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Two Tydeid Mites from the Ears of Noctuid Moths

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The present paper describes a new species of the tydeid genus *Pronematus* Canestrini, and compares it with the previously discovered *Pronematus pyrrhippeus* (Treat), which is redescribed in part from new material.

In his review of the genera of the Tydeidae, Baker (1965) proposed the genus *Pronematus* to accommodate certain species that differ from typical *Pronematus* in the chaetotaxy of the legs, as well as in having the fourth femur divided, and in having a complete complement of dorsal hysterosomal setae. Baker described *Pronematus vandus* as the type species, but assigned no other mite to the new genus until 1968, when, in his review of the genus *Pronematus*, he transferred *P. vandykei* Baker (1946) and *P. brachytarsus* Baker (1946) to *Pronematus*. In 1961 I described as *Pronematus pyrrhippeus* a few specimens of a mite that I had discovered in the ears of various noctuid moths in Tyringham, Massachusetts. Since 1961 I have found additional specimens of this mite in Tyringham on 32 noctuids of 12 species. Baker recognized *pyrrhippeus* as distinct from other species (oral commun., 1957), and in 1966 he indicated in correspondence the propriety of transferring it to *Pronematus*. I have used the combination *Pronematus pyrrhippeus* informally in two previous papers of non-taxonomic character (Treat, 1967 and 1969), but through an oversight Baker ignored the species altogether in his publications.

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Now, with new material available and with the tydeid genera more clearly defined, it is desirable that this mite be redescribed.

Since 1967 I have found in the external tympanic recesses of 14 specimens of the small herminiine noctuid *Epizeuxis aemula* Hübner from one to eight mites each, representing the second species of the family Tydeidae to be taken with some frequency from the ears of moths. The new mite, like its predecessor, is probably phoretic upon its noctuid host. Phoresy is not a well-recognized habit among tydeids. Mites of this family are generally known as free-living predators upon small insects, other mites, or their eggs. The host of the new species is an abundant and widely distributed moth whose larvae feed on many kinds of dead or fallen leaves. Moths of this species are often (Treat, 1970) hosts to the ascid mite *Blattisocius tarsalis* (Berlese), which commonly occupies the dorsum of the moth near the hind wing bases, and only occasionally enters a tympanic recess.

Pronematus pyrrhippeus (Treat)

Pronematus pyrrhippeus TREAT, 1961, pp. 147-152.

Pronematus pyrrhippeus: TREAT, 1967, p. 175; 1969, p. 276 ff.

FEMALE: As originally described (sex then undetermined), with corrections and additions as follows: Gnathosoma with two pairs of ventral setae, anterior pair minute; movable digit of chelicera about equal in length to palp tarsus; palp setal count, 5-1-2, normal for genus. Hysterosoma with five transverse rows (10 pairs) of dorsal setae, L1 present, L5 terminal or subventral, lateral to anal region; striations between setae D3 forming inverted V, apex forward; three pairs of intercoxal setae; two pairs of setae anterior, two pairs lateral to genital region; one pair of minute paranal setae on anal papilla; anus in favorable specimens showing oblique line or cleft internally; genital lobes tapering posteriorly, with pair of thickenings on median walls. Typical setal counts (10 specimens) on leg segments:

I, 6-3-3-3-1-2

II, 7-2-3-3-1-1

III, 7-2-2-2-1-3

IV, 7-2-1-1,1-0-1

Solenidia on tarsus I, II, tibia I, dorsal (not ventral as in inverted fig. 2 of Treat, 1961); tarsus I shorter than tibia I; femur IV divided.

LARVA (FIG. 3C): Similar to larva of *Pronematus leucohippeus* (see below) except dorsum very faintly striated, paragenital setae absent, tarsus I lacking pretarsus and empodium. Leg setal counts (in sole specimen):

I, 6-3-3-3-0-2

II, 6-2-3-3-0-1

III, 5-2-2-2-0-1

Length of idiosoma, 119 microns; maximum width, 67 microns.

EGG: In living condition, yellowish brown, smooth, transparent, bean-shaped, tapering at one end; average length (of one living specimen, two empty cuticula), 101 microns; maximum width, 58 microns.

