Acarologia

A quarterly journal of acarology, since 1959
Publishing on all aspects of the Acari

All information:
http://www1.montpellier.inra.fr/CBGP/acarologia/
acarologia@supagro.fr

Acarologia is proudly non-profit,
with no page charges and free open access

Please help us maintain this system by
encouraging your institutes to subscribe to the print version of the journal
and by sending us your high quality research on the Acari.

Subscriptions: Year 2018 (Volume 58): 380 €
http://www1.montpellier.inra.fr/CBGP/acarologia/subscribe.php
Previous volumes (2010-2016): 250 € / year (4 issues)
Acarologia, CBGP, CS 30016, 34988 MONTFERRIER-sur-LEZ Cedex, France

The digitalization of Acarologia papers prior to 2000 was supported by Agropolis Fondation under
the reference ID 1500-024 through the « Investissements d’avenir » programme
(Labex Agro: ANR-10-LABX-0001-01)

Acarologia is under free license and distributed under the terms of the
Creative Commons-BY-NC-ND which permits unrestricted non-commercial use, distribution, and
reproduction in any medium, provided the original author and source are credited.
STUDIES ON THE MORPHOLOGY AND TAXONOMY
OF HAEMOGAMASUS REIDI EWING, 1925 (ACARI : MESOSTIGMATA)*

BY

BRYCE C. REDINGTON.

Dept. of Zoology, University of Maryland, College Park, Maryland 20742 U.S.A.

During the spring of 1968 studies were conducted in the state of Maryland on the transmission of a protozoan, Hepatozoon griseiscutri Clark, 1958, to the eastern gray squirrel, Sciurus carolinensis Gmelin, 1788, by a haemogamasine mite. According to Keegan (1951) this vector species is conspecific with Enhaemogamasus ambulans (Thorell, 1872) (= Haemogamasus ambulans). His concept of the species was accepted by subsequent American acarologists (Clark, 1958, 1959; Furman, 1957, 1959, 1966; Jameson and Brennan, 1957; Young, 1959; and Strandtmann and Wharton, 1958). However, since Evans and Till (1966) redescribed H. ambulans, it has become obvious (Furman, 1968; and Strandtmann, 1969) that the H. ambulans of American authors is not the same species as that of the European authors. To my knowledge this discrepancy has not yet been settled.

At the suggestion of Dr. G. O. Evans, I undertook a detailed study of the morphology of the American species referred to as H. ambulans. An extensive review of the literature and observation of many specimens of the species considered by Keegan in his synonymy of H. ambulans leads to the conclusion that the American mite vector of Hepatozoon griseiscutri is Haemogamasus reidi Ewing, 1925.

MATERIALS AND METHODS.

Type and non-type specimens of Haemogamasus reidi, H. sciuropterii, H. onychomydis, H. twitchelli, and H. oregonensis, plus non-type specimens of H. ambulans (European species) and H. nidi were provided by the National Museum of Natural History, formerly the United States National Museum, Washington, D. C. Most specimens of H. nidi were provided by the British Museum (Natural History), London. Additional specimens of H. ambulans (= H. reidi) were provided by Dr. D. P. Furman, University of California, Berkeley; Dr. E. W. Jameson, Jr., University of California, Davis; and Dr. R. W. Strandtmann, Texas Technological University, Lubbock, Texas.

Haemogamasus reidi was redescribed from the type slide [National Museum of Natural

* Part of a thesis submitted in partial fulfillment of the requirements for the Ph. D. degree.
Acateloria, t. XII, fasc. 4, 1970.
History (= N.M.N.H.) No. 949] which contained seven females collected from a squirrel nest at Forestville, Prince George's County, Maryland, on April 21, 1924, by E. D. Reid. Numerous other female specimens collected in the field or laboratory-reared by the author were used to supplement this redescription, specifically, to help demonstrate character variability. In addition, descriptions of the male, deutonymph (male and female), protonymph, and larva of this species were made using the laboratory-reared progeny of females collected in the field. The egg description was made using gravid females collected in the field; this species is ovoviviparous.

Mites were collected by the author from tree-mounted squirrel boxes placed in numerous areas throughout the Eastern Shore counties of Maryland. Nest fauna was extracted using the Berlese funnel technique modified by Tullgren (1917). Drawings were done with camera lucida using a Wild microscope (model Uzo). Photographs were taken with a Zeiss photomicroscope (model 18222) using Kodak panatomic-x fine grain film. Most work was done using phase contrast light. Specimens of males, females, deutonymphs, protonymphs, and larvae used in the redescription of H. reidi were then permanently mounted in Hoyer's medium and placed in the acarology collection of the National Museum of Natural History, Washington, D. C.

**Description.**

*Haemogamasus reidi* Ewing, 1925.


*Haemogamasus ambulans* : Jameson (E. W.), and (J. M.) Brennan. 1957. Ecol. Monog. 27 : 45-54.


**Female.** From the type slide I have designated a lectotype setting it off with a black ring from the remaining six paralectotypes. The values given in the description refer to the lectotype with ranges of these values among all seven syntypes added in parentheses where applicable.

Cheliceral segment I, 94 μ (79-96 μ) long; segment II (fig. 5), 123 μ (113-130 μ); movable digit (fig. 5), 50 μ (50-54 μ) and bidentate. Fixed digit (fig. 5) bidentate, the teeth followed by a ridge. *Pilus dentilis* (fig. 5) long, thin, and strongly curved. Dorsal seta (fig. 5), long, stout, slightly curved upwards extending to base of *pilus dentilis*. Dorsal and lateral lyriform fissure distinct (fig. 5). Four pairs of barbed gnathosomal setae (fig. 2). Capitular setae 82 μ (73-84 μ) apart; between hypostomal setae 2, 58 μ (57-64 μ). Deutosternum (fig. 2) with 11 (11-12) transverse rows of denticles, two to five per row. Corniculi (fig. 2), 28 μ (27-33 μ) long; internal malae (fig. 2) with long pointed inner and short broad outer lobes, all pilose. Tectum
Fig. 1-6: *Haemogamasus reidi* Ewing.

Adult female: idiosoma in dorsal view (1); gnathosoma in ventral view (2); pedipalp in dorsal view (3); chelicera in external view (5); sternal shield (6). Adult male: pedipalp in dorsal view (4).
(fig. 2) slender, pointed, deeply denticulate, with about eight simple or forked projections on each side. Salivary styli (fig. 2) conspicuous, extending beyond tips of corniculi and almost to tip of labrum. Pedipalp (2-5-6-14-15) with two-tined apotele; both trochanteral setae barbed (fig. 2, 3).

Dorsal shield (fig. 1), 809 μ (740-828 μ) long by 450 μ (411-450 μ) wide, densely covered with setae mostly of uniform length; some posterior and marginal setae barbed. Surface of shield granular with sculpturing anteriorly and faint reticulations posteriorly.

