

## THE POST-EMBRYONIC STAGES OF A NEW SPECIES OF MAUDUYTTIA (Acarina: Anoetidae)<sup>1</sup>

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### ABSTRACT

This paper describes the larval, protonymphal, deutonymphal (hypopial), tritonymphal and adult stages of *Mauduyttia mallotae*, a new species of the mite family Anoetidae from water-filled treeholes. It also discusses the systematic position of *M. mallotae* and compares its immature stages with those of *Histiostoma jularum* (Koch), the only other species of anoeetid for which the immatures are adequately known.

The immature stages of the mite family Anoetidae are poorly known; in fact, only one detailed description of the immatures of an anoeetid is found in the literature (Hughes and Jackson, 1958). The deutonymphal (hypopial) stage is an exception, since many species descriptions are based on it. This paper describes all post-embryonic stages of a new species of anoeetid mite, *Mauduyttia mallotae*, found only in water-filled treeholes. In the interest of brevity, many features that are clearly illustrated in the figures are not included in written descriptions. Observations on the life history and ecology of *Mauduyttia mallotae* will be discussed in a subsequent paper (Fashing).

### SYSTEMATIC POSITION

The generic classification of the family Anoetidae is in a confused state and badly in need of revision. The genera are based on the hypopial stage, and in some cases are separated only by the position of a single seta, or by the presence or absence of a seta or disc on coxae I and III. Neither of the two available taxonomic monographs on the family Anoetidae (Scheucher, 1957; Hughes and Jackson, 1958) attempted a generic revision.

Scheucher (1957) provided generic keys to both males and females as well as to the hypopial stage, although several genera were omitted which do not occur in central Europe. Hughes and Jackson (1958) included all genera in their work, but gave a generic key only to the hypopial stage since they found no workable set of characters which could be used to adequately separate the adults. According to Scheucher (1957), the new species described below belongs in the genus *Histiostoma*.

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*stoma* Kramer based on hypopi, males and females. If the generic key to hypopi of Hughes and Jackson (1958) is used, the correct placement is in the genus *Mauduyttia* Oudemans, a monotypic genus known only from the hypopus. It should be pointed out, however, that neither key is completely adequate for the generic placement of this species.

Since Scheucher (1957) omitted several genera, including *Mauduyttia*, in her work, I have followed Hughes and Jackson (1958) and tentatively placed the new species in the genus *Mauduyttia* Oudemans based on the following deutonymphal characters: coxae I and III without discs or setae; coxa IV with seta *vm 1* mesial of disc *di 3*; suctorial plate with two functional suckers, two large central discs, and four discs laterally and posteriorly.

*Mauduyttia mallotae* differs from the only other known member of the genus, *M. tropicus* (Oudemans), in the following deutonymphal characters: sculptured dorsum; propodosoma not rectangular but crescent shaped; short, fused pedipalps; pigmented area surrounding the palps; seta *ta 9* of leg IV extremely long and like an additional leg segment in appearance. The adults of *M. tropicus* have not been described.

In 1901 Michael described *Histiostoma pyriforme* from exuded sap and wet decaying debris in beech trees. His specimens were probably collected from water-filled treeholes since they were thickly covered with Vorticellidae and other animals known to transport Vorticellidae are aquatic (E. C. Bovee, personal communication). *H. pyriforme* and *M. mallotae* have several characters in common. Both have long terminal tarsal setae on all legs, a character not shared with other known species. Other common characters, although not unique to these two species, include the accumulation of large amounts of excrement (guanine crystals) in the idiosoma, sculptured rostrum, pyriform idiosoma, serrated chelicerae and long palpal setae *pp 1*. As far as can be determined from Michael's description, *M. mallotae* and *H. pyriforme* differ only in the shape of the chelicerae. Thus the possibility exists that *M. mallotae* and *H. pyriforme* are in fact the same or closely related species. However, this is impossible to ascertain from Michael's brief description, and the location of the types of *H. pyriforme* is unknown.

### DESCRIPTION OF *Mauduyttia mallotae* n. sp.

The specific name refers to the crystalline syrphid fly genus *Mallota*, which is the dispersal agent for the deutonymphs.

**GENERAL FEATURES**—Relative position, shape and size of setae and other structures as indicated in figures. All measurements in microns and with a sample size of ten. Chaetotaxy and morphological nomenclature after Hughes and Jackson (1958). Idiosoma full of guanine crystals imparting an opaque appearance and necessitating the use of Keifer's clearing agent (Keifer, 1953) prior to mounting. **GNATHOSOMA**: Similar in all life stages except for size. Chelicerae (Fig. 5)

serrated distally, bearing 18–20 teeth which are small basally and distally, and increase in size centrally. Toothed region wider centrally with tip of region arching dorsally. Opposite toothed region is a slender projection  $\phi$  directed slightly ventrally. Proximal and laterad of toothed region and approximately twice its length is a cheliceral flagellum *cfl*. Proximal and mesial of toothed region are several other serrated or fingerlike projections. Pedipalps (Fig. 6) bear two setae distally on movable terminal segment; anterior seta *pp 1* about 2½ times longer than posterior seta *pp 2*. Anteriorly directed pair of ventral setae *pp 3* on distal portion of basal segment.

