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Mites of Utah mammals

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MITES OF UTAH MAMMALS

by

Dorald M. Allred and D Elden Beck*

INTRODUCTION

In 1949 a systematic survey was initiated by the junior author to determine the ecological relationships of parasitic arthropods associated with reptiles, birds, and mammals in Utah. Emphasis was given to the rodents rather than the larger mammals, birds, reptiles, and nests which were collected less frequently. Approximately 9,000 small mammals were examined for ectoparasites between April, 1949, and August, 1965 (Table 1). Financial support was obtained from the National Institutes of Health (Grants E-102, E-1273, A1-01273, and A1-01273-08) and from Brigham Young University primarily to study fleas and ticks, but lice and mites also were collected. The records of the mites taken during the sixteen-year period constitute the basis of this report.

Financial support specifically for analysis and publication of the data on mites was received from the National Institutes of Health (Grants GM 12321-01 and GM 12321-02). Release time was allowed the senior author by Brigham Young University as a Faculty Research Fellow (1965-66) to pursue work on this project. Other financial support and facilities furnished by Brigham Young University in past years contributed considerably toward our objectives. We appreciate the kindness of Dr. Russell W. Strandtmann, Texas Technological College; Dr. Frank J. Radovsky, George Williams Hooper Foundation; Dr. James M. Brennan, Rocky Mountain Laboratory; Dr. Richard B. Loomis, California State College at Long Beach; and Dr. Clive D. Jorgensen, Brigham Young University, for identification and/or verification of identification of some of the mites, for suggestions pertaining to some of the taxonomic problems, and for critical review of the manuscript. Many technicians assisted in mounting the mites over several years, but we are especially grateful to Mr. Selby Herrin, graduate student at Brigham Young University, for most of the mounting as well as pencil drawings of the mesostigmatids. Mr. Morris Goates, Skyline High School, Salt Lake City, identified and made pencil drawings of the chiggers. We are grateful to the many students and faculty of the Department of Zoology and Entomology and others who collected mites over the past 16 years.

Topographical and Faunal Features

Utah encompasses the western part of the Upper Colorado River Basin and the eastern part of the Great Basin (Fig. 615). The diversified topography varies in elevation from 2,760 ft to 13,498 ft, and the biotic features vary from desert shrub to alpine areas. Consequently there is a great diversity of habitats and fauna within the state. For further descriptions of the biotic and faunal areas of these basins, refer to the excellent discussions by Durrant (1952), Beck (1955), and Hayward, Beck, and Tanner (1958).

TABLE 1. NUMBERS OF MAMMALS EXAMINED AND FOUND INFESTED WITH ECTOPARASITES IN UTAH BETWEEN 1949 AND 1965 (BRIGHAM YOUNG UNIVERSITY, DEPARTMENT OF ZOOLOGY AND ENTOMOLOGY, PROJECT 10).

Group and species*	No. examined	No. infested with: Fleas	Lice	Mites	Ticks
SHREWS					
Sorex sp.	2				
S. palustris	5			2	
S. vagrans	7	1		1	1
BATS					
Corynorhinus townsendii	16			12	
Myotis sp.	642	47	2	597	
M. californicus	3	1		2	
Pipistrellus sp.	3			2	2
Tadarida brasiliensis	2			1	1
PIKAS					
Ochotona princeps	95	75	1	80	43
RABBITS AND HARES					
Lepus sp.	1				1
L. americanus	4	2			2
L. californicus	561	50	4	18	454
L. townsendii	13	6		8	

*Department of Zoology and Entomology, Brigham Young University, Provo, Utah.

Sylvilagus sp.	79	48		1	43
S. audubonii	60	33	6	13	41
S. idahoensis	16	11		4	11
S. nuttallii	20	16		2	17
SQUIRRELS AND RELATIVES					
Ammospermophilus leucurus	113	90	36	26	21
Cynomys sp.	3	2	2	3	2
C. gunnisoni	1	1			
C. leucurus	13	7	2	4	5
C. parvidens	3	3		1	2
Eutamias sp.	24	19	7	13	3
E. dorsalis	28	10	4	5	8
E. minimus	122	81	32	43	60
E. quadrivittatus	97	58	45	35	29
E. umbrinis	8	1	6		1
Glaucomys sabrinus	4	2	1	2	2
Marmota flaviventris	52	40	29	9	16
Sciurus aberti	1	1		1	1
Spermophilus armatus	254	170	132	98	116
S. beldingi	4	3			2
S. lateralis	130	76	18	54	82
S. richardsonii	7	7	4	1	4
S. spilosoma	2	2			1
S. townsendii	8	5	2	1	2
S. tridecemlineatus	5	2	3	1	1
S. variegatus	60	49	7	17	18
Tamiasciurus hudsonicus	56	33	11	14	8
POCKET GOPHERS					
Thomomys sp.	12	3	2	6	1
T. talpoides	151	64	54	37	19
T. umbrinus	73	30	47	29	2
HETEROMYIDS					
Dipodomys sp.	15		1	2	6
D. deserti	7	4	2	5	2
D. merriami	152	68	13	63	49
D. microps	87	6	11	48	32
D. ordii	820	293	222	610	351
Microdipodops megacephalus	6				6
Perognathus sp.	63	3	5	24	9
P. apache	12		1	10	
P. formosus	96	3	27	55	10
P. intermedius	1				
P. longimembris	72	1	2	14	30
P. parvus	224	46	19	82	86
BEAVERS					
Castor canadensis	4				
CRICETID RODENTS					
Neotoma sp.	9	6	1	4	4
N. albigula	3	2		1	1
N. cinerea	29	25	5	7	6
N. lepida	149	80	20	56	20
N. mexicana	1	1			
Onychomys sp.	9	7	2	3	
O. leucogaster	32	27	7	19	9
O. torridus	4	3	2	2	1
Peromyscus sp.	20	6	1	10	1
P. boylii	13	4	1	6	
P. crinitus	128	49	14	72	20
P. eremicus	198	85	45	102	12
P. maniculatus	3077	1821	723	1254	805
P. truei	184	63	33	103	23
Reithrodontomys megalotus	122	37	6	20	11
MICROTINE RODENTS					
Clethrionomys gapperi	27	7	10	15	5
Lagurus curtatus	1			1	
Microtus sp.	95	40	39	54	34
M. californicus	1	1			1
M. longicaudus	74	39	6	35	20
M. mexicanus	1	1			
M. montanus	59	32	44	52	16
M. pennsylvanicus	3		3	3	
Ondatra zibethicus	6	5		2	
Phenacomys intermedius	2	1	1	2	
MURID RODENTS					
Mus musculus	23		7	6	
Rattus norvegicus	151	25	98	73	6
R. rattus	9	4	2	3	
JUMPING MICE					
Zapus princeps	96	64	1	25	30
HYSTRICOMORPH RODENTS					
Erethizon dorsatum	36	1	1	22	
FOXES AND COYOTES					
Canis latrans	4	1			4
Urocyon cinereoargenteus	1				1
Vulpes macrotis	4	3			1
RACOONS AND ALLIES					
Bassariscus astutus	1	1			
Procyon lotor	1	1			
MUSTELIDS					
Martes sp.	1	1			1
Mephitis mephitis	1				1
Mustela erminea	1				
M. frenata	11	10	4	5	5
M. vison	2				2
Spilogale gracilis	11	7	2	2	8
Taxidea taxus	6		1		3
CATS					
Lynx rufus	6	3			2
CERVIDS					
Cervus canadensis	1				1
Dama hemionus	28		1		25
DOMESTIC ANIMALS					
Cat	4	2			2
Cow	3				1
Dog	16		4		9
Hog	1		1		2
Horse	7		1		6
Rabbit	2	1	2		
Sheep	2				

*Major groupings and names follow Hall and Kelson (1959) except for alphabetical arrangement of genera and species.

HISTORICAL REVIEW

Until recent years little was published on parasitic mites from Utah. Keegan (1949, 1953, 1956b) described a new species, erected a new genus based on Utah material, and listed a number of new records for the state. Allred and Beck (1953b) described a new species of chigger (which was later synonymized by Brennan and Beck, 1955), and studied mites of woodrat nests in Utah (1953a). Allred (1954a, 1954c, 1957b, 1957c, 1957d, 1958) studied mites found on mice of the genus *Peromyscus* in Utah, described a new species (1957a), discussed morphological variations and bionomics (1954b, 1957e, 1957f, 1957g, 1965), and listed additional host records (1961). Furman and Tipton (1955) named a new species from Utah and composed a key to the known species of *Myonyssus*. Brennan and Beck (1955)* listed host and distribution records, named new species, and included a key to the chiggers of Utah. Lipovsky, Crossley and Loomis (1955) also named a new genus and species of chigger from Utah. Woodbury (1956a, 1956b) composed a checklist of mites taken in ecological studies at Dugway and indicated host relationships. Strandtmann and Allred (1956) discussed mites of the genus *Brevisterna*, listed additional host and distribution records, and composed a key to the species. Howell, Allred and Beck (1957) studied mites found in woodrat nests and listed parasitic as well as free-living species. Allred and Marchette (1957) studied the feeding habits of *Brevisterna utahensis* in Utah. Talley (1957) studied the nasal mites of blackbirds. Allred and Roscoe (1957) studied parasitic mites in woodrat nests. Howell and Elzinga (1962) described a new species of fur mite and composed a key to the species of *Radfordia*. Elzinga (1960) listed mites of rodents from one specific area in Utah, and Ho (1962) listed mites from two areas. Ash (1963) studied the mites of deer mice in a chaparral community. Jenkins (1965) listed records of mites from squirrels taken in 12 counties.