Tritosternum (fig. 7) with base barbed, 37 μ (27-50 μ) long; pilose lacinae, 143 μ (100-143 μ) long. Presternal area (fig. 7) with numerous small backward-directed spines on the reticulations. Sternal shield (fig. 6, 7), 120 μ (114-123 μ) long by 147 μ (123-152 μ) wide anteriorly, by 208 μ (157-208 μ) wide posteriorly, with the usual three pairs of setae; no accessory setae; three pairs of lyriform pores. Between sternal setae 1, 107 μ (96-107 μ); between sternal setae 1 and 3, 103 μ (92-104 μ). Sternal setae 1 barbed. Metasternal setae free (fig. 7). Genito-ventral shield (fig. 7) flask-shaped, 379 μ (364-397 μ) long, including the entire anterior flap, by 184 μ (172-191 μ) wide at the base. A pair of genital setae situated anteriorly and 24 (17-26) accessory setae distributed on the posterior two-thirds of the shield. Anal shield (fig. 7) pear-shaped, 127 μ (106-130 μ) long by 106 μ (91-106 μ) wide with the usual three anal setae; no (none to three) accessory setae. Both paranal setae plain or barbed, 40 μ (37-47 μ) long; postanal seta barbed, 72 μ (52-76 μ) long. The area posterior and lateral to the postanal seta is covered with numerous aciculae.

Considerable variation in the number of genito-ventral and anal shield accessory setae was noted among females in this study. These two characters have been included frequently in past descriptions of numerous species in the genus Haemogamastus. Even the establishment of new species has on occasion rested heavily or entirely upon one or both of these characters, e.g. Euhaemogamastus sciuropteri Keegan, 1946 (= Haemogamastus sciuropteri). However, it has invariably been discovered later on that because these characters overlap among closely related species they lose their usefulness as distinguishing characters. Although the two characters in question are not primary ones in separating Haemogamastus reidi from closely related species, it is nonetheless interesting to note the magnitude of variability exhibited in each case. Although some variability is evident among the type female specimens, significantly more is indicated by the many additional specimens observed in this study. Numbers of setae on the genito-ventral shield varied from 17 in one of the type females to 53 in a California specimen. Examples of varying numbers of accessory setae (fig. 13, 15, 17) show 36, 52, and 18 setae, respectively. The number of accessory anal setae varied from none to three in the type females; however, the examination of additional specimens extended this range to none to five setae. Figures 8, 11, and 12 show five, three, and no accessory setae, respectively, on the anal shield.

Small metapodal shield (fig. 7) posterior to coxa IV. Stigma (fig. 7) at level of coxa IV with peritreme extending anteriorly to middle of coxa II. Anterior tip of peritrematal shield terminates very close to dorsal shield but appears to end freely; posterior part of shield fused to podal elements of coxa IV.

That portion of the female spermathecal system which is visible after clearing (fig. 21) consists first of a median sacculus foeminius located just posterior to coxae IV and directly beneath the dorsal shield. The shape of this structure varies considerably from one specimen to another; it is usually irregularly oval and longer than wide. From its anterior border extend two constricted arms, the rami sacculi, which appear to be of the same structure as the sacculus foeminius. These rami sacculi extend anteriorly until at their junction with the tubuli annulati they are located at the level of coxae IV. The tubuli annulati appear to be more heavily sclerotized than the
FIG. 7-12: *Haemogamasus reidi* Ewing.

Adult female: idiosoma in ventral view (7); anal shield with five accessory setae (8); leg II in dorsal view (9); anal shield with three accessory setae (11); anal shield with no accessory setae (12). Adult male: chelicera in external view (10).
sacculus foemenus or rami sacculi and have an annulated structure. The tubuli annulati wind antero-laterally and ventrally until at their junction with the atria they are located ventrally in the body cavity. The atria are positioned almost transversely between coxae III and IV. An orifice to the exterior, called Michael's sperm induction pore by Young (1959), is located laterally on each atrium. Since all these structures were observed and described from mites cleared in lactic acid which included a minute amount of lignin pink for staining while all other internal organs were not evident, it is believed that these organs are probably ectodermal in origin. An excellent description of these structures and their probable function in a number of mites, including some species of Haemogamasus, is provided by Michael (1892). Young (1959) expands on Michael's work giving a detailed account of the probable origin, structure, and function of these genital organs as part of a study on the internal anatomy of Haemogamasus ambulans (Thorell). After observing Young's text and illustrations of the external anatomy of the mite in question, it is clear that he was working with Haemogamasus reidi Ewing, 1925.

The leg chaetotaxy is shown numerically (Table 1) as proposed by Evans (1963). The chaetotaxy of the adult and deutonymph of H. reidi, as in all species of Haemogamasus, differs from the normal pattern found in most dermanyssids in that genu IV bears two postero-lateral setae instead of one. Most leg setae are barbed; a conspicuous heavily barbed postero-dorsal seta is located proximally on tarsus IV (fig. 28). Distal margins of all segments except tarsi serrated (fig. 9). Leg I claw: reduced. Length of leg segment/width of leg segment (μ) on legs I to IV as follows:

<table>
<thead>
<tr>
<th>Leg</th>
<th>Lectotype</th>
<th>Syntype range</th>
<th>Lectotype</th>
<th>Syntype range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leg I</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Genu</td>
<td>104/60</td>
<td>98-111/52-60</td>
<td>103/79</td>
<td>86-101/67-79</td>
</tr>
<tr>
<td>Tibia</td>
<td>99/50</td>
<td>99-120/47-55</td>
<td>75/69</td>
<td>74-94/52-69</td>
</tr>
<tr>
<td>Tarsus</td>
<td>177/39</td>
<td>172-184/37-43</td>
<td>133/38</td>
<td>133-154/37-45</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Leg III</th>
<th>Lectotype</th>
<th>Syntype range</th>
<th>Lectotype</th>
<th>Syntype range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tibia</td>
<td>75/43</td>
<td>79-86/37-44</td>
<td>121/42</td>
<td>108-123/40-50</td>
</tr>
<tr>
<td>Tarsus</td>
<td>133/33</td>
<td>193-152/33-43</td>
<td>215/33</td>
<td>210-232/33-47</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Leg IV</th>
<th>Lectotype</th>
<th>Syntype range</th>
<th>Lectotype</th>
<th>Syntype range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genu</td>
<td></td>
<td></td>
<td>98-108/45-50</td>
<td></td>
</tr>
<tr>
<td>Tibia</td>
<td></td>
<td></td>
<td>108-123/40-50</td>
<td></td>
</tr>
<tr>
<td>Tarsus</td>
<td></td>
<td></td>
<td>210-232/33-47</td>
<td></td>
</tr>
</tbody>
</table>

Male. This description is based on four specimens which are progeny of females collected by the author from a nest of Sciurus carolinensis in Queen Anne's County, Maryland, on June 15, 1967. These specimens have been placed in the National Museum of Natural History collection on slides numbered BR98, BR99, and BR100. In the description the mean value for each character determined from all four specimens is followed by the range in parentheses where applicable.

Cheliceral segment I, 71 μ (62-78 μ) long; segment II (fig. 10), 123 μ (118-130 μ); movable digit (fig. 10), 4.5 μ (44-46 μ) with a spur on leading edge. The movable digit with spermadactyl together, 52 μ (50-53 μ) long. The spermadactyl extends anteriorly from the exterior face of the movable digit, its distal portion at a right angle to the long axis of the movable digit and extending slightly beyond the distal end of the movable digit. Fixed digit usually shorter than movable digit with a long stout slightly bent pilus dentilis. Dorsal seta as in female. Dorsal and lateral lyriform fissure (fig. 10) distinct. Four pairs of barbed gnathosomal setae (fig. 16).
### TABLE I: Leg chaetotaxy of *Haemogamasus reidi* adult and deutonymphal, protonymphal, and larval stages as shown numerically in chaetotaxy formulas.

