

***Cavatorella spirodelae* Deonier (Diptera: Ephydriidae),
a new genus and new species from *Spirodela* (giant duckweed) in
China and Japan**

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Abstract: The new genus, *Cavatorella* is described based on the sole known *Cavatorella spirodelae*, new species, many specimens of which were collected in China from the aquatic plant *Spirodela polyrhiza* L. (giant duckweed) in 1991. A few adults were collected in Japan in 1955.

Introduction

Presently, the genus *Hydrellia* Robineau-Desvoidy in the tribe Hydrelliini of the subfamily Hydrelliinae is the largest genus of Ephydriidae and because the larvae of member species (leaf and stem-miners) of aquatic plants, it has gained considerable economic importance because of the pest status of certain species in rice and other cereals growing in or near water and the potential of other species for biocontrol of aquatic plant pest species. It was in the search for potential biocontrol agents that specimens of the new genus and new species described herein were collected in China. Several mounted specimens collected in Japan in 1955 were then discovered among miscellaneous specimens on loan.

Methods. The methods used in this study are similar to those in Deonier (1993). The most frequently used measurements and indices are defined as follows: **Body length**= Distance between most prominent part of face and posterior end of abdomen as measured in lateral view and as if head and abdomen were aligned horizontally. **Color**= Descriptions of color apply to views perpendicular to the sclerite concerned unless otherwise stated. Color designations are according to the ISCCNBS method. **Wing length**= Distance between the apex of the tegula and the wing tip. **Epistomal index**= Quotient of the epistomal width, or breadth, divided by minimum interocular distance on the face. **Mesofacial index**= Quotient of the mesofacial

height, as measured from epistoma to ptilinal suture, divided by the minimum interocular distance on the face. **Ocular index**= Quotient of the mesofacial height, as measured from epistoma to ptilinal suture, divided by the minimum interocular distance on the face. **Ocular index**= Quotient of the nearly vertical ocular height divided by the subocular height (minimum distance between compound eye and edge of subcranial cavity). **Subcranial index**= Quotient of the subcranial cavity width, or breadth, divided by the width of the anteclypeus (clypeus of some authors). **Vertex index**= Quotient of the vertex width, or breadth, as measured between compound eyes at level of ocelli, divided by the anteo-cellular distance (between median ocellus and ptilinal suture).

The material consisted almost entirely of specimens preserved in 70% isopropanol and stored in glass vials. However, there were 7 dry-mounted specimens. Depositories for type material are: National Museum of Natural History (USNM), Florida State Collection of Arthropods (FSCA), and the Shanghai Entomological Institute, Academia Sinica.

Tribe Hydrelliini

This tribe now contains three genera separated by the following key:

Key to the genera of Hydrelliini

1. Posterior notopleural macrochaeta near ventral notopleural margin, aligned or nearly so horizon-

- tally with anterior one; face varies, but not deeply concave in profile; acrostichal mesonotal setae (or setulae) present..... 2
- Posterior notopleural macrochaeta far removed from ventral notopleural margin (nearly in apex of triangle); face broad in anterior view and deeply concave in profile, with prominent epistoma; acrostichal mesonotal setae (or setulae) absent. *Lemnaphila* Cresson
2. Wing tip convexly rounded; longest dorsal interfractural costal seta 23 times longer than any other dorsal interfractural costal setae; ocular pubescence fairly dense and conspicuous; female without sterna 58 modified into ovipositor which appears plowlake in lateral view; male without paired convergent and downcurved styliform processes projecting from above fused surstyli..... *Hydrellia* Robineau-Desvoidy
- Wing tip ellipsoidal; longest dorsal interfractural costal seta about 5+ times as long as any other dorsal interfractural costal setae; ocular pubescence short, inconspicuous; female with sterna 58 modified into ovipositor appearing plowlake in lateral view; male with paired convergent and downcurved styliform processes projecting from above fused surstyli..... *Cavatorella* Deonier

Cavatorella, new genus

Type species. *Cavatorella spirodelae* Deonier, new species, by monotypy.