COLLECTION RECORDS (SINCE 1961)¹: All females unless otherwise noted. *Massachusetts*: Berkshire County, Tyringham, July 19, 1963, one from a male of *Acronycta dactylina* (Grote); July 2, 1964, three from a female of *Apamea lignicolora* (Guenée); July 8, 1964, one from a male of *Acronycta* sp. ?*impressa* Walker; July 23, 1964, one from a female of *Acronycta morula* Grote and Robinson; July 30, 1964, one from a female of *Acronycta* sp. ?*impressa*; August 14, 1964, one from a female of *Graphiphora haruspica* (Grote); July 4, 1965, three from a male, one from a female of *Apamea lignicolora*; July 5, 1965, one from a female of *Apamea lignicolora*; July 14, 1965, one from a female of *Apamea lignicolora*; July 26, 1965, two from a male of *Acronycta morula*; July 27, 1965, one from a female of *Polia imbrifera* (Guenée); August 7, 1965, one from a female of *Graphiphora haruspica*, one from a male of *Septis amputatrix* (Fitch); August 11, 1965, one egg from a male of *Eurois stricta* Morrison; August 15, 1965, one egg (which yielded a larva) from a male of *Acronycta hasta* Guenée; August 18, 1965, one from a female of *Acronycta vinnula* (Grote); July 3, 1966, one egg from a female of *Leuconycta diphteroides* Guenée; July 10, 1966, one from a male of *Apamea lignicolora*; July 14, 1966, one from a female of *Apamea lignicolora*; July 23, 1966, one female and one egg from a male of *Graphiphora haruspica*; July 28, 1966, one (lost) from a male of *Graphiphora haruspica*; July 29, 1966, three (one lost) from a male of *Apamea lignicolora*; August 9, 1966, one egg from a female of *Graphiphora haruspica*; August 16, 1966, one from a female of *Acronycta hasta*; June 30, 1967, one (lost) from a male of *Acronycta vinnula*; July 2, 1967, one from a male of *Acronycta morula*; July 11, 1967, two from a male of *Acronycta morula*; July 15, 1967, two from a male of *Apamea lignicolora*; August 6-12, 1967, one from a male of *Apamea lignicolora*; October 12, 1969, two from a female of *Amphipyra pyramidoides* Guenée.

BIOLOGY AND BEHAVIOR: The finding in 15 years of 55 specimens on 37 moths of 13 species representing noctuids of five subfamilies, all in

¹ The first specimen collected was not recorded in my earlier work (Treat, 1961). It was taken in Tyringham, Massachusetts, on July 24, 1954, from a male of *Graphiphora haruspica*. It was given to Dr. E. W. Baker in November, 1954.

the type locality, shows that this mite is fairly frequently associated with noctuid moths, but that it is not highly selective as regards host species. Collection dates ranging from June 18 to October 12 show that the association is seasonally widespread. One mite survived 19 days of refrigeration, while on its host, at a temperature of about 5 degrees Celsius. Hosts were of both sexes in nearly equal numbers (18 males, 19 females). Almost all of the mites were found in the external tympanic recesses, the chief exceptions being those that were probably displaced either by experimental procedures or by interaction with mites of other species. No injury to the host was ever detected.

Nine of the 37 recorded hosts carried mites of other species in addition to *P. pyrrohippeus*. These included two moths carrying *Androlaelaps casalis* (Berlese), one carrying *Blattisocius patagiorum* Treat, one carrying *Carpoglyphus lactis* (Linnaeus), three carrying *Dicrocheles phalaenodectes* (Treat), one carrying a species of *Leptus* Latreille, and one from which I lost an undetermined dermanyssid, probably *A. casalis*. In only one instance did I see anything suggesting predation of one mite species upon another. On August 7, 1965, I took a male of *Septis amputatrix* with a few shriveled eggs of *Dicrocheles phalaenodectes* in its left tympanic recess. I saw no living mites and I killed the moth with ethyl acetate vapor, then dissected it. The left countertympanic membrane was perforated and the countertympanic cavity contained a brown fecal deposit typical of *Dicrocheles phalaenodectes* colonies. The left tympanic membrane was perforated, and the tympanic air sac contained a few shriveled eggs and larvae of *D. phalaenodectes*. On the inner, anterior wall of the tympanic air sac was a well-rounded *P. pyrrohippeus* female in a characteristic resting position. I mounted this mite together with four of the *Dicrocheles* larvae. On the ventral surface of each larva, between the bases of coxae I and II or II and III of either the left or the right side, is a small, irregular mass of amorphous material. It is possible that this material exuded from a feeding puncture, and that these larvae and the remaining eggs had been killed by the tydeid. A living *P. pyrrohippeus* confined in a glass chamber, however, ignored the *Dicrocheles* eggs which I provided. In view of these facts, and of the occasional finding and hatching of *pyrrohippeus* eggs on noctuid hosts, it is still questionable whether phoresy fully describes the normal relation of the tydeids to the moths.