<table>
<thead>
<tr>
<th></th>
<th>LEG I</th>
<th>LEG II</th>
<th>LEG III</th>
<th>LEG IV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LEG I</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult &amp; Deutonymph</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coxa</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Trochanter</td>
<td>1 — 3</td>
<td>1 — 3</td>
<td>1 — 3 — 0</td>
<td>1 — 3 — 0</td>
</tr>
<tr>
<td>Femur</td>
<td>2 — 5</td>
<td>2 — 5</td>
<td>1 — 3 — 1</td>
<td>1 — 3 — 1</td>
</tr>
<tr>
<td>Genu</td>
<td>2 — 3 — 2</td>
<td>2 — 3 — 2</td>
<td>2 — 2 — 2</td>
<td>2 — 2 — 2</td>
</tr>
<tr>
<td>Tibia</td>
<td>2 — 3 — 2</td>
<td>2 — 3 — 2</td>
<td>2 — 1 — 1</td>
<td>2 — 1 — 1</td>
</tr>
<tr>
<td>Tarsus</td>
<td><strong>3 — 3</strong></td>
<td>3 — 3 — 3</td>
<td>3 — 3 — 3</td>
<td>3 — 3 — 3</td>
</tr>
<tr>
<td><strong>LEG II</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protonymph</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coxa</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Trochanter</td>
<td>1 — 2</td>
<td>1 — 2</td>
<td>1 — 2 — 0</td>
<td>1 — 2 — 0</td>
</tr>
<tr>
<td>Femur</td>
<td>2 — 4 — 2</td>
<td>2 — 4 — 2</td>
<td>1 — 3 — 0</td>
<td>1 — 3 — 0</td>
</tr>
<tr>
<td>Genu</td>
<td>1 — 2 — 2</td>
<td>1 — 2 — 2</td>
<td>1 — 2 — 2</td>
<td>1 — 2 — 2</td>
</tr>
<tr>
<td>Tibia</td>
<td>1 — 2 — 1</td>
<td>1 — 2 — 1</td>
<td>1 — 2 — 1</td>
<td>1 — 2 — 1</td>
</tr>
<tr>
<td>Tarsus</td>
<td><strong>3 — 3</strong></td>
<td>3 — 3 — 3</td>
<td>3 — 3 — 3</td>
<td>3 — 3 — 3</td>
</tr>
<tr>
<td><strong>LEG III</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Larva</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coxa</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Trochanter</td>
<td>1 — 2</td>
<td>1 — 2</td>
<td>1 — 2 — 0</td>
<td>1 — 2 — 0</td>
</tr>
<tr>
<td>Femur</td>
<td>2 — 4 — 2</td>
<td>2 — 4 — 2</td>
<td>1 — 3 — 0</td>
<td>1 — 3 — 0</td>
</tr>
<tr>
<td>Genu</td>
<td>1 — 2 — 2</td>
<td>1 — 2 — 2</td>
<td>1 — 2 — 2</td>
<td>1 — 2 — 2</td>
</tr>
<tr>
<td>Tibia</td>
<td>1 — 2 — 1</td>
<td>1 — 2 — 1</td>
<td>1 — 2 — 1</td>
<td>1 — 2 — 1</td>
</tr>
<tr>
<td>Tarsus</td>
<td><strong>3 — 3</strong></td>
<td>3 — 3 — 3</td>
<td>3 — 3 — 3</td>
<td>3 — 3 — 3</td>
</tr>
</tbody>
</table>

* Most dermanyssid adults, unlike all those in the genus *Haemogamasus*, have only one postero-lateral seta on genu IV.

** The chaetotaxy of tarsus I has not yet been worked out.

*** Most dermanyssid protonymphs, unlike all those in the genus *Haemogamasus*, have no postero-lateral seta on genu IV.
Fig. 13-18: *Haemogamasus reidi* Ewing.

Adult female: genito-ventral shield with 36 accessory setae (13); genito-ventral shield with 52 accessory setae (15); genito-ventral shield with 18 accessory setae (17).

Adult male: gnathosoma in ventral view (16).

Male deutonymph: gnathosoma in ventral view (18).

Protonymph: pedipalp in dorsal view (14).
Capitular setae, 78 µ (67-85 µ) apart; between hypostomal setae 2, 40 µ (37-42 µ). Deutosternum (fig. 16) with 10-13 transverse rows of denticles, two to seven per row. Corniculi (fig. 16) blunt, 22 µ (20-23 µ) long. Internal malae, tectum, and salivary styli (fig. 16) as in female. Pedipalp (fig. 4) as in female except the first antero-lateral seta on both the femur and genu is stouter; $a_1$ on the genu also ends rather bluntly.

Dorsal shield (fig. 19), 758 µ (712-809 µ) long by 448 µ (392-504 µ) wide. Characters same as in female except two large dorsal pores are present one on either side of the midline near the posterior margin of the shield.

Tritosternum (fig. 20) with base barbed, 30 µ (25-35 µ) long; pilose laciniae, 118 µ (99-130 µ) long. Presternal area as in female. Holoventral shield (fig. 20), 612 µ (567-678 µ) long by 131 µ (120-138 µ) wide at the level of genital opening, with four pairs of sternal setae, three pairs of lyriform pores in the sternal region, and three anal setae. Genital orifice located between sternal setae 1. Between sternal setae 1, 94 µ (87-100 µ); between sternal seta 1 and 3, 100 µ (95-100 µ). Sternal setae 1 barbed. Both paranal setae (fig. 20) simple or barbed, 39 µ (37-40 µ) long; postanal seta barbed, 58 µ (54-62 µ) long. Aciculae as in female. Numerous setae distributed over the opisthogastric region (fig. 20) which usually do not extend anterior to ventral setae 5 (the genital setae). Peritreme (fig. 20) extends from stigma to posterior margin of coxa II. Peritrematal shield as in female.

Chaetotaxy and ornamentation of legs as in female (Table 1). Stout setae present on femur II ($v_2$ and $v_3$); genu II ($av$); tibia II ($av$); and tarsus II ($mv$ and $av_2$) (fig. 20). Leg I claws reduced; most leg setae barbed. A conspicuous heavily barbed postero-dorsal seta is located proximally on tarsus IV (fig. 23). Length of leg segment/width of leg segment (µ) on legs I to IV as follows:

<table>
<thead>
<tr>
<th>Leg I</th>
<th>Mean</th>
<th>Range</th>
<th>Leg II</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tarsus</td>
<td>178/38</td>
<td>172-184/34-42</td>
<td>139/38</td>
<td>128-153/37-38</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Leg III</th>
<th>Mean</th>
<th>Range</th>
<th>Leg IV</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genu</td>
<td>77/45</td>
<td>72-84/45-46</td>
<td>114/48</td>
<td>101-125/45-52</td>
<td></td>
</tr>
<tr>
<td>Tibia</td>
<td>82/39</td>
<td>75-99/37-40</td>
<td>123/41</td>
<td>110-135/38-45</td>
<td></td>
</tr>
<tr>
<td>Tarsus</td>
<td>150/31</td>
<td>147-176/30-33</td>
<td>231/34</td>
<td>218-247/30-37</td>
<td></td>
</tr>
</tbody>
</table>

Deutonymph. This description is based on four specimens which are progeny of females collected by the author from a nest of *Sciurus carolinensis* in Queen Anne’s County, Maryland, on June 15, 1967. These specimens have been placed in the National Museum of Natural History collection on slides numbered BR101, BR102, and BR103. It was noted as specimens were being selected for this description that there was considerable variation in the dimensions of available deutonymphs. Furthermore, these deutonymphs appeared to fall roughly into two groups, large and small. Young (1959) noted this variation also, specifically in the length and width of the dorsal shield, and the length of the sternal shield. He could predict with a high degree of accuracy the sex of a deutonymph by measuring these structures on live specimens and maintaining these mites until they molted to adults. He found that female deutonymphs
Fig. 19-23: *Haemogamasus reidi* Ewing.