Diagnosis. Small shore flies, with male length 1.0-1.5 mm and female 1.2-1.7 mm; mostly semiglossy light brown to dark reddish brown with antennae and all legs light to moderate yellow. Specimens of *Cavatorella* are very similar to those of *Hydrellia* Robineau-Desvoidy, but are distinguished from the latter by the following combination of character states: 2-3 pairs of primary facial setae, all on lower 0.3 of face; wing narrower with tip noticeably ellipsoidal; longest dorsal interfractural costal setae distal and about 5+ times as long as longest dorsal interfractural costal seta; 1 pair of macrochaetous dorsocentral setae (postsutural, but nearly sutural); male genitalia with paired, downcurved, converging styliform processes projecting from above emarginate anterior border of fused surstyli on each side of tubular, tapering distiphallus and paired postgonites adjacent and parallel to and extending to apex of distiphallus; sternum 5 without copulobi, but with posterior margin directed posteroventrad and forming pouchlike recess into which tip of distiphallus and postgonite unci project;

gonal arch absent or replaced by single, median, straplike structure stretching from posterior edge of basiphallus to sternum 5; female post-abdomen highly modified as slitting ovipositor with terga 5-8 directed strongly anteroventrad around sterna 5-8; sterna 5-8, in lateral view, obviously cultriform (plowlake) and directed mostly posteroventrad. Larva and puparium very similar to those of *Hydrellia* except mouthhook with light spot, or window, in base scarcely visible and free end nearly blunt and with 8 distinct ventral creeping welts on the body. The excised egg has several occasional anastomosing ridges, but differs from most known *Hydrellia* eggs in apparently having only a terminal aeropyle and no distinct micropylar protuberance.

Cavatorella spirodelae Deonier,

new species
(Figures 1-12)

Description

Head. Wider than high in anterior view; face mostly sericeous light golden (metallic light yellow) or occasionally so faintly golden as appear sericeous silvery in anterior view and occasionally vertical, but usually with lower 0.5 slightly to moderately convex in profile; antennal foveae indistinct; epistoma straight, or flat, in anterior view; parafaciale mostly indistinct above midfacial level and extremely narrow and concolorous below this point to light brown or yellowish-brown pruinose gena; 2-3 primary facial setae, all on lower 0.3 of face, and with uppermost 1.3 times length of middle and (if present) 4-5 times length of lowest; secondary facial setula absent above primary facial row; antenna, except light brownish arista, entirely light or moderate yellow; antennomere 2 with 1-2 somewhat noticeable, slightly curved, spinoid dorsoapical setae and 3 with very sparse light yellow micropubescence; 4-6 (usually 5-6) dorsal aristal rays; frons moderately sloping, wider than long, with frontal vitta slightly differentiated from parafrontalia by nearly indistinct impression lines and occasionally by darker brown pruinosity of parafrontalia; frons and fronto-orbital areas mostly light yellowish-brown pruinose over dark brown, with frontal vitta occasionally bronzed; lateral ocelli wider apart than either from anterior ocellus; ocellar triangle only slightly elevated above rest of vitta; postocellar seta 3-4 times as long as ocellar seta; inner and outer vertical setae subequal and about 1.2 times as long

as postocellar seta; posterior fronto-orbital seta latero-clinate and about 1.5 times as long as antero-clinate anterior fronto-orbital seta (often with small setula between); about 1-2 postocular setae in row nearest orbit; maxillary palpus light to moderate yellow, with slight to moderate outer angle, or elbow, at about midlength and with 2-3 setae about 0.2 of palpus length. Epistomal index 1.8-2.2; mesofacial index 1.7-2.4; vertex index 4.0-6.2; ocular index 6.0-7.0; subcranial index 1.72.6; head width/head height 1.10-1.36.

Thorax. Postpronotum and mesonotum, in dorso-lateral view, mostly semiglossy dark reddish-brown pruinose except scutellum semiglossy light-brown pruinose; parascutellum light yellowish-brown pruinose; 2-4 (0 macrochaetous) ante-sutural and 1 (macrochaetous and often nearly sutural) postsutural dorsocentral setae; 3-5 antesutural and 4-5 postsutural acrostichal setae mostly somewhat longer than in *Hydrellia*; pleuron mostly light-gray pruinose, but posterior 0.5 of mesanepisternum with light yellowish-gray or yellowish-brown pruinosity and mesokatepisternum often with areas of light bluish-gray pruinosity; 1 mesokatepisternal seta (macrochaetous); legs including coxae entirely light to moderate yellow except distal 2-3 tarsomeres light brown dorsally. Wing length 1.2-1.8 mm; wing veins light brown; 4-6 setae on basal end of costa; 4-6 dorsal and 6-8 anterior interfractural costal setae, with longest dorsal most distal and about 5+ times as long as longest anterior interfractural costal seta; costal section indices: II/I 1.6-2.6; III/IV 4.2-5.0; V/IV 3.8-5.2; M_{1+2} .

