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Hypopygia of most Nearctic and Palearctic species of *Dibrachys* Foerster, key to most species of the genus, and descriptions of three new species

(Hymenoptera, Pteromalidae)

By M. Doğanlar

Abstract

In the subgenus *Dibrachys* s. str. the hypopygia of four Nearctic species, *D. confusus* (Girault), *D. clisiocampae* (Fitch), *D. pelos* Grissell, *D. relativus* spec. nov., five Palearctic species, *D. cavus* (Walker), *D. boarmiae* (Walker), *D. maculipennis* Szelenyi, *D. palandoekenus* spec. nov., *D. goettingenus* spec. nov. and one Holarctic species, *D. fuscicornis* (Walker), are studied and illustrated. A key to most species of the subgenus is provided by employing hypopygial and other characters of the adults. The Holarctic species, *D. saltans* (Ratzeburg), is regarded as a synonym of *D. fuscicornis* (Walker), syn. nov. and the Nearctic species, *D. clisiocampae* (Fitch) is considered a valid species and distinct from the Palearctic species, *D. cavus* (Walker). *Dibrachys relativus* spec. nov. from Canada, *D. palandoekenus* spec. nov. from Turkey, and *D. goettingenus* spec. nov. from Germany are described, illustrated, and available biological information of the species are provided.

Introduction

GRAHAM (1969) studied the European species of the genus *Dibrachys* Foerster and gave a detailed summary of literature on the genus and on generic synonyms. He provided a good diagnostic key for 8 European species, and also stated that the morphological characters separating some of the species of *Dibrachys* were rather insignificant and that the taxonomy of the European species was not yet completely clear. GRISELL (1974) revised the Nearctic species of the genus and gave a key for 5 species.

Presently, the genus *Dibrachys* contains 14 species. BOUČEK (1965) divided the European species into two subgenera and erected the subgenus, *Allodibrachys* Bouček for *D. hians* Bouček and *D. affinis* Masi and stated that all of the other species from the Nearctic and Palearctic Regions belong to the subgenus *Dibrachys* s. str. In the recent literature, 3 species from the Nearctic region, *D. confusus* (Girault), *D. daphne* Girault, *D. pelos* Grissell (PECK, 1963; GRISELL, 1974; BURKS, 1979), 6 species from the Palearctic region, *D. boarmiae* (Walker), *D. braconidis* (Ferrière & Faure), *D. vesparum* (Ratzeburg), *D. fuscicornis* (Walker), *D. maculipennis* Szelenyi, *D. lignicola* Graham (BOUČEK, 1965; GRAHAM, 1969), two species from the Holarctic region, *D. cavus* (Walker), *D. saltans* (Ratzeburg) (PECK, 1963; BOUČEK, 1965; GRAHAM, 1969; GRISELL, 1974) and one species, *D. australia* Girault, from Australia were described.

The genus, *Dibrachys* includes some species that could not be easily and distinctly separated from each other by the previous workers. For example, BOUČEK (1965) recorded *D. cavus* as a possible species-complex, and GRAHAM (1969) stated that *D. fuscicornis* must be closely related *D. saltans* through probably not indential to it, and he left the identity of *saltans* an open question. GRAHAM (1969) also stated that the differences between *D. boarmiae* and *D. cavus* are slight but that the two species may

be distinct, and he gave some useful characters for distinguishing them. Recently, SHARKOV (1982) recorded *D. boarmiae* from the USSR, redescribed it, and gave also some diagnostic characters for separating it from *D. cavus* and *D. braconidis*, mainly by following GRAHAM (1969).

In this work the hypopygial morphology of 10 species of the subgenus *Dibrachys* s. str. and some other adult characters, mainly the sculptures of face and clypeus, were studied; the specimens from the Nearctic and Palearctic regions in order to clarify some of the confusion in the systematics of the species. A key is provided for distinguishing thirteen species of the subgenus. Because of absence of the specimens of *D. hians*, *D. affinis*, *D. vesparum*, and *D. australia* for studying them, they were not included to the key. I have found that there is not a distinct character for separating the specimens of *D. saltans* from Canada, which were identified by Gahan in the Biosystematics Research Institute, Ottawa, and the specimens of *D. fuscicornis* from England. Therefore, I consider *saltans* to be a synonym of *fuscicornis* (syn. nov.). Differences on the hypopygia of the specimens of *D. cavus* and of the specimens of *D. clisiocampae* from British Columbia, Canada, which were previously identified as *cavus*, demonstrate that they are distinct species and therefore *D. clisiocampae* is a valid species which has previously been accepted as a synonym of *D. cavus* by several authors.

In this work *D. relativus* spec. nov. from Canada, *D. palandoekenus* spec. nov. from Turkey and *D. goettingenus* spec. nov. from Germany are described.

Material and methods

Material included the specimens of *Dibrachys* spp. reared from some hosts in British Columbia, Canada, specimens in the Canadian National Collection, Ottawa, in the British Museum (Natural History), London, and in the Hungarian Research Institute for Plant Protection, Budapest. In addition some specimens were reared from hosts in Turkey and in the Göttingen region, Germany, and swept from plants in Turkey, England and Germany.

Part of hypopygial terminology follows GRAHAM (1969) and the others were named by the author.

Abbreviations for the following characters are employed herein:

- EL: The distance between eyes at the level of the median ocellus.
- MPL: The distance between median and lateral ocelli.
- POL: The distance between the lateral ocelli.
- OOL: The distance between the lateral ocellus and eye.

Results and discussions

Key to most species of subgenus *Dibrachys* Foerster

- 1 Forewing infumate; face below antennal toruli finely wrinkled transversely or reticulated 2
- Forewing hyaline; face below antennal toruli striate vertically 7
- 2 Face below antennal toruli finely wrinkled transversely (fig. 1); anterior margin of clypeus shallowly emarginate; hypopygia (figs. 11, 12) with distance between anterolateral incision and the hind edge of sublateral sclerotized area equal or slightly longer than the greatest sublateral width of posterior lobe 3
- Face below antennal toruli reticulated (figs. 2, 10); anterior margin of clypeus deeply or shallowly emarginate; hypopygia (figs. 13, 14, 15) with distance between anterolateral incision and the hind edge of sublateral sclerotized area 1.25–1.60 times the greatest sublateral width of posterior lobe 4
- 3 EL 3 times POL in both sexes. Female: second annellus 1.50 times as broad as long; first funicular segment 1.30 times as long as broad; pedicellus about equal total length of annelli plus first funicular segment; propodeum without median carina. Male: Scape 6 times as long as broad; the distance between lower edge of toruli and anterior margin of clypeus 1.33 times the shortest distance between toruli and eye. Hypopygium as seen (fig. 11) *maculipennis* Szelenyi