Adult female: genital organs visible after clearing (21).
Adult male: idiosoma in dorsal view (19); idiosoma in ventral view (20); tarsus IV in dorsal view (23).
Larva: chelicera in external view (22).

a. = atrium; d.p.p. = dorsal posterior pore; p. = Michael's sperm induction pore; r.s. = rami sacculi;
s.f. = sacculus foemineus; t.a. = tubulus annulatus.
invariably exhibited larger features than did male deutonymphs. Accordingly, I have attempted to select two deutonymphs of each sex in order to more completely describe this stage of *H. reidi.* For each value considered in the description, the average of the two female deutonymphs is given first, followed by the average male deutonymph value in parentheses where applicable.

Cheliceral segment I, 47 μ (46 μ) long; segment II (fig. 34), 120 μ (110 μ); movable digit, 44 μ (40 μ). Dentition of chelicera, form of *pisus dentilis,* and dorsal seta as in female. Dorso- and laterally-lyriform fissure as in adults. Four pairs of barbed gnathosomal setae (fig. 18). Capitular setae, 84 μ (73 μ) apart; between hypostomal setae 2, 59 μ (53 μ). Deutosternum with 12 (12) transverse rows of denticles. Two to six per row. Corniculi 31 μ (27 μ) long; tectum as in female but only five to six projections on each side. Other gnathosomal features as in female.

Dorsal shield (fig. 33) with lateral incisions; hypertrichy and barbed setae distribution as in adults; shield surface sculptured in small scattered patches over the anterior three-fourths. Length of podonotal region, 419 μ (312 μ); length of opisthonotal region, 274 μ (229 μ). Maximum shield width just anterior to incisions, 321 μ (277 μ).

Tritosternum (fig. 27) as in adult, base 45 μ (39 μ) long; laciniae, 122 μ (113 μ) long. Prester nal area as in female. Sternal shield, 271 μ (242 μ) long with a maximum width of 164 μ (138 μ) between the level of sternal setae 2 and 3. Sternal shield bluntly rectangular anteriorly, narrowing behind sternal setae 3 and terminating posteriorly as a blunt narrow projection at the level of the posterior margin of coxae IV. Four pairs of setae and three pairs of lyriform pores with sternal setae 1 barbed. Sternal setae 4 subequal in length to the other sternal setae. Between sternal setae 1, 99 μ (83 μ); between sternal setae 1 and 3, 139 μ (130 μ). One pair of genital setae situated laterally to the posterior tip of the shield.

Anal shield (fig. 27) pear-shaped, 94 μ (84 μ) long by 94 μ (85 μ) wide, with the usual three anal setae and usually one plain accessory seta located at the anterior edge of the shield. Paranal setae barbed, 45 μ (40 μ) long; postanal setae barbed, 64 μ (56 μ) long. Aciculae as in female. Metapodal shields present as in female although smaller. Hypertrichy evident on opisthogastric region (fig. 27). Stigma with peritreme extending to the anterior portion of coxa III; shields weakly developed and free posteriorly.

Chaetotaxy and ornamentation of legs as in adults (Table 1). Most leg setae barbed; leg I claws not reduced. Mean length of leg segment/mean width of leg segment (μ) on legs I to IV as follows:

<table>
<thead>
<tr>
<th></th>
<th>LEG I</th>
<th></th>
<th>LEG II</th>
<th></th>
<th>LEG III</th>
<th></th>
<th>LEG IV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female deutonymphs</td>
<td>Male deutonymphs</td>
<td>Female deutonymphs</td>
<td>Male deutonymphs</td>
<td>Female deutonymphs</td>
<td>Male deutonymphs</td>
<td>Female deutonymphs</td>
</tr>
<tr>
<td>Genu.</td>
<td>112/74</td>
<td>96/61</td>
<td>92/82</td>
<td>81/71</td>
<td>80/60</td>
<td>67/52</td>
<td>105/55</td>
</tr>
<tr>
<td>Tibia</td>
<td>107/62</td>
<td>101/50</td>
<td>87/71</td>
<td>73/63</td>
<td>80/55</td>
<td>73/46</td>
<td>115/50</td>
</tr>
<tr>
<td>Tarsus</td>
<td>198/47</td>
<td>184/42</td>
<td>153/50</td>
<td>135/42</td>
<td>176/43</td>
<td>154/36</td>
<td>235/42</td>
</tr>
</tbody>
</table>
Fig. 24-29: *Haemogamasus reidi* Ewing.

Protonymph. This description is based on one specimen which is the progeny of a female collected by the author from a nest of *Sciurus carolinensis* in Queen Anne’s County, Maryland, on June 15, 1967. This specimen has been placed in the National Museum of Natural History collection on a slide numbered BR103.

Chelicerae poorly developed, apparently non-functional. Chelical segment II (fig. 35), 96 μ long; movable digit, 28 μ. Dentition reduced but similar to female except there is no tooth and ridge behind the *pilus dentilis*. Dorsal seta and *pilus dentilis* slightly reduced. Dorsal and lateral lyriform fissures present but reduced. Four pairs of barbed gnathosomal setae (fig. 24); capitular setae, 69 μ apart; between hypostomal setae 2, 52 μ. Deutosternum with 12 transverse rows of denticles, two to six per row. Tectum with seven to eight simple projections. Salivary styli, labrum, corniculi, and internal malae reduced. Pedipalp (1-4-5-12-15) with single palp trochantal seta barbed (fig. 14).

Podonotal shield (fig. 30), 353 μ long by 28 μ wide with about 14 pairs of setae. Pygidial shield, 208 μ long by 269 μ wide bearing about 11 pairs of setae. Hypertricity is evident lateral to both shields; a few postero-lateral setae barbed.

Tritosternum (fig. 31) with base faintly barbed, 43 μ long; laciniae pilose, 96 μ long. Pretarsal area with no reticulations; no sternal shield. Between sternal setae 1, 93 μ; between sternal setae 1 and 3, 136 μ. Sternal setae 1 barbed. Lyriform pores barely visible behind sternal setae 1, 2, and 3. Metasternal setae not present; genital setae present but very small. Anal shield (fig. 31) weakly developed, 94 μ long, 89 μ wide, with the usual three anal setae. Paranal setae barbed, 37 μ long; posterior seta barbed, 45 μ long. Acculacrea present. Oviposthagaster with five pairs of setae. Peritremes reduced, 38 μ long, extending from Stigma to anterior region of coxa IV; peritrematal shields not developed.