**FEMALE**—(Fig. 1) Length of idiosoma 384  $\mu$  (328–437) in ungravid female (up to 552  $\mu$  in gravid female); width at level of coxae IV 200  $\mu$  (170–234). Idiosoma pyriform in shape. **DORSUM**: rostrum sculptured; heavy sclerotization surrounds rostrum and bases of trochanters of Leg I, extends laterally to surround bases of trochanters of Legs II. Propodosoma with four pairs of setae: *dp 1* quite difficult to locate and not measured, *dp 2* 15  $\mu$ , *dp 3* 39  $\mu$ , *dp 4* 75  $\mu$ . Metapodosoma bearing five pairs of setae: *dm 1* 58  $\mu$ , *dm 2* 34  $\mu$ , *dm 3* 81  $\mu$ , *dm 4* 55  $\mu$ , *dm 5* 40  $\mu$ . Opisthosoma bearing seven pairs of setae: *do 1* 69  $\mu$ , *do 2* 90  $\mu$ , *do 3* 88  $\mu$ , *do 4* 100  $\mu$ , *do 5* 87  $\mu$ , *do 6* 79  $\mu$ , *do 7* 75  $\mu$  (*do 7* slightly ventral in position). Sulcus divides proterosoma from hysterosoma; integument with granular appearance along sulcus and granular patches posterior to it. Four pairs of pitlike structures present: *dpi 1*, *dpi 2*, *dpi 4*, *vpi 1* (*dpi 3* absent). Bursa copulatrix *bc* located centrally on a level with setae *do 1*. A pair of oil glands located slightly mesial and posterior of setae *do 2*. **VENTER**: Apodemata *a 1* unite to form a V-shaped sternum; *a 2* unites with *a 3* and *a 6* with *a 7*, both pairs project mesially; *a 4* absent. Sclerotized area over *a 8* and adjacent to base of trochanter IV. Genital aperture a transverse slit extending between apodemata *a 5*, arching slightly anteriorly and difficult to distinguish in most specimens. Two pairs of ringlike structures, *r 1* and *r 2*, on metapodosoma; *r 1* more or less round, located adjacent to genital opening and over apodemata *a 5*, and with small band of sclerotization surrounding it; *r 2* oval and located on coxae III. Anus a longitudinal slit located centrally in the lower third of the idiosoma. Idiosoma bearing seven pairs of short, hairlike setae. **LEGS**: (Similar to Fig. 3 for male) **Leg I**—Trochanter: hairlike seta *t*; Femur: seta *f* spine-like; Genu: setae *g 1* and *g 2* spine-like, solenidia *g 3* and *g 4* hairlike and arising from the same base; Tibia: setae *t 1* and *t 3* spine-like, solenidion *t 2* long and whiplike; Tarsus: solenidion *ta 1* (macro-sense organ) long, striated and of uniform diameter; *ta 2* (micro-sense organ) hairlike, arising from same base as *ta 1* and usually adhering close to it making it difficult to locate; *ta 3*, *ta 4*, *ta 5*, *ta 6*, *ta 7* spine-