Abdomen. Terga, in posterodorsal view, glossy, reddish-brown, but densely light-brown pruinose in dorsal view, except end of tergum 5 light bluish-gray pruinose. Male postabdomen: median 0.3 of sternum 5 widely, deeply, and angularly notched, somewhat congruent with apex of distiphallus in ventral view; sternum 5 with posterior margin directed posteroventrad and forming pouchlike recess into which tip of distiphallus and postgonite unci project; anterolateral margin of sternum 5 smoothly rounded to roundly acutangular posterolateral corners; sternum 5 with rows of about 8 setae each; no distinct copulobus as in most *Hydrellia*. Both pre- and postgonite emanating from gonal archlike structure on each side of distiphallus: pregonite as short midlength process or projection bearing fairly long slender seta or setoid spine; distiphallus apparently tubular and tapering from abruptly downturned and wider malliform (hammer-

like) basiphallus; phallapodeme appearing massive and enveloping basiphallus, with middorsal bulge and posterodorsal crestlike condyle. Surstyli fused as in *Hydrellia*; anterior margin with narrowly, roundly notched emarginations on each side of somewhat recessed, but nearly straight median 0.3; anterolateral corner outside each notch with shallow angular emargination between small and large angular projections; sides of fused surstyli with 2 lateral bulges; paired, downcurved, converging styliform processes projecting from above surstyli near roundly notched anterior emarginations parallel and ventral to basal 0.3 of distiphallus. Epandrium (syntergum 9+10) roundly truncate posteriorly. Female postabdomen: highly modified as slitting ovipositor with terga 5-8, in lateral view, strongly directed anteroventrad around sterna 5-8; sterna 5-9, in lateral view, obviously cultriform (plowlike) and directed mostly posteroventrad; postabdomen, in ventral view, with sternum 8 forming thin, ellipsoidal loop around membranous edge of gonopore; 7 forming plowlike point just anterior to gonopore, and 6 a protrusible and somewhat rotatable rake of 10-12 posteroventrally directed spinoid setae; sterna 2-5 subequal in width, with 3 and 4 subequal in length and 10-25 per cent longer than 2 and 5. Cercus, in lateral view, more or less semicircular, with 8-10 setulae, and about as wide as long. Ventral receptacle cupuliform, about 1.3 times as deep as wide (about 0.8 as large as cercus in lateral view).

Etymology. The generic name, *Cavatorella*, is the diminutive of the Latin noun *cavator* meaning in this instance little excavator. The specific epithet, *spirodelae* refers to at least one of its host plant species, *Spirodela polyrhiza* L.

Type: Holotype male, USNM.

Type locality: JAPAN: Kyoto, Midoro Pond (3 June 1955, P. H. Arnaud).

Paratypes: JAPAN: Same data as holotype, 4 males, 2 females. CHINA: Beijing, Hsing Hua University, Biology Pond (9-IX-1991, G. R. Buckingham), GRB9117. 1: adults on leaves of *Spirodela polyrhiza* L. with leafmines, 8 males, 6 females; puparia in leafmines of *Spirodela polyrhiza* L., 1 male, 13 unsexed puparia; puparia and larvae in leafmines of *Spirodela polyrhiza*, 2 third instar larvae, 6 puparia, and 1 adult female ex puparium; Hsing

Hua University, Canal (22-VIII-1991, G. R. Buckingham, GRB 9113.10, adults coll. on leaves of *Hydrocharis dubia* [BL.] Backer and *Potamogeton natans* L.), 1 male.

Immature Stages: Egg. Length 0.55 mm; maximum breadth 0.10 mm. Chorion translucent, yellowish-gray, corrugate with the few longitudinal ridges occasionally anastomosing and spaces between ridges apparently smooth. Micropylar protuberance absent, but with terminal acropylod cluster. (Specimens examined: 1 excised).

