n. sp.
(figs. 1-13)

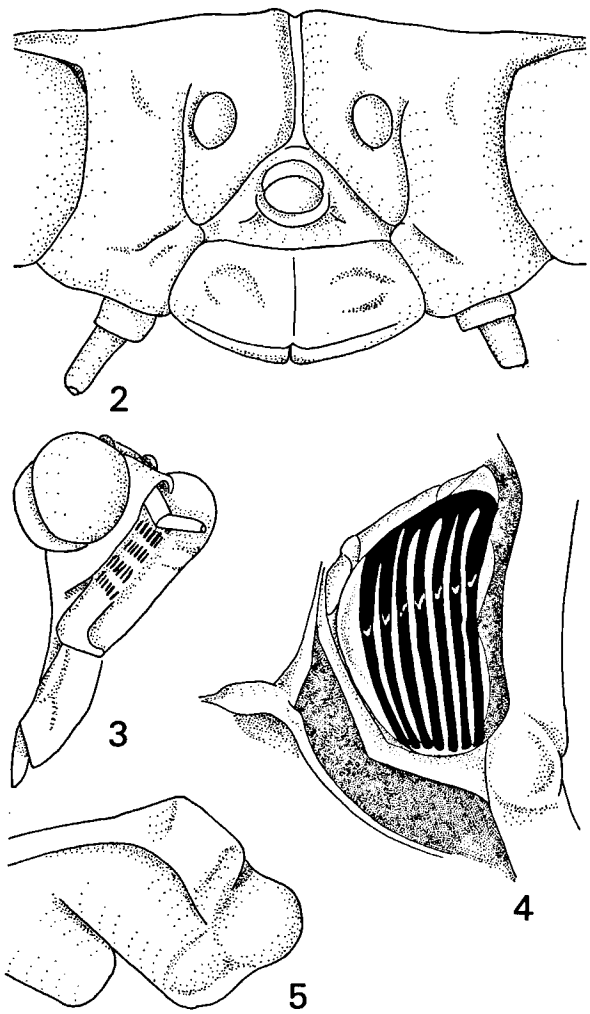
Holotype: "NW New Guinea, Sorong, 15-27.viii.1948, M.A. Lieftinck" (written), 1♂, MZB; Paratypes: same data as holotype but printed label: 2♂, 1♀, MZB; same data but 15.viii.1948, 1♂, ZMA.

This species can easily be recognized by the peculiar inflation of its aedeagus. The wing-shaped lateral crests of aedeagus are strongly enlarged, forming a broad and flattened collar around the sharply downward curved apical part of aedeagus, giving the aedeagus the aspect of the head of a cobra snake.

Description. — Body reddish ochraceous, without any special colour markings or speckling. Tegmen 1.2-1.3 × as long as body length. Female slightly larger than males.

Head (fig. 2): Broad and short. Anterior margin of postclypeus almost straight or slightly angular protruding. Postclypeus 2.6-3.6 × as wide as long and 0.6 × as wide as distance between eyes, and in dorsal view with weak medial furrow. Postclypeus not swollen in lateral view (fig. 3), lateral surface very smooth, apart from about 6 short and vague series of parallel ridges. In some specimens, these ridges restricted to inflated crest along proximal margin. Middorsal furrow on vertex and converging furrows on both sides of central ocellus very prominent. Vertex relatively flat, vertex lobes only slightly vaulted and central part of vertex only slightly elevated. Head 1.9-2.0 × as wide as distance between eyes. Distance between lateral ocelli 0.9-1.2 × distance between eye and lateral ocellus. Eyes 0.4-0.5 × as wide as distance between eyes.

Thorax: Pronotum with very weak middorsal furrow. Lateral lobes of pronotum and lateral corners of pronotal collar sharply bent downward anteriorly, forming a nearly continuous edge (fig. 5). Lateral corner of pronotal collar strongly inflated along this anterior edge. Pronotum 0.4 × as long as width of pronotal collar. Mesonotum with central pair of semi-oval, grey spots bordering pronotum margin, and pair of grey lateral bands, running from pronotum margin to corners of cruciform elevation. Mesonotum 0.7-0.9 × as long as width of pronotal collar.



Figs. 2-5. *Aedeastria cobrops* holotype: 2, head in dorsal view; 3, head in lateral view; 4, tymbal organ; 5, lateral corner of ponotum collar.

Legs: Ochraceous. Fore femur with row of three erect and pointed spines, diminishing in length towards tibia. Proximal spine about as long as distance to middle spine and only slightly longer than middle spine.