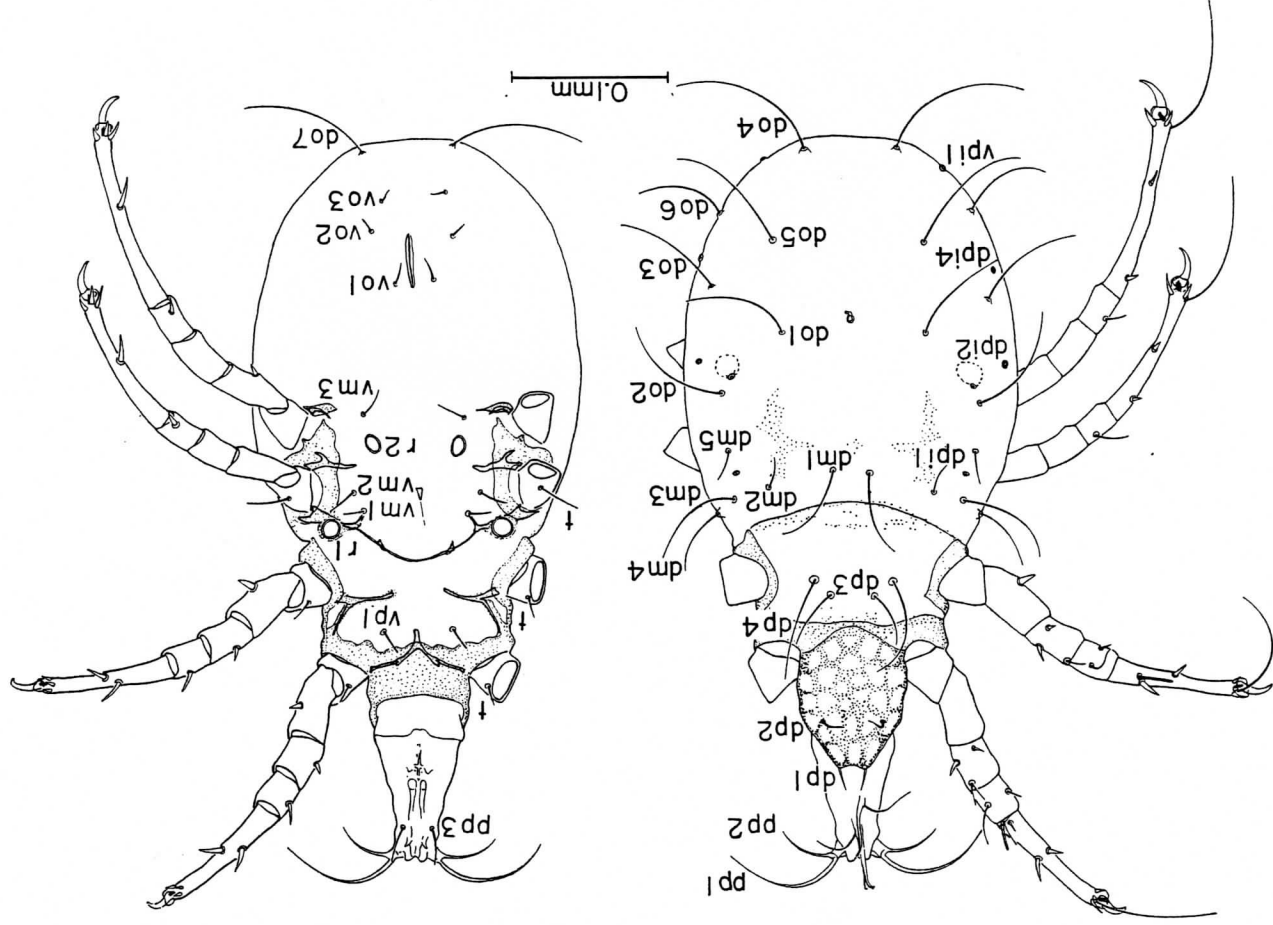


FIG. 1. Female; dorsal and ventral view.



tion of rostrum and bases of legs; and location and number of pitlike structures, oil glands and setae as in female. Lengths of setae as follows: *dp* 2 13  $\mu$ , *dp* 3 39  $\mu$ , *dp* 4 65  $\mu$ , *dm* 1 52  $\mu$ , *dm* 2 25  $\mu$ , *dm* 3 67  $\mu$ , *dm* 4 53  $\mu$ , *dm* 5 37  $\mu$ , *do* 1 55  $\mu$ , *do* 2 78  $\mu$ , *do* 3 80  $\mu$ , *do* 4 78  $\mu$ , *do* 5 72  $\mu$ , *do* 6 64  $\mu$ , *do* 7 58  $\mu$ . VENTER: Sclerotization extending around bases of legs similar to female except also extending over fused apodemata *a* 2 and *a* 3. Ringlike structure *r* 1 located mesiad and slightly posterior and fused apodemata *a* 6 and *a* 7; *r* 2 located mesiad of apodemata *a* 8. Genital apparatus located centrally between apodemata *a* 8. Anus a longitudinal slit "coupled" to the posterior end of the genital apparatus. Idiosoma bearing six pairs of hairlike setae (*vo* 1 absent). LEGS: (Fig. 3) Similar to female with the following exceptions: *Leg* I—*ti* 3 and *ta* 6 more slender; *ta* 15 more massive and clawlike. All legs more massive than in female.

LARVA—(Fig. 4) Idiosomal length 124  $\mu$  (113–134); width at level of coxae III 65  $\mu$  (59–71). Idiosoma not pyriform but widest at level just behind coxae II. Only sculptured dorsum of rostrum heavily sclerotized. Dorsum of idiosoma granular and similar in chaetotaxy to female but with setae *do* 6 and *do* 7 absent. Pitlike structures *dpi* 1, *dpi* 2 and *dpi* 4 present; oil glands absent. Ventral chaetotaxy much reduced with only *vp* 1 and *vm* 2 present. Apodemata *a* 1 do not unite; *a* 2 and *a* 6 absent. Leg chaetotaxy similar to legs I, II and III of female with the following exceptions: seta *t* absent on all legs and seta *ta* 15 absent from leg I. Leg IV absent.

PROTONYMPH—(Fig. 7) Idiosomal length 142  $\mu$  (119–174); width at level of coxae IV 71  $\mu$  (64–80). Idiosoma similar in shape and texture to larva, including sculpturing on rostrum. Dorsal chaetotaxy, pitlike structures and oil glands similar to female. Ventral chaetotaxy not as reduced as in larva, but still missing setae *vm* 1, *vm* 3, *vo* 2 and *vo* 3. Apodemata similar to female except for the absence of *a* 2. Chaetotaxy of legs I, II, and III similar to larva; leg IV differs from female by the absence of setae *f*, *ti* 2, *ti* 3 and two of the terminal tarsal setae including *ta* 9 (therefore no long terminal seta on leg IV).

