

# On the Structure of the Aedeagus of Shield Bugs (Heteroptera, Pentatomidae): III. Subfamily Asopinae

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**Abstract**—This communication is the third one in a series of papers treated the morphological review of the aedeagi of Pentatomidae and its possible taxonomic significance. Fully inflated internal structures of the aedeagus of 18 species of Asopinae were studied. The examination of the Asopinae confirmed the monophyly of this taxon and revealed three distinct types of the aedeagal structure within the subfamily. These types differ in the structure of the theca, median penal plates, and ventral, ventrolateral, and apical conjunctival lobes. These characters can be used in phylogenetic analysis as well as in a tribal classification of asopines.

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The present communication is the third one in a series of papers treated the morphological review of the aedeagi of shield bugs (Pentatomidae) and revealing the characters significant for the supergeneric classification of the group. The structure of the aedeagus of the family Pentatomidae and subfamilies Discocephalinae and Phyllocephalinae was described in the first communication (Gapon and Konstantinov, 2005). The present communication deals with the subfamily Asopinae. All the aedeagi are described in their natural (stretched) state, obtained by the method of hydraulic stretching with subsequent drying under air pressure (Gapon, 2001).

The following abbreviations are used for designating morphological structures in the figures: *a. c.*, apical part of the conjunctiva; *a. th.*, apical part of the theca; *b. th.*, basal part of the theca; *d. s.*, seminal duct; *g. s.*, secondary gonopore; *l. a.*, apical lobe of the conjunctive; *l. v.*, ventral lobe of the conjunctive; *l. vl.*, ventrolateral lobe of the conjunctive; *pr. a.*, apical outgrowths of median plates of the penis; *p. tr.*, pons transversus; *ram. d.*, distal branches of ventrolateral lobes; *ram. l.*, lateral branches of ventrolateral lobes; *tr. pr.*, longitudinal filaments of median plates of the penis; *tub. v.*, ventral tubercles of theca; *ves.*, vesica. In all the figures, the scale corresponds to 0.2 mm.

The subfamily Asopinae Amyot et Serville, 1843 is a holophyletic group, characterized by the presence of a thickened labium, the base of which is closely situated to the base of the labrum, the parallel anterior ends of the proboscal (bukkal) plates with adjoining

posterior ends, the male genitalia combining a well-developed apical part of the theca with genital plates (parandria) of the pygophore, and the predatory way of life. Many authors [Leston, 1953, 1954 (cited from Gapud, 1981); McDonald, 1966; Gross, 1975] point to the families Podopinae and Pentatominae as closely related to the subfamily Asopinae. Gapud (1991), denying relationship between Asopinae and Podopinae, treats the *Eurydema-Murgantia* group within Pentatominae as a sister group of Asopinae. At present, the supergeneric classification of the subfamily Asopinae is absent. Amyot and Serville (1843) and Schouteden (1907) subdivided Asopinae into two tribes: Asopini Amyot and Serville, 1843 and Discocerini Schouteden, 1907. The majority of species was included into the nominotypical tribe, and the genera *Discocera* and *Stiretrus*, into the tribe Discocerini. Later, however, the type species of the genus *Asopus* appeared to belong to the genus *Discocera*. Representatives of the subfamily are distributed nearly in all the zoogeographical regions. Recently, Thomas (1992, 1994) revised species of the subfamily Asopinae of the Old and New World, mentioning 187 species of 43 genera and 110 species of 26 genera, respectively. The aedeagi of 18 species of this group are described below.

*Macrorrhaphis acuta* Dallas, 1851 (Figs. 1, 2)

**Material.** Madagascar, Nanghoa, Itasy, III.1930 (Olsufjev), 1 specimen; Abessinia, Sekuala—Iac. Suai, H. Dzhalla maki, Hanash, 3–11.V.1903 (Sedov), 1 specimen; Daressal. D. O. Afr. (collection of I. Gudim), 1 specimen.

**Description.** Phallobase about as long as wide. Dorsal processes absent. Ventral processes in form of wide and short rectangular plates with rounded angles, strongly reflexed proximally, with outer margins projecting slightly beyond margins of basal. Ventral connectives ill-defined. Dorsal connectives about as long as basal plates, with small elongate conical sclerotized mushroom-like bodies at ends. Suspensory apodemae about as thick and long as dorsal connectives.

Theca uniformly heavily sclerotized, subdivided into two unequal parts. Both parts divided by distinct constriction; their longitudinal axes nearly perpendicular to each other. Basal part of theca small, tubular, narrowed at base and slightly widened at apex. Its ventral wall forming pair of small membranous ventral tubercles at base. Ejaculatory reservoir occupying nearly entire cavity of basal part of theca. Apical part of theca large, widened, strongly convex, enveloping base of conjunctive laterally and dorsally. Dorsoapical margin of apical part of theca forming rather deep V-shaped emargination. Lateral margins of apical part of theca projecting to form widely rounded angles. Wall of conjunctive running from wall of theca at level of base of dorsal emargination, making lateral apical angles of apical part of theca free. Dorsal wall of apical part of theca nonsclerotized along median line, appearing as narrow membranous stripe.

Conjunctive large, about twice as long as theca, with paired membranous ventrolateral lobes, unpaired basal lobe bearing sclerotized median plates of penis, and unpaired apical lobe. Ventrolateral lobes of conjunctive divided into two branches: proximal and distal. Proximal branch fine, running nearly perpendicular to axis of common base and slightly curved toward apex of conjunctive at apex. Distal branch thicker, appearing to be continuation of common base of lobes, directed toward, and nearly reaching base of theca. Distal branches diverging beginning from base of lobes, forming apical hooks, with fine sclerotized tips directed toward each other. Apical lobe long, with shallow median constriction and with apex divided by shallow emargination into two short lateral branches strongly widened laterally. Fine long digitiform membranous outgrowth running downwards from ventral surface of each branch.

Ventral lobe directed downwards and obliquely toward base of aedeagus; ventral lobe situated between ventrolateral lobes. Median plates of penis situated on sides of ventral lobe, consisting of longitudinal scler-

rotized filaments and oval apical outgrowths. Longitudinal fibers running in parallel along entire length, narrowed proximally and somewhat widened medially; running along ventral surface of lobe, only slightly curved at its sides. Distally, they turning into apical outgrowths at apex of ventral lobe. Apical outgrowths running nearly in parallel, with apices strongly curved toward base of conjunctive and with longitudinal axis running nearly in parallel to those of ventral lobe; their outer walls membranous, continuing membranous lateral walls of ventral lobe. Sclerotized inner walls of apical outgrowths connected by concave sclerotized bridge at base. Membranous part of ventral wall of ventral lobe convex, not separated from wall of conjunctive, narrowing toward apex, turning into rather high sclerotized carina fused at apex with pons transversus. Sperm duct fine and weakly sclerotized, widened and C-curved at apex. Vesica running from membranous wall near pons transversus between apical lobes, appearing as short curved sclerotized tube with secondary gonopore at apex.