Chaetotaxy of legs as in Table I. An extremely long (195 μ) postero-dorsal seta present on tarsus IV (fig. 32). Most leg setae barbed; leg segments not serrated distally; leg I claws not reduced. Length of leg segment/width of leg segment (μ) on legs I to IV as follows:

<table>
<thead>
<tr>
<th></th>
<th>LEG I</th>
<th>LEG II</th>
<th>LEG III</th>
<th>LEG IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genu</td>
<td>94/77</td>
<td>72/87</td>
<td>63/65</td>
<td>84/57</td>
</tr>
<tr>
<td>Tibia</td>
<td>102/67</td>
<td>74/77</td>
<td>65/58</td>
<td>86/52</td>
</tr>
<tr>
<td>Tarsus</td>
<td>153/55</td>
<td>137/52</td>
<td>137/45</td>
<td>172/42</td>
</tr>
</tbody>
</table>

Larva. This description is based on one specimen which is the progeny of a female collected by the author from a nest of *Sciurus carolinensis* in Queen Anne’s County, Maryland, on June 15, 1967. This specimen has been placed in the National Museum of Natural History collection on a slide numbered BR104.

Chelicerae (fig. 22) very poorly developed, non-functional. No dentition whatsoever, *pilus dentilis* only a stub, dorsal seta very reduced. Dorsal lyriform fissure absent; lateral lyriform fissure present but reduced. Two pairs of plain gnathosomal setae (fig. 26); between the anterior pair, 20 μ; between the posterior pair, 37 μ. Deutosternum with seven transverse rows of denticles, three to seven per row. Tectum reduced with five rounded projections anteriorly. Salivary styli, labrum, corniculi, and internal malae extremely reduced. Characteristic pedipalp (0-4-5-12-11). No dorsal shields, dorsum 534 μ long, 450 μ wide (fig. 36). All dorsal setae simple; slight hypertricity evident only around postero-lateral edges. Tritosternum (fig. 37) with plain base, 42 μ long; laciniae barbed, 87 μ long. Plain pretersternal area; no sternal shield. Between sternal setae 1, 77 μ; between sternal seta 1 and 3, 127 μ. All sternal setae plain; no

*Acarologia, t. XII, fasc. 4, 1970.*
FIG. 30-35: *Haemogamasus reidi* Ewing.

Female deutonymph: idiosoma in dorsal view (33). Male deutonymph: chelicera in external view (34). Protonymph: idiosoma in dorsal view (30); idiosoma in ventral view (31); tarsus IV in dorsal view (32); chelicera in external view (33).
lyriform pores visible. Metasternal and genital setae not present. Anal shield not developed; a vestigial anus barely visible. Paranal setae plain, 104 μ long; postanal seta plain, 77 μ long; small area of aciculae present. Opisthogaaster with four pairs of setae. Peritremes and stigmata totally absent.

Fig. 36-37: *Haemogamasus reidi* Ewing.
Larva: idiosoma in dorsal view (36); idiosoma in ventral view (37).

Chaetotaxy of legs as in Table r. Leg segments not serrated distally; most leg setae barbed; leg I claws not reduced. Length of leg segment/width of leg segment (μ) on legs I to III as follows:

<table>
<thead>
<tr>
<th></th>
<th>LEG I</th>
<th>LEG II</th>
<th>LEG III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genu</td>
<td>89/69</td>
<td>80/86</td>
<td>67/67</td>
</tr>
<tr>
<td>Tibia</td>
<td>101/65</td>
<td>69/72</td>
<td>60/60</td>
</tr>
<tr>
<td>Tarsus</td>
<td>160/52</td>
<td>123/50</td>
<td>127/45</td>
</tr>
</tbody>
</table>

Egg. This description is based on 10 gravid females collected by the author from the tail of an adult female *Sciurus carolinensis* captured at Patuxent Wildlife Research Center, Prince George's County, Maryland, on March 5, 1969. Only one egg visible inside each female; this species is ooviviparous. Eggs measured an average of 384 μ (348-425 μ) long by 243 μ (209-290 μ) wide, with a length/width ratio averaging 0.64 (0.56-0.70).
DISTRIBUTION AND HOSTS OF Haemogamasus reidi
IN THE UNITED STATES AND CANADA 1.

ALABAMA: (28) Macon Co. — Fox squirrel, Gray squirrel.
ALASKA: (I) Golovin — Alaska short-tailed mouse; (2) Ophir — Dawson red back mouse
(3) Takotna — Microtus sp., Vole; (4) Juneau — Sciurus hudsonicus.
COLORADO: (18) Dolores Co. — Neotoma cinerea oreolestes; (19) Montezuma Co. — N. c. arizonae.
ILLINOIS: (24) Urbana — Squirrel hole; (25) Seymour — Glaucomys volans volans.
IOWA: (21) Des Moines — Sciurus sp.
KENTUCKY: (27) Perryville — Sciurus niger.
MARYLAND: (44) Bowie — Sciurus carolinensis, Raccoon; (45) Forestville — Squirrel nest;
(46) Dorchester Co. — S. carolinensis nest, S. niger nest; (47) Talbot Co. — Glaucomys volans nest; (48) Queen Anne’s Co. — S. carolinensis nest; (49) Montgomery Co. — S. carolinensis.
MICHIGAN: (22) Alger Co. — Glaucomys sabrinus; (23) Allegan Co. — Sciurus niger rufiventer, Cottontail.
NEW HAMPSHIRE: (36) Grafton Co. — Tamiasciurus or Evotomys.
NEW MEXICO: (20) Mogollon Mts. — Callospermophilus lateralis arizonensis, Microtus mex. mogollonensis.
NEW YORK: (39) Tompkins Co. — Sturnus vulgaris, Tamiasciurus hudsonicus.
NORTH CAROLINA: (30) Halifax — Flying squirrel.
OHIO: (26) Good Hope Twp. — Grey squirrel.
PENNSYLVANIA: (40) Wayne Co. — Glaucomys sabrinus macrotis; (41) Monroe Co. — Sciurus hudsonicus.
SOUTH CAROLINA: (29) Clemson — Flying squirrel.
UTAH: (16) Logan Canyon — Neotoma cinerea cinerea; (17) Provo — Woodrat nest.
VIRGINIA: (42) East Falls Church — Glaucomys volans volans; (43) McLean — Flying squirrel.
WEST VIRGINIA: (37) Follansbee — Gray squirrel.
ONTARIO: (32) Point Abino — Sciurus carolinensis, Blarina brevicauda, Glaucomys volans;
(33) Kenwood — Flying squirrel; (34) Ontario — Blue jay, Red squirrel.
QUEBEC: (35) Gaspereau — Glaucomys sp.

1. A detailed listing of individual slides observed by the author including author’s collection number, collection date, specimens, and collectors is on file with Dr. E. W. Baker, U. S. Department of Agriculture, Washington, D. C.
2. Numbers in parentheses refer to site numbers on distribution map (Fig. 38).
Comparison of Haemogamasus reidi Ewing, 1925, with H. ambulans (Thorell, 1872) and H. nidi Michael, 1892.

Haemogamasus reidi has often been confused with the two European species H. ambulans and H. nidi, most frequently the former. H. nidi is included in this comparison because Keegan (1951) synonymized H. nidi in addition to H. reidi with Euthaemogamasus ambulans (Thorell, 1872) (= Haemogamasus ambulans). Since Evans and Till (1966) redescribed and figured both H. ambulans and H. nidi, Furman (1968) has suggested that the American vector species resembles H. nidi more closely than any other European species, including H. ambulans, listed in the genus by those European authors.