An egg of *P. pyrrohippeus*, found in the left tympanic recess of a female of *Acronycta hasta* at 11:30 P.M. on August 9, 1965, and transferred the next day to a cork-stoppered microvial at room temperature, yielded a living larva at some time between 11 P.M. on August 14, and 11:37 A.M. on August 15. The hatching time was thus at least five days. The red-

dish, living larva was creeping about in the vial when first observed. Two other eggs, which were left in the tympanic recesses of their hosts, yielded larvae that disappeared before they were discovered. For one of these eggs, first seen while still in contact with the female parent, the hatching time was estimated at four to six days.

One mite that was mounted alive for temporary study was able to abduct independently each of the paired lateral lobes of the genital region, and to draw them slightly forward. Living specimens studied in water under coverslips, or when first mounted in Hoyer's medium, showed central internal regions containing dense aggregates of minute, granular, refractile bodies, probably excretory, in seething motion resembling vigorous Brownian movement. In some instances the particles were concentrated in an ovoid mass near the posterior end of the hysterosoma, but more often they appeared in a central streak, probably the unpaired malpighian tubule, extending anteriorly to the level of coxae IV. Mass flow of particles between anterior and posterior regions occurred at times. Sparser particles, also in motion, were present in all coxae and trochanters of one specimen, as well as in more distal parts of leg IV. Red pigment droplets of various sizes could be seen in most living specimens; in one or two the pigment was yellow. At rest in the tympanic recess, living mites appeared unresponsive to light, but when wandering in glass containers, some showed a suggestion of negative phototaxis.

***Pronematus leucohippeus*,¹ new species**

Figures 1-3B

DIAGNOSIS: Chaetotaxy of the legs in the female differs from the generic formula as given by Baker (1965) in the presence of a seta on trochanters I and II, three setae on femur II, six on tarsus III, and only one on femur IV. Females key to *P. bachewingi* in Baker (1968), but differ in having the movable digit of the chelicera and the distal segment of the palpus little more than half the length of tibia I. Tarsus I is about three-fourths as long as tibia I, rather than only two-thirds as long, as in *bachewingi*.

FEMALE: Rostrum with cheliceral tips approximated, downwardly directed in unflattened specimens; movable chelae (fig. 1B) not exceeding pointed tip of fixed digit; two pairs of setae, anterior pair minute, on striated ventral infracapitular surface; minute adoral setae barely visible in some specimens; propharynx and pharyngeal pump strongly

¹ The specific name *leucohippeus* is derived from the Greek λευκος, white, plus ιππεύς, rider.