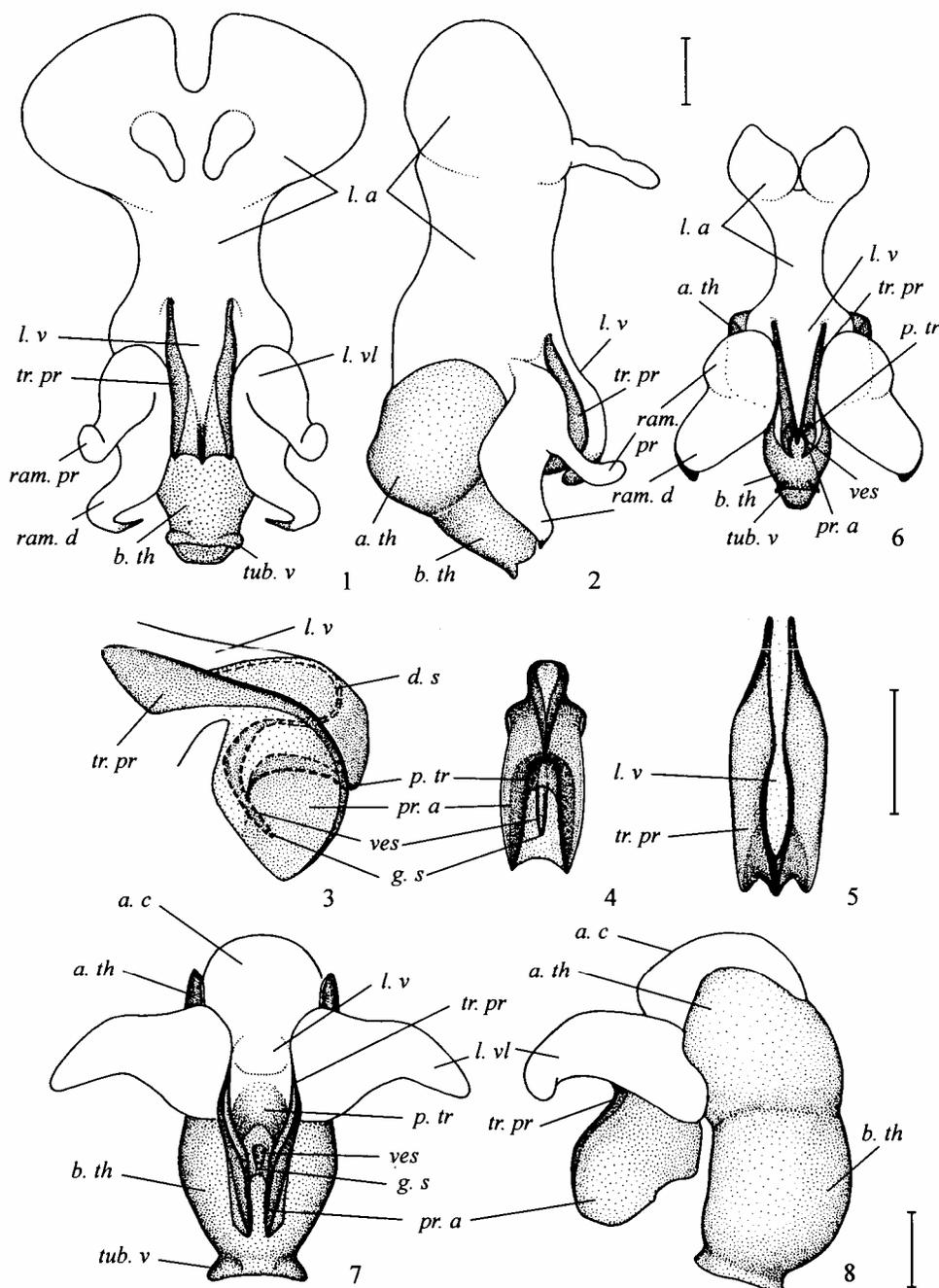
*Dorycoris pavoninus* (Westwood, 1837)

**Material.** Ankober, Shoa, Abessinia, VIII.1899 (Luk'yanov), 1 specimen; Harrar, Abessinia or., 8.VI.1913 (Svertshkov, expedition of Gumilev), 1 specimen; Madagascar, Analamazotra, XI.1930 (Olsufjev), 1 specimen.

**Description.** Aedeagus similar to that of preceding species. Phallobase slightly widened dorsally. Dorsal connectives slightly shorter than basal plates, with small, fine, conical mushroom-like bodies at ends. Ventral processes in form of small rectangular plates, strongly reflexed proximally, projecting slightly beyond lateral margins of phallobase.

Dorsal emargination of apical margin of apical part of theca rounded and moderately deep.

Proximal branches of ventrolateral lobes of conjunctive straight, directed ventrolaterally and slightly toward apex of conjunctive. Distal branches slightly longer and finer, directed ventrolaterally and toward base of aedeagus. Fine sclerotized hook directed toward base of branch situated at apex of each distal branch. Apical lobe with constriction at base, deeply divided into two long and thick arcuate branches with apices directed toward each other. Pair of membranous digitiform outgrowths situated on ventral surface of apical lobe at base of its branches, similarly to that of *Macrorrhaphis acuta*.



**Figs. 1–8.** (1, 2) *Macrorhaphis acuta*, aedeagus [(1) ventral, (2) lateral view]; (3–5) *Friarius alluaudi* (Schouteden), aedeagus [(3) ventral lobe, lateral view; (4) apex of ventral lobe; (5) ventral lobe, ventral view]; (6) *Afrius flavirostrum* (Signoret), aedeagus, ventral view; (7–8) *Dinorhychus dybowskyi* Jakovlev, aedeagus [(7) ventral, (8) lateral view].

Longitudinal fibers of median plates of penis set rather widely, running in parallel along entire length. Apical carina of ventral lobe short. Apical outgrowths small.

***Platynopiellus septendecimaculatus*** (Beauvois, 1811)

**Material.** Abome, Dahome (collection of I. Gudim) (*Platynopus 17-maculatus* Pal. Beauv. Kiritschenko det.), 1 specimen.

**Description.** Aedeagus similar to that of preceding species. Phallobase as long as wide, slightly widened dorsally. Dorsal connectives about as long as basal plates, with wide, long, conical mushroom-like bodies at ends. Ventral processes rectangular, short, strongly reflexed proximally, not projecting beyond lateral margins of phallobase.

Basal part of theca small; apical part large, strongly widened, convex. Dorsoapical emargination of apical

part of theca wide and shallow, with straight base. Nonsclerotized line on dorsal wall wide, narrowing in middle of its length.

Ventrolateral lobes of conjunctive divided into three branches. Proximal branches wide, rounded, directed toward apex of conjunctive. Distal branches wider, directed toward base of aedeagus, with diverging apices each bearing small rounded sclerite. Fine, ventrolaterally directed intermediate branch situated between proximal and distal branches of each lobe. Apical lobe long, swollen at base on dorsal side, narrowing toward apex, with subapical constriction deeper on dorsal and ventral sides. Apex of apical lobe spear-shaped, convex at base (especially at sides), narrowing toward apex, notched at apex. Ventral wall of apical lobe without outgrowths.

Longitudinal fibers of median plates of penis long, situated in parasagittal plain in proximal part and in frontal plain in distal half, curved there toward base of aedeagus, strongly widened, concave, looking like groove. In this part, their margins elevated, turning into very long low carina. Membranous ventral wall between longitudinal fibers narrow and flattened. Apical outgrowths very short. Split between apical outgrowths not visible from outside.

