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THE MESOSTIGMAL COMPLEX OF *ARGIA* USING SCANNING ELECTRON MICROSCOPY (ZYGOPTERA: COENAGRIONIDAE)

S.R. MOULTON II[1], S.E. TRAUTH and G.L. HARP
Department of Biological Sciences, Arkansas State University,
State University, Arkansas 72467, United States

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The mesostigmal plates and associated structures (together referred to as the mesostigmal complex) were examined using scanning electron microscopy (SEM) for adult female *A. translata, A. tibialis* and *A. apicalis*. Several anatomical features unique to the respective spp. are described in terms of lobe formation, carinae arrangement, and the presence or absence of grooved areas.

INTRODUCTION

Mechanical barriers have been suggested by several authors in reference to reproductive isolation in the Odonata. These include incompatibility of genitalia (WATSON, 1966), sperm removal (WAAGE, 1979, 1984), inappropriate tactile responses (ROBERTSON & PATERSON, 1982; TENNESSEN, 1982), and the incompatibility of structures for tandem formation (JOHNSON, 1962, 1972a; CORBET, 1963; PAULSON, 1974).

Tandem occurs when the male caudal appendages grasp the posterior lobe of the pronotum. Located in this area, just posterior to and often under the posterior lobe, are a pair of structures called the mesostigmal plates. The male cerci apparently fit onto these structures. Within the genus *Argia,* there are subtle to gross differences in the mesostigmal plates, and these play a major role in the identification of the females (cf. JOHNSON, 1972b).

The purpose of this study is to investigate the mesostigmal plates and associated structures from three species of *Argia* using SEM.

[1] **Present address:** Cove Corporation, Box 10, Breeden Rd, Lusby, Maryland 20657, United States

MATERIAL AND METHODS

Collections of female *Argia translata*, *A. tibialis*, and *A. apicalis* were made along streams in northeastern Arkansas between 7 and 28 September 1985. Specimens were killed and placed in 70% ethanol for temporary storage. Upon preparation of the damselflies for SEM, they were first dehydrated by placement in 95% ethanol. Further drying was accomplished by placing the specimens on paper toweling at room temperature. Preparation of the mesostigmal plates required removal of all structures, including the prothorax, from the main thoracic region. Ultimately, the metathorax was also removed to improve SEM results. Structures were then mounted to copper holders with double-sided tape, non-conducting paint or Elmer's Epoxy and Resin TM; the latter gave better mounting results. Prior to viewing with SEM, specimens were coated with gold-palladium using a Hummer IV sputter coater for two minutes. Scanning was conducted on a JEOL-100 CXII TEM-SCAN electron microscope. Specimens were viewed at an accelerating voltage of 20 kv. In addition, specimens used in the scanning procedures were utilized in morphometric analyses.

Two steps in the preparation of the mesostigmal plates are critical if best results are to be achieved. First, it is important that the specimens be completely dried. Improper drying will cause charging artifacts to form when liquids are heated and exuded through pores during electron bombardment. Second, affixing the specimens to the copper holders should be done with a substance that will quickly secure them. Poorly mounted structures are often ruined and can cause technical problems should they become detached while inserted in the electron microscope.

RESULTS AND DISCUSSION

A generalized diagram of the mesostigmal plates is shown in Figure 1. The plates and associated structures will be hereafter referred to as the mesostigmal complex. Morphometric determinations are given in Table I.

Numerous tuberosities were discovered on the plates of each of the three species (Fig. 2). The tuberosities are situated on all exposed surfaces, including the lobes if present. They are uniform in size and exhibit a pad-like appearance. They may serve to cushion the coupling process when contact is made with the male during tandem formation. The morphologies of the mesostigmal complex for *A. translata*, *A. tibialis*, and *A. apicalis* are shown in Figure 3.

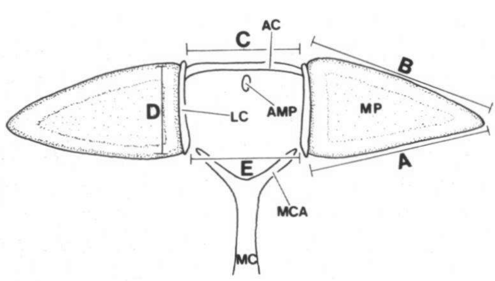

Fig. 1. Generalized mesostigmal complex. LC: lateral carina; — AC: anterior carina; — MC: median carina; — MCA: median carina arm; — AMP: anterior median pit; — MP: mesostigmal plate. (Adapted and modified from JOHNSON, 1972b).

ARGIA TRANSLATA HAGEN, 1865

The anterior edge of the mesostigmal plate is primarily straight throughout its length but shows a slight curvature on its distal margin (Fig. 3A-B). Medially, the anterior edge is abruptly curved to form a distinct projection above the lateral regions of the anterior carina. The posterior edge is markedly curved. A thin and distinctly raised lobe projects from the posterior-most region of this edge. The mesial edge of this lobe is merely an extension of the lateral carina. Posteriorly the lobe is broad whereas anteriorly it is constricted, giving it a hatchet-shaped appearance. The lateral carinae (mesial edges of the mesostigmal plates) are noticeably concave. The median carina (Fig. 3A), lying as a dorsal ridge along the mesothorax, is bifurcated with each arm extending for some distance to the inner margins of the lateral carinae. The division of the median carina occurs posteriorly to the mesostigmal lobes.