Other workers have published data on mites from Utah principally as incidental records associated with studies of other areas or fauna. These are listed in the species discussions that follow.

MEDICAL AND ECONOMIC IMPORTANCE

Dermanyssus americanus and *D. gallinae* have been involved with encephalomyelitis, but their exact relationship with the virus is not entirely clear (Baker *et al.*, 1956). Transmission of trypanosomes and avian spirochaetosis has been demonstrated for *D. gallinae* (Macfie and Thompson, 1929; Manwell and Johnson, 1931; Seddon, 1951). Rickettsialpox transmission has been related to *D. sanguineus* (Huebner *et al.*, 1946). The implication of these species with disease suggests a similar potential for *D. becki* which also occurs in Utah.

Ornithonyssus bacoti has been involved with murine typhus, rickettsialpox, tularemia, plague and nematode parasites (Baker *et al.*, 1956). Transmission of encephalomyelitis and Newcastle disease has been related to *O. sylviarum* (Baker *et al.*, 1956).

Laelaps jettmari has been involved with hemorrhagic fever (Asanuma, 1952), and *L. kochi* has a suspected implication with tularemia (Baker, *et al.*, 1956). Nothing is known of the potential of other species of *Laelaps* which occur in Utah.

Tularemia has been isolated from *Eulaelaps stabularis* and *Haemolaelaps mohrae* (Baker, *et al.*, 1956). Other species of *Haemolaelaps*, including the cosmopolitan *H. glasgowi*, have not as yet been implicated with disease transmission. Ornithosis virus of turkeys has been isolated from *Haemolaelaps casalis*, *Haemogamasus pontiger*, and *Ornithonyssus sylviarum* (Eddie, *et al.*, 1962).

Hirstionyssus isabellinus has been implicated with tularemia in the laboratory (Francis and Lake, 1922).

In addition to their disease transmission potential, mites occasionally are pests of man by their bites or invasion of his tissues. *Dermanyssus*

*Although the printed date on this publication is 31 December 1955, it was not off the press and distributed until early 1956. Consequently, for purposes of priority this reference should be considered as 1956. However, to maintain continuity of publication dates, throughout this paper it is listed as 1955.

gallinae, *D. sanguineus*, *O. bacoti*, *O. bursa*, *O. sylviarum* and *H. casalis* have been known to attack man, and there is some circumstantial evidence to incriminate *E. stabularis* and *H. pontiger*. Still other parasitic mites may bite man on occasion.

The high populations of rodents in the temperate desert areas of Utah, and the presence of many mites which have been implicated with disease transmission as shown above, create a potential reservoir of diseases in nature communicable to man, which necessitates an increased knowledge of their natural history and other aspects of ecology.

ACCOUNTS OF THE SPECIES

In the discussion that follows, a brief statement is given about each family represented, usually followed by a listing of each species known to occur in Utah. However, several families are listed for which mites were not identified beyond the family level. These were occasionally found on mammals but are not considered regular consortes with them. Their inclusion is for convenience in separating them from mites which have more common occurrence and which for the most part are parasitic on their mammalian hosts.

Following the list of each species, comments on taxonomic or morphological variations are included when applicable. Under the heading "Distribution," published records for the United States are noted. In most cases only the earliest published record is given. Recently published literature which duplicates previous records is not indicated. Where more than ten hosts are known for a state other than Utah, only a general statment on host relationships is given. Names for host records were taken verbatim from literature references. In Table 3 the equivalent names listed by Hall and Kelson (1959) are indicated in parentheses. For more specific locality references, records for Utah are listed by county.

Following the heading "Other Utah Records" or "Utah Records," heretofore unpublished data are listed as represented by our surveys over the past sixteen years. For the most part the only records given are those which are new host or county records for Utah. In most instances where our collections duplicate previously listed records, we have not repeated them. Each of our records is represented by detailed collection data in our files, but it is not practical to list such details at this time. Information on these data may be obtained by request. "Seasonal Occurrence" is a summary of months over the total sixteen-year period. Under "Comments" when sufficient data are available, the geographic distribution in Utah (northerly or southerly) and occurrence in the Great Basin or Upper Colorado River Basin are indicated (Fig. 615). Apparent host preferences and other mite species associations are also listed.

Keys to families, genera and species are inserted where appropriate. Keys to the nymphs and males of some groups of Mesostigmata are lacking because of insufficient descriptions, or because these stages are unknown for many species. Key characteristics selected to separate the families, genera and species of mites known to occur on mammals in Utah are for the most part those which are most easily seen. These may not be valid when dealing with species not included here. A properly cleared and mounted specimen is a necessary prerequisite to its identification when dealing with the dorsal plate, chelicerae, legs, and specialized seta on the palpal tarsus. Such characters are best seen with a phase-contrast microscope. Where a specific feature is not visible or for the purpose of verification, structures other than those listed in the keys may be used, and drawings of these for most species or a representative of each genus or family are appended. Setae usually are not shown except on the ventral plates of the mesostigmatids and the scuta of the trombiculids. The keys to the males were composed using some specimens from areas other than Utah, and from literature descriptions. Relating the male or nymph to the female with which it is found is an aid to its identity, but discretion should be used. Where possible, verification should be made by comparing the specimen with one whose identity is known, and with the description of the type where such is adequate and available.

In the descriptions of new species, measurements given are in microns. For purposes of structural orientation and to avoid duplication, figure references in the keys relate to Figures 1 to 5 on pages 5 to 7, and other illustrations beginning on page 71.

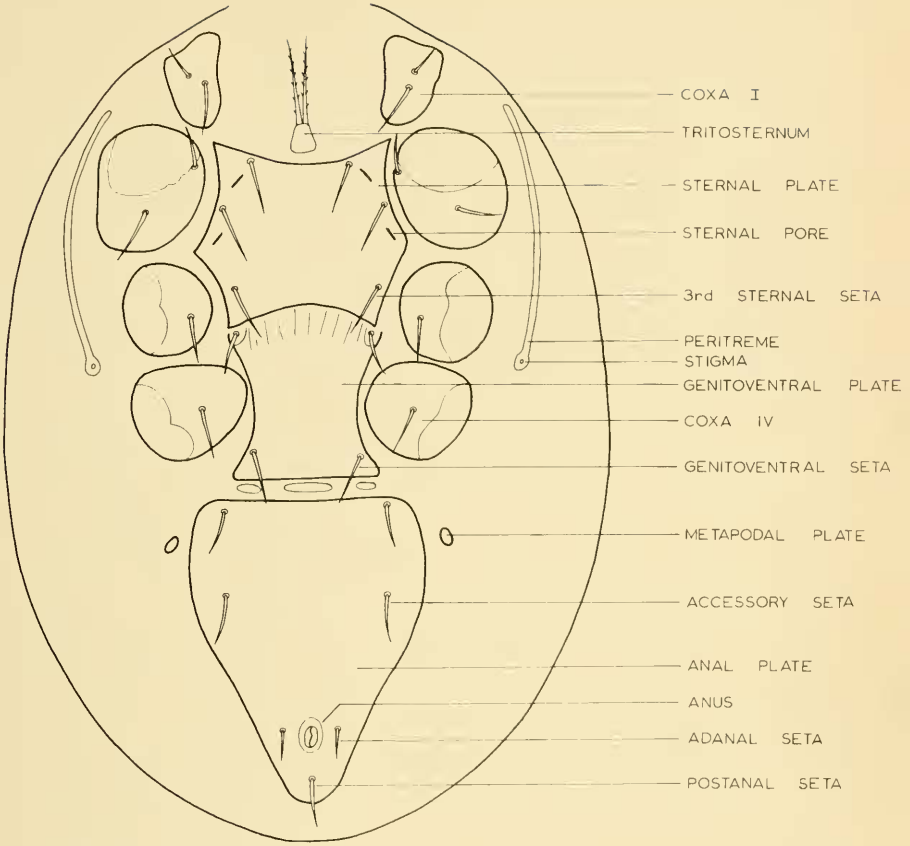


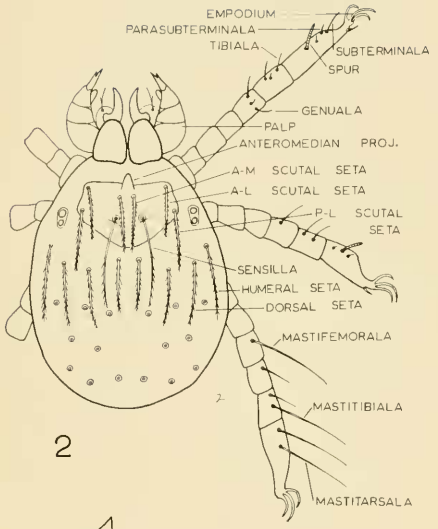
Fig. 1. Neoparasitidae, female ventral.