***Friarius alluaudi*** (Schouteden, 1905) (Figs. 1–5)

**Material.** Madagascar, vall. Mandraka, XII.1934 (Olsufjev), 1 specimen; Madagascar, Perinet, 16.I.1935 (Robinson), 1 specimen; Madagascar, Perinet, 14.III.1935 (Olsufjev), 1 specimen.

**Description.** Aedeagus similar to that of preceding species. Phallobase about as long as wide. Dorsal connectives slightly shorter than basal plates, with wide, short, conical mushroom-like bodies at ends. Ventral processes wide, slightly longer and less strongly reflexed proximally than those of preceding species; their outer angles distinctly projecting beyond lateral margins of phallobase; inner angles smoothed.

Dorsoapical emargination of apical part of theca rather deep, narrow, rounded. Nonsclerotized stripe on dorsal wall of apical part of theca weakly widened at apex.

Proximal branches of ventrolateral lobes reduced to small swellings. Distal branches with diverging apices bearing small rounded sclerites at ends. Apical lobe rather long, with median constriction; its branches ellipsoid, divided from very base, slightly curved downwards, without outgrowths on ventral surfaces.

Longitudinal fibers of median plates of penis moderately widely spaced, running nearly in parallel, narrow in basal part and gradually weakly widened toward apex in ventral view. In distal half, inner margins of longitudinal fibers lamellate, widened, strongly curved in sagittal plain; at bases of apical outgrowths, fibers turning into very long low carina. Membranous wall between longitudinal fibers narrowing distally, convex. Apical outgrowths long, strongly curved toward wall of theca, so that split between apical outgrowths not visible from outside.

***Afrius (Subafrius) flavirostrum*** (Signoret, 1861)

(Fig. 6)

**Material.** Madagascar, Analamazotra, Perinet, XI.1930 (Olsufjev), 1 specimen.

**Description.** Aedeagus similar to that of preceding species. Phallobase as long as wide. Dorsal connectives fine and short, with weakly sclerotized conical mushroom-like bodies at ends. Ventral processes rectangular, small, slightly reflexed proximally.

Dorsoapical emargination of theca rounded, moderately deep and wide. Nonsclerotized line on dorsal wall of apical part of theca widened toward apical margin.

Proximal branches of ventrolateral lobes of conjunctive in form of small swellings; distal branches longer and finer, each with small terminal sclerite. Apical lobe strongly narrowing before apex; its branches separated from base, small, adjoining ventrally, elongate and diverging dorsally.

Longitudinal fibers narrow, set apart proximally, gradually and weakly widened and converging toward apex. Inner margins of longitudinal fibers elevated in sagittal plain. Carina at base of apical outgrowths rather long and high. Membranous wall between longitudinal fibers nearly flat, uniformly narrowing toward apex. Apical outgrowths moderately long, converging; split between apical outgrowths distinctly visible in view from outer side. Vesica rather long.

***Andrallus spinidens*** (Fabricius, 1787)

**Material.** Turkmenia, Choloyuk, Atrek River, 9.IX.1932 (Ushinskii), 1 specimen; Lake Ashur-Ada, SW of Caspian Sea (Khodorevskii), 1 specimen.

**Description.** Aedeagus similar to that of preceding species. Phallobase as long as wide. Dorsal connectives rather long, but shorter than basal plates. Mush-

room-like bodies long, narrow, conical. Ventral processes rectangular, long, moderately wide, projecting slightly beyond lateral margins of phallobase, reflexed proximally at apex. Suspensor apodemae slightly longer than basal plates.

Apical part of theca significantly larger than basal one. Lateroapical angles of apical part of theca widely rounded; dorsoapical emargination shallow, smoothly rounded. Nonsclerotized stripe on dorsal wall fine.

Proximal branches of ventrolateral lobes of conjunctive slightly longer than those of preceding species, but shorter than distal branches, narrowing at apices, directed ventrolaterally. Distal branches long, narrowing toward apices, directed toward base of aedeagus and sideways; each branch with small terminal sclerite. Apical lobe long, with weak subapical constriction; its branches short, vesicular, fused at base.

Longitudinal fibers of median plates of penis long, strongly converging. Their bases situated in sagittal plain; distal parts situated in frontal plain, rather wide. Membranous area between fibers narrow, weakly convex. Apical outgrowths short; almost entirely split between apical outgrowths distinctly visible from outside. Vesica rather long, narrowing toward apex.

*Dinorhycus dybowskyi* Jakovlev, 1876 (Figs. 7, 8)

**Material.** Primorskii Terr., Taiga Vill., 20.XI.1971, 1 specimen; North Korea, Pektusan Mt., South Hamgen Prov., 21.VIII.1950 (Borkhsenius), 1 specimen.

**Description.** Aedeagus differing in structure from that of preceding species. Phallobase slightly wider than long. Dorsal connectives comparatively long, shorter than basal plates. Mushroom-like bodies with long fine bases and narrow plates. Ventral processes rectangular, short, projecting beyond lateral margins of phallobase, reflexed proximally at apices. Suspensor apodemae slightly longer than dorsal connectives.

Apical part of theca significantly larger than basal one. Lateroapical angles of apical part of theca widely rounded; Dorsoapical emargination shallow, smoothly rounded. Nonsclerotized stripe on dorsal wall fine.

Proximal branches of ventrolateral lobes of conjunctive slightly longer than those of preceding species, but shorter than distal branches, narrowing toward apices, directed ventrolaterally. Distal branches long, narrowing toward apex, directed toward base of aedeagus and sideways; each branch with small termi-

nal sclerite. Apical lobe long, with weak subapical constriction; its branches short, vesicular, fused at base.

Longitudinal fibers of median plates of penis long, strongly converging. Their bases situated in sagittal plain; distal parts situated in frontal plain, rather wide. Membranous area between fibers narrow, weakly convex. Apical outgrowths short; almost entirely split between apical outgrowths distinctly visible from outside. Vesica rather long, narrowing toward apex.

*Pinthaeus sanguinipes* (Fabricius, 1781) (Fig. 9)