Third instar Larva. Length 2.00-2.30 mm; maximum breadth 0.33-0.37 mm. Frontoclypeal length 0.20-0.30 mm (Figure 5). Ventral frontoclypeal index 1.5-2.5; bifurcation index 1.0-1.2; clypeal arch index 1.8-2.1. Clypeal arch sloping at about 30° in relation to lower frontoclypeal margin. Mouthhook beak and base distinct, with mouthhook somewhat blunt at apex, and with several rounded microscopic teeth and 1 apical tooth; mouthhook light spot, or window, small and usually scarcely visible. Metapneustic, with posterior spiracular peritremes spinous, similar to those of *Hydrellia*, but with somewhat incurved apices; 8 distinct ventral creeping welts, each with several transverse rows of microspinules and with anterior row of about 4 microsetulae; abdominal segments each with pair of lateral microsetulae. Body opaque, with yellowish tinge. (Specimens examined: 2).

Puparium. Length 1.60-2.20 mm; maximum breadth 0.50-0.70 mm; mostly fusiform. Puparial length: minimum breadth 11.0-15.0; maximum breadth: minimum breadth 3.0-6.0; analplate index 2.0-3.0. Prothoracic end semicircular to nearly truncate in ventral view; headlobe scar usually circular to obovoid; maximum puparial breadth: maximum prothoracic breadth 1.0-1.2; anal plate reniform, with anterior margin convex. Empty puparium mostly translucent, light yellowishbrown to light brown. (Specimens examined: 19; 2 had dorsal exit holes cut by emerging parasitic Hymenoptera and 3 had obvious meconia in them).

Immature specimens examined. 1 egg (excised), 2 third instar larvae, and 19 puparia from: Beijing, China, Biology Pond, Hsing Hua University.

Remarks

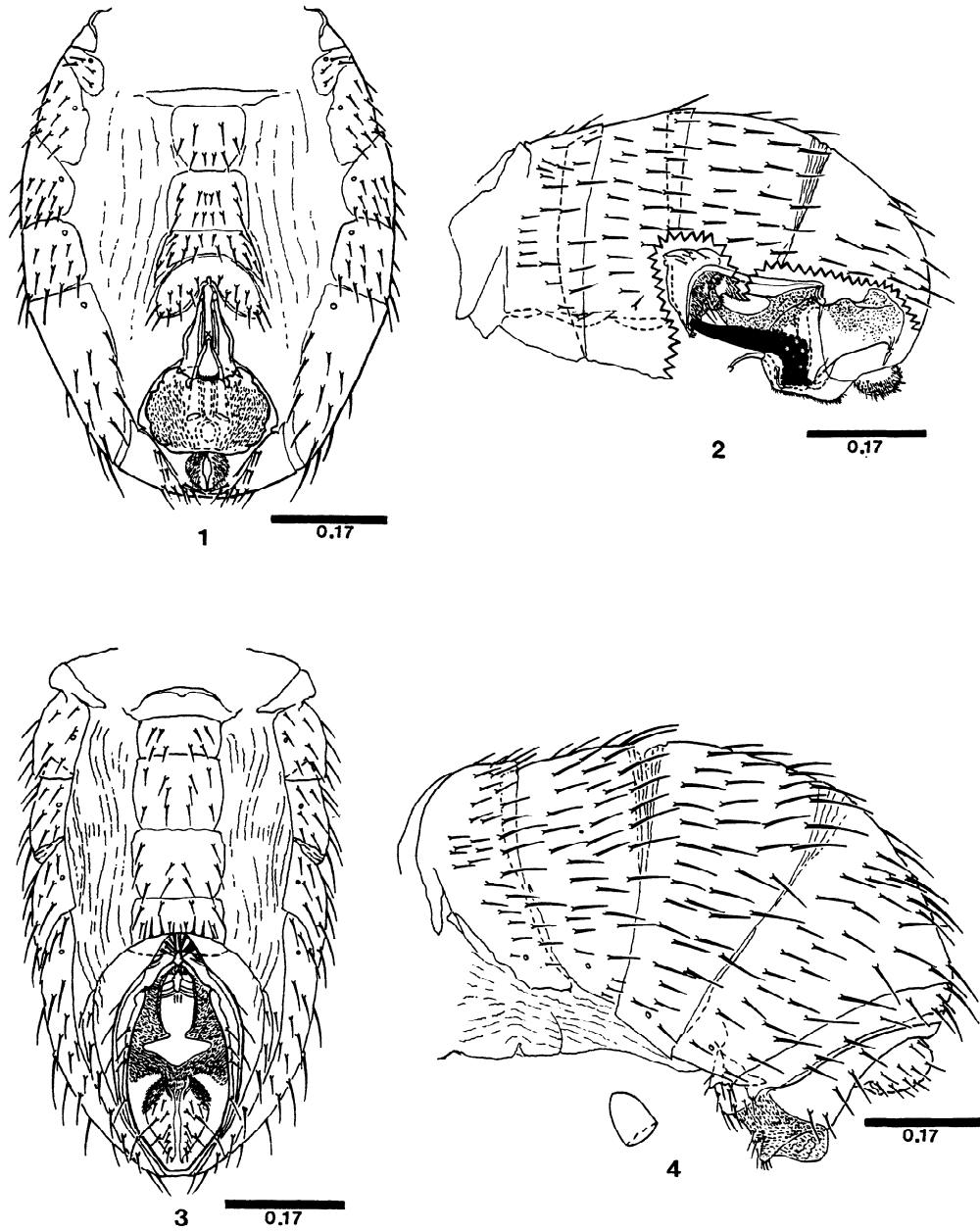
The nearly invisible light spot, or window, in the base of the black larval mouthhook and the 8 distinct creeping welts are the main character states which distinguish the larvae from those of *Hydrellia*. Although these differences may seem insignificant, it should be remembered that natural selection and evolution is to be expected to operate at a more intense pace in the adult, or sexual stage. It is in this stage where intense sexual selection occurs and where barriers against interbreeding must quickly evolve. Also, in these aquatic endophytophages, evolution toward host-plant specificity entails selection of behavior and mechanisms which insure detection of proper host plant and appropriate oviposition. It is my contention that in spite of the many similarities in nongenital characters with *Hydrellia*, evolution along the aforementioned lines in the adult stage has passed the generic limits.