- EL 2.76 times in female and 2.64–2.88 times in male; female: second annellus quadrate; first funicular segment quadrate or slightly longer than broad; pedicellus 1.33–1.36 times total length of annelli plus first funicular segment; propodeum with median carina. Male: Scape 4.33–4.66 times as long as broad; distance between lower edge of toruli and anterior margin of clypeus 1.12–1.16 times the shortest distance between toruli and eye. Hypopygium as seen (fig. 12) **pelos** Grissell
- 4 Anterior margin of clypeus deeply emarginate, with a long and deep median impression above emargination (fig. 2). Female: First funicular segment (fig. 4) 1.33 times as long as broad; distance between lower edge of toruli and anterior margin of clypeus 1.20 times the shortest distance between toruli and eye. Hypopygium as seen (fig. 13) **palandoekenus** spec. nov.
- Anterior margin of clypeus shallowly emarginate. Female: First funicular segment transverse or subquadrate; distance between lower edge of toruli and anterior margin of clypeus equal the shortest distance between toruli and eye 5
- 5 Second annellus subquadrate; head 2.10 times as broad as long in dorsal view; head and thorax brightly metallic blue or blue green; **braconidis** (Ferrière & Faure)
- Second annellus twice as broad as long; head 1.95–2.00 times as broad as long in dorsal view; head greenish blue or dark bluish, thorax bronze or dark bluish; 6
- 6 All of the funicular segments equal in length; length of pedicellus plus flagellum 0.78–0.80 times width of head; face as seen (fig. 10); genae strongly reticulated. Hypopygium as seen (fig. 14) . . . **confusus** (Girault)
- Fifth and sixth funicular segments 0.80 times as long as the length of the other segments which are equal in length; length of pedicellus plus flagellum 0.68 times width of head; face as seen (fig. 6); genae finely wrinkled transversely. Hypopygium as seen (fig. 15) **relativus** spec. nov.
- 7 Anterior margin of clypeus deeply emarginate, with a long and deep median impression 8
- Anterior margin of clypeus shallowly emarginate, with a short and shallow median impression 9
- 8 Forewing with post marginal vein subequal or longer than marginal vein; breadth of oral fossa about 1.50 times malar space, the latter half of length of eye. **daphne** Girault
- Forewing with postmarginal vein half or less length of marginal vein; breadth of oral fossa 2.80–3.00 times malar space, the latter one third of length of eye . . . **fuscicornis** (Walker) (= *saltans* Ratzeburg syn. nov.)
- 9 Female: Breadth of oral fossa 2.50–2.80 times malar space; gaster short, 1.60–1.80 times as long as broad, at most as long as head plus thorax. Male: Antennal scape with a projecting lobe at its apex; gaster with a testaceous subbasal spot. 10
- Female: Breadth of oral fossa 2.10–2.50 times the malar space; gaster at least longer than head plus thorax. Male: Antennal scape without a distinct lobe at its apex; gaster with or without a pale spot 11
- 10 Female: Eyes 1.35–1.40 times as long as broad; POL 1.50 00L; temples in dorsal view of head about one third as long as eyes. Male: Antennal scape in anterior view (fig. 663 of GRAHAM, 1969) with a small apical lobe; pedicellus without lobe **lignicola** Graham
- Female: Eyes 1.54–1.66 (1.63) times as long as broad; POL 1.72–1.77 00L; temples in dorsal view of head 0.29–0.30 times as long as eyes. Male: Antennal scape with a small apical lobe on dorsolateral side; pedicellus in dorsal view with a distinct lobe on its outer margin (figs. 21 A, B, 22) . . . **goettingenus** spec. nov.
- 11 Hypopygium (figs. 18a, b) with greatest median width of posterior lobe 1.00–1.07 times greatest sub-lateral width of posterior lobe; head 1.90–2.03 times as broad as its maximum length in dorsal view **boarmiae** (Walker)
- Hypopygium (figs. 16, 17) with greatest median width of posterior lobe 1.21–1.41 times greatest sub-lateral width of posterior lobe; head 1.78–1.96 times as broad as its maximum length in dorsal view 12
- 12 Hypopygium (fig. 16) 1.65–1.70 times as broad as long, with distance between the branches of hind edge of sublateral sclerotized area 1.33–1.63 times shortest distance between anterolateral incision and interior lobe **cavus** (Walker)
- Hypopygium (fig. 17) 1.85–2.00 times as broad as long, with distance between the branches of hind edge of sublateral sclerotized area 1.83–2.9 times shortest distance between anterolateral incision and interior lobe **clisiocampae** (Fitch)

Dibrachys (Dibrachys) maculipennis Széleányi

(Figs. 1, 11)

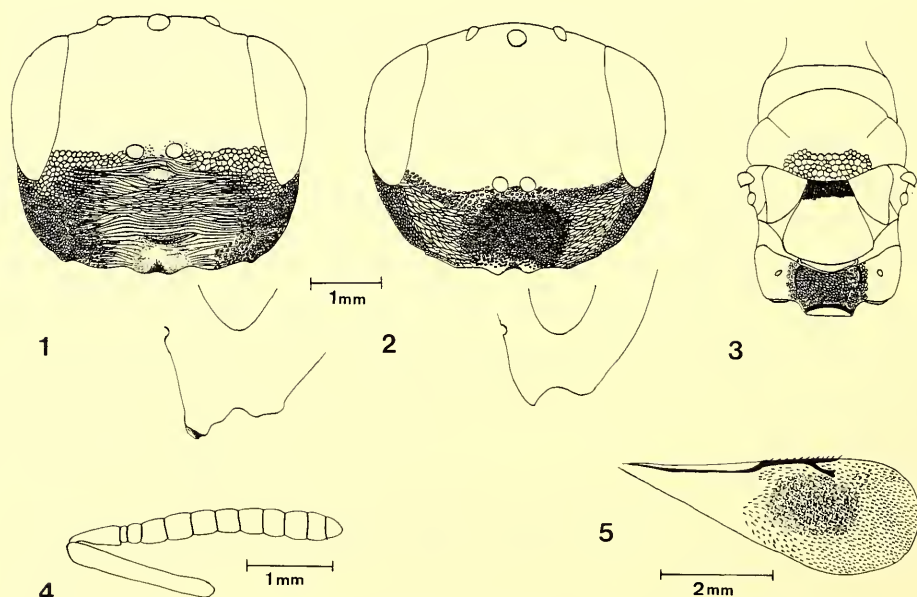
Dibrachys maculipennis Széleányi, 1957: 307–308, fig. 1, ♂♀; BOUČEK, 1965: 30; PECK, 1969: 418–421; GRAHAM, 1969: 805–814.

Type material. Paratypes, 15 ♀ and 7 ♂, Adony, Hungary, 11.–16.7.1948 (Dr. Jermý), reared from pupae of *Hyphantria cunea* Drury, in Hungarian Research Institute for Plant Protection, Budapest.

Description of hypopygium as follows: Interior lobe broad, hind edge of sublateral sclerotized area slightly sclerotized, median area with 16 setae, length of anterolateral margin 1.60 times the shortest distance between anterolateral incision and interior lobe.

Hungary.

Biology: Parasite of *Hyphantria cunea* Drury.