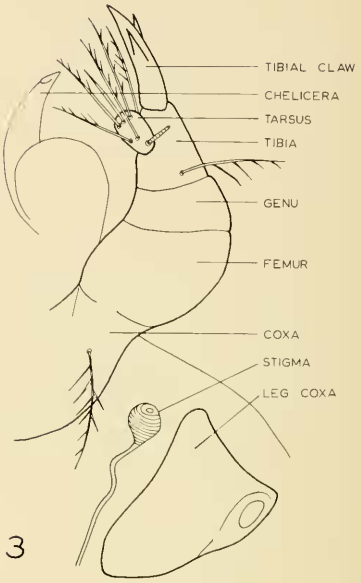
KEY TO FAMILIES OF FEMALE AND MALE MITES AND LARVAL TROMBICULIDS FOUND ON MAMMALS IN UTAH

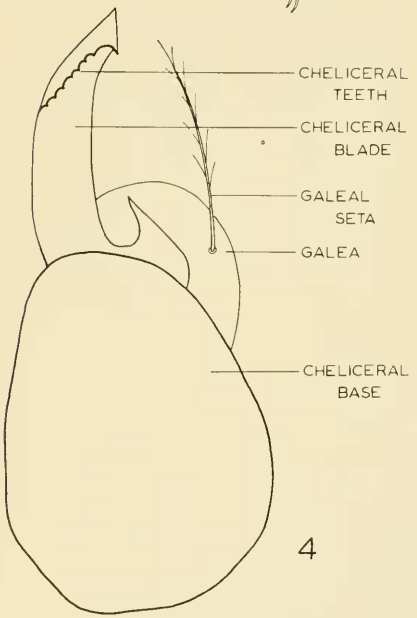
1. With a lateral stigma situated dorsal to and at level between coxae III and IV (Fig. 1) ... 2
   Without lateral stigma as above ... 12

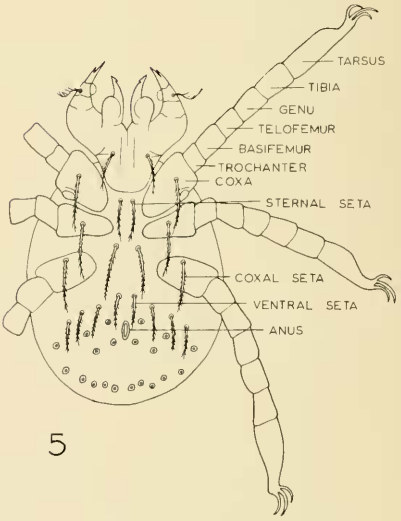
2. With tritosternum (Fig. 1); ventral and dorsal plates well-developed (Fig. 1) ... 4
   Without tritosternum; dorsal and ventral plates much reduced or absent (Fig. 8) ... 3

3. Coxae arranged essentially in two parallel lines, situated on anterior half of body (Fig. 7); poorly selerotized mites with few small setae ... Halarachnidae, page 9
   Coxae somewhat radially arranged, occupying anterior three-fourths of body (Fig. 8); heavily selerotized mites, densely covered with setae (from bats) ... Spinturnicidae, page 9









Figs. 2-5. Chigger larva. 2, body dorsal; 3, left half gnathosoma ventral; 4, right chelicera dorsal; 5, body ventral.

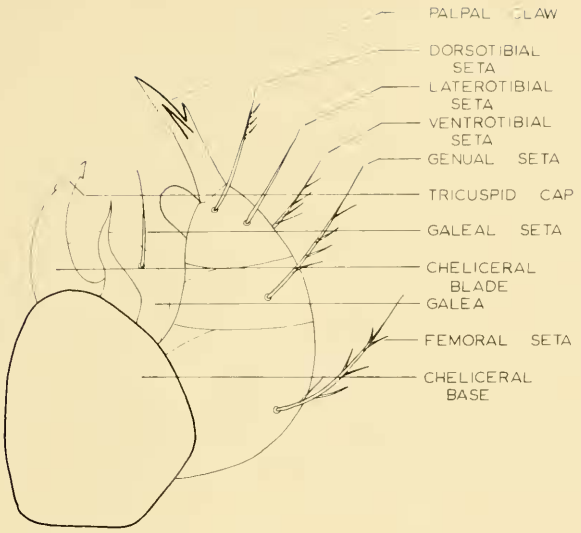


Fig. 6. Chigger larva, right half gnathosoma dorsal.

4. Specialized seta on palpal tarus with three tines (Fig. 407) ..... Complex of Gamasolaelaptidae, Macrochelidae, Neoparasitidae, Pachylaelaptidae, Parasitidae, pages 8-9

Specialized seta with two tines 5

5. Anterior edge of sternal plate with circular structure and/or posteriorly extending tube, the genital opening (Fig. 353); ventral plates fused into one holoventral plate (Fig. 355) or sometimes two plates (sternogenital and ventroanal, Figs. 362, 171, or sterno-genitoventral and anal, Figs. 351, 170) (males in part) 10

Anterior edge of sternal plate without such genital opening; ventral plates separate as three distinct plates (Fig. 1) (females, in part) 6

6. Genitoventral plate truncate posteriorly, usually almost touching enlarged anal plate which is frequently truncate anteriorly (Fig. 1) 7

Genitoventral plate rounded or pointed, not truncate, widely separated from anal plate which may be truncate anteriorly but usually is elliptical or oval (Fig. 195) 8

7. Metapodal plate large, triangular (Fig. 410); genitoventral plate expanded laterally behind coxae IV (Fig. 220) ..... Haemogamasidae, page 10

Not as above ..... Phytoseiidae (=Amblyseiidae and Blattisocidae, in part), page 15

8. Dorsal plate thickly beset with setae which overlap those following; genitoventral plate with four or more pairs of accessory setae (Fig. 220) ..... Haemogamasidae, page 10

Dorsal plate setae relatively sparse, seldom overlapping those behind; genitoventral plate with less than four pairs of accessory setae (Fig. 258) 9

9. Chelicera moderate to small, sometimes long, styletlike, filamentous; chela lacks teeth, weakly sclerotized (Figs. 386, 389) ..... Dermanyssidae, page 16

   Chelicera strongly developed; chela large, with teeth, heavily sclerotized (Fig. 383) ..... Laelaptidae, page 33

10. Body densely clothed with setae which frequently extend past bases of those behind; holoventral plate usually widely expanded laterally behind coxae IV (Fig. 354) ..... Haemogamasidae, page 10

    Not as above 11

11. Chelicera small, hyaline, weakly scherotized, sometimes long, styletlike (Fig. 389) ..... Dermanyssidae, page 16

    Chelicera strongly developed, heavily sclerotized (Fig. 383) ..... Laelaptidae, page 33

12. Palp relatively large, conspicuous (Fig. 2); chelicera modified as piercing stylet (Fig. 4), sometimes when long and needle-like, frequently recurved when withdrawn within body (Fig. 389) 13

    Palp small, inconspicuous; chelicera strongly chelate, although it may be small; body elongate, rounded or bilobed posteriorly (Fig. 599) ..... Listrophoridae, page 41

13. First pair of legs greatly modified for clasping hairs (Fig. 596) ..... Myobiidae, page 42

    First pair of legs not as above 14

14. With three pairs of legs; scutal plate provided with pair of flagelliform or expanded sensillae (Fig. 2); tarsus II lacks multiple empodium (Fig. 2) ..... Trombiculidae, page 42

    With four pairs of legs; lacks scutal plate; tarsus II with multiple empodium (Fig. 598) ..... complex of Tetranychidae and Cheyletidae, page 56

PACHYLAELAPTIDAE Vitzthum, 1931

Fig. 7

Mites of this family occur in accumulations of organic debris, and frequently on beetles. They likely are predaceous. Their occurrence on mammals in our studies was infrequent.

GAMASOLAELAPTIDAE Oudemans, 1939

Fig. 194

Mites of this family occur in mesic situations where they likely are predaceous on other small arthropods. Their occurrence on mammals in our studies likely was accidental.

NEOPARASITIDAE Oudemans, 1939

Fig. 1

Mites of this family are similar in habits and occurrence to those in the family Gamasolaelaptidae. They were infrequently found on mammals in our surveys.

Halaracinidae Oudemans, 1906

Mites of this family are endoparasitic in the nasal passages of mammals, both marine and terrestrial. Their recovery is dependent on special techniques which are not usually utilized in routine ectoparasite field surveys.

Zumptiella bakeri Furman, 1954

Figs. 46, 120, 200, 209

Distribution. CALIFORNIA: *Tamiasciurus douglasii* (Furman, 1954a).

Utah records. Sevier Co.: *Eutamias quadrivittatus.* Utah Co.: *Citellus armatus.*

Seasonal occurence. Two females were taken in July.

Spinturnicidae Oudemans, 1901

These mites occur almost exclusively on bats, and likely are world-wide in distribution.

KEY TO GENERA OF SPINTURNICIDAE

Peritreme on dorsal surface only (Fig. 594) ..... *Paraspinturnix*
Peritreme extends to ventral surface of body (Fig. 59) ..... *Spinturnix*

Paraspinturnix globosus Rudnick, 1960

Figs. 8, 148, 281, 325, 594

Distribution. ARIZONA: Bat; INDIANA: *Myotis sodalis;* OKLAHOMA: *Myotis grisescens, Myotis velifer;* TENNESSEE: *M. sodalis;* UTAH: Utah Co.: *Myotis* sp. (Rudnick, 1960).

Other Utah records. None.

