Phoretomorph: A New Phoretic Phase Unique to the Pyemotidae (Acarina: Tarsonemoidea)[1]

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ABSTRACT

The phoretomorph, representing a new type of phoresy for the Acarina, is a female specialized for riding insects. Certain pyemotid species possess both phoretomorphic and non-phoretomorphic females, but others are monomorphic and have one or the other.

Many tarsonemoid mites exhibit highly specialized interrelationships with various insects, particularly those whose adult forms reproduce in soil organic matter or under bark. The insects may provide to these mites a food supply and/or suitable substrate (e.g., for growing fungus), a highly structured habitat, and automatic dispersal to other such habitats.

Dispersal via phoresy is perhaps the most efficient means of enabling small animals to find their requisite microhabitats with a high degree of probability, and has been utilized by many mite species in all of the major suborders. The phenomenon has apparently evolved several times in the Acarina and shows a wide range of complexity. In highly adapted forms, observable morphological and behavioral characteristics are often striking.

Farish and Axtell (1971) outlined 4 basic types of phoresy in Acarina as follows:

(1) Unspecialized females phoretic; attachment by chelicerae or by clasping with legs. Some Mesostigmata, principally Macrochelidae.

(2) With behaviorally specialized but normally appearing deutonymphs which attach by their claws. Some Mesostigmata, particularly Parasitidae and related forms.

(3) As (2) above but attachment to the host by means of a specialized anal pedicel. Uropodina.

(4) With highly heteromorphic deutonymphs ("hypopi") possessing specialized structures for clinging (suckers, tenent hairs). Claws often absent (Acaridiae). These hypopial forms are so morphologically different from the adults that they were originally classified into different suborders.

Here we introduce a 5th type, wherein dimorphic females are present within a species. One, termed phoretomorph, is specialized for phoresy; the other is defined as "normal."

The existence of 2 female types was noted independently by Rack (1974a) in *Siteroptes graminum* (Reuter 1900) and by us in an undescribed species of *Pyemotes* (Cross and Moser 1975). In *S. graminum,* structural dimorphism is not extensive: the 2 female forms are easily recognizable as belonging to the same genus, and neither appears to be phoretic; however, life histories differ in that one form omits the free larval stage while the other does not. In *Pyemotes* neither female has a free larval stage, but one is specialized for phoresy and one is not; thus, the dimorphism is more pronounced than in *S. graminum,* although still within generic limits.

However, in rearing 2 species of *Siteroptes* associated with *Dendroctonus frontalis* Zimmerman and in examining a series of *Siteroptes* sp. from *Gladiolus,* we found dimorphic females which differ so markedly from one another that they are usually classed in different genera. In one bark-beetle mite and in the mites found on *Gladiolus,* the phoretomorphic females fall into the genus *Pediculaster* Vitzthum, 1931 (Fig. 1, 2, species A). Even more unexpectedly, phoretomorphic females from the remaining bark-beetle *Siteroptes* clearly belong to our erstwhile genus *Pygmephorellus* (Cross and Moser 1971) (Fig. 3, 4, species B). In the 2 reared species, normal and phoretomorphic females both gave rise to both normal and phoretomorphic daughters. Although phoresy was not seen in the above mites, it is assumed on the evidence of the adaptive structures. Phoresy in small-clawed pyemotids is either rare or non-existent, whereas the literature is abundant with records of phoretic, large-clawed forms (e.g., Cross and Moser 1971, Rack 1974b). These findings are analogous to the earlier discoveries (above) that hypopial forms were not separate taxa but very aberrant forms of Acaridae (Michael 1884).