Figs. 1–5. *Dibrachys* spp.: 1–2, head, frontal view, with sculpture on face and clypeus, and ventral part of head in lateral view, 1, *D. maculipennis* Széleányi, 2, *D. palandoekenus* spec. nov.; 3–5, *D. palandoekenus* spec. nov., 3, thorax and propodeum; 4, ♀ antenna; 5, ♂ forewing.

Dibrachys (Dibrachys) pelos Grissell

(Fig. 12)

Dibrachys pelos Grissell, 1974: 314–319, figs. 1, 2, 12–17, ♂♀.

Type material. Holotype ♀, Canby, Modoc County, California, U.S.A., 28.9.1969 (R. F. Denno, E. E. Grissell), reared from prepupa of *Sceliphron caementarium* (Drury). Allotype ♂ and 14 ♀, 28 ♂ paratypes same data, and 50 ♂ paratypes reared on *Sceliphron* larvae in the laboratory. 50 ♀ paratypes collected Dozier, Solano County, California, September, 1971, reared from cells of *Osmia nigrifrons* Cresson containing prepupa of *Stelis chlorocyanea* Cockerell and cultured on *Megachile pacifica* Panzer (R. W. Thorp, R. W. Rust) (GRISSELL, 1974).

Additional localities and host data: Connecticut, Storrs, on mud dauber larvae. District of Columbia, on *Sphex pennsylvanicum* L. Maryland, Woodstock, on nest of *Ancistrocerus tigris* (Saussure). Arizona, Portal (GRISSELL, 1974); Pitt Meadow, Vancouver district, British Columbia, Canada, 45 ♀, 32 ♂, reared from nest of *Sphex* spec., and many adults reared on pupae of *Galleria mellonella* L. in the laboratory by the author.

Description of hypopygium as follows: Interior lobe narrow, hind edge of sublateral sclerotized area highly sclerotized throughout, median area with 9 setae, length of anterolateral margin 1.25 times the shortest distance between lateral incision and interior lobe.

GRISSELL (1974) stated that *D. pelos* is a species closely related to the American species *D. confusus*, and the European species *D. maculipennis*. However, I believe that *D. pelos* is closer to *maculipennis* than that to *confusus*. The diagnostic characters for this species as follows: Face below antennal toruli finely wrinkled transversely, second annellus quadrate, scape of male 4.33–4.66 times as long as broad. Hypopygium (fig. 12) with interior lobe narrow.

Canada, U.S.A.

Biology: A detailed work on the biology of this species was published by GRISSELL (1974), and he stated that the genera *Sceliphron* and *Stelis* in the nest of *Osmia nigrifrons* are natural hosts for *D. pelos*. The parasite was also reared on *Ancistrocerus*, *Megachile* and *Tachytes* in the laboratory by GRISSELL (1974). The species was also reared in the pupae of *G. mellonella* in laboratory by the author.

***Dibrachys (Dibrachys) palandoekenus* spec. nov.**

(Figs. 2–5, 13)

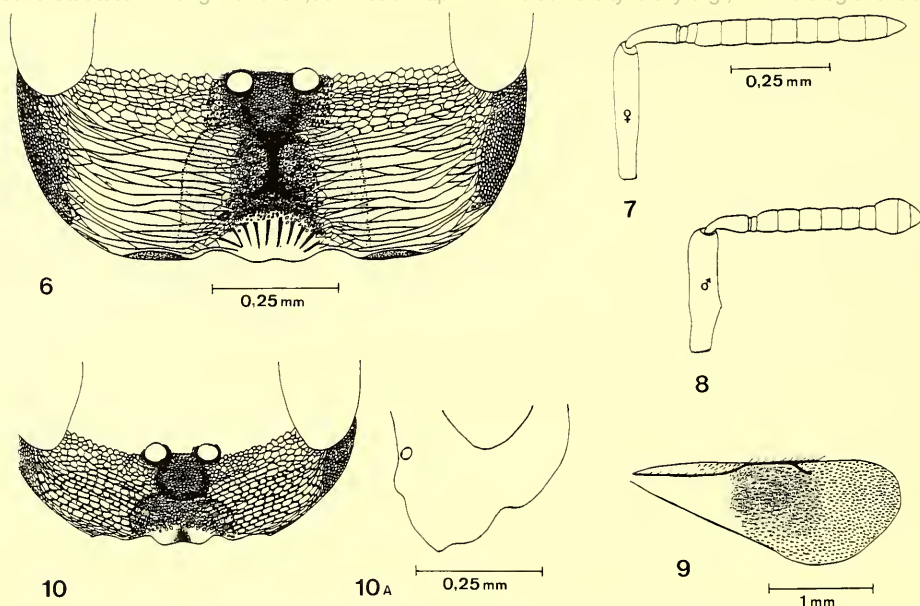
♀: Head and thorax bronze, dark bluish. Antennal scape testaceous, pedicellus brown, flagellum fuscous. Coxae concolorous with thorax, femora and tibiae testaceous, tarsi and fore tibia yellow. Forewing with a large strongly infumate discal cloud. Gaster black.

Head (fig. 2) in dorsal view 1.94 times as broad as its maximum length; EL:MPL:OPL:OOL = 59:9:21:15. OOL 3 times diameter of lateral ocellus. Breadth of oral fossa 2.20 times malar space, the latter 0.56 times length of an eye; eyes 1.60 times as long as broad. Antenna (fig. 4): Scape about as long as an eye, combined length of pedicellus and flagellum 0.80 times breadth of head; pedicellus 2.33 times as long as broad, and as long as length of annelli plus first funicular segment; second annellus 1.43 times as broad as long; first three funicular segments slightly longer than broad, funicular segments 4–5 quadrate, 6th slightly transverse; club twice as long as broad, and distinctly shorter than length of preceding two funicular segments.

Thorax (fig. 3) 1.66 times as long as broad; pronotal collar 0.23 times length of mesoscutum, latter 1.76 times as broad as long, and coarsely reticulated; scutellum finely reticulated, as long as broad and slightly shorter than mesoscutum; propodeum more coarsely reticulated than scutellum, medially 0.37 times length of scutellum, without median carina, plicae indicated only anteriorly. Forewing with basal cell and basal vein bare, speculum open below; marginal vein slightly more than twice length of stigmal vein, latter as long as post marginal vein.

Gaster oval, longer than head plus thorax. Hypopygium (fig. 13) 1.80 times as broad as long; distance between anterolateral angles 1.27 times length of hypopygium; distance between median and anterior lobes 1.55 times length of median sclerotized area, latter with 19–20 setae in two rows, and as long as distance between anterolateral incision and interior lobe; greatest median width of posterior lobe about 1.3 times distance between anterolateral incision and interior lobe; distance between the farthest branches of hind edge of sublateral sclerotized area about twice length of median sclerotized area.

♂: Differs from the female as follows: Head with frons and face greenish blue. Forewing (fig. 5) with a large strongly infumate discal cloud. Pedicellus twice as long as broad; second annellus 2.00–2.50 times as broad as long; gaster slightly shorter than thorax.