Spinturnix orri Rudnick, 1960

Figs. 11, 59, 147, 283, 324

Distribution. CALIFORNIA, OREGON, TEXAS: *Antrozous pallidus;* UTAH: Millard Co., Salt Lake Co., Wayne Co.: *A. pallidus* (Rudnick, 1960).

Other Utah records. None.

Parasitidae Oudemans, 1901

Fig. 192

Mites of this family are predaceous on other small arthropods usually associated with moist organic debris. They were infrequently found on mammals in our surveys.

Macrochelidae Vitzthum, 1930

These mites are commonly found in soil and on animals. They likely are predaceous and are frequently found on mammals, although unlikely in a parasitic association.

Macrocheles sp.

Figs. 113, 199, 223, 407, 551

Distribution. COLORADO: *Thomomys talpoides* (Miller and Ward, 1960). OKLAHOMA: *Sigmodon* sp. (Ellis, 1960). TEXAS: *Citellus spilosoma, Rattus norvegicus, Speotyto cunicularia* (Eads, Menzies, and Miles, 1952). UTAH: Utah Co.: *Reithrodontomys megalotis* (Elzinga, 1960). ? locality: *Citellus armatus* (Jenkins, 1965).

Other Utah records. Cache Co.: *C. armatus, T. talpoides.* Juab Co.: *Dipodomys ordii, Peromyscus maniculatus.* Kane Co.: *Perognathus longimembris, Thomomys bottae.* Utah Co.: *C. armatus, Marmota flaviventris, Mus musculus, Zapus princeps.* Wasatch Co.: *C. armatus.* Washington Co.: *Onychomys torridus.*

Seasonal occurrence. A total of 115 females was collected during February, April, May, June, July, and December. Most were taken in June.

Comments. Mites of this species were most common in the northern part of Utah in the Great Basin. They are known from six counties.

In three of 25 collections, *Macrocheles* sp. was the only mite on its host.

HAEMOGAMASIDAE Oudemans, 1926

Mites of this family are world-wide parasites of small mammals. Most of their lives are spent in the nests of their hosts except for times of feeding.

KEY TO GENERA OF FEMALE HAEMOGAMASIDAE

1. Sternal plate short, about one-half as long as wide, possesses only first or second pair of usual sternal setae (Figs. 201, 205); one or two pairs of accessory setae may be present ..... *Brevisterna*

   Sternal plate length more than one-half its width, with usual three pairs of sternal setae (Fig. 199) 2

2. Anal plate wider than long (Fig. 121); metapodal plate large, triangular (Fig. 410) ..... *Eulaelaps*, page 11

   Anal plate as long as or longer than wide (Fig. 110); metapodal plate small, usually oval 3

3. Tarsus II with large spines (Fig. 601) ..... *Ischyropoda*, page 11
   Tarsus II similar to other legs ..... *Haemogamasus*, page 12

KEY TO GENERA OF MALE HAEMOGAMASIDAE

1. Ventral plates fused into one holoventral plate (Fig. 359) 2

   Two ventral plates, anal plate separate (Fig. 351) ..... *Ischyropoda*, page 11

2. Holoventral plate greatly expanded, extends laterally behind coxa IV (Fig. 352) 3

   Holoventral plate only slightly expanded, does not extend behind coxa IV (Fig. 359) ..... *Brevisterna*

3. Holoventral plate strongly reticulate posteriorly; has five pairs of nude setae between posterior level of coxa IV and anterior edge of plate ..... *Eulaelaps*, page 11

   Holoventral plate not reticulate posteriorly; has five or more pairs of setae between posterior level of coxa IV and anterior edge of plate (when only five pairs present, anterior pair barbed) ..... *Haemogamasus*, page 12

KEY TO SPECIES OF FEMALE *Brevisterna*

Sternal plate with only the usual first pair of setae; one or two pairs of accessory setae may be present (Fig. 201) ..... *montanus*

Sternal plate with only the usual second pair of setae; no accessory setae (Fig. 205) ..... *utahensis*, page 11

Brevisterna montanus (Ewing), 1922

Figs. 43, 118, 201, 231, 546

Strandtmann and Allred (1956) stated that of three specimens on the type slide, two have two accessory setae and one has four. The genitoventral plate bears about 14 setae, and the dorsal plate covers most of the body. Three of the Utah specimens have two accessory setae, one has only one, and two lack accessory setae on the sternal plate. Two specimens possess 16 setae on the genitoventral plate, and the other four possess 14, 15, 18 and 19, respectively. The setae

are frequently not symmetrically arranged on the genitoventral plate except for the anterior two pairs, and the plate has irregular, unsymmetrical borders in most cases. The dorsal plate covers about one-half to two-thirds of the dorsal surface.

Distribution. MONTANA: *Sciurus hudsonicus* (Strandtmann and Wharton, 1958).

Utah records. Two females were taken from *Eutamias quadrivittatus* from Utah County in June, and four females from the same host from Daggett County in August.

Brevisterna utahensis (Ewing), 1933

Figs. 44, 73, 78, 109, 182, 205, 216, 330, 359, 548

Strandtmann and Allred (1956) and Allred (1957b, 1957g) discussed morphological variations of this species. The specimens in our study are within the ranges indicated by them.

Distribution. ARIZONA. CALIFORNIA: *Neotoma* sp. (Keegan, 1953). NEVADA: *Neotoma lepida, Peromyscus crinitus* (Allred and Goates, 1964a, 1964b). TEXAS: *Neotoma micropus* (Eads, Menzies, and Miles, 1952). UTAH: Carbon Co.: *Peromyscus maniculatus* (Allred, 1957b). Juab Co.: *N. lepida* (Howell, Allred, and Beck, 1957). Sevier Co.: *N. lepida* (Ewing, 1933). Tooele Co.: *N. lepida, Onychomys leucogaster* (Keegan, 1953), *P. crinitus* (Woodbury, 1956b). Utah Co.: *O. leucogaster* (Elzinga, 1960). Wayne Co.: *P. crinitus;* Washington Co.: *P. eremicus* (Allred, 1957b).

Other Utah records. Daggett Co.: *Eutamias quadrivittatus, Neotoma cinerea.* Duchesne Co.: *N. cinerea.* Emery Co.: *P. crinitus, Peromyscus truei.* Grand Co.: *N. lepida.* Kane Co.: *N. lepida, P. maniculatus, P. truei.* Piute Co.: *N. lepida.* San Juan Co.:*Peromyscus boylii, P. maniculatus, P. truei.* Sanpete Co.: *P. maniculatus.* Utah Co.: *Citellus variegatus, E. quadrivittatus, Mus musculus, N. cinerea, N. lepida, P. maniculatus.* Washington Co.:*Dipodomys merriami, Lepus californicus, N. lepida, Perognathus formosus.* Wayne Co.: *N. lepida, P. maniculatus, P. truei.*

Seasonal occurrence. Totals of 39 deutonymphs, 23 males and 114 females were taken. Mites were collected every month except January, March, and December. The high incidence of gravid females taken in April, May and June (50%, 42% and 23%, respectively) is indicative of a spring reproductive period. This is further supported by the high incidence of deutonymphs taken in July (78% of the total mites collected for that month). Males were not abundant and were taken only during April, May, June, November, and December.

Comments. Mites of *B. utahensis* are more common in the southern than in the northern part of Utah, and more typical of the upper Colorado River Basin than of the Great Basin. In the Great Basin collections, with only three exceptions, they were found close to the high mountains that divide the two basins.

This mite apparently is most closely associated with wood rats (*Neotoma* spp.). Two-thirds of the other incidental collections were taken from rodents which live in close association with wood rats and their habitat. Fifty percent of the collections were from *Neotoma* spp., and 44% of these were from *N. lepida.* Association with *N. lepida* suggests a southern distribution, whereas the occurrence of *B. utahensis* on *N. cinerea* may account for its more northerly occurrence.

In 19 of the 43 collections, *B. utahensis* was the only mite species found on its host.

Eulaelaps stabularis (Koch), 1836

Figs. 121, 203, 246, 410, 553

Distribution. ALABAMA: *Blarina brevicauda, Peromyscus gossypinus, Peromyscus nuttallii, Reithrodontomys humilis, Sigmodon* sp. (Hays and Guyton, 1958). CALIFORNIA: *B. brevicauda* (Jameson, 1950d). COLORADO: *Thomomys talpoides* (Miller and Ward, 1960). MARYLAND: *Microtus pennsylvanicus* (Drummond, 1957). NEW YORK: *Napeozapus insignis* (Whitaker, 1963). OREGON: *Microtus montanus, Peromyscus maniculatus* (Hansen, 1964). TEXAS: *Didelphis* sp., *Geomys* sp., *Rattus rattus* (Randolph and Eads, 1946).

Utah records. Daggett Co.: *Microtus* sp. Sanpete Co.: *P. maniculatus.* Utah Co.: *Citellus armatus, P. maniculatus, Rattus norvegicus.*

Seasonal occurence. Seven females were taken in February, May, June and August.