Table I
Mean linear dimensions (mm) of the mesostigmal plates for *Argia translata, A. tibialis,* and *A. apicalis* (see also Fig. 1)

Linear dimension	*translata*	*tibialis*	*apicalis*
A	0.623	0.435	0.586
B	0.456	0.487	0.474
C	0.406	0.425	0.556
D	0.446	0.252	0.260
E	0.363	0.570	0.260
(N)	*3*	*4*	*5*

A: Length of posterior edge; — B: Length of anterior edge; — C: Anterior distance between plates; — D: Width of plate at widest point; — E: Posterior distance between plates.

ARGIA TIBIALIS (RAMBUR, 1842)

The anterior edge of the mesostigmal plate is straight along its entire margin except for an abrupt curvature above the anterior carina (Fig. 3C-D). Posteriorly, the edge is straight and does not extend to produce a lobed structure, but there is a shelf-like concavity at the posterior mesial corner which further projects into an upward lip. Upon closer examination, this lip (Fig. 3D) possesses a narrow groove parallel to the lateral carinae. The lat-

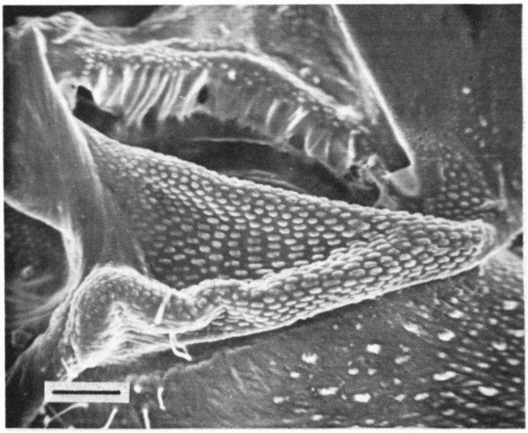

Fig. 2. Mesostigmal plate of *Argia tibialis* with pad-like tuberosities. — (Line = 40 μm).

eral carinae show no signs of concavity but remain linear in nature. The median carina bifurcates posterior to the mesostigmal plates. Each arm of this bifurcation extends antero-laterally to the posterior-mesial corner of each plate. Anterior to the bifurcation is a heart-shaped pad. Each half of this pad spreads anteriorly and laterally to each mesostigmal plate while paralleling the arms of the median carina. A deep depression is formed on the plate.

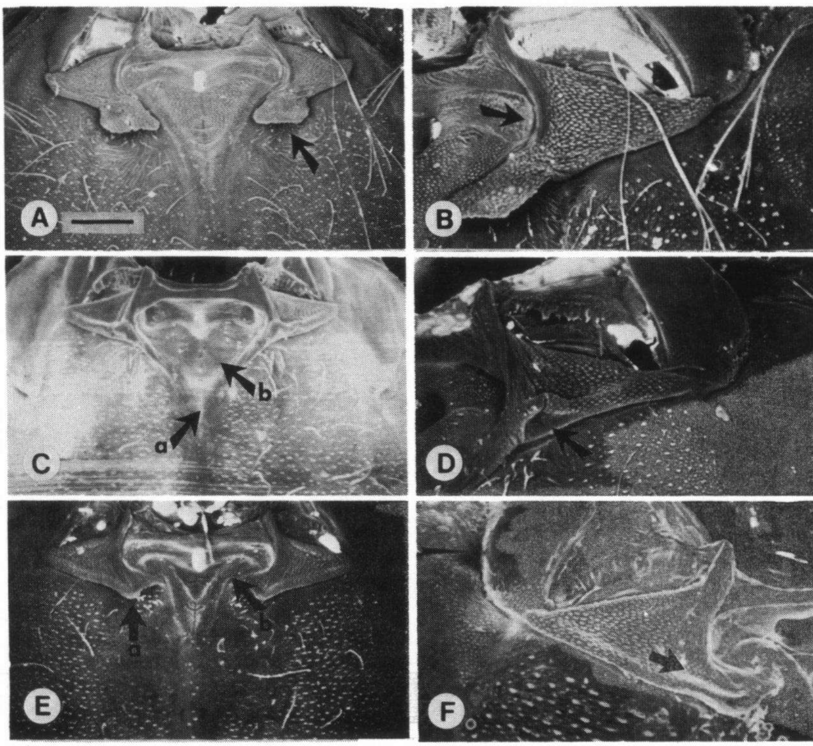

Fig. 3. *Argia translata* (A) 50x, (B) 100x; *A. tibialis* (C) 50x, (D) 100x; *A. apicalis* (E) 50x, (F) 100x, left plate. — (Line in A = 150 μm for A, C, and E; line in A = 75 μm for B, D, and F; — A: arrow denotes hatchet-shaped lobe; — B: arrow denotes extreme curvature of lateral carina; — C: arrows denote bifurcation of median carina and presence of heart-shaped pad; — D: arrow points to shelf--like concavity; — E: (a) arrow denotes weak lobe formation; — (b) arrow denotes position of lateral carina; — F: arrow points to channel-like extension).

ARGIA APICALIS (SAY, 1839)

The anterior edge of the mesostigmal plate is similar to that seen in *A. tibialis* (Fig. 3C-F). The posterior edge is linear for much of its length and develops a slight curvature posteriorly. This accommodates the formation of a poorly-defined lobe which is low in relation to the thorax. The anterior and posterior margins of the mesostigmal plates are rounded so as to form a shallow depression on the plate. This depression is continued as a "channel" to the weakly developed lobe. A wing-like extension is also present, attached basally to the mesial margin of the lobe and posterior margin of the lateral carina. The lateral carinae are slightly concaved. Bifurcation of the median carina occurs between the posterior--mesial regions of both mesostigmal plates. The arms of this carina rise, diverge, and enclose the wing-like extension previously described.

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