Figs. 6–10. *Dibrachys relativus* spec. nov.: 6–9: 6, ♀, head, frontal view with sculpture on face and clypeus, 7, ♀, antenna; 8, ♂, antenna; 9, ♀, forewing; 10, *D. confusus* (Girault), ♀, head, frontal view with the sculpture on face and clypeus, 10 A, ventral part of head in lateral view.

Holotype ♀, Turkey, Erzurum, 7.6.1979, reared from the cocoons of *Apanteles glomeratus* L., parasitizing *Pieris brassicae* L. (Doğanlar). Paratypes, 4 ♂♂, same data as the holotype. Holotype and two paratypes, in Insect Museum of Department of Plant Protection, Agriculture Faculty, Atatürk University, Erzurum, Turkey, and two paratype males in the British Museum (Natural History), London.

Diagnosis: *D. palandoekenus* can be distinguished from all other species of *Dibrachys* by the following combination of characters: Face below antennal toruli reticulated, anterior margin of clypeus deeply emarginate, first funicular segment in female 1.33 times as long as broad.

Turkey.

Biology: *D. palandoekenus* has been reared from the cocoons of *A. glomeratus* parasitizing *P. brassicae*. The cocoons were also parasitized by *Gelis* spec.. From the cocoons 5 specimens of *Gelis* spec., 3 specimens of *A. glomeratus* and 5 specimens of *D. palandoekenus*, and one dipterous pupa were obtained.

Dibrachys (*Dibrachys*) *braconidis* (Ferrière & Faure)

Homoporus luniger Nees var. *braconidis* Ferrière & Faure, 1925: 226, fig. 1, ♀.

Dibrachys (*Dibrachys*) *braconidis* (Ferr. & Faure); BOUČEK, 1965: 30; GRAHAM, 1969: 807, 814; BOUČEK, 1977: 34; SHARKOV, 1982: 620–622.

Type material. Type ♀, France, region of Lyon, in BM (NH) as type Hym. 5.683. Detailed information of the systematics and morphology of this species was given by GRAHAM (1969) and SHARKOV (1982).

France: region of Lyon, 1923, reared as an external parasite (and often gregarious) of the larvae of *A. glomeratus* (GRAHAM, 1969).

Yugoslavia: Croatia, Rovinj, Istria, 10.6.1966, reared from *Bruandia reticulatella* Stnt. (BOUČEK, 1977).

Biology: This species has also been recorded as a parasite of *Luffia lapidella* (Goeze) and *L. ferchaultella* (Steph.) (Lepidoptera: Tinaeidae), CILB, 1960; as a parasite in bags or cocoons of some Lepidoptera, e. g. Tinaeidae; and also in cocoons of Braconids (BOUČEK, 1977).

***Dibrachys (Dibrachys) confusus* (Girault)**

(Figs. 10, 14)

Coelopisthia confusa (Girault, 1916: 246, ♀.

Dibrachys confusus (Girault); PECK, 1951: 554; PECK, 1963: 682–683; GRISSELL, 1974: 313, 315, figs. 3, 8.

Type material. Type ♀, in the U.S. National Museum, Washington, D.C. (PECK, 1963).

D. confusus was poorly described by GIRAULT (1916), and previously, it has not been redescribed in the modern sense. In order to indicate the characters of *D. confusus* I give a redescription by examination of the following specimens:

2 ♀, Wanless, Manitoba, August, 1953, (T. V. Cole), lab. reared from cell of *Megachile* spec., and 1 ♀, Holtfarm, Wisconsin, Bayfield Co., 21.12.1955, (J. T. Medler).

Redescription:

♀: Head and thorax bronze, dark blue; scape and pedicellus testaceous; flagellum fuscous; legs, except hind coxae which are slightly metallic, testaceous to yellow; tegulae brown to yellow. Gaster black.

Head (fig. 10) in dorsal view twice as broad as its maximum length; EL 7–9 times MPL; POL 1.25–1.38 times OOL, OOL 1.70–2.00 times MPL and 2.40–3.00 times the diameter of lateral ocellus; breadth of oral fossa 2.00–2.30 times malar space, the later about half length of an eye. Eye about 1.50 times as long as broad; scape 0.80–0.85 times length of an eye; pedicellus twice as long as broad, and about as long as length of annelli plus first funicular segment; second annellus 1.66–2.00 times as broad as long; first funicular segment slightly transverse; funicular segments 5–6 are distinctly transverse; club 1.66 times as long as broad, distinctly shorter than three preceeding segments.

Thorax 1.66 times as long as broad; pronotal collar 0.13–0.16 times as long as mesoscutum, latter 1.75 times as broad as long; scutellum as long as broad and slightly shorter than median length of mesoscutum; median length of propodeum half length of scutellum, with distinct median carina and plicae. Gaster slightly shorter than head plus thorax, about 1.75 times as long as broad.

Description of hypopygium as follows: Median sclerotized area very wide anteriorly, almost V-shaped, its sides with some branches medially; interior lobes very narrow; distance between anterolateral incision and hind edge of sublateral sclerotized area 1.60 times greatest lateral width of posterior lobe; distance between branches of hind edge of sublateral sclerotized area 1.87 times shortest distance between anterolateral incision and interior lobe.

Canada, U.S.A.

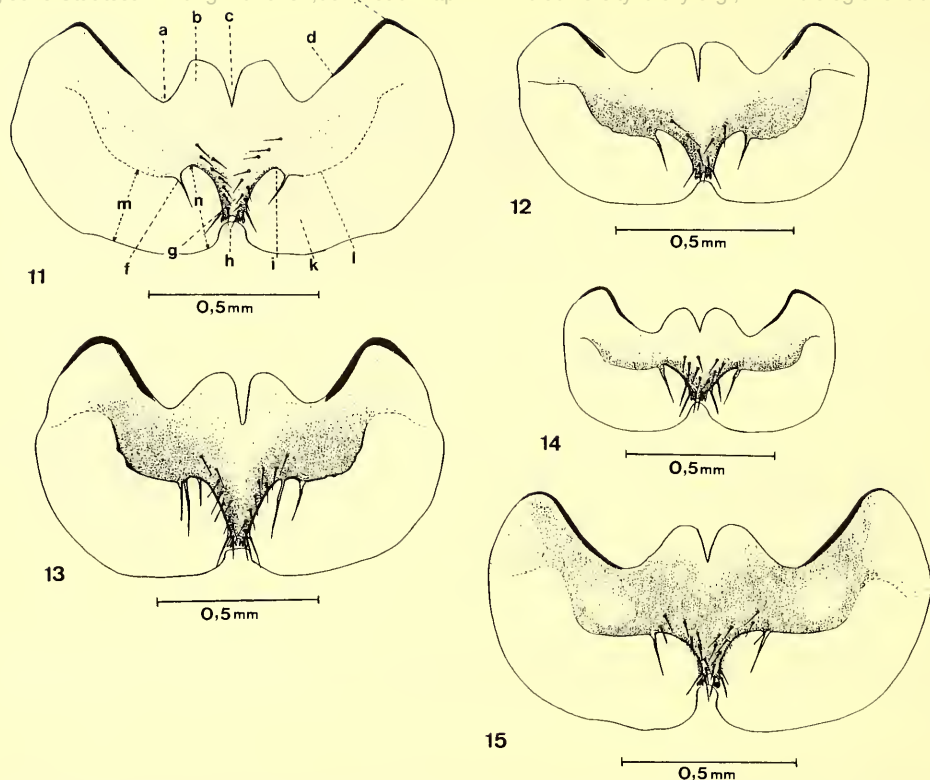
Biology: The species was reared from the cells of *Megachile* spec. in the laboratory by T. V. Cole.