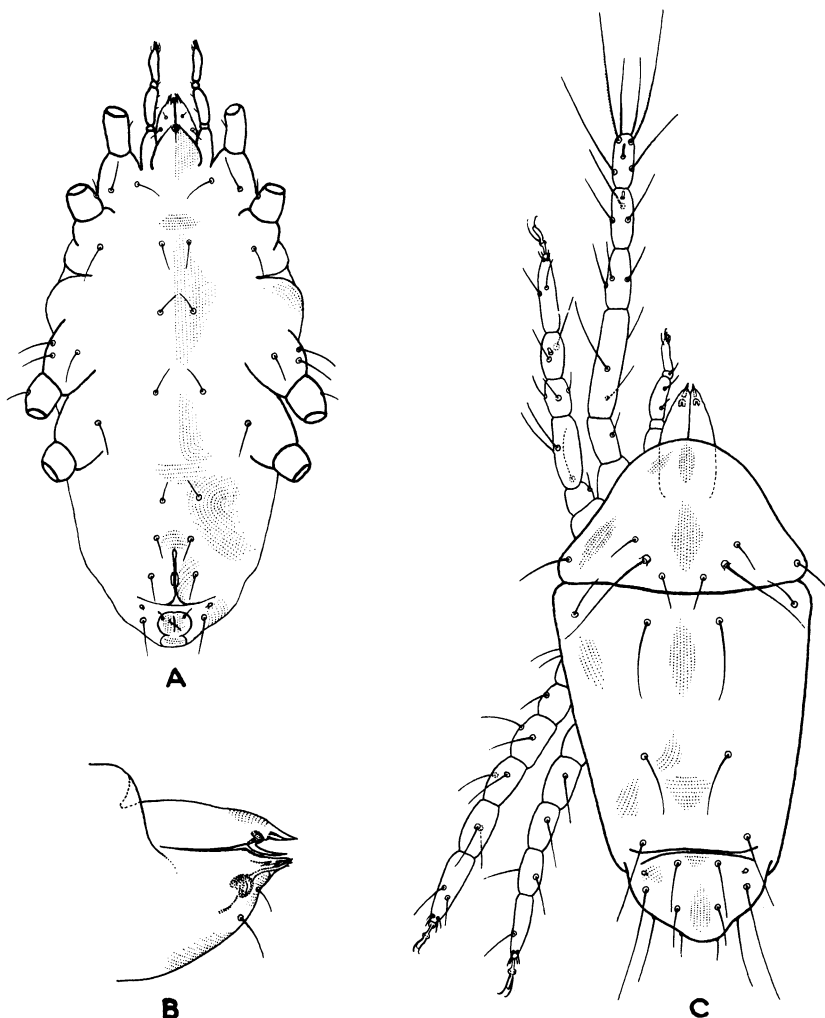


FIG. 1. *Pronematus leucohippeus*, female. A. Idiosoma, ventral view. $\times 228$. B. Gnathosoma, right side view. $\times 456$. C. Idiosoma and left legs, dorsal view. $\times 228$.

refractile, pump region yellow; palp tarsus (fig. 2A) with three normal setae, one cylindrical seta slightly bent at tip and approximating a pale, broadly based, finely tapered structure of about equal length; no club-shaped seta on palp tarsus; one seta on palp tibia, two dorsally on femorogenual segment.

Propodosoma (fig. 1C) with fine longitudinal striations appearing slightly lobed in favorable specimens; all setae serrate, P1 pair between and posterior to slender sensory setae. Hysterosoma with fine, faintly lobed dorsal striations, longitudinal between setae D1, diverging posteriorly near D2, transverse between D2 and D3, longitudinal between D4 pair; dorsal setation normal for genus, with L2 approximating line of D1 to D5, L4 terminal or subventral, L5 apparently missing; all setae probably minutely serrate, although appearing smooth in some specimens; posterior part of hysterosoma with transverse folds in living and most mounted specimens; a minute round body (or pore?) with pale stalk (or duct?) at or just below surface about 10 microns anterior to base of each seta L3. Ventral surface of idiosoma striated as shown (fig. 1A), with three pairs of serrate intercoxal setae, two pairs of setae anterior, one pair lateral to genital region; one pair of minute paranal setae on anal papilla, easily overlooked; minute round bodies similar to above on ventral surface about seven microns anterior to bases of setae L4. Genital aperture (fig. 3A) with pair of thickenings on median walls; transverse opening variable in mounted specimens, in some showing lateral rows of minute teeth; anal region usually distorted in mounted specimens, often obscured, typically with irregular ventral protuberances and oblique line or cleft internally.

Average length of idiosoma, 251 microns, of propodosoma, 81 microns; average maximum width, 132 microns. Average length of leg I (fig. 2B), 214 microns; tarsus I, 29 microns; tarsus I without pretarsus, empodium, or claws, with dorsal apical setae about 62 microns long, ventral apical setae about 57 microns long, all setae serrate; solenidion of tarsus I, 6 to 8 microns long, of tibia I, 4 microns long. Leg II (fig. 2C), 186 microns long, with tarsal solenidion 3 microns long. Leg III (fig. 2D), 202 microns long; leg IV (fig. 2E), 190 microns long; femur IV undivided. Typical setal counts on leg segments in 18 to 20 specimens:

- I, 6-3-3-3-0-2
- II, 6-2-3-3-1-1
- III, 6-2-2-2-1-3
- IV, 5-2-1-1-0-1

MALE: Unknown.