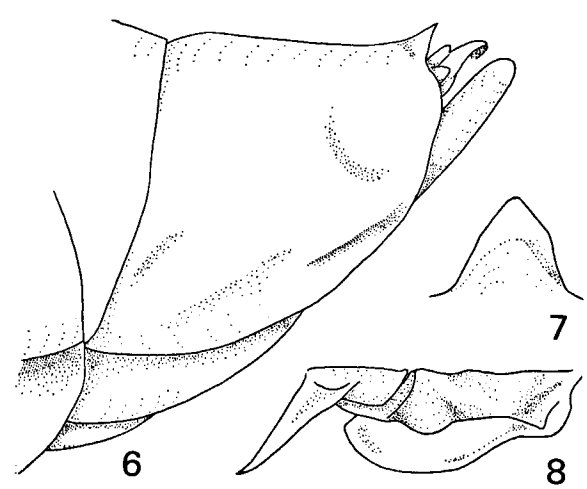
Tegmina and wings: One male has nine apical areas in left tegmen, caused by division of 6th apical area.

Tymbal organs (fig. 4): With seven sclerotized transverse ridges spanning tymbal from dorsal to ventral margin. Intercalary ridges hardly discernible, almost completely embedded in transverse ridges.

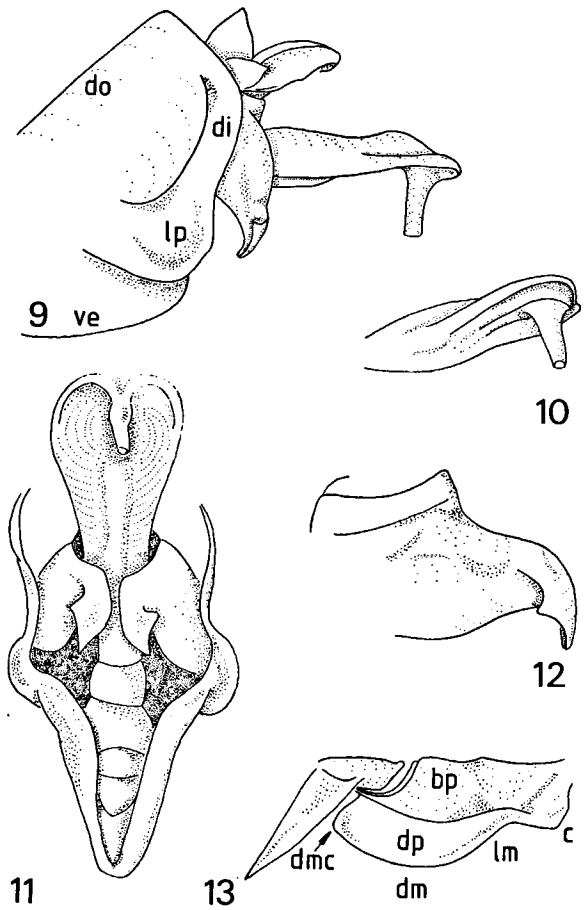
Opercula: Male operculum (fig. 13) very short. Basal part of operculum vaulted, with distinct crest around its rectangular distolateral corner, distal part of operculum erect and oblong. Lateral margin of distal part rises abruptly from crest around distolateral corner of operculum base and forms a wide angle with distal margin. Distal margin convexly rounded. Distomedial corner rectangular. Meracanthus well developed, reaching well beyond operculum, almost to distal margin of abdominal segment 2. Female operculum (fig. 8) almost identical to that of male, basal part more strongly vaulted, however.

Abdomen: Male abdomen very light ochraceous, almost transparent. Male abdomen 1.1-1.3 × as long as head and thorax together, in female 1.4 × . Female caudodorsal beak (fig. 6) erect and very short, not reaching beyond ovipositor sheaths and anal valves, broad and triangular in dorsal view (fig. 7).

Male genitalia: Pygofer in lateral view (fig. 9) very angular. Caudodorsal beak absent, though in one specimen distal margin of pygofer slightly convex in dorsal view. Anal valves thus totally free of pygofer. Dorsal margin of pygofer straight, distal margins straight, but almost rectangularly bending



Figs. 6-8. *Aedeastria cobrops*, female paratype: 6, genital segment in lateral view; 7, caudodorsal beak in dorsal view; 8, operculum.