DEUTONYMPH—(Fig. 8) Idiosomal length 80  $\mu$  (72–87); width 53  $\mu$  (46–61). Idiosoma egg shaped; with short, membranous, anterior extension covering gnathosomal base. Fused pedipalps short, approximately as long as wide, and usually not extending beyond propodosoma. Heavily pigmented area surrounding base of palps, and dorsally appearing as two dark bands. Palpal setae *pp* 1 slightly longer than combined lengths of genu and tibia I. DORSUM: Sculptured; setae fine, minute

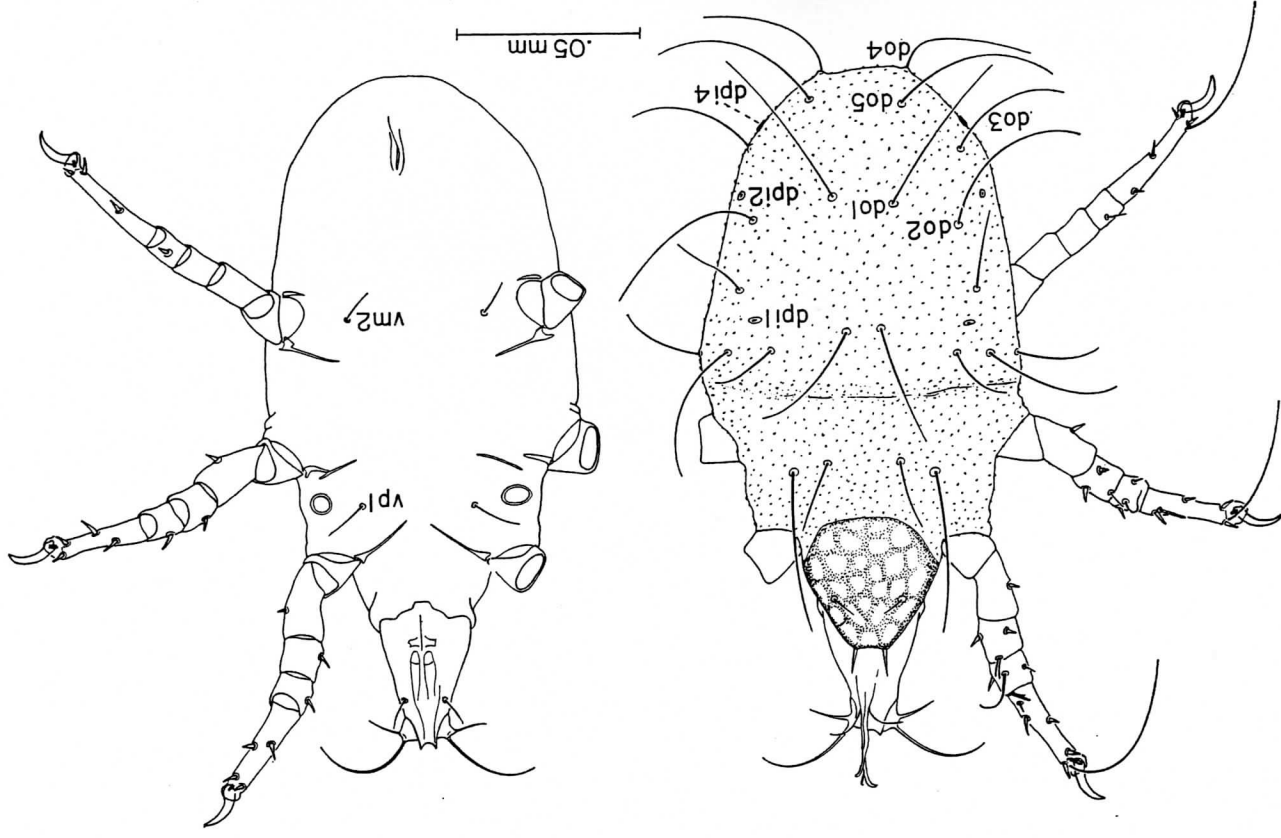
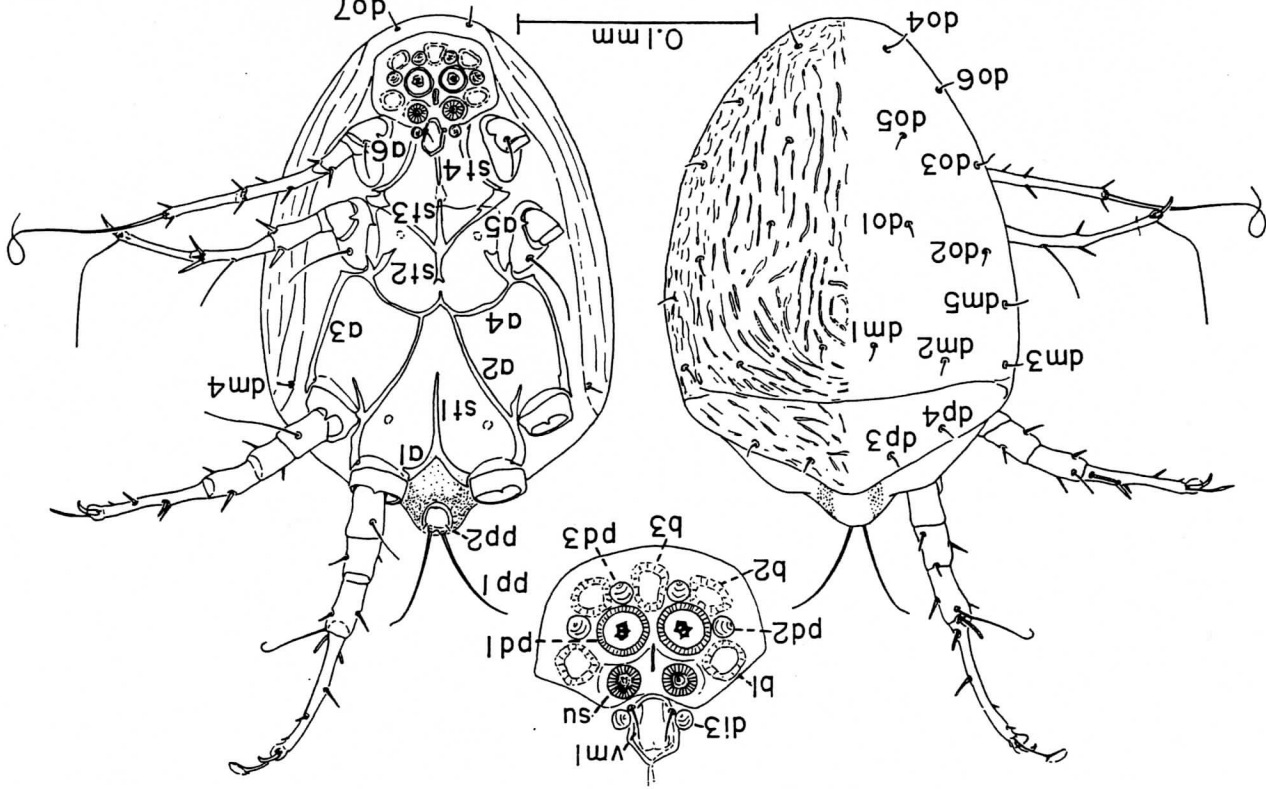
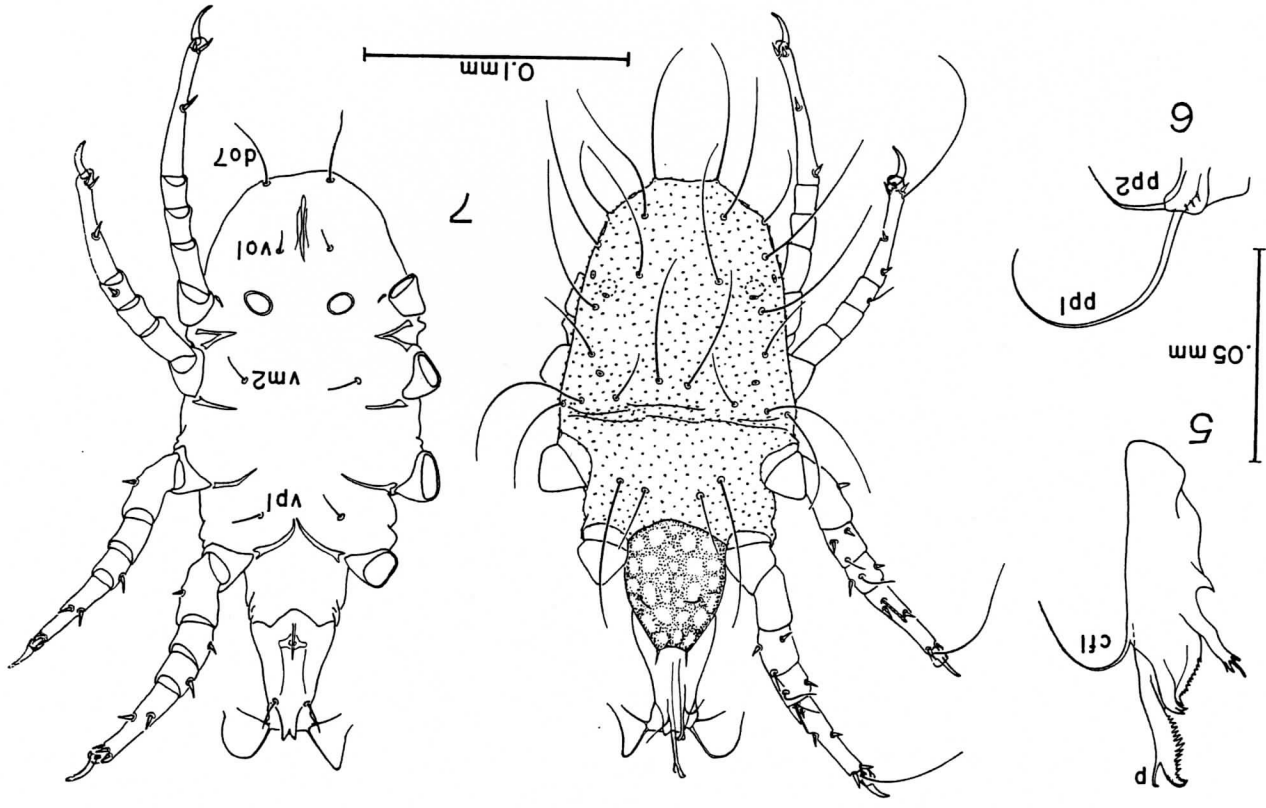