TRITONYMPH: Similar to female but without genital aperture; body and leg chaetotaxy identical to that of female; length of idiosoma (in sole specimen), 250 microns, of propodosoma, 63 microns; maximum width, 121 microns; length of leg I, 170 microns, leg II, 160 microns, leg III, 170 microns, leg IV, 190 microns.

LARVA (FIG. 3B): Gnathosoma and palpi similar to that of female,

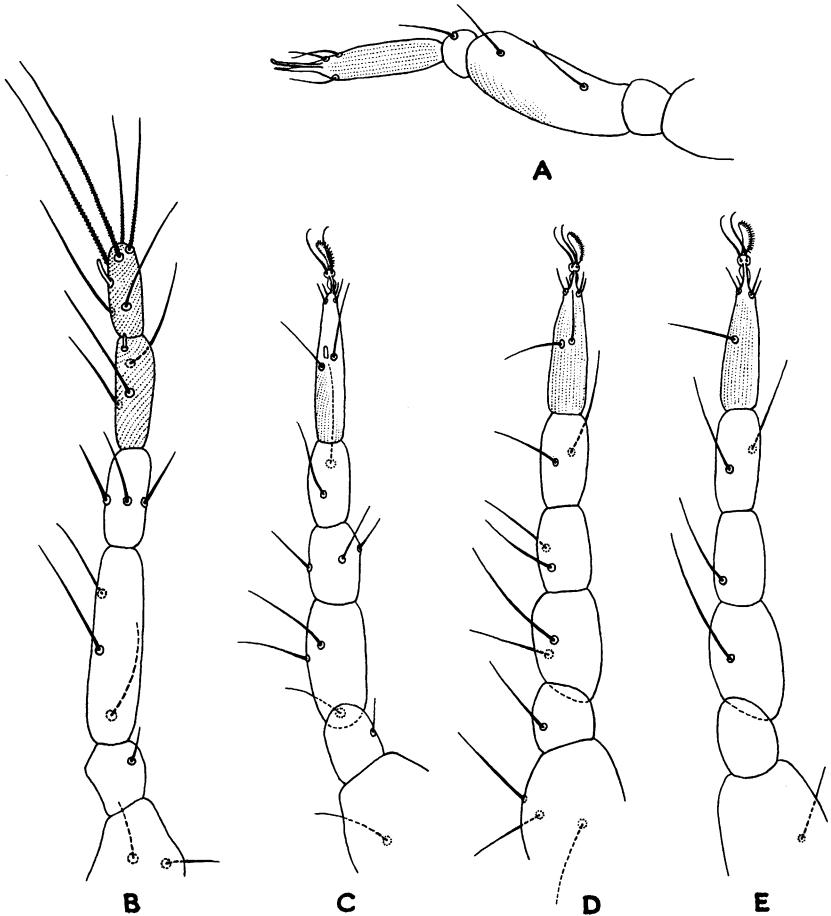


FIG. 2. *Pronematus leucohippeus*, female. A. Left palp, dorsal view. $\times 1100$. B. Left leg I, dorso-medial view. $\times 440$. C. Left leg II, dorsal view. $\times 440$. D. Left leg III, dorsal view, $\times 440$. E. Left leg IV, dorsal view. $\times 440$. Striations are shown on distal segments only.

but with rostral tips of infracapitulum divergent and only one pair of setae detectable. Idiosoma unstriated; dorsal surface with eight pairs of setae; ventral surface with only two pairs of intercoxal setae, one pair of ?paragenital setae; paranal setae minute. Tarsus I with pretarsus and empodium but without claws; solenidion present; leg chaetotaxy similar to that of female except for absence of setae on all trochanters, only one seta on coxa III, only five on tarsus III. Length of idiosoma