Comments. The records by Allred (1954a) of *Eulaelaps* sp. from *P. maniculatus* from Iron, Salt Lake, Sanpete and Utah counties likely are of *E. stabularis.*

KEY TO SPECIES OF FEMALE *Ischyropoda*

Dorsal plate truncate posteriorly (Fig. 47); genitoventral plate little wider than anal plate (Fig. 214) ..... *furmani*, page 12

Dorsal plate rounded posteriorly (Fig. 42); genitoventral plate at least twice as wide as anal plate (Fig. 238) ..... *armatus*, page 12

KEY TO SPECIES OF MALE *Ischyropoda*

Expanded portion of posterior part of sternogenitoventral plate not wider than anterior part of plate (Fig. 353) ..... *furmani*

Expanded portion of posterior part of sternogenitoventral plate much wider than anterior part of plate (Fig. 351) ..... *armatus*

Ischyropoda furmani Keegan, 1956

Figs. 47, 74, 108, 169, 179, 208, 214 327, 353, 545, 600

Distribution. UTAH: San Juan Co.: *Onychomys leucogaster;* Tooele Co.: *Dipodomys ordii, Microdipodops megacephalus, O. leucogaster, Perognathus longimembris, Peromyscus maniculatus* (Keegan, 1956b), *Neotoma lepida* (Allred and Roscoe, 1957).

Other Utah records. San Juan Co.: *D. ordii, Perognathus* sp.

Seasonal occurrence. One male was taken in May, and five females in May and September.

Comments. Keegan (1956) listed *Microdipodops pallidus* as a host for this mite in Tooele County. This error of host identification inadvertantly supplied Keegan was corrected to *M. megacephalus* (Allred, 1965).

Ischyropoda armatus Keegan, 1951

Figs. 42, 69, 100, 106, 170, 217, 238, 326, 351, 374 458, 538, 547, 601

Distribution. ARIZONA: *Neotoma albigula;* CALIFORNIA: *Citellus* sp., *Dipodomys deserti, Dipodomys merriami, Perognathus californicus, Perognathus inornatus, Perognathus xanthonotus, Peromyscus* sp., *Thomomys bottae;* COLORADO: *Onychomys leucogaster, Thomomys umbrinus* (Keegan, 1951; Miller and Ward, 1960). NEVADA: *D. merriami, Dipodomys microps, Onychomys torridus, Perognathus formosus, Perognathus longimembris, Peromyscus crinitus* (Allred, 1962, 1963; Coates, 1963; Allred and Coates, 1964a). NEW MEXICO: *Peromyscus maniculatus, Thomomys* sp. (Keegan, 1951). OKLAHOMA: *Dipodomys ordii* (Ellis, 1960). TEXAS: *D. ordii, Dipodomys spectabilis, Neotoma micropus, O. leucogaster, Sylvilagus auduboni* (Eads, Menzies, and Miles, 1952). UTAH: *P. maniculatus* from the following counties: Beaver, Box Elder, Daggett, Duchesne, Kane, Morgan, Piute, Rich, Summit, Utah and Washington; Duchesne Co.: *Peromyscus truei;* Garfield Co.: *Peromyscus* sp. (Allred, 1957a). Tooele Co.: *D. microps, D. ordii, O. leucogaster* (Keegan, 1953), *P. formosus* (Ho, 1962). *Perognathus parvus* (Keegan, 1953), *P. maniculatus* (Woodbury, 1956b). Utah Co.: *D. microps* (Ho, 1962), *D. ordii, O. leucogaster, P. maniculatus* (Elzinga, 1960), *P. truei* (Allred, 1957a).

Other Utah records. Beaver Co.: *D. ordii.* Box Elder Co.: *D. microps, D. ordii, P. parvus.* Duchesne Co.: *D. ordii.* Garfield Co.: *Perognathus* sp. Iron Co.: *D. ordii, P. parvus.* Juab Co.: *D. microps, D. ordii, O. leucogaster, P. formosus, P. longimembris, P. parvus.* Kane Co.: *D. ordii, P. formosus, P. longimembris, P. parvus.* Millard Co.: *D. microps.* San Juan Co.: *D. ordii, O. leucogaster, Perognathus flavus.* Sanpete Co.: *D. microps, D. ordii.* Uintah Co.: *D. ordii.* Utah Co.: *Erethizon epixanthum, Lepus californicus, P. parvus.* Washington Co.: *Citellus variegatus, D. merriami, D. microps, Myotis californicus, O. leucogaster, O. torridus, P. formosus.* Wayne Co.: *D. ordii, P. parvus, P. maniculatus.*

Seasonal occurrence. Totals of 37 males, 134 females and 22 deutonymphs were collected. Males were taken from May through October, mostly in July; females from April through December, mostly in June and July; and deutonymphs from June through September, mostly in June.

Comments. Mites of *I. armatus* are widely distributed over the state, and are known from 20 counties.

This species apparently prefers grasshopper mice (*Onychomys* spp.) and pocket mice (*Perognathus* spp.) as its hosts. Its population index was 3 to 5 on *Onychomys*, 4 to 5 on *Perognathus*, two on *Dipodomys* and one on *Peromyscus*.

In half of its 75 collections, *I. armatus* was the only mite on its host.

KEY TO SPECIES OF FEMALE *Haemogamasus*

1. Sternal plate with accessory setae (Fig. 211) ..... *alaskensis*, page 13

   Sternal plate with only three usual pairs of setae (Fig. 212) 2

2. Posterior margin of sternal plate invaginated to level midway between first and second pairs of sternal setae (Fig. 204) ..... *pontiger*, page 13

   Posterior margin of sternal plate almost straight or not invaginated anterior to second pair of sternal setae (Fig. 206) 3

3. Some setae (especially posteriorly and on legs) with filamentous barbs (Fig. 207) 4

Setae lacking barbs, although few posteriorly may have minute teeth resembling bases of broken barbs ..... *liponyssoides*, page 14

4. First pair of sternal pores parallel with anterior margin of sternal plate (Fig. 202) ..... *ambulans*, page 14

First pair of sternal pores situated at angle to anterior margin of sternal plate (Fig. 207) ..... *longitarsus*, page 15

KEY TO SPECIES OF MALE *Haemogamasus*

1. Some accessory setae of holoventral plate situated anterior to level of coxa IV (Fig. 352) 2

Accessory setae of holoventral plate not anterior to coxa IV (Fig. 354) 4

2. Accessory setae of holoventral plate situated at anterior edge of plate opposite coxa II ..... *alaskensis*

Accessory setae of holoventral plate not at anterior edge of plate, not anterior to coxa III 3

3. Moveable digit of chelicera almost twice as long as fixed digit ..... *longitarsus*, page 15

Moveable digit only slightly longer than fixed digit ..... *ambulans*, page 14

4. Holoventral plate with less than 20 pairs of setae ..... *pontiger*

Holoventral plate with more than 40 pairs of setae ..... *liponyssoides*, page 14

Haemogamasus alaskensis Ewing, 1925

Figs. 45, 102, 110, 211, 226, 329, 543

In the series from Utah there is considerable variation. The number of accessory setae on the sternal plate varies from 22 to 25. Those on the genitoventral plate vary from 47 to 95. In some only the first sternal setae are barbed, whereas in others the first and second pairs are barbed.

Distribution. ILLINOIS: ? host; MAINE: *Clethrionomys gapperi, Myotis lucifugus, Napeozapus insignis* (Keegan, 1951). MARYLAND: *Microtus pennsylvanicus* (Drummond, 1957). MASSACHUSETTS: *C. gapperi, M. pennsylvanicus;* NEW YORK: *M. pennsylvanicus, Tamiasciurus hudsonicus, N. insignis* (Keegan, 1951; Whitaker, 1963). NORTH CAROLINA: *Microtus montanus;* PENNSYLVANIA: *C. gapperi* (Keegan, 1951). UTAH: Morgan Co.: *Blarina brevicauda* (Keegan, 1951). Salt Lake Co.: *Peromyscus maniculatus* (Allred, 1957b). WASHINGTON: *Microtus oregoni* (Keegan, 1951).

Other Utah records. Carbon Co.: *Microtus longicaudus, Zapus princeps.* Duchesne Co.: *Peromyscus* sp. Utah Co.: *Ochotona princeps.*

Seasonal occurrence. Two females were taken in June, three in July, and one deutonymph in July.

Comments. Mites were found only in the northern part of the state, but in both the Great and Upper Colorado River basins.

This species is associated with voles (*Microtus* spp.) and other rodents such as red-backed mice and jumping mice of a similar habitat in mountainous areas.

In one of the four collections this mite was the only species on its host. In one other collection it was associated with *Haemogamasus ambulans.*

Haemogamasus pontiger
(Berlese), 1903

Figs. 50, 115, 204, 243, 354, 552

Euhaemogamasus ondemansi of authors (Strandtmann and Wharton, 1958).

Distribution. COLORADO: *Tamiasciurus fremonti* (Keegan, 1951). NEVADA: *Neotoma lepida,*

Peromyscus crinitus (Allred and Goates, 1964a, 1964b). NEW YORK: ? host (Keegan, 1951). OREGON: *N. lepida* (Hansen, 1964). UTAH: Iron Co.: *Peromyscus maniculatus* (Allred, 1957b). Juab Co.: *N. lepida* (Allred and Beck, 1953a). Kane Co.: *P. maniculatus* (Allred, 1957b). Tooele Co.: *N. lepida* (Woodbury, 1956b). Utah Co.; *P. maniculatus;* Washington Co.: *Peromyscus eremicus* (Allred, 1957b).

Other Utah records. Carbon Co.: *P. maniculatus.* Kane Co.: *N. lepida.* Piute Co.: *N. lepida.* San Juan Co.: *Peromyscus boylii.* Utah Co.: *Eutamias quadrivittatus.*

Seasonal occurrence. Fourteen females and two males were taken from April through July, and in September and October. Two males were collected in May and July. Gravid females were taken in May and June.