Adaptive requirements for phoresy include many of the same features necessary for survival in extreme environments (i.e., those deficient in food, moisture, etc.) and are a logical extension of the latter. Rack (personal communication) points out correctly that females of *S. graminum* are not known to be phoretic; she apparently believes that in *S. graminum* the omission of the larval stage, resulting in a shortened generation time and presumably in an increased rate of natural increase, is more important than the development of structural adaptations for phoresy (Rack 1972). We agree that *S. graminum* shows little specialization for phoretomorphy; however, even in this instance, the heteromorphic female possesses an enlarged claw I and thickened leg I, suggesting that phoresy may exist. More advanced forms would include increased specializations for attaching to the host and for riding. The reduced segmentation, thickening, and enlargement of the claws, all of legs I, together with the smaller, more compact body form characteristic of phoretomorphs of the *Siteroptes* mentioned here (Fig. 2, 4), might be such modifications. Physiological and behavioral adaptations would also be required. Perhaps the ultimate in structural adaptation among the pyemotids would

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parallel that of certain members of the saproglyphid genus *Chaetodactylus,* in which both a highly specialized encysted, apodous "resting" deutonymph and a greatly specialized phoretomorphic deutonymph occur (Krombein 1962).

The discovery of phoretic and non-phoretic female morphs opens the door to a reevaluation of the dynamics of phoresy and introduces new evolutionary and classificatory problems into the family Pyemotidae. Perhaps many species of pyemotids possess phoretomorphic—or at least polymorphic—females. Besides *Pediculaster,* other phoretic pyemotid taxa are particularly suspect, e.g., *Pyemotes scolyti* (Oudemans 1936), *P. parviscolyti* (Cross and Moser 1971), most Acarophenacinae, most members of the *Pygmephorus s. str., Sicilipes,* etc. Also, in some cases, more than 2 female morphs may exist in the same species. Gurney and Hussey (1967, whose "2nd larval stage" of *Pediculaster mesembrinae* (Canestrini 1880) is undoubtedly the *Siteroptes* form of that mite, mention that populations of *P. mesembrinae* and *Bakerdania quadratus* (Ewing 1917) replace one another in time in mushroom cultures. Possibly the latter is another morph of the former (i.e., both are *Siteroptes*).

It also seems quite likely that one or the other of the morphs may become fixed, either accidentally or due to selection. We have seen no "normal" (i.e., *Siteroptes*) females in the mite we called *Pygmephorellus bennetti* (Cross and Moser 1971), despite the fact that we have reared the mite repeatedly in the laboratory and have observed it hundreds of times under bark. Likewise, the phoretic form seems to be lacking in certain species (e.g., *Pyemotes* of the *ventricosus* group).

We have no information concerning the genetic basis of our dimorphism. The latter's occurrence in *Pyemotes* (and probably other genera) besides *Siteroptes* argues in favor of its antiquity. The 2 male morphs in each of the known species are quite similar, suggesting that the mechanism of inheritance may be simple, e.g., one or but a few loci, their effects perhaps occurring early in the development of the organism. In the event that one morph should become lost via accident or selection, as suggested above, the surviving form would be the carrier of a markedly altered phyletic line. Particularly if the fixation has occurred by accident, this line would then presumably receive the full force of selection and be subject to an increased rate of evolution.