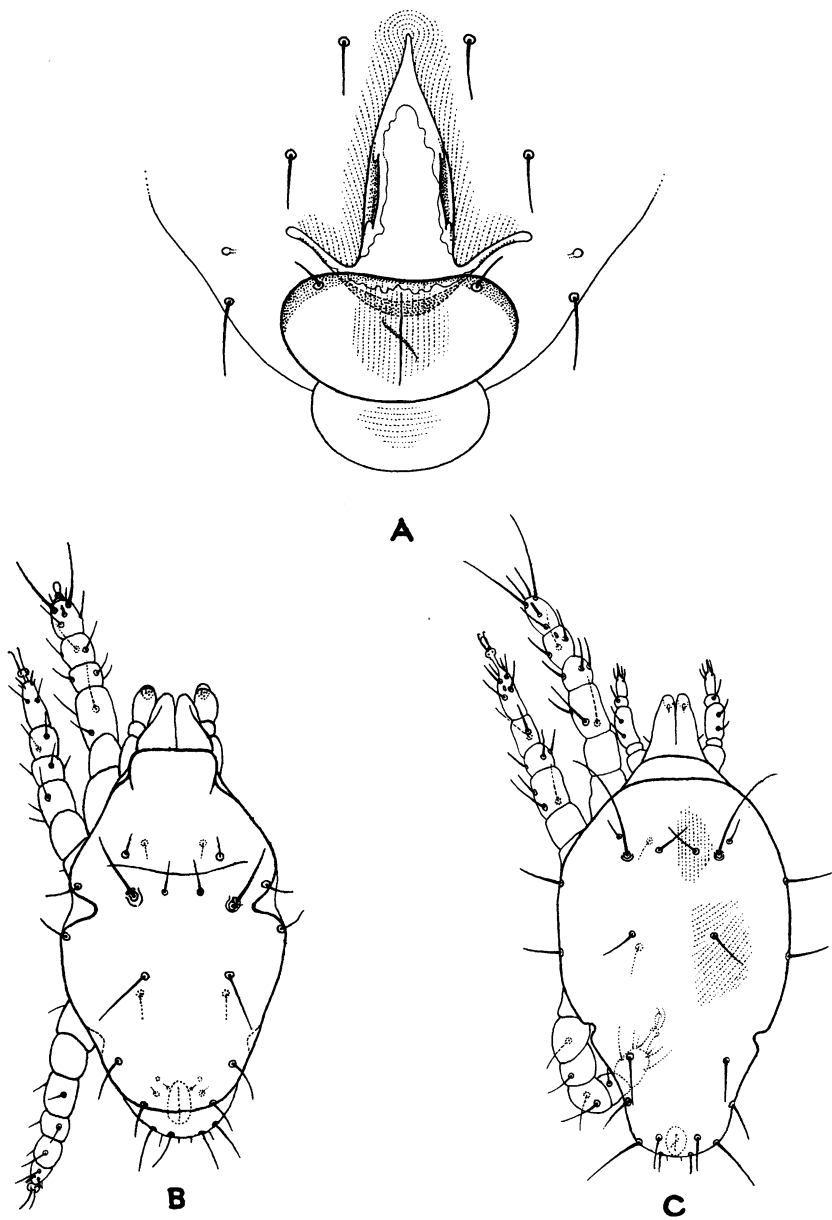


FIG. 3. A. *Pronematus leucohippeus*, genito-anal region of female, ventral view, slightly schematized. $\times 1280$. B. *P. leucohippeus*, larva, dorsal view. $\times 512$. C. *Pronematulus pyrrohippeus*, larva, dorsal view; position of ventral setae is shown on the left side only. $\times 512$.

(in sole specimen) when first mounted, 122 microns, maximum width, 63 microns; corresponding measurements three months later, 104 and 92 microns respectively.

EGG: In living condition, colorless, ovoid, smooth, transparent; length (of sole specimen), 96 microns, maximum width, 54 microns.