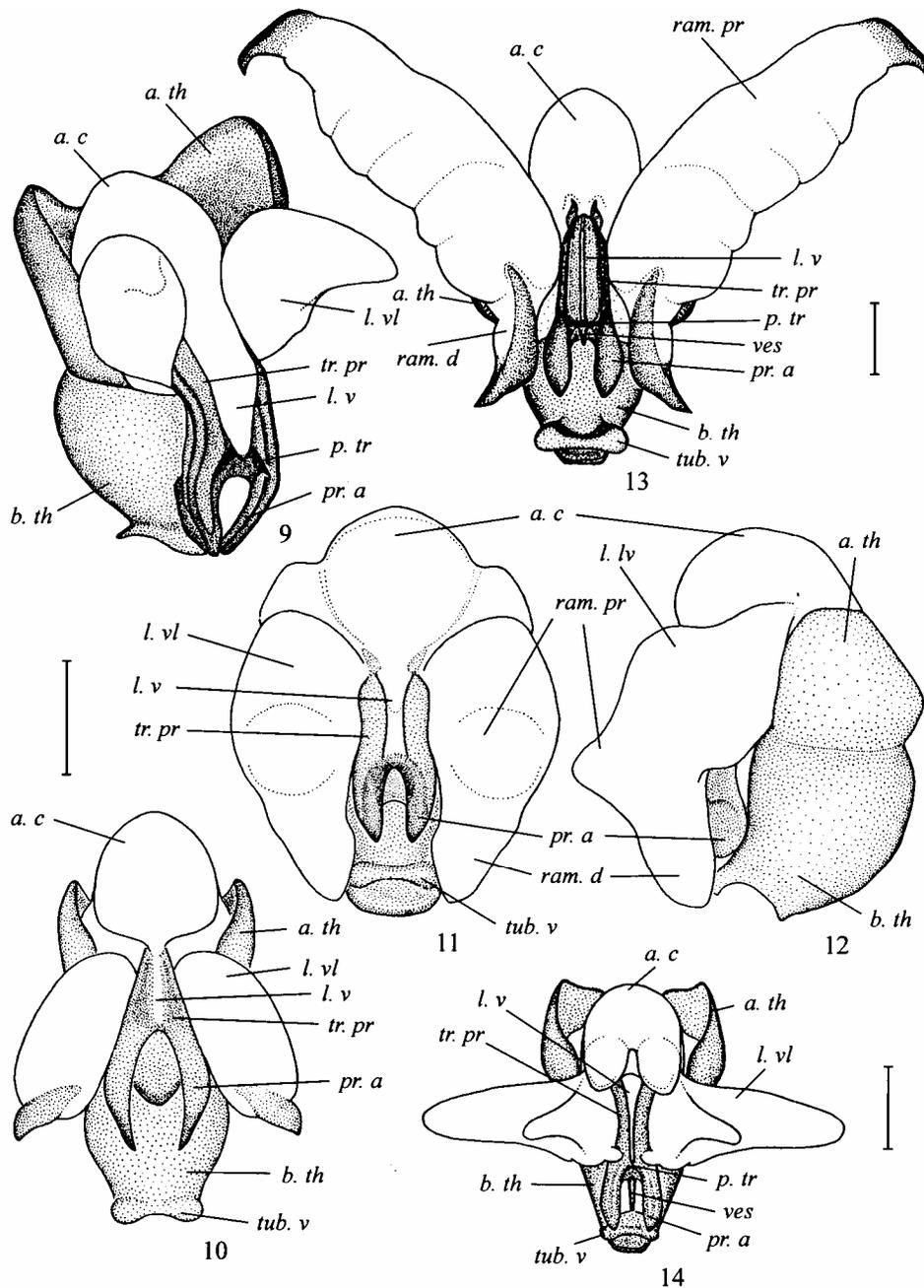
**Material.** Nizhegorodskaya Prov., Staraya Pustyn', 28.VIII.1939 (Kiritshenko), 1 specimen; Primorskii Terr., Odarka River valley, 25 versts (15 km) from Evgen'yevka Station, 4.VII.1911 (A. Cherskii), 1 specimen; Primorskii Terr., Spasskii Distr., Yakovlevka, 15.VII.1926 (Dyakonov, Filip'ev), 1 specimen.

**Description.** Phallobase as long as wide. Dorsal connectives significantly shorter than basal plates, with small conical mushroom-shaped bodies at ends. Ventral processes rectangular, short, rather narrow, widely spaced, strongly reflexed proximally. Suspensor apodemae thicker and significantly longer than dorsal connectives.

Basal and apical parts of theca divided by distinct constriction; apical part of theca slightly longer than basal one. Lateroapical angles of apical part of theca strongly elongate, projecting far beyond apex of conjunctive, narrowly rounded. Dorsoapical emargination of apical part of theca wide, deep, trapeziform. Nonsclerotized area on dorsal wall very small, triangular, situated near apical margin of theca.

Conjunctive small, similar to that of preceding species. Ventrolateral lobes without emargination at apices, long, directed toward ventral surface, running nearly in parallel, only slightly diverging and somewhat curved toward base of aedeagus, without apical sclerites. Apical lobe indistinct. Apex of conjunctive in form of narrow cupola surrounded at sides by angles of apical part of theca.

Ventral lobe long, strongly curved before middle, directed toward base of theca; apices of its apical outgrowths reaching base of theca. Longitudinal fibers of median plates of penis moderately widely spaced, running in parallel, very narrow at base, gradually widened distally. Their inner margins elevated in form of very narrow plates situated in sagittal plain. Mem-



**Figs. 9–14.** Aedeagus: (9) *Pinthaeus sanguinipes* (Fabricius), ventrolateral view; (10) *Arma custos* (Fabricius), ventral view; (11–12) *Troilus luridus* (Fabricius) [(11) ventral, (12) lateral view]; (13) *Alcaorrhunchus grandis* (Dallas), ventral view; (14) *Euthyrhynchus floridanus* (Linnaeus), ventral view.

branous area between longitudinal weakly convex, narrowing distally. Ventral margin of pons transversus peak-shaped elevated. Apical outgrowths very long, with converging apices. Vesica rather long.

***Rhacognathus punctatus*** (Linnaeus, 1758)

**Material.** St. Petersburg, near Udelnaya Station, Shtolevskoe bog, 23.V.1922 (V. Fridolin), 1 specimen;

Yamburg Distr., Serezhino, 1.VIII.1895 (Bianki), 1 specimen; Vologda Prov., Totma, 23.VII.1933 (Barovskii), 1 specimen; Irkutsk Prov., Taishet, 16.VII.1940 (Barovskii), 1 specimen.

**Description.** Aedeagus similar to that of preceding species. Phallobase about as long as wide. Dorsal connectives slightly shorter than basal plates. Mushroom-like bodies short, but rather wide, conical. Ventral

processes short, wide, projecting slightly beyond lateral margins of phallobase, reflexed proximally at apices.

Apical part of theca about as long as basal part, widened at apex, but not very convex. Lateroapical angles of apical part of theca elongate. Dorsoapical emargination shallow, weakly rounded, very wide.

Ventrolateral lobes of conjunctive long, without emargination at apices, swollen at base and gradually narrowing toward apex, directed sideways, slightly curved toward aedeagus at apices. Inner wall of curve of each lobe with rather long sclerotized free plate directed toward apex. Apex of conjunctive swollen, higher than that of preceding species (projecting beyond lateral angles of apical margin of theca free along significant part and not adjoining conjunctive).

Ventral lobe small, narrow at base and widened at apex, running toward base of aedeagus. Longitudinal fibers weakly and gradually widened from narrow bases. Membranous area between fibers narrow and convex, lowered distally. Apical outgrowths caliciform curved, wide, with apices directed toward each other. Pons transversus, connecting bases of apical outgrowth, narrow and not projecting beyond their ventral margins. Sperm duct curved similarly to that of preceding species, but less widened at apex.

*Cazira verrucosa* (Westwood, 1834)

**Material.** Vietnam, 40 km NE of Tai Hguen, 600–800 m, 16.I.1964 (Kabakov), 1 specimen; Central Vietnam, Buon Mui, 35 km N of An Khe, path in forest, 1–20.VII.1984 (Sergeeva), 1 specimen.