FIG. 4. Larva; dorsal and ventral view.

FIGS. 5–7. 5, right chelicera of male. 6, distal portion of right pedipalp of male. 7, dorsal and ventral view of protonymph.

FIG. 8. Deutonymph; dorsal and ventral view.



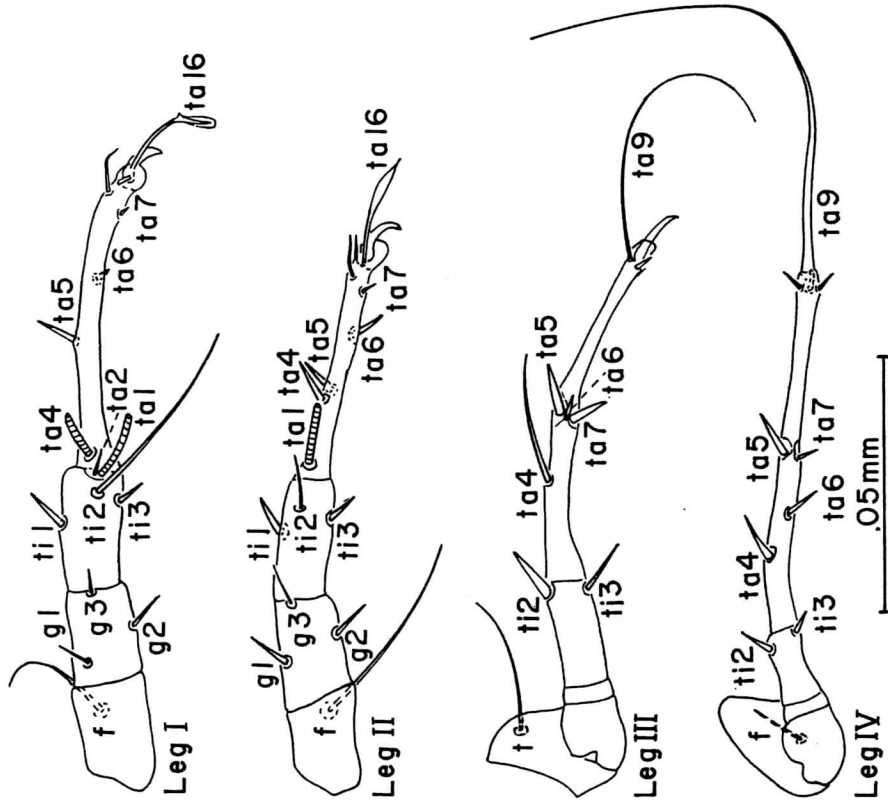


FIG. 9. Deutonymph; dorso-lateral view of right legs with the exception of the trochanters on legs I and II.

and of approximately equal length. VENTER: Coxae I and III without setae or discs, but with non-pigmented areas in their place. Coxa IV with seta *vm 1* small and mesiad of disc *di 3*. Apodemata *a 1* fused at midline to form sternum *st 1*; *st 1* not making contact with apodemata *a 4*; apodemata *a 2* joining *a 4*; *a 4* continuous at midline and not joining *st 2*; apodemata *a 5* continuous at midline and united with *st 2* and