TYPE DATA: Description is based on 30 females, one tritonymph, one larva, and one egg, all from *Epizeuxis aemula* taken by the author at light, unless otherwise noted. Collection data are as follows. *Massachusetts*: Berkshire County, Tyringham, October 17, 1967, two females from a female host; October 1, 1968, one female and one tritonymph from a male host; October 5, 1968, two females (one lost) from a male host; October 18, 1968, two females from a male host; July 11, 1969, one female from a male host; July 25, 1969, eight females from a female host; July 26, 1969, one female from a male host; July 30, 1969, two females from a male host; August 9, 1969, one female from a female host; October 2, 1969, five females and one egg (from which the larva was reared) from a male host; October 12, 1969, four females from a female host. Three mites from two female hosts taken in Tyringham on October 3, 1969, disappeared while their hosts were being kept alive for observation. *New Jersey*: Morris County, Chester, two females from a pinned female host in the American Museum of Natural History, labeled "Chester/VIII N. J./J. B. Smith Collection/Rutgers."

The holotype, in the collection of the American Museum of Natural History, was taken in Tyringham, Massachusetts on October 12, 1969, from a female host. Paratypes will be deposited in the American Museum of Natural History, the United States National Museum, Smithsonian Institution, the British Museum (Nat. Hist.), and the Acarology Laboratory of the Ohio State University.

BIOLOGY AND BEHAVIOR: The living mites strongly resemble *Pronematus pyrrhippeus* both in behavior and, except for the lack of color, in appearance. Save for three females from under the left tegula of their host, and three that were taken from near the base of the right forewing, all were found in the external tympanic recesses. The exceptions may have resulted from the mites having been driven from the ears by females of the ascid mite *Blattisocius tarsalis* (see below). When there was more than one mite, both ears were usually occupied. The mites were inactive when discovered, and sometimes remained so for two or three days, although they could be aroused by prodding. One moth still had three living mites after six days' confinement mostly in a refrigerator at about 2 degrees Celsius. "Resting" mites kept their front legs extended forward, elevated, and slightly abducted, often using them with vibra-

tory movements to palpate the substrate. Some of the mites seemed to adhere lightly to the surface of the host by attachment at their posterior ends, although even these were easily dislodged. Even though no damage to the host was detected, the mites are so small that the possibility of parasitism cannot be ruled out unequivocally.

Of the 14 recorded hosts, seven were males and seven were females. Five of the moths (three males, two females) also carried one or more females of the ascid mite *Blattisocius tarsalis*. These mites are most often found dorsally on or near the first abdominal segment, but occasionally they wander about and sometimes enter a tympanic recess. On only one occasion did I see an encounter between mites of the two species. This was at 10:55 P.M. on July 28, 1969. The moth, a female, had been refrigerated much of the time since its capture on July 25. It had initially carried five *P. leucohippeus* in its left ear and three in its right, as well as at least five *B. tarsalis* on the abdominal dorsum and one ventrally in the thoraco-abdominal cleft. The mites from the left ear had already been removed. At the time of observation two *B. tarsalis* and three *P. leucohippeus* were still present, two of the latter in the right tympanic recess and one found only later under the base of the right forewing. One of the *B. tarsalis* entered the right tympanic recess and moved about there in an exploratory manner, often colliding with the two tydeids, but not attacking them or, as far as I could see, reacting to them in any special way. One of the tydeids held its ground on the floor of the tympanic recess. The other moved about rapidly, palpating the substrate, the surroundings, and the intruding ascid with its forelegs. At length it moved to the axillary region of the right forewing, where the third *Pronematus* was then also seen. The *Blattisocius* soon left the ear, but both tydeids remained under the wing base until I discontinued observation.

I have seen only one egg of *P. leucohippeus*. It was deep in the left tympanic recess of a male host taken at about 9:50 P.M. on October 2, 1969. There were three female mites with the egg; a fourth occupied the right tympanic recess. I transferred the egg to a depression slide under a cover glass sealed with petroleum jelly. The egg hatched sometime between 4:30 and 5:05 P.M. on October 4. During the next hour, the larva remained at rest on the empty, transparent egg cuticle, occasionally lowering and raising its forelegs, one at a time. At 6 P.M. I mounted it in Hoyer's medium.