***Dibrachys (Dibrachys) relativus* spec. nov.**

(Figs. 6–9, 15)

Dibrachys maculipennis Peck, 1969: 420 (nec SZELÉNYI, 1957).

Dibrachys confusus Grissell, 1974: 318, (ex parte) (nec *Coelopisthia confusa* Girault, 1916).



Figs. 11–15. Hypopygia of *Dibrachys* spp.: 11, *D. maculipennis* Szélényi; 12, *D. pelos* Grissell; 13, *D. palandokenus* spec. nov.; 14, *D. confusus* (Girault); 15, *D. relativus* spec. nov. a, anterolateral incision; b, median lobe; c, anterior median incision; d, anterolateral margin; e, anterolateral angle; f, branch of hind edge of sublateral sclerotized area; g, median sclerotized area; h, posterior median incision; i, interior lobe; k, posterior lobe; l, hind edge of sublateral sclerotized area; m, greatest sublateral width of posterior lobe; n, greatest median width of posterior lobe.

Besides the characters given in the key to species *relativus* has also the following:

♀: Head, except face, and thorax bronze dark bluish; face greenish blue; scape and pedicellus testaceous, flagellum fuscous; coxae concolorous with thorax, femora and tibiae testaceous, tarsi yellow; gaster black.

Head (fig. 6) in dorsal view 1.95 times as broad as maximum length; EL:MPL:POL:OOL = 78:13:27:21. OOL 3.5 times diameter of lateral ocellus; breadth of oral fossa 2.25 times malar space, the latter 0.54 times length of an eye; eye 1.70 times as long as broad; antenna (fig. 7) with scape about 0.80 times as long as an eye; combined length of pedicellus plus flagellum 0.68 times breadth of head; pedicellus 2.50 times as long as broad, and slightly longer than length of annelli plus first funicular segment; second annellus twice as broad as long; first four funicular segments equal in length and slightly longer than broad; funicular segments 5 and 6 shorter than the other segments and subquadrate; club 3.50 times as long as broad and about as long as three preceding segments.

Thorax about 1.85 times as long as broad; pronotal collar 0.25 times as long as mesoscutum, mesoscutum 1.60 times as broad as long; scutellum distinctly broader than long and slightly shorter than mesoscutum; propodeum 0.60 times length of scutellum, with distinct median carina and plicae. Forewing (fig. 9) with basal cell and basal vein bare, speculum open bellow; marginal vein 1.77 times length of stigmal vein; stigmal vein as long as or slightly shorter than postmarginal vein.

Gaster about as long as length of head plus thorax, and about 1.60 times as long as broad.

Description of hypopygium (fig. 15) as follows: Hypopygium 1.89 times as broad as long; median sclerotized area narrow; distance between anterolateral angles 1.34 times length of hypopygium; interior lobes broad; distance between anterolateral incision and hind edge of sublateral sclerotized area 1.43 times the greatest lateral width of posterior lobe; distance between branches of hind edge of sublateral sclerotized area 2.40 times the shortest distance between anterolateral incision and interior lobe; distance between median and anterior lobes 1.50 times length of median sclerotized area, the latter with 19–20 setae in four rows; length of median sclerotized area as long as distance between anterolateral incision and interior lobe; the greatest median width of posterior lobe 1.60 times distance between anterolateral incision and interior lobe.

♂: Similar to female except as follows: Head with face and frons olive green; scape yellowish testaceous; upper 2/3 of scape stout; pronotal collar 0.18 times median length of mesoscutum; scutellum as long as broad; gaster petiolate, only slightly longer than broad, and about 0.72 times length of thorax; face flat, reticulated; anterior margin of clypeus deeply emarginate, with a deep fovea above emargination; head in dorsal view 2.06 times as broad as own maximum length; EL:MPL:POL:OOL = 55:8:19:14. OOL 2.33 times diameter of lateral ocellus; breadth of oral fossa twice malar space; eyes 1.45 times as long as broad. Antenna (fig. 8) with scape 4.66 times as long as broad, and as long as length of an eye; combined length of pedicellus plus flagellum 0.80 times width of head; first four funicular segments quadrate, segment 5 slightly and segment 6 distinctly transverse; club 1.33 times as long as broad, and distinctly shorter than three preceding segments; forewing hyaline.

Holotype ♀. Spring Coulee, Alberta, Canada. 1961, reared from *Megachile relativa* (G. A. Hobbs) from nest in artificial domicile, CNC, No: 61–392, in the Biosystematics Research Institute, Ottawa, Canada.

Allotype ♂. Spring Coulee, Alberta, Canada, 1961, reared from *Megachile relativa* (J. F. Virostek), from nest in artificial domicile, CNC No: 61–392, in the Biosystematics Research Institute, Ottawa, Canada.

Paratypes: 4 ♀, 3 ♂, same data as holotype (W. G. Nummi), CNC No: 61–392, in the authors collection.

The species was misidentified as *D. maculipennis* by PECK (1969). Later it was again misidentified as *confusus* by GRISELL (1974). Perhaps, Grissell did not see all of the specimens deposited under the name of *maculipennis* in the Canadian National Collection because the specimens under this name were mixed with *confusus* when the author was there in 1977.

Diagnosis: *D. relativus* can be distinguished from all other species of *Dibrachys* by the following combination of characters: Anterior margin of clypeus shallowly emarginate; second annellus twice as broad as long; funicular segments 5 and 6 distinctly shorter than the other segments and typical face sculpture as seen fig. 6.

Canada.

Biology: See above.

Dibrachys (Dibrachys) daphne Girault

Dibrachys daphne Girault, 1917: 9, ♀; PECK, 1951: 554; 1963: 683; GRISELL, 1974: 314.

Type material. Holotype ♀. Duarte, California, in U.S.N.M.

The diagnostic characters for this species as follows: Anterior margin of clypeus deeply emarginate; face below antennal toruli striate vertically; forewing with postmarginal vein subequal or longer than marginal vein.

U.S.A.

Biology: The species has been recorded as a parasite of *Sympherobius barberi* (Banks) and *S. californicus* (Banks) (Sympherobiidae) (PECK, 1951; 1963; BURKS, 1979).

Dibrachys (Dibrachys) fuscicornis (Walker)

(Fig. 19)

Pteromalus fuscicornis Walker, 1836: 484–485, ♀.