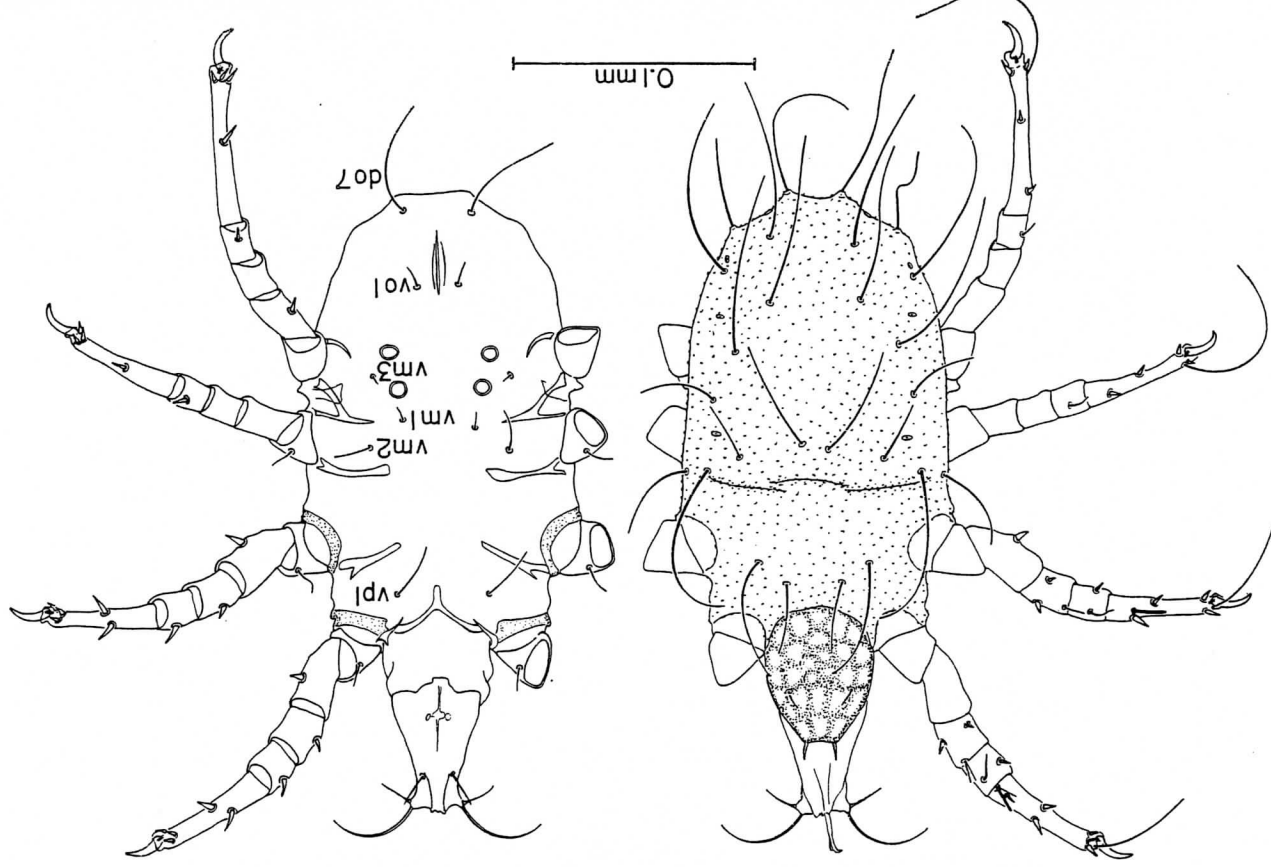


FIG. 10. Tritonymph; dorsal and ventral view.

st 3. Suctorial plate trapezoidal; discs *pd* 2 and *pd* 3 slightly larger than coxal disc *di* 3; disc *pd* 1 larger in diameter than other discs or suckers *su*. LEGS: (Fig. 9) Relative position, size and shape of setae as figured. *Leg I*—*ta* 1 and *ta* 4 striated, *ta* 16 spoon-shaped; *Leg II*—*ta* 16 lancet-shaped; *Leg IV*—*ta* 9 very long and tapering, appearing like an additional leg segment.

TRITONYMPH—(Fig. 10) Idiosomal length  $201 \mu$  (180–234); width at level of coxae IV  $101 \mu$  (90–116). Idiosomal shape, texture and rostral sculpturing similar to protonymph, however bands of sclerotization found ventrally around bases of trochanters of legs I and II. Dorsal chaetotaxy and pitlike structures similar to female; oil glands absent. Ventral chaetotaxy as in male, except *vo* 1 present and *vo* 2 and *vo* 3 absent.

HABITAT AND DISTRIBUTION—Specimens of *Manduytia mallotae*, with the exception of the hypopus, have been collected only from water-filled treeholes. I have collected all stages from water-filled treeholes at the University of Kansas Sunflower Entomological Reserve, Johnson County, Kansas; and at Cook Forest, Forest County, Pennsylvania. Hypopi have also been taken from living specimens of the syrphid flies *Mallota posticata* and *M. bantius* collected at Sunflower Reserve, and from pinned specimens of these flies collected by G. P. Waldbauer at Allerton Park, near Monticello, Illinois, and Masson State Forest, near Forest City, Illinois.

LOCATION OF TYPES—Holotype (female), allotype (male), and female, male, tritonymphal, deutonymphal, protonymphal and larval paratypes will be deposited in the Snow Entomological Museum, University of Kansas, Lawrence, Kansas. Paratypes will be deposited with the following: U. S. National Museum, Washington, D. C.; Institute of Acarology, Ohio State University, Columbus, Ohio; Canadian National Collection, Ottawa; British Museum (Natural History), London; Laboratoire de Zoologie Médicale, Institut de Médecine Tropicale, Anvers, Belgium; and Zoological Institute of the Academy of Sciences of the USSR, Leningrad.

#### DISCUSSION

The life cycle of *Manduytia mallotae* differs from the typical anoetid life cycle (eggs, larva, protonymph, facultative deutonymph, tritonymph and adult) in that it is larviparous. No eggs were found in lab cultures, even when isolated females were observed; and fully developed larvae were seen in eggs still within the mother in slide-mounted specimens. In one slide-mounted specimen two larvae were observed outside their egg membranes but still within the mother. The occurrence of viviparity in an anoetid does not appear extraordinary since some species have been reported to retain the eggs through at least part of embryonic development (Perron, 1953; Hughes and Jackson, 1958; Scheucher, 1957). Viviparity also occurs in *Histiostoma feroniarum* (Dufour), but infrequently (Scheucher, 1957).

Although life history studies have been conducted on various anoetid species (e.g., Perron, 1953; Behura, 1953; Oliver, 1962), only the immatures of *Histiostoma julorum* (Koch) have been described in detail (Hughes and Jackson, 1958). *Manduytia mallotae* and *H. julorum* share many common characters, but there are differences in the chaetotaxy as well as idiosomal qualities in some stages. Other than the absence of tarsal seta *ta* 10 in *M. mallotae*, the general setal patterns and numbers are the same in the corresponding sexes of adults in both species. The immatures, however, differ with the reduction of the following setae in *M. mallotae*: tarsal seta *ta* 10 in all stages; tarsal seta *ta* 15 of leg I in the larva and protonymph; ventral setae *vm* 3 and *vo* 2 in the protonymph; and ventral seta *vo* 2 in the tritonymph. Also, pitlike structures, granular idiosoma and sculptured rostrum present in *M. mallotae* are not found in *H. julorum*. Bosses and elevations found at the dorsal setal bases in immatures of *H. julorum* are not found in *M. mallotae*.