**Description.** Aedeagus similar to that of preceding species. Phallobase slightly wider than long. Dorsal connectives shorter than basal plates, bearing at ends large mushroom-like bodies with rather long and fine stems and wide plates. Ventral processes rather long, wide, reflexed proximally at apices. Suspensory apodemes slightly longer than dorsal connectives.

Apical part of theca slightly longer and less heavily sclerotized than basal part. Dorsoapical emargination of apical part of theca wide and rather deep. Dorsoapical angles high and narrowly rounded.

Ventrolateral lobes of conjunctive very wide, swollen at bases, directed ventrolaterally. Their apices narrower, curved toward base of aedeagus, sclerotized at ends. Apex of conjunctive in form of wide cupola, extended in dorso-ventral direction, not projecting beyond dorsoapical angles of apical part of theca.

Longitudinal fibers of median plates of penis narrowing and somewhat converging at base, separate and running in parallel along rest of length. Membranous wall between fibers swollen. Apical outgrowths of median plates long (with apices nearly reaching base of theca), wide, running in parallel, converging at apices. Their inner walls significantly more heavily sclerotized than outer ones. Pons transversus rather wide, not projecting beyond ventral margins of apical outgrowths. Vesica very small.

*Coryzorhaphis leucocephala* Spinola, 1837

**Material.** Brazil, San Paulo (Collection of I. Gudim), 1 specimen.

**Description.** Aedeagus similar to that of preceding species. Phallobase about as long as wide. Dorsal connectives about as long as basal plates, with very short conical mushroom-like bodies at ends. Ventral processes long, with wide external angles distinctly projecting beyond margins of basal plates and with apices slightly reflexed proximally.

Apical part of theca longer than basal part, extended in dorso-ventral direction. Dorsoapical emargination of apical part of theca wide and shallow. Lateroapical angles widely rounded.

Ventrolateral lobes of conjunctive not very wide at bases and narrow at apices, directed toward ventral surface and gradually curved toward base of aedeagus. Apex of conjunctive in form of rounded cupola, projecting beyond apical angles of apical part of theca.

Longitudinal fibers of median plates of penis widely spaced at base, narrower and running in parallel in distal part. Membranous walls between fibers swollen at bases and flat and weakly sclerotized at apices. Apical outgrowths of median plates rather long and wide, more heavily sclerotized along ventral margins; their outer walls membranous, inner walls more heavily sclerotized. Pons transversus narrow, weakly sclerotized, not projecting beyond ventral margins of apical outgrowths. Vesica short, strongly curved, directed toward ventral surface.

*Oechalia schellenbergii* (Guerin-Méneville, 1831)

**Material.** Australia, N.S.W., Konargo, 35 km NW Denilguin, 15.IV.1978 (Tobias), 1 specimen; Australia, 70 km N from Alice-Springs, 8.V.1978 (Tobias), 1 specimen; Australia, N.T., 23°46'S, 133°04'E, Elery Gorge, 80 km W Alice Springs, 5.XI.1979 (Zaitzev), 1 specimen; Australia, N.T., 23°37'S, 133°53'E, 9 km N Alice Springs, 6.XI.1979 (Zaitzev), 1 specimen;

**Description.** Phallobase slightly wider than long, less heavily sclerotized than that of preceding species. Dorsal connectives as long as basal plates, bearing at ends small mushroom-like bodies with virtually indistinct plates. Ventral processes long, moderately wide, widely spaced, nearly not reflexed proximally at apices. Suspensory apodemae about as long as phallobase.

Structure of theca similar to that of preceding species. Dorsoapical emargination of apical part of theca wide and shallow, with nearly straight base. Dorsal wall of theca with small nonsclerotized area, widened toward apical margin of theca.

Ventrolateral lobes of conjunctive directed sideways, their apices somewhat curved toward base of conjunctive and sclerotized at ends. Apical lobe indistinct, apex of conjunctive widely rounded.

Longitudinal fibers of median plates of penis widely spaced, running in parallel, fine and situated in parasagittal plain at base and wider and situated in frontal plain in distal part. Membranous wall between fibers flat, with sperm duct projecting in median part. Carina at base of apical outgrowths indistinct. Apical outgrowths short, fused at base on dorsal side along rather long distance, with converging apices; split between outgrowths visible from outside, but very small. Outer walls of apical outgrowths membranous. Vesica not visible from outside.

*Arma custos* (Fabricius, 1794) (Fig. 10)

**Material.** Primorskii Terr., Vinogradovka, 13.V.1929 (Kiritshenko), 1 specimen; Primorskii Terr., Vinogradovka, 22.V.1929 (Kiritshenko), 1 specimen; Pripet, Scrygalovo, 13.VIII.1930 (Guttermann), 1 specimen.

**Description.** Aedeagus similar to that of preceding species. Phallobase slightly wider than long. Dorsal connectives significantly shorter than basal plates. Mushroom-like bodies with reduced stems and small plates. Ventral processes very short, narrow, widely spaced, weakly reflexed proximally at apices, not projecting beyond lateral margins of basal plates.

Apical part of theca slightly shorter and wider than basal part. Dorsoapical emargination of apical part of theca very wide, shallow, rectangular.

Ventrolateral lobes of conjunctive rather small, wide along entire length, directed toward base of aedeagus, slightly diverging, with large projecting

sclerites at apices. Apex of conjunctive about as long as wide, slightly overhanging base of lateral lobe.

Longitudinal fibers of median plates of penis wide, approximate, running in parallel, narrow at bases, and widened at apices. Membranous area between fibers rectangular, flat. Apical outgrowths of median plates rather long; slit between fibers wide, well-visible from outside. Pons transversus very narrow. Sperm duct very weakly curved in apical part and opening as wide secondary gonopore occupying nearly entire ventral wall of ventral lobe between apical outgrowths. Vesica reduced, forming small carina around secondary gonopore.

*Troilus luridus* (Fabricius, 1775) (Figs. 11, 12)

**Material.** Erzberg, Saxon, 1 specimen; Sichuan, Tajnlu, 5.VII.1893 (Potanin), 1 specimen; Sichuan, Tajnlu, 24.VI.1893 (Potanin), 1 specimen; Bikin River, tributary of Ussuri River, 10.VII.1948 (Kurentsov), 1 specimen.

**Description.** Aedeagus slightly differing from that of preceding species. Phallobase wider than long. Dorsal connectives slightly shorter than basal plates, with narrow and long sclerotized mushroom-like bodies at ends. Ventral processes short, wide, rectangular, with rounded angles, not projecting beyond lateral margins of phallobase.

Basal part of theca large, more convex on dorsal side, with membranous ventral tubercles. Ejaculatory reservoir occupying nearly entire cavity of basal part. Apical part of theca slightly shorter than basal part, slightly less heavily sclerotized, gradually widening dorsally; its apical margin significantly wider than apex of basal part of theca. Lateroapical angles of apical part of theca nearly not projecting, widely rounded. Dorsoapical emargination inconspicuous. Longitudinal axes of basal and apical parts of theca forming nearly straight angle.

Conjunctive small, with ventrolateral lobes strongly widened and swollen in basal part. Ventral wall forming in middle of each lobe small tubercle directed toward ventral surface; this tubercle can be homologized with proximal branch of ventrolateral lobe of some species described above. Distal parts of ventrolateral lobes finer, running in parallel, directed toward, and nearly reaching base of theca. These can be homologized with distal branches of the ventrolateral lobes of some species described above. Apical lobe indistinct. Apex of conjunctive swollen and wide at base and upcurved at apex.