H. reidi differs from H. ambulans and H. nidi in a number of characters. The female of H. reidi has a long thin pilus dentilis which is gradually curved over its distal half to make a right angle with its proximal end. In numerous cases it may even be recurved. The H. ambulans female has a much shorter and straighter setiform pilus dentilis; that of H. nidi is almost bulb-shaped at the proximal end and appears much stouter and straighter. The pilus dentilis of the H. reidi male is long, stout, and slightly bent. This organ in the male of H. ambulans in contrast is setiform; that of H. nidi is short, straight, and slightly inflated proximally.

The spermadactyl of H. reidi is bent distally to form a right angle with the long axis of the movable digit and extends slightly beyond its distal end. This organ in H. ambulans is bent distally only about 45 degrees or less to the long axis of the movable digit. Finally, in H. nidi the organ is similar to that of H. reidi except it is slightly shorter than the movable digit and displays from a lateral view a rounded protruding flange on its leading edge.

The dentition of the fixed digit of the male chelicera and movable digit of the female chelicera is similar among the three species. The movable digit of the male chelicera of H. reidi ends in a large terminal tooth which is at right angles with its long axis and extends slightly beyond the distal end of the fixed digit. The movable digit of the chelicera of H. ambulans has a prominent bifid ending which also extends beyond the distal end of the fixed digit, while that of H. nidi terminates in a claw-like process and extends only as far as the distal end of the fixed digit. Two small teeth are located behind the pilus dentilis in females of H. ambulans whereas in H. reidi and H. nidi there is only one tooth followed by a long ridge.

All three pairs of hypostomal setae in H. reidi and H. nidi are barbed, while hypostomal setae 1 of H. ambulans are smooth. No accessory setae are found on the sternal shield in females of H. reidi and H. nidi while present in H. ambulans. In males, ventral accessory setae extend anteriorly to the level of sternal setae 5 (rarely 4), 3, and 1, in H. reidi, H. nidi, and H. ambulans, respectively. The number of accessory setae on the genito-ventral shield of females of H. nidi, H. reidi, and H. ambulans is: greater than 60, 17 to 53, and 25 to 40, respectively. H. ambulans males do not possess stout setae on leg II segments as do H. reidi and H. nidi.

Two large pores are found on each side of the midline near the posterior margin of the dorsal shield in males of all three species, but in H. nidi are also found two rounded nodules situated between these pores. These nodules, but no pores, are present in H. nidi females while females of H. reidi and H. ambulans have neither pores nor nodules.

Discussion.

Ewing (1925) described Haemogamasus reidi as a new species on the basis of his examination of seven female specimens. Ewing (1933) then split the genus Haemogamasus into two
genera, *Haemogamasus* and *Euhaemogamasus*, on the basis of the presence or absence on the female of accessory sternal setae, respectively. Thus, the name *Haemogamasus reidi* was changed to *Euhaemogamasus reidi*. **KEEGAN** (1951) made a number of incorrect assumptions which led to the synonymizing of *Euhaemogamasus reidi* and a number of other species with *Euhaemogamasus ambulans* (*THORELL*, 1872) (≡ *Haemogamasus ambulans*). On the basis of an extensive literature search, I will attempt to clarify the present confused relationships among all species names dealt with by **KEEGAN** by briefly reviewing each pertinent paper.

**KEEGAN** (1951) listed the following as synonyms of *Euhaemogamasus ambulans* (*THORELL*, 1872) (≡ *Haemogamasus ambulans*):

- *Dermanyssus ambulans* Thorell, 1872.
- *Gamasus ovalis* Koch, 1878.
- *Haemogamasus nidi* Michael, 1892.
- *Laelaps ovalis*: Trägårdh, 1902.
- *Haemogamasus michaeli* Oudemans, 1903.
- *Hypoaspsis ambulans*: Trägårdh, 1904.
- *Haemogamasus reidi* Ewing, 1925.
- *Haemogamasus twitchelli* Ewing, 1925.
- *Euhaemogamasus onychomydis* Ewing, 1933.
- *Euhaemogamasus sciuropteri* Keegan, 1946.

**THORELL** (1872) described a mite collected on Disko Island, Greenland, calling it *Dermanyssus ambulans*. The description was made from a single specimen and was so general one could not even determine to which genus the species belongs. No drawings were included in the description.

**Koch** (1878) described a specimen from Jenissej, Siberia, naming it *Gamasus ovalis*. This paper's text and illustrations highly suggest a mite of the present genus *Haemogamasus* due to the density of setae on the idiosoma and the size and shape of the ventral shields.

**Michael** (1892) described a mite found in nests of moles, *Talpa europoea*, in England calling it *Haemogamasus nidi*. Significant characters mentioned include the male fixed digit of the chelicera ending in a claw-like structure, the spermadactyl extending slightly anterior and lying perpendicular to the distal end of the movable digit, and a rounded flange extending from the leading edge of the spermadactyl.

**Trägårdh** (1902) transferred *Dermanyssus ambulans* Thorell to the genus *Laelaps* but questioned his own action in doing this. In the same paper he transferred *Gamasus ovalis* Koch to the genus *Laelaps* with no accompanying explanation. **Trägårdh**'s conclusions in 1902:

- *Laelaps ambulans*: Trägårdh, 1902.
- Syn.: *Dermanyssus ambulans* Thorell, 1872.
- *Laelaps ovalis*: Trägårdh, 1902.
- Syn.: *Gamasus ovalis* Koch, 1878.

Two years later, **Trägårdh** (1904) rejected the action in his 1902 paper of transferring *Dermanyssus ambulans* to the genus *Laelaps* by leaving *Laelaps ambulans* out of the synonymy of his newly established combination *Hypoaspsis ambulans*. He began this paper by saying, "The only present specimen of *Dermanyssus ambulans* agrees completely with that of *Gamasus ovalis*." He thus renamed these *Hypoaspsis ambulans* (*THORELL*). It is significant that **Trägårdh** then mentioned the presence of two pairs of accessory setae on the sternal shield and six
pairs of accessory setae on the genital shield of the female of *Hypoaspis ambulans*. TRAGÅRDH's conclusions in 1904:

*Hypoaspis ambulans*: Trågårdh, 1904.  
Syn.: *Gamasus ovalis* Koch, 1878.  
*Laelaps ovalis*: Trågårdh, 1902.

TRÅGÅRDH (1910) then transferred *Hypoaspis ambulans* to the genus *Eulaelaps*. However, he lumped females of two different species [*Haemogamasus ambulans* (Thorell), which he referred to as "the large nymph" or "tritonymph"; and *Haemogamasus nidi* Michael, 1892, which he referred to as "the smaller nymph" or "deutonymph"] together as *Eulaelaps ambulans*. Thus TRÅGÅRDH's opening statement, "My specimens agree completely with those arcic specimens described by me in 1904" is only partially correct. He stated that the "deutonymph" had an extraordinarily large *pilus dentilis*, half as long as the claw, with the proximal end almost bulb-shaped. Also he indicated that there was one small tooth behind the *pilus dentilis* of the "deutonymph." These characters are highly suggestive of *Haemogamasus nidi*. In the drawing of the ventral side of the same specimen no accessory setae were shown on the sternal shield. This character also indicates that this specimen is not the same species as described by TRÅGÅRDH in 1904. TRÅGÅRDH's description of the "large nymph" or "tritonymph" is only an enlargement of the same specimen described by him as *Hypoaspis ambulans* in 1904. These descriptions clearly resemble *Haemogamasus ambulans* (Thorell). His 1910 illustration of the female chelicera clearly shows the fixed digit with a bifid tip, then a long thin curved *pilus dentilis* followed by two small teeth. The movable digit ends with a tooth-like projection, not a claw; two smaller teeth follow this terminal tooth. The movable and fixed digits are of the same length. TRÅGÅRDH's 1904 illustration of the sternal shield of the female *Hypoaspis ambulans* drawn with two pairs of accessory setae clearly resembles *Haemogamasus ambulans* while ruling out *Haemogamasus nidi*. TRÅGÅRDH's conclusions in 1910:

*Eulaelaps ambulans*: Trågårdh, 1910.  
Syn.: *Gamasus ovalis* Koch, 1878.  
*Laelaps ovalis*: Trågårdh, 1902.  
*Hypoaspis ambulans*: Trågårdh, 1904.