DISCUSSION

Except for the record of two females of *Pronematus leucohippeus* from

a single host taken in Chester, New Jersey, nothing is known of the distribution of either of these tydeids outside the type locality. Because of their minuteness and their habit of concealment deep within the tympanic recess, the mites would almost always escape discovery in collections of pinned moths unless the hosts were first relaxed or dissected. Experience in Tyringham suggests that even for *P. leucohippeus*, which has so far been found only in a single host species, the incidence is not high enough to warrant an extensive search of this kind. The tympanic hood in *Epizeuxis aemula*, the host of *leucohippeus*, is not easily retracted even in a fresh or living moth, and the mites are therefore easily overlooked. For *P. pyrrhippeus* the incidence in any one of the several host species is usually very low, so that a great many moths might be examined without yielding any mites. Systematic inspection of freshly collected living or at least pliable moths is most likely to provide new information.

Seasonal distribution of both species is fairly broad, even as represented in the few records here reported. It extends from late June to mid-October for *P. pyrrhippeus*, from late July to mid-October for *P. leucohippeus*. Records for *pyrrhippeus* extend back to 1954. It is noteworthy that although moths were examined almost nightly in every succeeding summer, there are no records for 1956, 1958, 1960 through 1962, and for 1968, whereas there are 12 records for 1965, nine for 1966, and five each for 1964 and 1967. As *pyrrhippeus* occurs on hosts of several different species and it was impractical to record every moth examined, the incidence of infestation cannot be given. It appears, however, that phoretic activity if not mite population was minimal from 1960 to 1962, and was greatest from 1964 to 1967, cresting in 1965. Reasons for this variation are unknown. Comparable records for *P. leucohippeus* are not available, because moths of the host species were not routinely examined until 1967. In that year I found only one infested moth out of 31 examined. The following year, 1968, which yielded no records of *pyrrhippeus*, produced three of *leucohippeus* out of 62 moths examined, whereas 1969, with only one record of *pyrrhippeus*, gave nine of *leucohippeus* out of 104 moths examined. It should be interesting to see whether subsequent collections bear out the suggested reciprocity in phase relationships between the two species.

The ecological relation between these mites and the moths that carry them cannot be stated unequivocally. Whereas most of the evidence suggests phoresy, there is some indication that on occasion the mites may be paraphagic. Even the possibility of parasitism cannot be ruled out completely. The finding of eggs on some moths and of a

nymph on one does not necessarily show that development is or can be completed in that situation. Whatever the relationship of the mites to the moths, it is scarcely one that might have been expected from our scanty knowledge of the habits of other tydeids.¹

In view of the many anatomical and behavioral similarities of the two species, one might question whether generic separation is justified. Both species differ in chaetotaxy of the legs from their respective generic formulae as given by Baker (1965), and the differences are consistent in series of 10 or more specimens each. The deviations occur in five podomeres of *Pronematus leucohippeus*, trochanters I and II, femur II, and tarsus III, each having one more seta than the typical number, and femur IV having one seta fewer. In *Pronematulus pyrohippeus*, four podomeres are atypical according to Baker's formula, genu and femur II, and tarsi III and IV each having one more seta than the formula demands. Whereas the chaetotaxy of the legs also differs significantly in the two species here considered, the departures of both from Baker's formulae suggest that leg chaetotaxy, especially if studied in only one or two representatives of a given taxon, may be less than definitive as a basis for generic separation.² With respect to the other criteria used by Baker to separate *Pronematulus* from *Pronematus*, the two species in question clearly fall into his two categories; *pyrohippeus* has the divided femur IV and the five complete rows of dorsal hysterosomal setae, whereas *leucohippeus* does not. For these reasons it seems best to accept the generic distinction provisionally, in the hope that future collections will eventually make possible a further clarification.

ACKNOWLEDGMENT

I thank Dr. Edward W. Baker of the United States National Museum, Smithsonian Institution, for examining specimens and for giving me helpful advice regarding them.

¹ My collection contains four undetermined specimens of the genus *Tydeus* Koch, taken from various noctuids in Tyringham, Massachusetts between 1955 and 1969, and two specimens of *Lorryia reticulata* Oudemans, taken in Tyringham on October 9, 1954, from a moth (?*Feltia* sp.) that had been killed by a spider. Dr. S. L. Tuxen recently sent me a mite of the genus *Lorryia* taken from a male of *Pseudaletia unipuncta* (Haworth) in Kvisker, Iceland, October 18, 1959. The moth is believed to be a migrant from Spain.

² The sole free-living *Pronematus* (of undetermined species) in my collection differs both from Baker's formula and from *P. leucohippeus*.

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