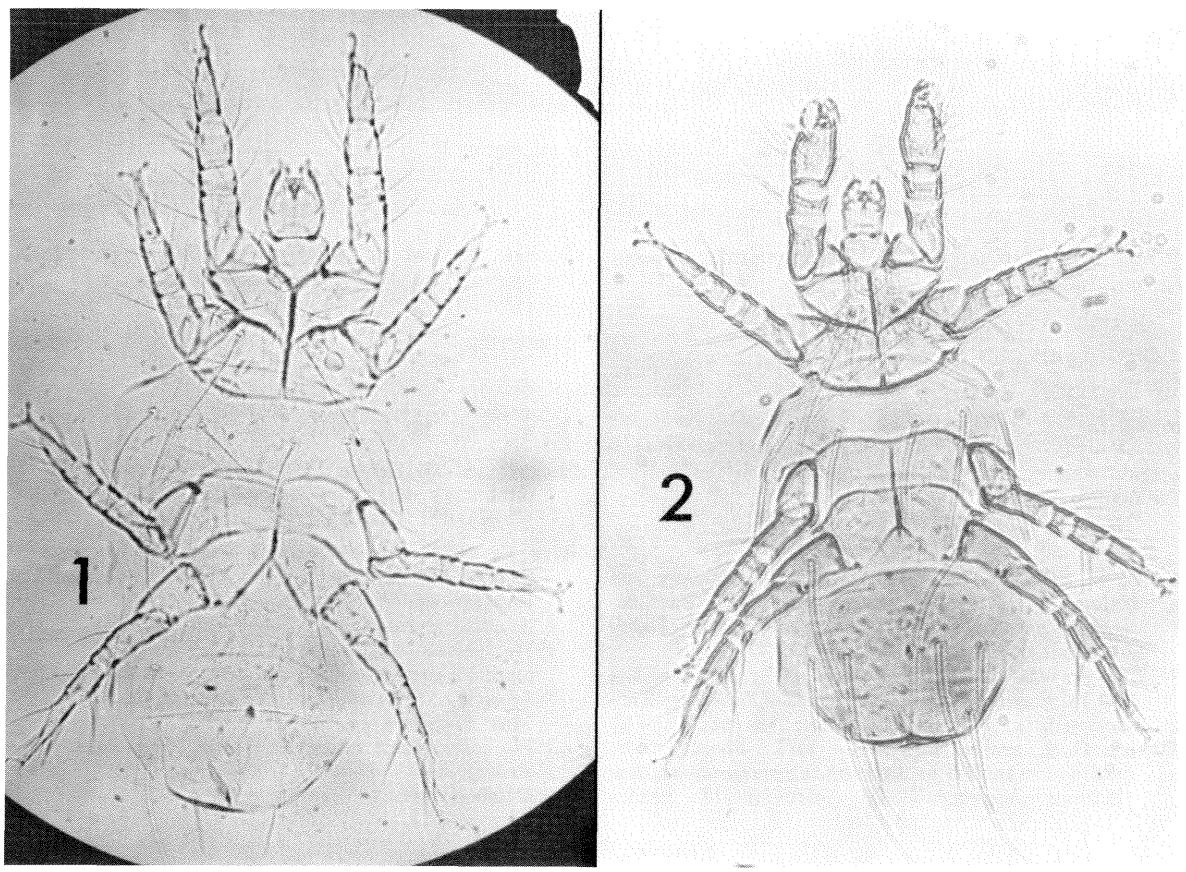

FIG. 1.—Normal *"Siteroptes"* form of species A.
FIG. 2.—Phoretomorphic *"Pediculaster"* form of species A.