Comments. Mites of *H. pontiger* likely are distributed over the entire state in both the Great and Upper Colorado River basins. They are known from eight counties.

This species apparently has a preference for white-footed mice and wood rats, particularly *P. boylii* and *N. lepida.*

In five of its 12 collections, *H. pontiger* was the only mite on its host.

Haemogamasus liponyssoides occidentalis Keegan, 1951

Figs. 48, 107, 206, 220, 377, 549

Euhaemogamasus liponyssoides occidentalis of authors (Strandtmann and Wharton, 1958).

Keegan (1951) designated a subspecies of *H. liponyssoides* Ewing, 1925 as *H. liponyssoides occidentalis.* He indicated that *H. liponyssoides* was principally eastern in its distribution, and *H. l. occidentalis* occurred in the western United States.

Distribution. CALIFORNIA: *Clethrionomys occidentalis, Microtus californicus, Neotoma fuscipes, Neurotrichus gibbsi, Scapanus latimanus, Sorex trowbridgii* (Keegan, 1951; Jameson and Brennan, 1957; Radovsky, 1960b). OREGON: *Microtus townsendii, Mustela saturata, Neurotrichus* sp., *Scapanus townsendii;* UTAH: Morgan Co.: *Blarina brevicauda;* WASHINGTON: *Scapanus orarius, S. townsendii, Thomomys fuscus* (Keegan, 1951).

Other Utah records. Utah Co.: *Microtus longicaudus.* Wayne Co.: *Microtus* sp.

Seasonal occurrence. Two females were taken in July and two in August.

Comments. Hansen (1964) listed *H. liponyssoides* from *M. longicaudus* and *Microtus montanus* from Oregon. These likely are *H. l. occidentalis.*

Haemogamasus ambulans (Thorell), 1872

Figs. 49, 51, 52, 53, 79, 112, 114, 116, 117, 191, 202, 210, 212, 218, 249, 252, 273, 284, 328, 352, 380, 383, 396, 400, 542, 544, 550, 559.

Euhaemogamasus ambulans of authors (Strandtmann and Wharton, 1958).

According to Strandtmann (personal correspondence), Russian workers interpret *H. ambulans* as possessing many accessory sternal setae. This is similar to what Keegan (1951) called *H. alaskensis. Haemogamasus ambulans* is also considered synonymous with *H. nidiformis* Bregetova. For the present we prefer to follow Keegan in the interpretation of the *Haemogamasus* forms.

There are four distinct forms of this species in the Utah series, herein designated as A, B, C and D. One significant difference between them is in the shape and size of the specialized seta on the fixed digit of the chelicera. In form A the chelicera is large, and the seta on the fixed digit is of normal shape. In the other three forms the chelicerae are smaller. In Form D the seta of the fixed digit is normal, but in forms B and C it is modified as a ribbon-shaped structure. The peritreme in forms B, C and D is narrow, whereas in form A it is large. In forms A, C and D the peritreme extends to the middle or anterior edge of coxa II, whereas in form B it extends only to the anterior edge of coxa III. On the genitoventral plate of forms A and B there are twice as many accessory setae as on forms C and D. The posterior margin of the sternal plate is invaginated to a point anterior to the level of the third pair of setae in forms A, C and D, but posterior to the third setae in form B.

These differences may be significant enough to warrant subspecific or even specific rank, but at present there is sufficient overlap to justify retention of these as morphological variants within the same species.

Distribution. CALIFORNIA: *Clethrionomys* sp., *Microtus californicus, Neotoma fuscipes, Peromyscus boylii, Sciurus griseus, Thomomys monticola* (Keegan, 1951; Jameson and Brennan, 1957). COLORADO: *Thomomys talpoides, Thomomys umbrinus* (Keegan, 1951; Miller and Ward, 1960). ILLINOIS: ? host; MARYLAND: Raccoon; MICHIGAN: *Sciurus niger;* MONTANA: *Sorex palustris;* NEW HAMPSHIRE: *Clethrionomys gapperi;* NEW YORK: *Tamiasciurus hudsonicus;* NORTH CAROLINA: "Birds;" OHIO: "Squirrel" (Keegan, 1951). OREGON: *Lagurus curtatus, Microtus longicaudus, Microtus montanus, Onychomys leucogaster, Peromyscus maniculatus, Sorex vagrans, T. talpoides, Zapus princeps* (Hansen, 1964). PENNSYLVANIA: *Glaucomys sabrinus;* SOUTH CARO-

LINA: "Squirrel" (Keegan, 1951). UTAH: Beaver Co.: *P. maniculatus* (Allred, 1957b). Cache Co.: *Neotoma cinerea* (Keegan, 1951). Daggett Co.: *P. maniculatus;* Iron Co.: *P. maniculatus* (Allred, 1957b). Juab Co.: *Neotoma lepida* (Allred and Beck, 1953a). Rich Co.: *P. maniculatus;* Salt Lake Co.: *P. maniculatus;* Sanpete Co.: *P. maniculatus;* Summit Co.: *P. maniculatus* (Allred, 1957b). Utah Co.: *Mus musculus* (Ho, 1962), *N. lepida* (Allred and Beck, 1953a), *P. maniculatus;* Wasatch Co.: *P. maniculatus* (Allred, 1957b.) VERMONT: *Glaucomys sabrinus;* VIRGINIA: *Glaucomys volans;* WASHINGTON: *Thomomys fuscus* (Keegan, 1951).

Other Utah records. Beaver Co.: *Citellus lateralis.* Box Elder Co.: *Dipodomys ordii, Perognathus parvus, P. maniculatus.* Carbon Co.: *M. longicaudus.* Daggett Co.: *G. sabrinus, Microtus* sp., *Z. princeps.* Duchesne Co.: *T. talpoides.* Grand Co.: *O. leucogaster.* Iron Co.: *Eutamias umbrinus.* Juab Co.: *D. ordii.* Kane Co.: *N. lepida, Peromyscus* sp. Morgan Co.: *P. maniculatus.* San Juan Co.: *N. cinerea, Thomomys bottae, T. talpoides.* Sanpete Co.: *T. talpoides.* Summit Co.: *Ochotona princeps.* Tooele Co.: *Peromyscus truei.* Utah Co.: *Citellus armatus, C. gapperi, M. montanus, N. cinerea, O. princeps, T. bottae, T. talpoides, Z. princeps.* Wasatch Co.: *T. hudsonicus, T. talpoides.* Washington Co.: *P. maniculatus.*

Seasonal occurrence. Totals of 96 females, one male and five deutonymphs were taken. The females were collected from March through August, and in November and December. Greatest numbers were taken in June, July and August. The male was taken in August, and the deutonymphs in June, July and August. Two females in June each contained an egg, and a female in August contained a larva. Early summer likely is the reproductive period for this species. The small number of males taken is indicative that they are nest dwellers.

Comments. Mites of *H. ambulans* were found more commonly in the northern part of Utah in the Great Basin. They are known from 20 counties.

This species was taken from a variety of rodents, but was most commonly associated with gophers (*Thomomys* spp.) and jumping mice (*Zapus* sp.). Squirrels (*Spermophilus* spp.) were also frequent hosts.

In 22 of 53 collections, *H. ambulans* was the only mite on its host. In four collections it was associated with other species of *Haemogamasus.*

Haemogamasus longitarsus
(Banks), 1910
Figs. 119, 207, 287

Euhaemogamasus barberi of authors (Strandtmann and Wharton, 1958; Johnston, 1959).

One specimen from Utah has barbs on the first two pairs of sternal setae rather than just on the first as is apparently typical.

Distribution. ? hosts from DELAWARE, MARYLAND, NEW YORK, and VIRGINIA (Keegan, 1951). ? locality from *Blarina brevicauda, Citellus richardsoni, Microtus pennsylvanicus* (Strandtmann and Wharton, 1958). MARYLAND: *Pitymys pinetorum* (Drummond, 1957). UTAH: Utah Co.: *Peromyscus maniculatus* (Allred, 1957b).

Other Utah records. Box Elder Co.: *P. maniculatus.* Cache Co.: *Thomomys talpoides.* Daggett Co.: *P. maniculatus.* Garfield Co.: *Microtus longicaudus.* Utah Co.: *Thomomys* sp.

Seasonal occurrence. Four females were taken in June and two in July.

Comments. Mites of this species were more common in northern than in southern Utah, and are known from both the Great and Upper Colorado River basins. They are known from only five counties.

In its six collections *H. longitarsus* was associated with mites of other species.

Phytoseiidae Berlese, 1916
Fig. 193

This family includes mites which are predaceous, most frequently found on plants where they attack phytophagus mites. Inasmuch as small mammals frequently transport plants and seeds into their burrows and nests, these mites are occasionally found associated with them.

KEY FOR THE SEPARATION OF FEMALES OF THE GENUS *Kleemania* FROM OTHER GENERA OF THE FAMILIES PHYTOSEIIDAE, AMBLYSEIIDAE, AND BLATTISOCIDAE

Sternal plate with pattern resembling three asymmetrical cog-wheels (Fig. 262) ..... *Kleemania,* page 16

Sternal plate lacking such pattern ..... genera other than *Kleemania*

Kleemania sp.