Pteromalus saltans Ratzeburg, 1852: 232, ♂ ♀, syn. nov.; DALLA TORRE, 1898: 146, 155; SCHMIEDEKNECHT, 1909: 351, 357.

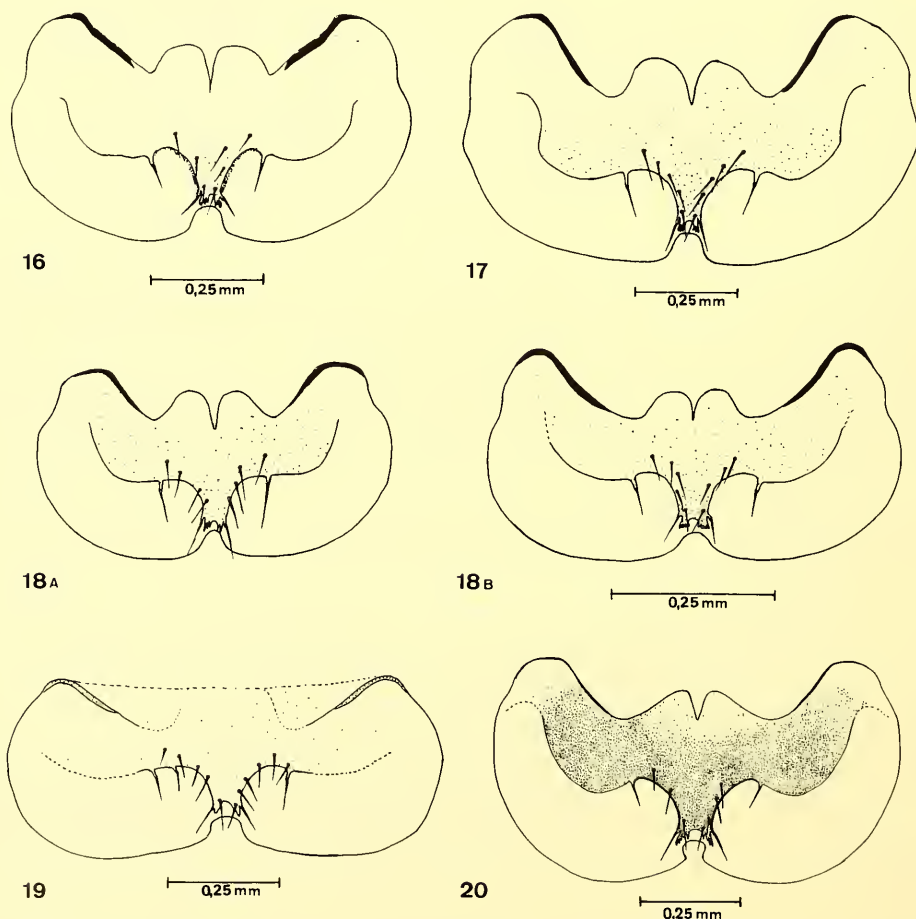
Coelopisthoidea cladiae Gahan, 1913: 179–180, ♂ ♀, syn. nov.

Dibrachys cladiae (Gahan) GIRAULT, 1916: 408.

Dibrachys saltans (Ratz.) GAHAN 1938: 212; PECK, 1951: 554; PECK, 1963: 683; BOUČEK, 1965: 30; GRAHAM, 1969: 809; GRISSELL, 1974: 314.

Type material. *Pteromalus fuscicornis* Walker. Syntypes, 3 ♀, the first specimen, bearing a Waterhouse label was designated as lectotype by GRAHAM (1969).

Pteromalus saltans Ratzeburg, 1852:232, ♂ ♀; the types from Germany, from cocoons of *Cladius uncinatus*, formerly in the Ratzeburg collection in Eberswalde, are now presumably destroyed (GRAHAM, 1969). GAHAN (1938: 212) mentioned that in 1927 he studied types of *Pteromalus saltans* in



Figs. 16–20. Hypopygia of *Dibrachys* spp.: 16, *D. cavus* (Walker); 17, *D. clisiocampae* (Fitch); 18 a, b, *D. boarmiae* (Walker), a, large specimen, b, small specimen; 19, *D. fuscicornis* (Walker); 20, *D. goettingenus* spec. nov.

the Ratzeburg collection in Forstliche Hochschule at Eberswalde, Germany, and gave the following characters for *saltans*: “The head distinctly thick antero-posteriorly; the frons deeply concave; mandibles with their lower basal angles unusually prominent and their ventral margins more or less reflexed; clypeus distinctly incised at the middle; occipital carina present but less strongly developed; pedicellus fully three times as long as broad, and second ring joint (annellus) subquadrate”. GRAHAM (1969) stated that all of these characters apply well to the female of *fuscicornis*, except that the second ring joint (annellus) of *saltans* is subquadrate and that of *fuscicornis* is very distinctly transverse. The characters given by GRISEL (1974) for the North American specimens of *saltans* also apply well to specimens of *fuscicornis* from England. From study of syntypes in the CNC, syntypes in the BM (NH) and specimens collected in London by the author, it is found that the second annellus of *saltans* from North America is distinctly transverse (1.43–1.57 times as broad as long), while that of *fuscicornis* is about 1.37 times as broad as long, and that the hypopygia of specimens from the both regions are identical. No differences could be found between the clypeal regions of specimens from either region, and therefore I consider these species to be indistinguishable and synonym.

Coelopisthoidea cladiae Gahan. Types, ♂♀, upper Marlboro, Prince George Co., Md., 1913, reared from *Cladius isomerus* Norton, in the U.S.N.M. (PECK, 1963). This species was synonymized by GAHAN (1938) himself with *saltans*, and is a subjective synonym of *fuscicornis*.

Besides the characters given in the key to the species and by GRAHAM (1969) *fuscicornis* has the following:

♀: Palpi, scape and pedicellus yellow in specimens from North America and testaceous and infusate in specimens from England; head in dorsal view 1.72–1.80 times as broad as long; EL:MPL:POL:OOL=50:11:22:12.00L4.20–4.40 times diameter of lateral ocellus; eyes 1.50 times as long as broad; scape 0.83 times length of an eye; pedicellus 2.33–2.80 times as long as broad and 1.08–1.27 times length of annelli plus first funicular segment; first three funicular segments slightly and funicular segments 4–6 distinctly transverse; combined length of pedicellus plus flagellum 0.80 times width of head; marginal vein twice the length of stigmal vein.

Description of hypopygium (fig. 19) as follows: Hypopygium slightly sclerotized, hard to see under stereo microscope, 2.36 times as broad as long.

The diagnostic characters for this species as follows: Anterior margin of clypeus deeply emarginate, face below antennal toruli striate vertically; forewing with postmarginal vein half or less the length of marginal vein; breadth of oral fossa 2.80–3.00 times malar space.

England, Germany, U.S.A.