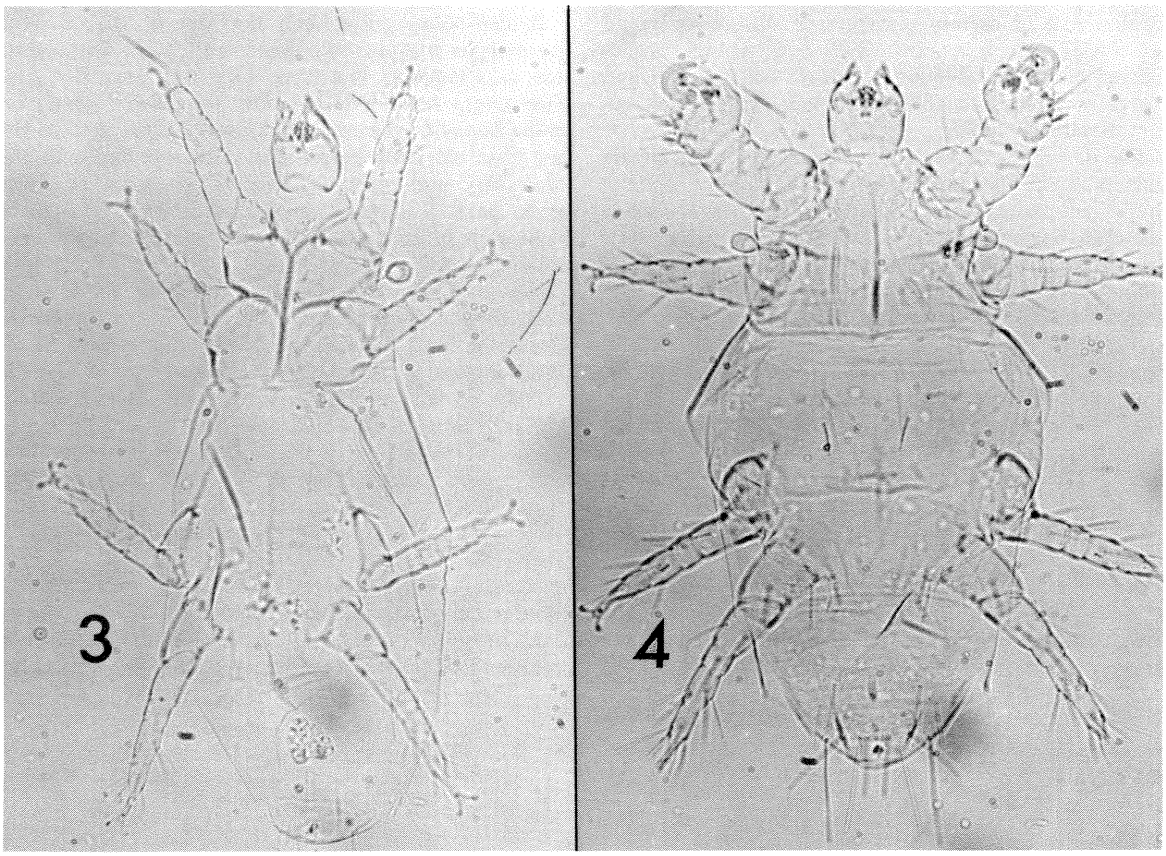

FIG. 3.—Normal *"Siteroptes"* form of species B.
FIG. 4.—Phoretomorphic *"Pygmephorellus"* form of species B.

Whether this has happened in the Pyemotidae is presently open to question.

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REFERENCES CITED

Cross, E. A., and J. C. Moser. 1971. Taxonomy and biology of some Pyemotidae (Acarina: Tarsonemoidea) inhabiting bark beetle galleries in North American conifers. Acarologia 13: 47–64.

1975. A new dimorphic species of *Pyemotes* and a key to previously-described forms (Acarina: Tarsonemoidea). Ann. Entomol. Soc. Am. 68: 723–732.

Farrish, D. J., and R. C. Axtell. 1971. Phoresy redefined and examined in *Macrocheles muscaedomesticae* (Acarina: Macrochelidae). Acarologia 13: 16–29.

Gurney, B., and N. W. Hussey. 1967. *Pygmephorus* species (Acarina: Pyemotidae) associated with cultivated mushrooms. Ibid., 9: 353–8.

Krombein, K. V. 1962. Natural history of Plummer's Island, Maryland, XVI. Biological notes on *Chaetodactylus krombeini* Baker, a parasitic mite of the megachilid bee *Osmia (Osmia) lignaria* Say. Proc. Biol. Soc. Wash. 75: 237–49.

Michael, A. D. 1884. The *Hypopus* question, or the life-history of certain *Acarina*. J. Linn. Soc. Lond. (Zool). 17: 371–95.

Rack, G. 1972. Pyemotiden and Gramineen in schwedischen landwirtschaftlichen Betrieben. Ein Beitrag zur Entwicklung von *Siteroptes graminum* (Reuter, 1900 Acarina, Pyemotidae). Zool. Anz. 188: 157–74.

1974a. Neue und bekannte Milbenarten der Überfamilie Pygmephoroidea aus dem Saalkreis bei Halle (Acarina, Tarsonemida). Entomol. Mitteil. Zool. Mus. Hamburg 4: 499–521.

1974b. Zwei neue Arten der Gattung *Pediculaster* von australischen Dipteren (Acarina, Tarsonemida, Pygmephoridae) Acarologia 16: 500–5.