Figs. 9-13. *Aedeastria cobrops*, male: 9, pygofer in lateral view, holotype; 10, aedeagus from aslant, paratype; 11, pygofer and aedeagus from behind, holotype; 12, clasper in lateral view, holotype; 13, operculum, paratype. Lettering: bp = basal part of operculum; c = crest around distolateral corner; di = distal margin of pygofer; do = dorsal margin of pygofer; dm = distal margin of operculum; dmc = distomedial corner of operculum; dp = distal part of operculum; lm = lateral margin of operculum; lp = lateral protuberance; ve = ventral margin of pygofer.

backwards to well developed and bluntly rounded lateral protuberances. A sharp fold runs, from these protuberances upwards, partly along distal margin of pygofer. Pygofer wall slightly inflated at ventral margins (fig. 11). Clasper bases strongly bent around anal valves, forming an almost continuous ring, only interrupted halfway between claspers. Claspers very short, triangular in lateral view (fig. 12), proximal part bending around aedeagus, distal part bending outwards again towards a broad, slightly bicuspidate and downwards bent, apex. Aedeagus (figs 9-10) very long and strongly inflated. This inflation turns into a laterally amplified, slightly dome-shaped structure, which stands as a shield around slender and downward bent short apical part of aedeagus, giving aedeagus in ventral view the aspect of the head of a cobra snake (fig. 11). The shield is presumably homologous with wing-shaped lateral crests, characteristic of the "*Baeturia* and related genera complex." Underside of aedeagus with fine pattern of concentric ridges. Aedeagus pore circular.

Measurements: Body length: ♂ 15.6-16.7 mm ($\bar{x}$ 16.2 mm), ♀ 18 mm; tegmen length: ♂ 19.2-20.6 mm ($\bar{x}$ 19.8 mm), ♀ 21.9 mm; head length: ♂ 1.3-1.5 mm ($\bar{x}$ 1.4 mm), ♀ 1.4 mm; head width: ♂ 3.6-4.0 mm ($\bar{x}$ 3.8 mm), ♀ 3.8 mm; pronotum length: ♂ 1.9-2.1 mm ($\bar{x}$ 2.1 mm), ♀ 2.2 mm; width of pronotal collar: ♂ 4.8-5.4 mm ($\bar{x}$ 5.2 mm), ♀ 5.4 mm; mesonotum length: ♂ 3.8-4.1 mm ($\bar{x}$ 4.0 mm), ♀ 4.2 mm.

Distribution (fig. 1): This species is only known from Sorong on the north western coast of Cendrawasih (Vogelkop peninsula of New Guinea).

Remark: The abdomen of all male specimens is somewhat shriveled.

Etymology: Cobrops is derived from "cobra" and "ops" (Greek: face) and applies to the shape of aedeagus which, if seen in ventral view, strongly resembles the head of the cobra snake *Naja naja* (Linnaeus).

Aedeastria sepia n. sp.
(figs. 1, 14-23)

Types: Holotype: "Roon, ex. coll. Fruhstorfer" (printed, orange-brown label); "Distant Coll. 1911-383" (printed), ♂, BMNH. Paratypes: same data as holotype, 2♂, BMNH; same data 1♂, 1♂ det. *Baeturia bicolorata*, KBIN. Other material: N. Guinee, Ach Arth Speyer, 1899, P. de Borre, 1♂, BMNH; NEW GUINEA (W): Bintoeni Bay,

Maccluer Gulf, R. Tisa, 8.v.1941, E. Lundquist, 1♂, MZB; PAPUA: NEW GUINEA (NE): Mokai vill., Torricelli Mts., 750 m, 1-23.i.1959, W.W. Brandt, 1♂, BPBM.

This species is slightly larger than the foregoing and can easily be recognized by the aedeagus shape, and the broad horse-shoe shaped crest inside along ventral margin of pygofer.

Description. — Body reddish ochraceous without any special marking or speckling. Tegmen 1.2-1.3 × as long as body length.