Biology: *D. fuscicornis* was reared from cocoons of *Cladius uncinatus* in Germany and from *Cladius isomerus* Nort. in the U.S.A. (Hym., Tenthredinidae) and from stems of *Stipa comata* (Gramineae) in the U.S.A. This information was recorded under *saltans* by GAHAN (1938) and PECK (1951; 1963). GRAHAM (1969) stated that *fuscicornis* was associated with hosts on *Salix*. Imagines Aug.–Sept.

Dibrachys (Dibrachys) lignicola Graham

Dibrachys (Dibrachys) lignicola Graham, 1969: 807, 810, ♂♀.

Type material. Holotype ♀. Ireland, Co. Dublin, Harold's Cross, 22.8.1954, on a wooden post in garden at 14, Clareville Road (Graham), in Hope Department, University Museum, Oxford. Paratypes: England, Berkshire, Wytham, ♀♀, 10.–17.8.1952 (Graham); Ireland, Co. Dublin, Harold's Cross, ♀♀, 14.6.–17.9.1937; 1 ♀; 17.6.1941 (Stelfox); 1 ♀, 21.8.1954; ♀♀, 1 ♂, same data as holotype.

Paratypes in Stelfox and Graham collections (GRAHAM, 1969). The diagnostic characters for this species as follows: Anterior margin of clypeus shallowly emarginate; eyes in female 1.35–1.40 times as long as broad; POL 1.50 OOL; scape of male in anterior view with a small projecting lobe.

Ireland, England.

Biology: Unknown.

Dibrachys (Dibrachys) goettingenus spec. nov.

(Figs. 20, 21 A, B, 22)

In addition to the characters given in the key to species *goettingenus* has also the following:

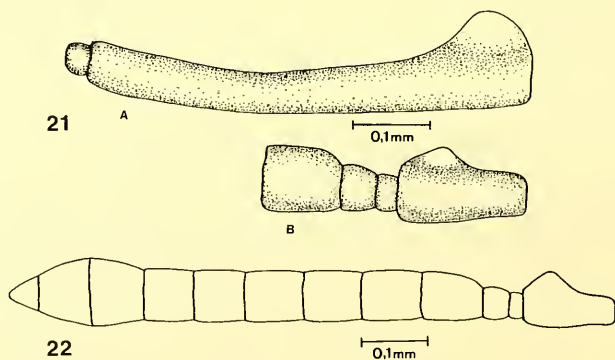
♀: Head and thorax olive green to dark blue. Antennal scape infusate; pedicellus and flagellum dark brown; coxae concolorous with thorax, apices of tibiae and tarsi yellow, pretarsi brown; other parts of leg fuscous; wings hyaline; gaster black.

Head in dorsal view 1.83–1.91 times as broad as long. EL:MPL:POL:OOL=50:10:20:11. OOL about twice diameter of lateral ocellus. Scape distinctly shorter than length of an eye (16:20); pedicellus 2.60–2.90 times as long as broad, and slightly shorter than length of annelli plus first funicular segment; combined length of pedicellus and flagellum 0.80–0.90 times width of head; distance between toruli and eyes 0.90 times distance between toruli and apical margin of clypeus.

Thorax 1.72 times as long as broad; pronotal collar 0.13 times as long as median length of mesoscutum, the latter 1.66 times as broad as long; scutellum as long as broad, distinctly shorter than mesoscutum, frenal line distinctly indicated with coarser reticulation than that on other parts of scutellum, propodeum 0.53 times as long as length of scutellum, with median carina slightly indicated, plicae indicated only anteriorly, nucha smooth but bordered by a distinct line anteriorly. Gaster slightly longer than thorax.

Description of hypopygium (fig. 20) as follows: Highly sclerotized; median sclerotized area with 6–7 setae in two rows; distance between anterolateral incision and the hind edge of sublateral sclerotized area 0.77 times greatest lateral broad of posterior lobe; greatest median width/of posterior lobe slightly greater than the greatest sublateral width of posterior lobe; shortest distance between branches of hind edge of sublateral sclerotized area almost 5 times shortest distance between anterolateral incision and interior lobe; posterior median incision circular, narrowing backwards.

♂: Similar to female except as follows: Antennae wholly infusate; gaster with a pale subbasal spot. EL: MPL: POL: OOL = 41:6.5:17:9. Breadth of oral fossa 2.4 times malar space, the latter one third length of an eye; scape short, 0.6 times length of an eye; pedicellus twice as long as broad; second annellus 1.33 times as broad as long; combined length of pedicellus and flagellum 0.98 times width of head; distance between toruli and eyes 0.75 times distance between toruli and clypeus; thorax 1.59 ti-



Figs. 21–22. *Dibrachys goettingenus* spec. nov. ♂: 21 A, right antennal scape in fronto-lateral view; 21 B, pedicellus, annelli and first funicular segment in dorsal view; 22, pedicellus and flagellum in dorsal view.

mes as long as broad; pronotal collar 0.16 times as long as mesoscutum, the latter 1.76 times as broad as long; scutellum as long as mesoscutum; propodeum 0.58 times as long as length of scutellum, plicae distinct but at the middle slightly indicated; Marginal vein of forewing 1.83 times as long as stigmal vein; gaster slightly shorter than thorax.

Holotype ♀, Germany, Göttingen-Weende, 13.7.1983, reared from cocoons of *Gilpinia hercyniae* (Hartig) (Hym., Diprionidae) on spruce in the research plot of the Institute of Forest Zoology on the university campus, in the Sammlung von Institut für Forstzoologie der Universität Göttingen, Göttingen BRD.

Paratypes: 2 ♂♂, 14 ♀♀, same data as holotype. 1 ♂, 5 ♀♀ paratypes in the Sammlung von Institut für Forstzoologie der Universität Göttingen; 3 ♀♀ paratypes in the British Museum (Natural History). The other paratypes in the author's collection.

Diagnosis: *D. goettingenus* is very close to *D. lignicola*. It differs from *lignicola* in having eyes in female 1.54–1.66 times as long as broad; POL 1.72–1.77 OOL; scape in male with a small apical lobe on dorsolateral side; pedicellus of male in dorsal view with a distinct lobe on its outermargin.

Biology: *D. goettingenus* parasitizes cocoons of *G. hercyniae* in the field and laboratory. From one cocoon of *G. hercyniae* 2 ♂♂, 14 ♀♀ emerged on the same day. Adults fed on honey droplets and laid eggs into the cocoons of *G. hercyniae*. After feeding on honey the males lived for 3 days, and females for 2–7 days.

***Dibrachys (Dibrachys) boarmiae* (Walker)** (Figs. 18a, b)

Pteromalus Mesoleptorum (Kollar M. S.), Walker, 1847: 230 (nom. nud.).

Pteromalus Boarmiae Walker in Newman, 1863: 8609, ♀.

Dibrachys (Dibrachys) boarmiae (Walker) GRAHAM, 1969: 807, 812–813; BOUČEK, 1970: 70; SHARKOV, 1982: 620–624.