Ventral lobe running toward base of aedeagus, gradually narrowing toward apex. Longitudinal fibers of median plates of penis narrowing at base and rather wide along most part of length. Apical outgrowths sclerotized on both sides, wide, calyciform curved, rather widely spaced. Pons transversus wide, with emargination of ventral margin. Membranous wall between longitudinal fibers wide. Sperm duct without dilations and curves inside ventral lobe, opening in ventral emargination of pons transversus as secondary gonopore bordered on dorsal side with small, curved, sclerotized carina curved like groove.

*Alcaeorrhynchus grandis* (Dallas, 1851) (Fig. 13)

**Material.** Brazil, Sao Paulo, Piracicaba (G. Bondar), 1 specimen; Brazil, Cruz Alta Rio Grande Do Sul (collection of I. Gudim), 1 specimen.

**Description.** Aedeagus differing from that of preceding species. Phallobase large, about as long as wide. Dorsal processes indistinct. Dorsal connectives very short. Mushroom-like bodies large, heavily sclerotized, with fine sclerotized stems and strongly widened plates. Ventral processes in form of rather long and wide rectangular plates slightly reflexed proximally at apices; their external angles distinctly projecting beyond lateral margins of basal plates; inner angles rounded.

Basal part of theca small, narrowed at base and widened at apex, with membranous ventral tubercles. Apical part of theca about as long as basal part, very wide and convex. Dorsoapical emargination shallow, very wide, with straight base. Lateroapical angles widely rounded.

Conjunctive large. Its ventrolateral lobes divided into 2 branches. Proximal branches very long, directed apicad, diverging, with heavily sclerotized apices curved sideways. Distal branches small, less convex, with heavily sclerotized inner walls turning at ends into plates with directed apices directed sideways. Shape of conjunctive in ventral view resembling letter "X" extended in apical part. Apical lobe indistinct. Apex of conjunctive in form of rather high cupola projecting far beyond lateral apical angles of apical part of theca.

Ventral lobe long, directed toward base of aedeagus, most strongly curved in basal part. Longitudinal fibers of median plates of penis in form of wide carinae very closely converging at base and then gradually diverging, running in perpendicular to fron-

tal plain of basal lobe. Wall between longitudinal fibers flat, weakly sclerotized, appearing to be depressed between their bases. Its surface forming along median line convex canal holding sperm duct. Apical outgrowths of median plates sclerotized on both sides, long and rather narrow, calyciform curved, with ventral margins reflexed toward each other. Apical outgrowths not connected by dorsal wall nearly along entire length, connected by narrow sclerotized bridge in upper part. Vesica in form of small, sclerotized, conical tube.

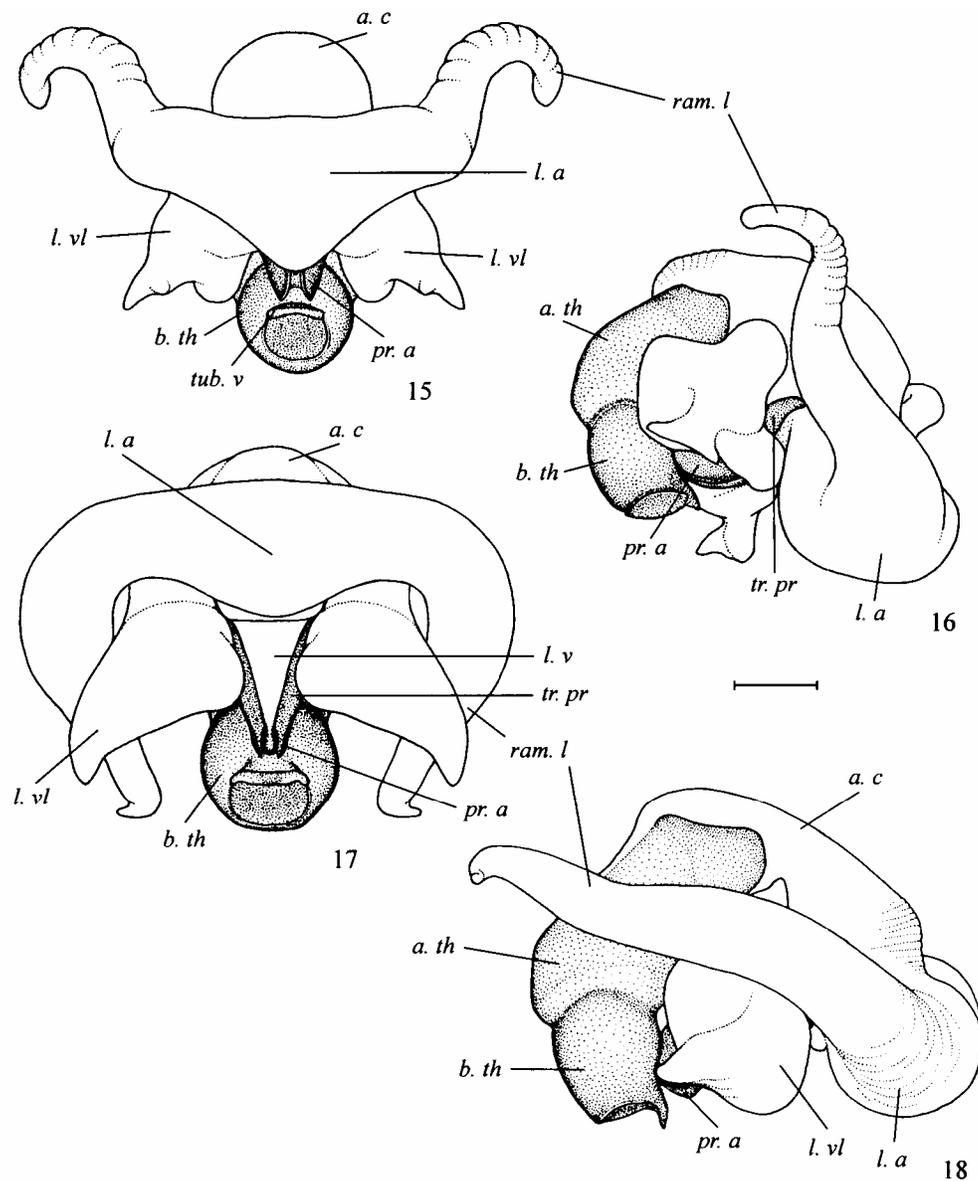
*Euthyrhynchus floridanus* (Linnaeus, 1767) (Fig. 14)

**Material.** Mexico, Veracruz, X.1978 (Izhevskii), 1 specimen; 1 specimen without geographic label (*Euthyrhynchus floridanus* L. Oshanin det.).

**Description.** Aedeagus differing from that of preceding species. Phallobase as long as wide. Dorsal processes indistinct. Dorsal connectives significantly shorter than basal plates. Mushroom-like bodies sclerotized, elongate, with narrow stems and weakly widened plates. Ventral processes rather short, wide, distinctly projecting beyond lateral margins of basal plates, with rounded inner angles. Ventral processes weakly reflexed proximally at apices. Suspensory apodemes about as long as phallobase with ventral processes.