Figs. 156, 262, 319

Distribution. NEVADA: *Dipodomys merriami, Dipodomys microps, Onychomys torridus, Perognathus formosus, Perognathus longimembris, Peromyscus crinitus, Peromyscus maniculatus, Peromyscus truei* (Allred, 1962, 1963; Goates, 1963; Allred and Goates, 1964a). UTAH: Tooele Co.: *Dipodomys ordii, Onychomys leucogaster, P. formosus, P. longimembris, P. crinitus, P. maniculatus* (Woodbury, 1956b). Utah Co.: ? host (Elzinga, 1960).

Other Utah records. Box Elder Co.: *D. ordii, Perognathus parvus.* Carbon Co.: *Eutamias minimus.* Daggett Co.: *D. ordii.* Duchesne Co.: *Citellus lateralis.* Emery Co.: *D. ordii, P. crinitus.* Juab Co.: *D. microps, D. ordii, P. parvus, P. maniculatus.* Kane Co.: *D. ordii, P. longimembris, P. maniculatus.* Millard Co.: *D. microps.* San Juan Co.: *D. ordii, O. leucogaster.* Utah Co.: *P. maniculatus.* Wayne Co.: *P. maniculatus.*

Seasonal occurrence. The 88 females were taken from May through September, mostly in June.

Comments. Mites of this species are distributed over the state in 12 counties.

In seven of 33 collections *Kleemania* sp. was the only mite on its host.

There is some question as to the parasitic nature of these mites. Likely they are predaceous, but because of their common occurrence on rodents, they are included here.

DERMANYSSIDAE Kolenati, 1859

This family represents a diverse group of mites parasitic on a variety of animals. They are worldwide in distribution and may be commonly found on mammals.

KEY TO GENERA OF FEMALE DERMANYSSIDAE

1. Anal plate more than half as wide as body, concave on anterior margin (Fig. 111) ..... *Myonyssus*, page 17

   Anal plate narrow, convex or rarely truncate on anterior margin (Fig. 113) 2

2. Coxa III with one or more spurs or slight semi-circular protuberance on posteromedian side (Fig. 468) 3

   Coxa III lacks spur or protuberance 4

3. Coxa III with well-formed spur (Fig. 468) ..... *Hirstionyssus*, page 17

   Coxa III with rounded protuberance ..... *Ichoronyssus*, page 31

4. Chelicera filamentous, very long; chela so minute as to be almost indiscernible (Fig. 389) ..... *Dermanyssus*, page 31

   Chelicera not as above, with distinct and well-formed chela (Fig. 386) 5

5. With two dorsal plates (Figs. 32, 35) 6

   With one dorsal plate (Fig. 40) 7

6. Posterior dorsal plate large, longer than anal plate (Fig. 35) ..... *Steatonyssus*, page 32

   Posterior dorsal plate small, shorter than anal plate (Fig. 37) ..... *Ornithonyssus*, page 32

7. Anterior pair of sternal pores situated against lateral margins of plate resulting in lateral projections of plate for their accommodation (Fig. 248); third sternal setae on separate, small, distinct plates (Fig. 248) ..... *Ichoronyssus*, page 31

   Anterior pair of pores not against edge of plate which is without lateral projections for their accommodation; third sternal setae, if not on plate, not on distinct separate plates (Fig. 257) ..... *Ornithonyssus*, page 32

Myonyssus montanus
Furman and Tipton, 1955
Figs. 111, 219, 255, 564

Distribution. UTAH: San Juan Co.: *Ochotona princeps* (Furman and Tipton, 1955).

Other Utah records. Summit Co.: *O. princeps*.

Seasonal occurrence. Three females were taken in August.

KEY TO SPECIES OF FEMALE *Hirstionyssus*

1. Tarsus II has apical spurs (Fig. 606) 2
   Tarsus II lacks spurs 13

2. Coxa I has spur (Fig. 436); inner spurs of coxae II and III bifid (Figs. 457, 460) ..... *staffordi*, page 18
   Coxa I lacks spur; other coxal spurs simple (Fig. 463) 3

3. Coxa II has two spurs (Fig. 450) 4
   Coxa II has three spurs (Fig. 442) 11

4. Coxa III has one spur (Fig. 461) ..... *tarsalis*, page 18
   Coxa III has two spurs (Fig. 463) 5

5. Coxa IV lacks spur 6
   Coxa IV has spur (Fig. 514) 7

6. Inner spurs on coxae II and III rounded or truncate (Figs. 456, 462) ..... *affinis*, page 19
   Inner spurs on coxae II and III sharply pointed (Fig. 455) ..... *palustris*, page 19

7. Inner spur on coxa II broadly rounded (Fig. 454) ..... *punctatus*, page 20
   Inner spur on coxa II acutely or bluntly pointed (Figs. 451, 452) 8

8. Sternal plate seven times as wide as long; posterior border invaginated to level anterior to second sternal setae (Fig. 225) ..... *invaginatus*, page 21
   Sternal plate less than six times as wide as long; posterior border not invaginated beyond level of second sternal setae (Fig. 228) 9

9. Peritreme does not extend beyond anterior edge of coxa II (Fig. 555) ..... *eutamiae*, page 21
   Peritreme extends to middle of coxa I 10

10. Inner spur of coxa II short (not over 8 mm long), about as wide as long (Fig. 450) ..... *utahensis*, page 22
    Inner spur of coxa II long (about 18 mm long), much longer than wide (Fig. 449) ..... *angustus*, page 24

11. Femur II has blunt spur near anterior margin (Fig. 540) *femuralis*, page 25
    Femur II lacks spur 12

12. Inner spurs of coxae II and III broadly rounded (Fig. 447) ..... *longichelae*, page 25

Inner spurs of coxae II and III bluntly pointed (Fig. 446) ... *thomomys*, page 26

13. Coxa II has two spurs ... 14

Coxa II has three spurs ... 17

14. Coxa IV has spur ... 15

Coxa IV lacks spur ... 16

15. Inner spur of coxa II represented only by slightly raised hump (Fig. 445) ... *torus*, page 27

Inner spur of coxa II distinct, pointed spur (Fig. 444) ... *neotomae*, page 29

16. Genitoventral plate has two pairs of setae (Fig. 299) ... *bisetosus*, page 29

Genitoventral plate has only usual pair of setae (Fig. 295) *isabellinus*, page 29

17. Peritreme very wide for entire length, equal to almost half the thickness of legs (Fig. 569) ... *triacanthus*, page 30

Peritreme of normal width or only slightly widened (Fig. 568) ... 18

18. Sternal plate less than four times as wide as long (Fig. 244) ... *hilli* variant, page 30

Sternal plate four or more times as wide as long ... 19

19. Peritreme ends at anterior edge of coxa II (Fig. 573); sternal plate about five times as wide as long (Fig. 242) ... *hilli*, page 30

Peritreme ends at middle of coxa I (Fig. 575); sternal plate about eight times as wide as long (Fig. 245) ... *incomptus*, page 30

Hirstionyssus staffordi
Strandtmann and Hunt, 1951

Figs. 12, 122, 213, 282, 436, 457, 460, 479, 602

Distribution. GEORGIA: *Mephitis elongata, Spilogale putorius*; OKLAHOMA: *Spilogale interrupta*; TEXAS: *Mephitis mesomelas, Spilogale leucoparia* (Strandtmann and Hunt, 1951).

Utah records. Utah Co.: *Spilogale gracilis*.

Seasonal occurrence. The 19 females were taken in July. Each of 12 contained an egg.

Comments. This mite likely is more common and widely distributed than has been reported. An obvious reluctance on the part of scientists to collect and examine its common host likely accounts for the few records available.

Hirstionyssus tarsalis, new species

Figs. 13, 123, 215, 270, 459, 461, 563, 603

Utah records. Box Elder Co.: *Peromyscus maniculatus*, Lynn, two females, July, 1957. Daggett Co.: *P. maniculatus*, Deep Creek Camp Ground, one female, June, 1958.

Type data. Holotype female, B.Y.U. collection no. 445. Taken from *Peromyscus maniculatus*, Deep Creek Camp Ground, Daggett Co., Utah, 23 June 1958. In the acarology collection of the Department of Zoology and Entomology, Brigham Young University, Provo, Utah. The trivial name *tarsalis* refers to tarsus IV which possesses a long spur-like seta.

Female

Gnathosoma. Greatest width at base, 94; length to base of palpal trochanter, 58. All setae nude. Cheliceral digits moderate in length and thickness, 50 long from base of moveable digit; lack teeth.

Legs. Length from distal edge of coxa to base of pretarsus: I, 218; II, 185; III, 197; IV, 271. Width of genua: I and II, 58; III, 43; IV, 41. Tarsus II has pair of apical, slightly curved, blunt spurs, 8 long. Tarsus IV has apical, spur-like seta, 22 long. Coxa I has two subequal setae, proximal one slightly larger. Coxa II has two

spurs: usual anterocaudal one of moderate thickness and sharply pointed; inner spur bluntly pointed, 7 long and 7 wide. Coxa III has one inner posterior spur, sharply pointed, 12 long and 7 wide. Coxa IV lacks spur.

Dorsal plate. Elliptical; all sides convex; tapers to blunt point posteriorly; 480 long, greatest width 268. Has 26 pairs setae; most anterior pair 17 long, anteromedial setae 31 long, medial setae 12 long, posterior ones 21 long.