Type material. Syntypes, 3 ♀, mounted on the same card and bearing a label “*boarmiae*” in Walker's handwriting (GRAHAM, 1969). Graham designated the third specimen as a lectotype and a detailed information on the systematics of this species was given by him. He also stated that the differences between *boarmiae* and *cavus* are insignificant, but he thought that the two were distinct species and gave characters and biological data for the two species. BOUČEK (1970) recorded *D. boarmiae* from Italy and stated that *boarmiae* is very poorly known. KILINÇER (1976) gave detailed information on its biology and some physiological relationships with *Galleria mellonella* L. under the name of *D. cavus*. SHARKOV (1982) recorded *boarmiae* from USSR, redescribed the species and gave some diagnostic characters for distinguishing it from *cavus* and *braconidis*, mainly by following GRAHAM (1969). SHARKOV (l. c.) also gave a very long host list for the species.

After studying specimens of *boarmiae* reared from different hosts in Anatolia, it is found that the ratio between the width and length of the head in dorsal view varies from 1.90 in small specimens to 2.03 in large specimens. This ratio in *cavus* varies from 1.78 in small specimens to 1.96 in large specimens. While this ratio has been used by GRAHAM (1969) and SHARKOV (1982) for distinguishing the two species, I found that the main difference between *boarmiae* and *cavus* is the ratio between the greatest median width of posterior lobe and the greatest sublateral width of posterior lobe of the hypopygium. These ratios are 1.00–1.07 in *boarmiae* and 1.21–1.41 in *cavus* (figs. 16, 18a, b). In small specimens the anterior lateral angles of hypopygium (fig. 18 b) are slightly longer than those of large specimens (fig. 18 a).

England, Austria, Italy, Yugoslavia, USSR, Turkey (new record).

Biology: A long list of host species has been given by SHARKOV (1982). *D. boarmiae* has also been reared from cocoons of *Yponomeuta malinella* Zell. and collected from fields in eastern Anatolia and on larvae and pupae of *Apis mellifera* L. in the laboratory by the author.

Dibrachys (Dibrachys) cavus (Walker)

(Fig. 16)

Pteromalus cavus Walker, 1935: 477, ♂♀.

Pteromalus decedens Walker, 1835: 478, ♂♀.

Pteromalus perversus Walker, 1835: 479, ♂.

Pteromalus tenuis Ratzeburg, 1844: 195, ♂.

Pteromalus boucheanus Ratzeburg, 1844: 196, ♀.

Dibrachys boucheanus (Ratz.) THOMSON, 1878: 161, ♂♀.

Dibrachys cavus (Walker) KURDJUMOV, 1913: 11; BOUČEK, 1965: 30; 1977: 34; GRAHAM, 1969: 807, 810–812; SHARKOV, 1982: 620–622.

GRAHAM (1969) listed the following type material, and chose the lectotypes of these nominal species:

Pteromalus cavus Walker. Syntypes 1 ♂, 6 ♀♀, in the old B. M. collection and the last specimen in the series was designated as lectotype.

Pteromalus decedens Walker. Syntypes, 4 ♂♂, 7 ♀♀, all bearing Waterhouse labels, the lectotype is the ninth in the series.

Pteromalus perversus Walker. 1 ♂ (probably holotype), was discussed and regarded within the range of variation of male *cavus*.

Pteromalus tenuis Ratzeburg and *P. boucheanus* Ratzeburg. The types, formerly in the Ratzeburg collection, are now presumed to be destroyed. *P. tenuis* was synonymized by Ratzeburg with *cavus*. *P. boucheanus* was recognized as species of *Dibrachys* by THOMSON (1978), and he stated that *P. boucheanus* was a probable synonym of *cavus*.

GRAHAM (1969) provided characteristics of *cavus*, and information on its biology and distribution. BOUČEK (1977) recorded this species from Yugoslavia together with *boarmiae* and also gave information on its biology and distribution. SHARKOV (1982) compared *cavus* with the closely related species, *boarmiae* and *braconidis*, and gave some diagnostic characters for them.

The literature, given by PECK (1951; 1963), in regarding the North American species as *cavus*, is very extensive. While the specimens, reared from several hosts in the Vancouver District, British Columbia, Canada, were considered distinct from the Palearctic specimens of *cavus* which were obtained from Turkey, England and Germany by studying the hypopygial differences.

The diagnostic characters for this species as follows: Hypopygium 1.65–1.70 times as broad as long; distance between branches of hind edge of sublateral sclerotized area 1.33–1.63 times shortest distance between anterolateral incision and interior lobe.

Europe (probably whole), Turkey.

Biology: *D. cavus* has been recorded as a common primary and secondary parasite in pupae or cocoons of many Lepidoptera, some Diptera and Hymenoptera (Braconidae, Ichneumonidae) (GRAHAM, 1969; BOUČEK, 1977).

Dibrachys (Dibrachys) clisiocampae (Fitch)

(Fig. 17)

Cleonymus clisiocampae Fitch, 1855: 431–432, ♂♀.

Cheirpachus nigro-cyanus Norton, 1869: 327, ♀, *syn. nov.*

Pteromalus gelechia Webster, 1883: 151–152, ♂♀, *syn. nov.*

Pteromalus chinobae Howard, 1889: 1872, 1889, ♀, *syn. nov.*

Artrolytus apatela Ashmead, 1893: 162, ♀, *syn. nov.*

Artrolytus pimplae Ashmead, 1894: 339, ♂♀, *syn. nov.*

Dibrachys pimplae (Ashmead) GIRAULT, 1911: 375.

Dibrachys clisiocampae (Fitch) GIRAULT, 1916: 408.

Dibrachys nigrocyaneum (Norton) GIRAULT, 1917: 88.

Dibrachys apatela (Ashmead) GIRAULT, 1920: 211.

Dibrachys cavus Peck, 1963: 674 (nec *Pteromalus cavus* Walker, 1835).

PECK (1951: 1963) gave a huge list of synonyms and type material for this species as a synonym of *cavus*. After studying the hypopygia, the first available name, *Cleonymus clisiocampae* (Fitch), in the synonym list of PECK (1963) for *cavus* from North America is regarded as the valid name for the American species. After regarding *clisiocampae* as the valid name, all of the synonyms given by PECK (1951; 1963) for *D. cavus* from North America become subjective synonyms of *D. clisiocampae*. However, hypopygia of the types of these nominal species must be checked in order to verify these synonyms.

The main characters distinguishing this species from *cavus* can be seen on the hypopygium (fig. 17) described as follows: The distance between anterolateral angles 1.18–1.21 times length of hypopygium; distance between anterior and median lobes about 1.50 times length of median sclerotized area, the latter with 9–10 setae in two rows and as long as or slightly shorter than distance between anterolateral incision and interior lobe; greatest median width of posterior lobe 1.33–1.80 times distance between anterolateral incision and interior lobe; distance between anterolateral incision and hind edge of sublateral sclerotized area about equal to greatest lateral width of posterior lobe; greatest interior width of posterior lobe 1.10–1.40 times greatest lateral width of posterior lobe.

North America

Biology: A very long host list for this species has been given by PECK (1963) as *D. cavus*.

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