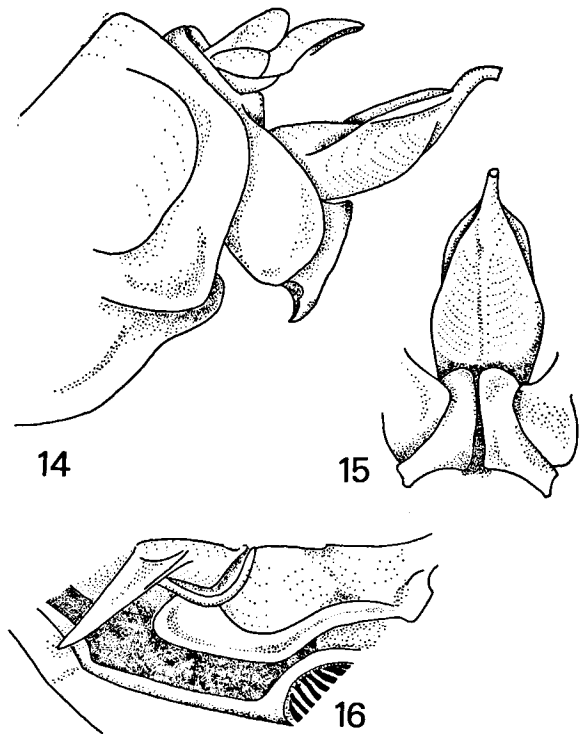
Head: Anterior margin of postclypeus broadly rounded. Postclypeus 2.6-3.3 × as long as broad. Medial furrow in dorsal surface of postclypeus less pronounced than in *A. cobrops*, or absent. Postclypeus not swollen in lateral view. Series of short parallel ridges on sides of postclypeus more distinct than in *A. cobrops* and often restricted to inflated crest along proximal margin. Furrows on vertex as prominent as in *A. cobrops*. Head 1.9-2.0 × as wide as distance between eyes. Distance between lateral ocelli 0.9-1.1 × distance between eye and lateral ocellus. Eyes 0.4-0.5 × as wide as distance between eyes.

Thorax: Pronotum as in *A. cobrops*, sharply bent downwards at anterior margin of lateral lobes; anterior edge of lateral corner of pronotal collar inflated. Pronotum 0.4 × as long as width of pronotal collar. Mesonotum almost plain ochraceous and 0.7-0.8 × as long as width of pronotal collar.

Tymbal organs: With nine parallel sclerotized ridges spanning tymbal from dorsal to ventral margin, most proximal ridge ends close to ventral margin. Intercalary ridges could not be discerned.

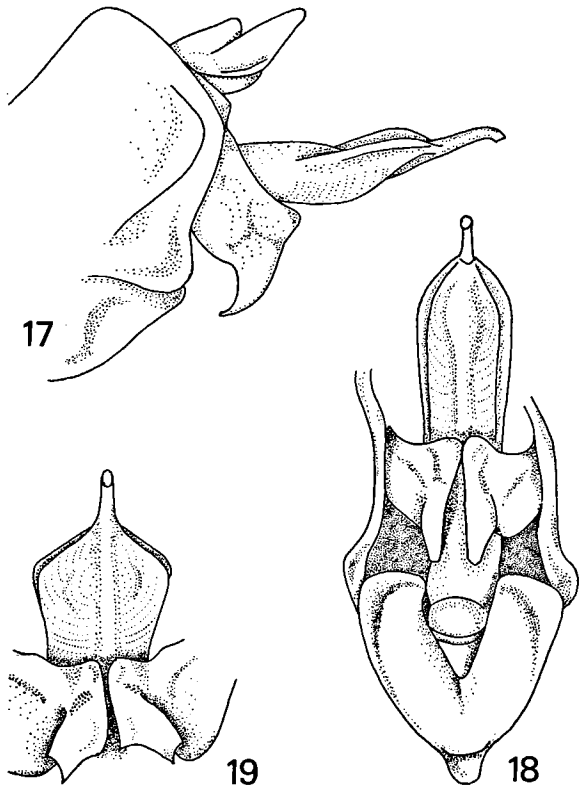
Operculum (fig. 16): Very short. Lateral margin of distal part rising more gradually from distolateral crest around lateral angle of operculum base, than in *B. cobrops*. Distal margin of operculum almost straight. Meracanthus reaching well beyond both operculum and proximal margin of abdominal segment 2.

Abdomen: Light ochraceous, but not transparent as in *A. cobrops*, and 1.0-1.3 × as long as head and thorax together.



Figs. 14-16. *Aedeastria sepia*, holotype: 14, pygofer in lateral view; 15, aedeagus from behind; 16, operculum.