Basal part of theca small; its apical part long, strongly widened at apex, but not very convex. Dorsal wall of apical part of theca with narrow median nonsclerotized stripe along entire length. Dorsoapical emargination wide, smoothly rounded, shallow. Lateroapical angles widely rounded.

Ventrolateral lobes of conjunctive divided into three branches. Branches of 1st pair long, wide, directed sideways, can be compared with distal branches of some species described above. Branches of 2nd pair shorter, fine, appearing as those running from large bases of branches of 1st pair, directed ventrolaterally, can be homologized with proximal branches of some species described above. Branches of 3rd pair smallest, extending from bases of lobes in middle and closer to basal part of conjunctive, directed toward each other, slightly overlying longitudinal fibers of median plates of penis. Apical lobe small, curved, directed downwards from place of fusion with dorsoapical margin of apical part of theca. At apex, apical lobe divided into two small spherical swellings hanging over bases of median plates of penis.



**Figs. 15–18.** Aedeagus: (15, 16) *Discocera coccinea* (Fabricius), [(15) ventral, (16) lateral view]; (17, 18) *Oplomus pulcher* Dallas [(17) ventral, (18) lateral view].

Ventral lobe long, with apex not directed toward wall of theca. Longitudinal fibers of median plates of penis running in parallel along entire length, wide, narrowed only at bases. Membranous wall between longitudinal fibers very narrow and flat. Apical outgrowths of median plates most heavily sclerotized along ventral margin. Their outer walls membranous; inner walls weakly sclerotized. Sperm duct curved and widened at apex, which typical of most of Asopinae. Vesica about half as long as apical outgrowths, slightly curved.

*Discocera coccinea* (Fabricius, 1798) (Figs. 15, 16)

**Material.** Peru, Marcapata (collection of I. Gudim).

**Description.** Aedeagus slightly similar to that of preceding species. Phallobase about as long as wide. Dorsal connectives significantly shorter than basal plates, with elongate and narrow mushroom-like bodies at ends. Ventral processes in form of wide and rather short plates with rounded angles, nearly not reflexed proximally. Suspensory apodemae about as long as phallobase with ventral processes.

Basal part of theca small, tubular, with fused membranous ventral tubercles at base. Apical part of theca extended in ventral direction, very strongly swollen, less heavily sclerotized than basal part (especially along median line of dorsal wall). Dorsapical emar-

gination of apical part of theca ill-defined; lateroapical angles rounded.

Conjunctive large, extended in dorso-ventral direction. Ventrolateral lobes of conjunctive short, narrowed at bases and widened toward apices, each with three apices. Apices of 1st pair long, situated at sides, forked at ends, directed sideways and toward base of aedeagus. Apices of 2nd pair long, situated medially, directed toward each other, adjoining above longitudinal fibers of median plates of penis. On dorsal side, ventrolateral lobes strongly swollen; rounded apices of these swellings directed upwards. Wall of conjunctive strongly swollen on dorsal side at base. Apex of conjunctive low and convex. Ventral side of conjunctive with very large apical lobe separated by constriction and overhanging ventral lobe. At base, conjunctive convex, forming at sides one pair of very long lateral branches directed dorso-laterally and toward apex and surrounding conjunctive at sides; apices of these branches narrowing and slightly curved.

Most part of ventral lobe concealed by median apices of ventrolateral lobes. Longitudinal fibers of median plates of penis widely spaced at base (base of apical lobe situated between them), with converging apices, and running nearly in parallel. Apical outgrowths rather wide, strongly curved toward base of conjunctive, with heavily sclerotized ventral margins. Outer walls of apical outgrowths very weakly sclerotized, nearly membranous; inner walls more heavily sclerotized. Pons transversus narrow, not projecting beyond ventral margins of apical outgrowths. Vesica very small, in form of curved tube.

*Oplomus pulcher* Dallas, 1851 (Figs. 17, 18)

**Material.** Mexico, Veracruz, X.1987 (Izhevskii), 2 specimens.

**Description.** Aedeagus similar to that of preceding species. Phallobase about as long as wide. Dorsal connectives significantly shorter than basal plates, with rather narrow elongate mushroom-like bodies at ends. Ventral processes in form of wide plates with margins projecting beyond lateral walls of phallobase. Suspensory apodemae slightly longer than phallobase with ventral processes.

Wide area of dorsal wall of apical part of theca very weakly sclerotized along entire length of median line. Dorsoapical emargination of apical part of theca more distinct than that of preceding species.

Ventrolateral lobes of conjunctive with three apices. Apices of 1st pair directed sideways and slightly curved at pointed apex. Apices of 2nd pair directed medially, widely rounded, slightly overlapping longitudinal fibers of median plates of penis. Apices of 3rd pair directed toward apex, pointed, rather short. Apical lobe separated by small constriction, strongly swollen at base bearing one pair of very long lateral branches surrounding conjunctive at sides; apices of this branches projecting beyond dorsal margins of apical lobe.

In contrast to that of preceding species, ventral lobe exposed in ventral view. Bases of longitudinal fibers widely spaced, surrounding base of apical lobe; apices gradually converging, forming small apical carina with flat membranous tip. Membranous wall between longitudinal fibers oblong-triangular, flattened. Apical outgrowths strongly curved toward wall of theca. Outer walls of apical outgrowths very weakly sclerotized, nearly membranous; inner wall distinctly less heavily sclerotized. Pons transversus very narrow.

## DISCUSSION

Aedeagi of the examined representatives of the subfamily Asopininae are characterized by the following common features:

(1) Phallobase rather strongly and uniformly sclerotized, about as long as wide. Dorsal processes absent. Mushroom-like bodies conical and sclerotized. Ventral processes in form of small triangular plates reflexed proximally to certain extent.

(2) Theca subdivided into distinctly separated basal and apical parts. Basal part cylindrical, uniformly and heavily sclerotized, with developed membranous ventral tubercles at base. Ejaculatory reservoir occupying nearly entire cavity of basal part of theca. Apical part of theca wider than basal part; with dorsoapical depression; its lateral angles rather long, surrounding base of conjunctive.

(3) Conjunctive with paired membranous ventrolateral lobes and unpaired ventral lobe. Apex of conjunctive either in form of low cupola or long, distally bifurcate apical lobe occasionally curved downwards.

(4) Ventral lobe well developed, bearing median plates of penis. Latter consisting of sclerotized longitudinal fibers running from base of ventral lobe along its lateral surfaces and apical outgrowths situated on apex of ventral lobe. Bases of apical outgrowths con-

nected on ventral side by sclerotized pons transversus. Dorsal of pons transversus, sclerotized vesica running from membranous wall of apex of ventral lobe between apical outgrowths and opening as secondary gonopod at end; vesica in form of tube not projecting beyond apices of apical outgrowths of median plates, occasionally absent. Sperm duct C-curved and widened in distal part.