OUDEMANS (1903, 1913) described a mite which he called *Haemogamasus michaeli* which is clearly synonymous with *Haemogamasus nidi* Michael, 1892. Important specific characters mentioned were: no accessory setae on the sternal shield of the female, *pilus dentilis* very large and lancet-shaped in the female, about 70 accessory setae on the genito-ventral shield, the first pair of hypostomal setae barbed, and ventral accessory setae extending anteriorly to the level of sternal setae 3 on the male.

HIRST (1914) while studying acari occurring on the brown rat, *Mus norvegicus* (= *Rattus norvegicus*), in Great Britain, identified some specimens as *Haemogamasus nidi* and maintained he could find no differences between his specimens and either the type specimens of MICHAEL (1892) or mites identified by OUDEMANS (1903, 1913) as *Haemogamasus michaeli*. HIRST'S conclusions in 1914:

*Haemogamasus nidi* Michael, 1892.  
Syn.: *Haemogamasus michaeli* Oudemans, 1903.

From the foregoing discussion, I conclude:

*Haemogamasus ambulans*: Bregetova, 1953.
Upon observing the descriptions of both *Haemogamasus ambulans* (Thorell) and *Haemogamasus nidi* Michael by Evans and Till (1966), it is immediately obvious that the American vector species under consideration is neither of these two species. Since *Haemogamasus ambulans*, *Haemogamasus nidi*, and all their synonyms are now removed from consideration, the next available name is *Haemogamasus reidi* Ewing, 1925. Upon observation of Ewing's type slide, all seven female specimens were found to highly resemble females of the vector species in this study.

The relationship of *Haemogamasus reidi* to the last three species on Keegan's list of synonyms is as follows: *Haemogamasus twitchelli* Ewing, 1925, is considered a synonym of *Haemogamasus ambulans* (Thorell, 1872). Ewing's type slide (N.M.N.H. No. 952) contains two individuals, one male designated as the holotype, and one female. Both were taken from a Dawson red-back vole, *Evotomys dawsoni* (= *Clethrionomys dawsoni*), at Crater Mountain, Ophir, Alaska, by A.H. Twitchell on July 26, 1924. The male clearly resembles *Haemogamasus ambulans*. The most obvious characters are the slightly bent spermadactyl, the absence of stout setae on leg II segments, and the extent of the ventral accessory setae up to the first pair of sternal setae. The female, however, clearly resembles *Haemogamasus reidi*. Keegan (1951) mistakenly thought Ewing had designated the female on the slide as the holotype.

*Euhaemogamasus onychomydis* Ewing, 1933 (= *Haemogamasus onychomydis*) is considered a distinct species from *Haemogamasus reidi*. The type slide (N.M.N.H. No. 1068) contains one female taken from a grasshopper mouse, *Onychomys* sp., at Oraibi, Arizona, in June, 1927, by P.E. Trapier. Keegan (1931) did not report personally seeing this slide although he did observe one other slide (see footnote *, p. 649) which is *Haemogamasus onychomydis*. This species exhibits a larger chelicera (movable digit about 75 μ long versus 50 μ in *Haemogamasus reidi*) with a short straight setiform pilus dentilis. The movable digit ends as a slightly bent claw rather than in a tooth. A conspicuous brush border is present at the base of the movable digit. The pointed corniculi are considerably larger (about 65 μ long) than those of *Haemogamasus reidi*. Finally, the leg setae are more thickly barbed and all dorsal and most opisthosomal setae are barbed. With the description of this species Ewing (1933) established the new genus *Euhaemogamasus* to include those mites of the genus *Haemogamasus* (*H. reidi*, *H. onychomydis*, *H. oregonensis*, and others) possessing no sternal accessory setae.

*Euhaemogamasus sciuropteri* Keegan, 1946 (= *Haemogamasus sciuropteri*) is conspecific with *Haemogamasus reidi*. The type slide (N.M.N.H., no number) contains one female collected from *Sciurus* sp. at Des Moines, Iowa, on December 29, 1944, by H.J. May. Keegan (1946) considered this species to be unique in the genus by having a constant number of anal setae (five) but it later became evident to Keegan that this character varied considerably and could not reliably be used to separate species in this genus.

* Although Trägårdh (1904) listed *Gamasus ovalis* Koch, 1878, and *Laelaps ovalis* : Trägårdh, 1902, as synonyms of *Hypoaspis ambulans* (Thorell), these conclusions are considered of doubtful value (Evans, 1968).
Keegan (1951) dealt with another species, *Euhaemogamasus oregonensis* Ewing, 1933 (= *Haemogamasus oregonensis*), although he left it out of his synonymy list while describing it in the text as highly resembling "*E. reidi*, *H. twitchelli*, *E. onychomydis*, and *E. sciuropteri". The two type slides (N.M.N.H. No. 1070) each contain one female collected from a forest tree mouse at Netarts, Oregon, on December 6, 1930, by R. R. Walker. This species clearly resembles *H. reidi* and must be considered conspecific with it.

Since Keegan's work (1951) *Euhaemogamasus ambulans* has been referred by most authors to the genus *Haemogamasus*. Asanuma (1951) described a new species, *Haemogamasus kusumotoi*, found on a variety of small mammals in Manchuria, in which was seen for the first time either the presence or absence of accessory sternal setae on female specimens of the same species. Asanuma thus questioned the existence of two genera, *Haemogamasus* and *Euhaemogamasus*, set up by Ewing in 1933 to separate mites with and without accessory sternal setae, respectively. Since *Haemogamasus* is the older name, Asanuma proposed the abandonment of *Euhaemogamasus* Ewing, 1933, under the synonymy of *Haemogamasus* Berlese, 1889.

Very early it was indirectly questioned whether *Haemogamasus ambulans* should be used in referring to the American vector species. Bregetova (1953), citing Tragardh's works (1902, 1904, 1910) and Keegan's work (1951), noted as we have that *H. ambulans* and *H. nidi* could not be considered conspecific because the former had sternal accessory setae and the latter did not. She erroneously agreed with Keegan, however, that *H. reidi*, *H. twitchelli*, *E. onychomydis*, *H. oregonensis*, and *H. sciuropteri* were synonymous with *H. nidi*. Three years later, Bregetova (1956) again noted the differences between *H. ambulans* and *H. nidi* in a paper which included a key to these and some other species of the genus *Haemogamasus*.

American workers, however, have continued to call the vector species *H. ambulans*. Furman (1959 a) commented that *H. ambulans* (Thorell) was widely distributed in the nests and less frequently on the bodies of a variety of rodents in Europe and North America. Undoubtedly, most of these mites in North America are *H. reidi*, not *H. ambulans* (see p. 658 and Fig. 38).