In both *M. mallotae* and *H. julorum*, neither primary nor secondary sex structures are present in any immature stage. Scheucher (1957) in discussing anoetids in general and Perron (1953) working with *Anoetus laboratorum* (Hughes) stated that the tritonymph female has genital structures and is capable of mating, but they may have observed males being carried by tritonymph females and not actual mating. Behura (1957) found that males of *Histiostoma polyperi* (Oudemans) mount tritonymph females, await the final molt, and then mate with the adult female.

Another interesting aspect found in both *M. mallotae* and *H. julorum* is the absence of oil glands in the larval and tritonymphal stages. Brady and Wharton (1970) have postulated that the oil glands function as repugnatorial glands. It seems that if this were the case in anoetids, such glands would be present in all stages, not just protonymphs, deutonymphs and adults.

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## BIOLOGY AND SYSTEMATICS OF THE PLEBEJUS (ICARICIA) ACOMON GROUP (Lepidoptera: Lycaenidae) I. REVIEW OF THE GROUP<sup>1</sup>

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### ABSTRACT

Information from distribution, foodplant ecology, and morphology suggests recognition of three closely related species within the *Plebejus acmon* group: *Plebejus newrona* (Skinner), *P. acmon* (Westwood & Hewitson), and *P. lupini* (Boisduval). Three subspecies of *P. acmon* and two of *P. lupini* are recognized. *Plebejus newrona* is distinct from *P. acmon* in wing pigmentation and distinct from *P. lupini* in genital morphology. *Plebejus acmon* and *P. lupini* are largely sympatric species or semispecies that intergrade in certain areas of their distribution and remain distinct in other areas. Morphological intergradation, geographic variation in melanic pigmentation, and possible character displacement in the *P. acmon-P. lupini* complex are discussed.

Available biological data on generation time, diapause, foodplants utilized, and seasonal and geographic distribution are summarized.

*Plebejus acmon* (Westwood & Hewitson) and two allied blues, *P. lupini* (Boisduval) and *P. newrona* (Skinner), form a group of closely related butterflies limited in distribution to western North America. *Plebejus newrona* is a monomorphic species with respect to wing pigmentation phenotype, and generally is easily separated on this basis from the other species. *Plebejus acmon* and *P. lupini* are sexually dimorphic species, and possibly more closely related to each other than either is to *P. newrona*. The group is characterized, and members may be distinguished from other members of the subgenus *Icaricia*, by the

presence of a distinct orange subcostal border on the upper surface of the hind wings in both sexes, similar morphology of the male valvae, and larval utilization of *Eriogonum* as a foodplant.

The purpose of this paper and others to follow in the series is to provide a critical synthesis of taxonomic, distributional, and biological information on all species and subspecies within the *Plebejus acmon* group. In the present paper, phenetic relationships are discussed, geographic distributions are given, and biological data are summarized. Particular reference is given to the *P. acmon-P. lupini* complex of geographically variable taxa.

### MATERIALS AND METHODS

Morphological data presented are based on examination of over 7,000 adult *Plebejus acmon* group specimens: in 800 of these, the genital structures have been examined. Biological data are based primarily on California material and were obtained from extensive field work, as well as rearing of all of the species and most of the subspecies. Rearing procedure followed that of Goodpasture (1971). Progeny of females from the following California localities have been reared to adults: *P. newrona*: Chuchupate Range Station, Ventura County, 5,000 feet; *P. acmon acmon*: Lake Sherwood, Ventura County; Monticello Dam, Napa County, 400 feet; Davis, Yolo County; and near Rumsey, Yolo County; *P. lupini lupini*: Echo Lake, El Dorado County, 8,000 feet; *P. lupini monticola*: La Posta Creek at Hwy 80, San Diego County, 3,100 feet; Sierra Pelona Road, Mint Canyon, Los Angeles County, 3,000 feet; and near Frazier Park, Kern County, 4,800 feet.

### TAXONOMY

Numerous superficial attempts have been made to clarify the species level status within the *Plebejus acmon* complex. Clemence (1909) conceived of *Plebejus (Rusticus) acmon*, occurring in cismontane San Gabriel Mountains, southern California, as consisting of three "distinct forms": type *acmon*; an early spring form; and *P. acmon monticola* (Clemence). His description, presumably of a male *P. acmon*, "... darker blue than the type form [*P. acmon acmon*], and heavily margined in black," probably refers to early generation specimens of *P. lupini monticola*. McDunnough (1914) in a study of the Boisduval lycaenid types recognized *P. acmon*, *P. lupini*, and *P. monticola* as distinct species including these in what he termed the *acmon* group. Comstock (1927) considered *lupini*, *monticola*, and *chlorina* (Skinner) subspecies of *acmon*, and perpetuating the error of Clemence, figured *P. lupini monticola* as *P. acmon cotilei* (Grinnell) (plate 55, figs. 4 & 5). Downey (1961) suggested that *P. acmon*, *P. lupini*, *P. monticola*, and *P. chlorina* comprise a single species, but gave no supporting data. Nabokov (1945) and more recently J. Tilden (personal communication) examined the genitalia of all of the *Icaricia* and suggested specific status for *newrona*, *acmon*, and *lupini*.

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