At least three schemes of the structure of the aedeagus can be readily distinguished in the subfamily Asopinae within this common complex of characters. These schemes are described below:

**Scheme A.** Basal part of theca short and narrow, apical part long (Figs. 2, 6), wide, and strongly convex; its dorsal wall nonsclerotized along entire length of median line. Membranous stripe formed as result of this desclerotization stretching and moving apart lateral parts during unwrapping of conjunctive. Conjunctive large (Figs. 1, 2, 6). Its ventrolateral lobes subdivided into three branches: proximal, distal, and intermediate (in *Platynopiellus septendecimaculatus*); distal branch with sclerotized hook or small rounded sclerite at apex. Apex of conjunctive forming apical lobe with shallow constriction at base. Apical lobe directed toward apex and subdivided into two short branches at end. Apex of ventral lobe strongly curved toward wall of theca; therefore, slit between apical outgrowths of median plates of penis hardly visible. Longitudinal fibers of median plates converging, forming sclerotized carina at apex (Figs. 2–6). Apical outgrowths of median plates with membranous outer, and sclerotized inner walls (Fig. 3). This scheme of structure of aedeagus observed in *Macrorrhaphis acuta*, *Dorycoris pavoninus*, *Platynopiellus septendecimaculatus*, *Friarius alluaudi*, *Afrius flavirostrum*, and *An-drallus spinidens*.

**Scheme B.** Basal part of theca short and narrow; its apical part very large and convex (Figs. 16, 18). Dorsal wall of apical part of theca weakly sclerotized and nearly membranous along entire length of median line. Conjunctive very large (Figs. 15–18). Ventrolateral lobes with 3 pairs of relatively small apices; apices of one pair directed medially, overlapping longitudinal fibers of median plates of penis (Figs. 16, 17). Apex of conjunctive in form of low cupola, extended in dorso-ventral direction. Apical lobe large, shifted toward ventral side of conjunctive, separated by constriction, directed downwards, forming two long lateral branches enveloping conjunctive at sides and directed up-

wards. Apex of ventral lobe strongly curved toward wall of theca, and, therefore, slit between apical outgrowths of median plates of penis hardly visible. Longitudinal fibers of median plates converging, forming at apex very short and low sclerotized carina (Fig. 17). Apical outgrowths of median plates with membranous outer, and sclerotized inner walls. This scheme of structure of aedeagus observed in *Discocera coccinea* and *Oplomus pulcher*.

The aedeagus of *Euthyrhynchus floridanus* (Fig. 14) is rather similar to scheme A, but also exhibits some features of scheme A. The apical lobe of the conjunctive resembles that of scheme A, but it is curved downwards as the result of shortening of the ventral wall of the constriction at its base, which corresponds to scheme B. However, the apical lobe does not form long lateral branches (they are replaced by small swellings characteristic of scheme A). The presence of the three-branched ventrolateral lobes of the conjunctive, one pair of which is directed medially and conceals the median plates of the penis, also relates the aedeagus of *Euthyrhynchus floridanus* to scheme B. The dorsal wall of the apical part of the theca, not sclerotized along the entire length, is one more feature common for schemes A and B. The parallel, instead of widely spaced, bases of the longitudinal fibers are also correspond to scheme A.

**Scheme C.** Basal part of theca long and wide (Figs. 7–9). Constriction between it and weakly convex apical part shallow (most distinct in *Pinthaeus sanguinipes*). Not sclerotized stripe on dorsal wall of apical part of theca strongly reduced or absent. Ventrolateral lobes of conjunctive not subdivided into branches, narrowing toward apex; sclerotized at apex in some species (*Rhacognathus punctatus*, *Arma custos*, *Cazira verrucosa*, and *Oechalia schellenbergii*). Apical lobe undeveloped; apex of conjunctive in form of low cupola. Ventral lobe directed toward base of aedeagus, but its apex not curved toward wall of theca, and, therefore, slit between apical outgrowths of median plates of penis distinctly visible in ventral view (Figs. 7, 9). Longitudinal fibers of median plates not forming apical carina. Usually, both outer and inner walls of apical outgrowths of median plates sclerotized, except for *Arma custos*, *Coryzorhaphis leucocephala*, and *Oechalia schellenbergii*, in which outer wall membranous. This scheme of structure of aedeagus characteristic of *Dinorhynchus dybowskyi*, *Pinthaeus sanguinipes*, *Rhacognathus punctatus*, *Cazira verrucosa*, *Coryzorhaphis leucocephala*, *Oechalia*

*schellenbergii*, and *Arma custos*. This scheme is also found in the following species examined by us, but not described in the present communication: *Amyotea malabarica* (Fabricius, 1775), *Cermatulus nasalis nasalis* (Westwood, 1837), *Podisus nigrispinus* (Dallas, 1851), *P. distinctus* (Stål, 1860), and *Zicrona caeruella* (Linnaeus, 1758).

In the structure of the aedeagus, *Troilus luridus* and *Alcaeorrhynchus grandis* occupy a somewhat isolated position among the examined species of the subfamily Asopinae. These are characterized by the following features: ventrolateral lobes of conjunctive two-branched. In *Troilus luridus*, proximal branches presented by small tubercles at mid-length of ventrolateral lobe and distal branches, by narrower apices of lobes (Figs. 11, 12). In *Alcaeorrhynchus grandis*, proximal branches very long and, similarly to distal branches, sclerotized at apices (Fig. 13). In both species, apical part of conjunctive in form of low cupola (curved downwards in *Troilus luridus*); apex of ventral lobe not curved toward wall of theca; longitudinal fibers of median plates not forming apical carina; and both walls of apical outgrowths sclerotized. According to most of structural characters, aedeagi of these species corresponding to structural scheme C.

The majority of species examined by us are characterized by the stable structure of the aedeagus within one or three structural schemes. Species, demonstrating one structural scheme of the aedeagus, distinctly differ from those possessing another structural scheme. Species with the aedeagus combining the features of two structural schemes also can be attributed (based on the majority of key characters) to certain structural schemes, within the limits of which they are considered in the present paper. Probably, the three described structural schemes of the aedeagus correspond to natural groups of the tribe rank in the subfamily Asopinae.

Thomas (1992) indicated the artificial character of the tribes Asopini Amyot et Serville, 1843 and Discocerini Schouteden, 1907, relating the genera *Discocera*, *Stiretrus*, *Oplomus*, *Perillus*, *Heteroscelis*, and *Coryzorhaphis* on the basis of the structure of the scutellum (probably, a synapomorphy) and some other characters (plesiomorphic ones). The shape and structure of the entirely stretched aedeagi evidently demonstrate close relations between the genera *Discocera* and *Oplomus*. According to the figure of the aedeagus of *Heteroscelis robustus* Thomas, 1992, given in the monograph of Thomas (1992), it also belongs to struc-

tural scheme B together with the aedeagi of *Discocera* and *Oplomus*. This figure shows the aedeagus in ventral view, the partly stretched conjunctive of which obviously forms a pair of the ventrolateral lobes with two branches and the long left lateral branch of the apical lobe. The aedeagus of *Coryzorhaphis* corresponds to structural scheme C, and, therefore, this genus cannot be, probably, treated as closely related to *Discocera*, *Oplomus*, and *Heteroscelis*. Unfortunately, the genera *Stiretrus*, *Perillus*, and *Heteroscelis* were not studied in the present work. The results obtained testify to the great taxonomic importance of characters of the entirely stretched aedeagus and to the necessity of the use of these characters in the taxonomy of the subfamily Asopinae.

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