Acknowledgements

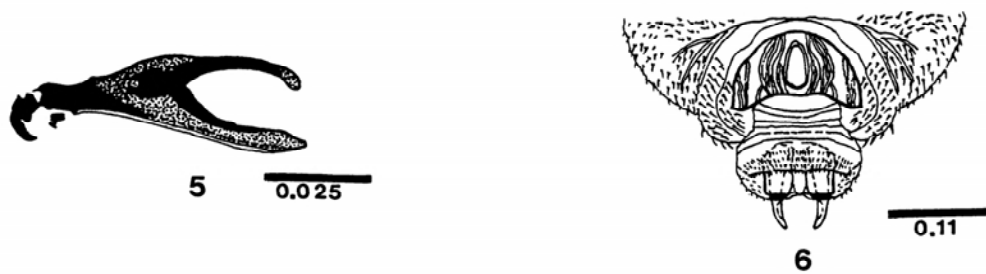
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References

- Deonier, D. L. 1993. A critical taxonomic analysis of the *Hydrellia pakistanae* species group (Diptera: Ephydriidae). *Insecta Mundi* 7: 133-158.



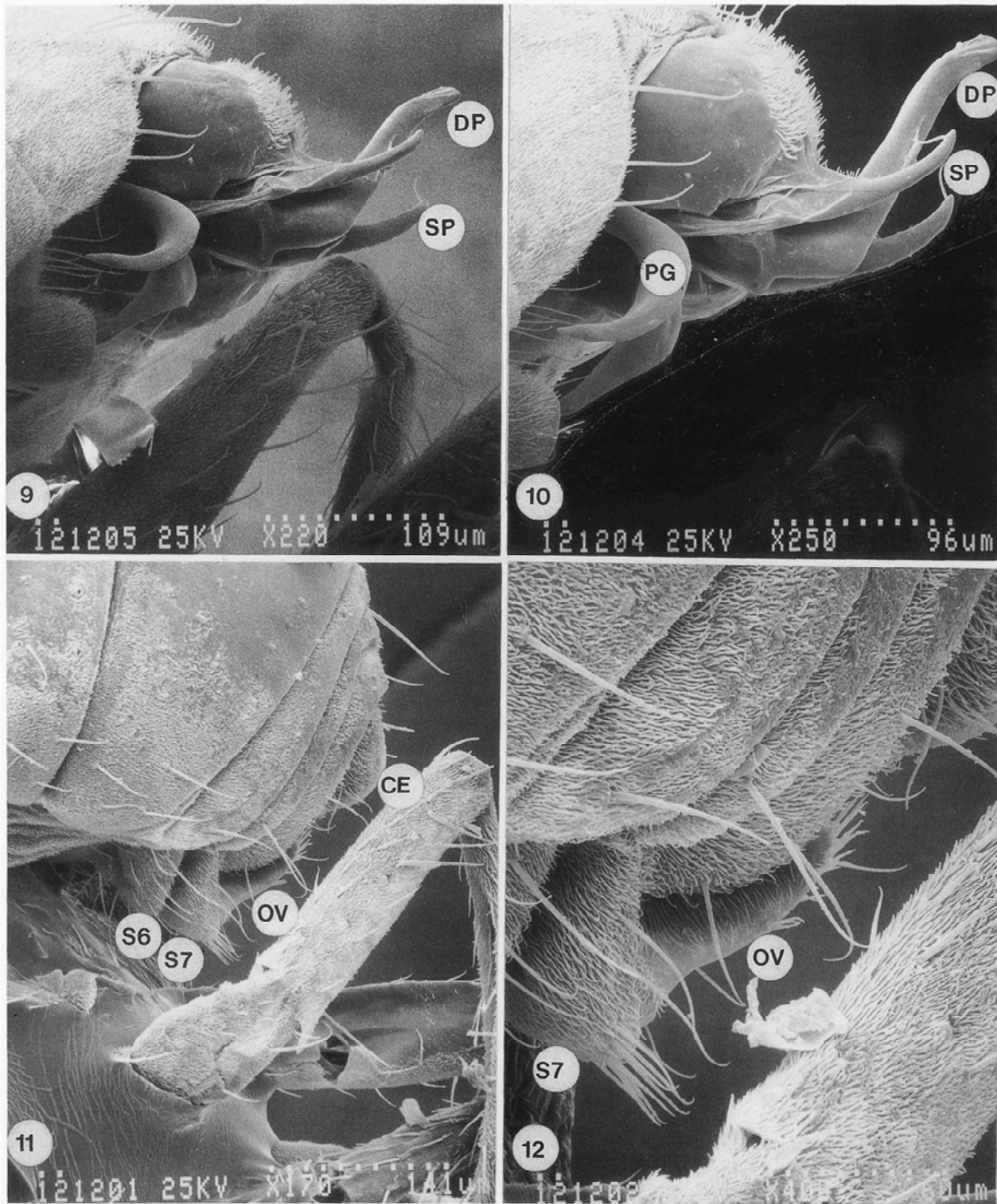
Figs. 1-4. *Cavatorella spirodelae* Deonier, n. gen., n. sp. 1. male abdomen, ventral view, 2. male abdomen, left lateral view, 3. female abdomen, ventral view, 4. female abdomen, left lateral.



Figs. 5-6. *Cavatorella spirodelae* Deonier, n. gen., n. sp. 5. feeding apparatus (mouthhook and cephalopharyngeal skeleton), third instar larva, left lateral view, 6. puparium, posterior end showing anal plate and tracheospiracular peritremes, ventral view.



Figs. 7-8. *Cavatorella spirodelae* Deonier, n. gen., n. sp. 7. male habitus, left lateral view (36X), 8. female habitus, left lateral view (26X).



Figs. 9-12. *Cavatorella spirodelae* Deonier, n. gen., n. sp. 9. male postabdomen, left ventrolateral view showing distiphallus and styliform processes expressed unnaturally posteriad, 10. male postabdomen, left ventrolateral view, 11. female postabdomen, left lateral view showing sterna 6, 7, and 8 (modified as ovipositor), 12. female postabdomen, left lateral view showing enlargement of S7 and S8 (modified as ovipositor). Abbr.: CE=cercus; DP= distiphallus; OV= sternum 8 modified as ovipositor; PG= postgonite; SP= styliform processes; S6, S7= sterna 6 and 7. PO1