Recently, however, workers have begun to question the wide usage of *H. ambulans* in North America. Furman (1968) reporting again on this species called it *H. ambulans* (Thorell) sensu (Keegan, 1951), contending that this name was used in the sense of earlier American workers [Keegan (1951); Furman (1959, 1959 a)] and not as used by Evans and Till (1966). Furman stated that according to the American mite most closely resembled *H. nidi* but hinted that he questioned whether they were conspecific since Evans, in a personal communication to Furman, expressed doubt whether the European *H. nidi* and the American species were identical.

Strandtmann (1969) also stated that the *H. ambulans* of American authors was not the same as the *H. ambulans* of European workers and suggested that an explanation to this effect accompany any mention of the name *H. ambulans* in North America.

Conclusions.

The American vector of the eastern gray squirrel protozoan, *Hepatozoon griseiscutri*, is *Haemogamasus reidi* Ewing, 1925. This mite has been commonly confused with two European species, *Haemogamasus ambulans* : Bregetova, 1953, and *Haemogamasus nidi* Michael, 1892, usually the former. *Haemogamasus onychomydis* Ewing, 1933, a valid American species, also should not be considered conspecific with *Haemogamasus reidi*. The relationships of all concerned species names should be as follows:
Fig. 38: Map of continental United States, Alaska, and southern Canada showing location of collection sites of *Haemogamasus reidi* from which specimens have been examined by the author. Site numbers correspond to those listed in section covering distribution and hosts of *Haemogamasus reidi* (p. 658).

*Haemogamasus reidi* Ewing, 1925.

Syn.: *Euhaemogamasus oregonensis* Ewing, 1933.
*Euhaemogamasus sciuropteri* Keegan, 1946.
*Euhaemogamasus ambulans* : Keegan, 1951, partim.

*Haemogamasus onychomydis* (Ewing, 1933).

Syn.: *Euhaemogamasus onychomydis* Ewing, 1933.
*Euhaemogamasus ambulans* : Keegan, 1951, partim¹.

¹. Keegan personally observed one slide (N.M.N.H. collection) containing one female of *Haemogamasus onychomydis* which he called *Euhaemogamasus ambulans* (= *Haemogamasus ambulans*). This specimen was
Haemogamasus ambulans (Thorell, 1872).

Syn.: Dermanyssus ambulans Thorell, 1872.
Hypoaspis ambulans: Trägårdh, 1904.
Haemogamasus twitchelli Ewing, 1925.
Haemogamasus ambulans: Bregetova, 1953; Evans and Till, 1966.

Haemogamasus nidi Michael, 1892.

Syn.: Haemogamasus michaeli Oudemans, 1903.
Euhaelaps ambulans: Trägårdh, 1910.
Haemogamasus ambulans: Keegan, 1951, partim.

KEY TO FOUR SPECIES OF Haemogamasus WHICH HAVE BEEN COMMONLY CONFUSED IN AMERICAN LITERATURE.

Females.

1. Sternal shield with accessory setae; *pilus dentilis* setiform; two teeth behind *pilus dentilis*; hypostomal setae 1 smooth........................................... Haemogamasus ambulans (Thorell, 1872)

Sternal shield without accessory setae; *pilus dentilis* may or may not be setiform; less than two teeth behind *pilus dentilis*; hypostomal setae 1 barbed........................................... 2

2. *Pilus dentilis* setiform; movable digit ends as a slightly bent claw, about 75 μ long; corniculi large, about 65 μ long; leg setae thickly barbed; all dorsal and most opisthogastral setae barbed. Haemogamasus onychomydis (Ewing, 1933)

*Pilus dentilis* not setiform; movable digit ends as a tooth; corniculi 25-40 μ long; leg setae sparsely barbed; only posterior and marginal setae on dorsum and opisthogastr barbed............................................... 3

3. *Pilus dentilis* stout, straight, almost bulb-shaped proximally; more than 60 accessory setae on genito-ventral shield; two nodules near posterior margin of dorsal shield................................. Haemogamasus nidi Michael, 1892

*Pilus dentilis* long, thin, curved distally; less than 60 accessory setae on genito-ventral shield; without nodules near posterior margin of dorsal shield........................................... Haemogamasus reidi Ewing, 1925

Males

(that of Haemogamasus onychomydis is unknown).

1. *Pilus dentilis* setiform; spermatadactyl bent distally about 45 degrees to long axis of movable digit; movable digit of chelica with bifid tip; ventral accessory setae extend anteriorly to level of sternal setae 1; no stout setae on leg II segments.. Haemogamasus ambulans (Thorell, 1872)

*Pilus dentilis* not setiform; spermatadactyl bent distally about 90 degrees to long axis of movable digit; ventral accessory setae do not extend anteriorly to sternal setae 1; stout setae present on leg II segments........................................... 2

2. *Pilus dentilis* short, straight, slightly inflated proximally; spermatadactyl slightly shorter than movable digit; spermatadactyl shows from lateral view a rounded protruding flange on leading


1. Keegan personally observed two slides containing specimens of Haemogamasus nidi which he called Euhaemogamasus ambulans (= Haemogamasus ambulans). One slide (N.M.N.H. collection) contained one female collected from Apodemus sylvaticus, Torrington, Devon, England, on March 18, 1937, by D. G. Nichols. The other slide (JAMESON collection) contained one female collected from Apodemus sylvaticus, Reskadinnick, Camborne, Cornwall, England, on March 17, 1946, by F. A. Turk.
Acknowledgements.

The writer wishes to express his sincere appreciation to the following individuals for their assistance during this work:

Prof. G. O. Evans, Department of Agricultural Zoology, University College, Dublin, Ireland; for his original suggestion of this work and his help in the redescription and subsequent suggestion concerning the manuscript;

Dr. L. A. Jachowski, Jr., and Dr. G. F. Otto, Professors, Department of Zoology, University of Maryland, for their advice and encouragement throughout the study;

Dr. V. F. Fleyger and Dr. D. M. Harman, Natural Resources Institute, University of Maryland; Dr. E. W. Baker and Mr. R. L. Smiley, U. S. Department of Agriculture, Washington, D. C.; Dr. D. P. Furman, University of California, Berkeley; Dr. R. W. Strandtman, Texas Technological University; Dr. E. W. Jameson, University of California, Davis; Mr. K. H. Hyatt, British Museum (Natural History), London; Dr. G. Anastos, University of Maryland, and Mrs. Eileen d'Araujo, Bishop Museum, Honolulu, for valuable materials;

Dr. A. McIntosh, University of Maryland, for helpful suggestions concerning nomenclature and taxonomy;

Mr. T. S. Kaufman, University of Maryland, for suggestions concerning the drawings; and

Mr. V. Montvilloff, University of Maryland, for aid in translating the Russian papers.

BIBLIOGRAPHY


Clark (G. M.), 1958. — Hepatozoon griseisciuri n. sp.; a new species of Hepatozoon from the grey squirrel (Sciurus carolinensis Gmelin, 1788), with studies on the life cycle. — J. Parasit., 44 : 52-63.


Evans (G. O.), 1968. — Personal communication.


JAMESON (E. W.) and BRENNAN (J. M.), 1957. — An environmental analysis of some ectoparasites of small forest mammals in the Sierra Nevada, California. — Ecol. Monog., 27: 45-54.


Strandtmann (R. W.), 1969. — Personal communication.