Genitalia: Pygofer in lateral view (fig. 14) very angular. Dorsal margin of pygofer straight, distal margins straight, but almost rectangularly bending backwards to well developed and bluntly rounded lateral protuberances. A sharp fold running from these protuberances upwards, partly along distal margin, and downwards partly along ventral margin of pygofer. Distad to this fold, pygofer slightly bending outwards to ventral margin. Pygofer forming broad, horse-shoe shaped crest inside along ventral margin, which bends around base of aedeagus (fig. 19). Clasper base strongly bent around anal valves, forming an almost continuous ring, only interrupted halfway between claspers. Claspers in lateral view (fig. 21) longer and more robust than in *A. cobrops*. Proximal part of clasper broad and square-shaped, bending around massive



Figs. 17-19. *Aedeastria sepia*: 17, pygofer in lateral view, Tisa river; 18, pygofer and aedeagus from behind, Tisa river; 19, aedeagus from behind, Mokai village.

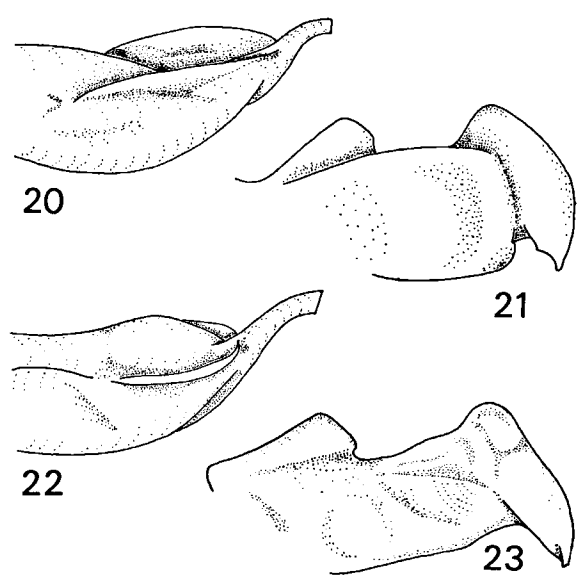
aedeagus. The more slender apical part, which is separated from proximal part by a sharp fold in type specimens, bends outwards to broad and bicuspidate downwards directed apex. Aedeagus (fig. 20) even more robust than in foregoing species, extending far beyond pygofer and claspers. Proximal part of aedeagus strongly inflated, to almost square in cross section. Apical part not inflated, tubular, and slightly curved downward. Aedeagus pore circular. Distal half of inflated part with upwards curved, wing-shaped lateral crests, forming a cup-like hollow in dorsal plane of aedeagus. Lateral sides and underside of inflated part of aedeagus with vague pattern of concentric ridges, giving the aedeagus the aspect of sepia bone.

Measurements: Body length: 16.3-19.5 mm ($\bar{x}$ 18.1 mm ± 1.1 mm); tegmen length: 20.8-25.1 mm ($\bar{x}$ 23.0 mm ± 1.2 mm); head length: 1.6-1.8 mm ($\bar{x}$ 1.7 mm); head width: 4.1-4.8 mm ($\bar{x}$ 4.4 mm); pronotum length: 2.2-2.6 mm ($\bar{x}$ 2.4 mm); width of pronotal collar: 5.7-6.7 mm ($\bar{x}$ 6.3 mm); mesonotum length: 4.2-4.9 mm ($\bar{x}$ 4.7 mm).

Distribution (fig. 1): This species is recorded from Cendrawasih, Roon Island in Geelvink Bay and Torricelli Mts.

Remark: Pending the availability of additional material, the specimens from the three different localities are described as one single species, though they vary rather strongly in shape of aedeagus and clasper.

The specimen from Tisa river (Cendrawasih), is characterized by a very long and straight aedeagus (fig. 17, 18); its clasper is very slender and almost pointed at apex (fig. 23). The aedeagus of the type specimens from Roon is shorter, very broad just above the claspers and gradually tapering to apex (fig. 15), proximal part of clasper very smooth, strongly bent around aedeagus and separated by a sharp fold from the slender apical part (fig. 21). Caudal half of abdomen missing in one



Figs. 20-23. *Aedeastria sepia*: 20, aedeagus in lateral view, holotype; 21, clasper in lateral view, holotype; 22, aedeagus in lateral view, Mokai village; 23, clasper in lateral view, Tisa river.

paratype from BMNH. The aedeagus of the specimen from Mokai vill. (Torricelli), finally, has its greatest width more distally (fig. 19), tapers more strongly to its apex and is strongly inflated dorsally between wing-shaped crests (fig. 22). The clasper of this specimen is very similar to that of the Roon specimens, though the fold between proximal and apical part is less distinct. The specimen with locality label "N. Guinee" most closely resembles the Roon specimens in all respects.

Etymology: The aedeagus of this species strongly resembles the cuttlebone of the cephalopod genus *Sepia*.

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