Sternal plate. Five times as wide as long (width measured between outer edges of third sternal setae); anterior border only slightly convex; posterior border concave, invaginated to level even with second sternal seta; lateral margins moderately concave; anterior corners elongate and sharply pointed; posterior corners narrowly extend between coxae II and III. Has three pairs subequal setae, first and third pairs about 29, middle pair about 36 long; distance between posterior pair of setae 2.7 times as great as distance between first pair; first pair of setae on anterior margin of plate, second pair set in from lateral margins, third pair on posterior edge of plate.

Genitoventral plate. Width 79 (measured between outer edges of genitoventral setae); length 86 (from anterior edge of genitoventral seta to posterior border of plate); has prominent internal ridges; has narrow, darkened border effect; thickly punctate; setae 24 long, situated slightly posterior to mid-coxa IV.

Anal plate. Elongate oval; evenly convex but more strongly posteriorly; with cribum. Length 65 (from base of postanal seta to anterior edge of plate); greatest width 55; has light border completely encircling plate; lightly punctate. Adanal and postanal setae subequal, about 19 long; adanal setae situated opposite middle of anus.

Unsclerotized part of venter. Has 13 pairs of setae posterior to genitoventral setae (not counting those on posterior borders); setae about equal, 24 long.

Peritreme. Sinuous, ends at anterior fourth of coxa I; granulo-punctate for entire width and length; about equal width (5 wide) for entire length.

Hirstionyssus affinis (Jameson), 1950

Figs. 14, 124, 221, 286, 456, 462, 556, 604

Distribution. CALIFORNIA: *Eutamias minimus, Peromyscus boylii, Tamiasciurus douglasii* (Jameson, 1950b; Strandtmann and Wharton, 1958).

Utah records. Box Elder Co.: *E. minimus.* Kane Co.: *Perognathus formosus, Peromyscus truei.*

Seasonal occurrence. Seven females and six protonymphs were taken in June and July.

Comments. Little is known about the host relationships of this species.

In two of the three collections, *H. affinis* was the only mite on its host. In one collection it was associated with *Hirstionyssus utahensis.*

Hirstionyssus palustris, new species

Figs. 15, 131, 222, 261, 455, 463, 558, 605

Utah records. Carbon Co.: *Sorex palustris,* three miles south of Scofield, two females, July, 1960.

Type data. Holotype female, B.Y.U. collection no. 4808. Taken from *Sorex palustris,* 3 mi south of Scofield, Carbon Co., Utah, 29 July 1960, by D Elden Beck and Clyde L. Pritchett. In the acarology collection of the Department of Zoology and Entomology, Brigham Young University, Provo, Utah. The trivial name *palustris* is Latin for "marshy," and refers to the habitat of the type host.

Female

Gnathosoma. Greatest width at base, 73; length to base of papal trochanter, 70. All setae nude. Cheliceral digits 47 long from base of moveable digit, moderate in thickness, lack teeth.

Legs. Length from distal edge of coxa to base of pretarsus: I, 273; II, 225; III, 200; IV, 275. Width of genua: I and II, 53; III, 45; IV, 43. Tarsus II has apical spurs of medium size and slightly curved. Coxa I has two subequal setae, about 28 long. Coxa II has two spurs: usual anterocaudal spur sharply pointed, about 20 long; inner spur sharply pointed, 18 long and 11 wide. Coxa III has two spurs: outer posterior one sharply pointed, 10 long and 5 wide; inner spur sharply pointed, 18 long and 10 wide. Coxa IV lacks spur.

Dorsal plate. Covers most of dorsum; sides parallel for two-thirds of length; tapers to blunt tip; 510 long; greatest width 290. Has approximately 23 pairs of delicate subequal setae, 10 to 15 long, except for anteromedial and terminal ones which are slightly larger, 15 to 20 long.

Sternal plate. Three and eight-tenths times as wide as long (width measured between outer edges of third sternal setae); anterior border slightly convex; posterior border concave, invaginated almost to level of second setae; lateral margins concave; anterior corners sharply pointed, extend between coxae I and II; pos-

terior corners sharply pointed, extend between coxae II and III. Has three pairs of setae: anterior pair 49 long, median pair 50, posterior pair 45; distance between posterior pair of setae slightly more than twice distance between anterior pair; first pair of setae on anterior edge of plate, second pair set in from sides, third pair situated on extreme posterior corners.

Genitoventral plate. Width 88 (measured between outer edges of genitoventral setae); length 133 (from anterior edge of genitoventral seta to posterior border of plate); broadly rounded, almost truncate; has prominent internal ridges; has distinct light border; setae 30 long, situated at level opposite middle of coxa IV.

Anal plate. Sub-oval, sides broadly rounded, anterior edge almost truncate. Has narrow eribum, 13 long. Length 75 (from base of postanal seta to anterior edge of plate); greatest width, 75; has distinct darkened border. Adanal and postanal setae subequal, 24 to 25 long; adanal setae situated at level opposite middle of anus.

Unselerotized part of venter. Has 15 pairs of setae between level of genitoventral seta and posterior end of anal plate, not counting peripheral setae; those closest to genitoventral plate 30 long, others 20 to 25 long.

Peritreme. Sinuous, narrow, extends to middle of coxa I.

Hirstionyssus punctatus, new species

Figs. 16, 125, 224, 258, 454, 467, 483, 562, 606

Utah records. Box Elder Co.: *Eutamias minimus*, Lynn, one female, July, 1957. Daggett Co.: *Glaucomys sabrinus*, Deep Creek Campground, six females (each of three with an egg), June, 1958. Kane Co.: *Peromyscus maniculatus*, head of Cottonwood Creek, six females, two deutonymphs, June, 1958. Summit Co.: *Eutamias quadrivittatus*, Bald Mtn., 14 females, August, 1957.

Type data. Holotype female, from *Eutamias quadrivittatus*, Bald Mtn., Summitt Co., Utah, 25 August 1956. In the acarology collection of the Department of Zoology and Entomology, Brigham Young University, Provo, Utah. The trivial name *punctatus* refers to the punctation of the anal plate.

Female

Gnathosoma. Greatest width at base, 115; length to base of palpal trochanter, 77. All setae nude. Cheliceral digits moderate in length and thickness, 60 long from base of moveable digit; lack teeth.

Legs. Length from distal edge of coxa to base of pretarsus: I, 370; II, 320; III, 285; IV, 406. Width of genua: I, 58; II, 62; III, 46; IV, 43. Tarsus II has pair of apical, slightly curved, blunt spurs, 9.6 long. Tarsus IV has apical, spur-like seta, 17 long. Coxa I has two subequal setae, proximal one slightly longer. Coxa II has two spurs: usual anterocaudal one long and sharply pointed; inner spur thumb-like, broadly rounded, almost truncate, 14 long, 12 wide. Coxa III has two spurs: outer posterior one sharply pointed, 12 long and 7 wide; inner posterior one bluntly pointed, 14 long and 12 wide. Coxa IV has sharply pointed spur, 13 long and 7 wide.

Dorsal plate. Sides neither concave nor convex, but slightly sinuous; tapers to blunt point; 558 long; greatest width, 330. Has 26 pairs of setae; most anterior pair 16 long, anteromedial setae 31 long, medial setae 16 long, posterior ones 31 long.

Sternal plate. Three and nine-tenths times as wide as long (width measured between outer edges of third sternal setae); anterior border convex; posterior border concave, invaginated to level almost to second setae; lateral margins moderately concave; anterior corners elongate but bluntly pointed; posterior corners narrowly extend along anterior margins of coxae III. Has three pairs of subequal setae, third pair slightly longer than first and second; distance between posterior pair of setae 2.8 times as great as distance between first pair; first pair of setae on anterior margin of plate, second pair set in considerably from lateral margins, third pair set in from posterior margin.

Genitoventral plate. Width 98 (measured between outer edges of genitoventral setae); length 127 (from anterior edge of genitoventral seta to posterior border of plate); has conspicuous internal ridges; has narrow, darkened border effect; lightly punctate. Setae 34 long, situated at level opposite mid-coxa IV.

Anal plate. Elongate oval; evenly convex but more strongly tapered posteriorly. With eribum. Length 77 (from base of postanal seta to anterior edge of plate); greatest width 72; has dark border completely encircling plate; lightly but thickly punctate. Adanal and postanal setae subequal, about 31 long; adanal setae situated opposite middle of anus.

Unselerotized part of venter. Has 15 pairs of setae posterior to genitoventral setae (not counting those on posterior borders); setae about equal, 31 long.

Peritreme. Slightly sinuous; ends at anterior fourth of coxa II; granulo-punctate for entire width and length; 9.6 wide at base, gradually tapering to 4.8 at tip.

Hirstionyssus invaginatus, new species

Figs. 17, 18, 127, 130, 225, 227, 267, 276, 452, 453, 464, 468, 484, 485, 560, 561, 607, 608

Hirstionyssus occidentalis (Ewing) of Utah records (in part).

Utah records. Cache Co.: *Citellus armatus*, Blacksmith Fork Junction, one female, June, 1953. Rich Co.: *C. armatus*, Laketown, seven females, June, 1953. Sanpete Co.: *C. armatus*, 11 miles east of Mt. Pleasant, one male, one female, August, 1951. Summit Co.: *C. armatus*, Lake Creek Summit, 19 females, August, 1953. Utah Co.: *C. armatus*, Provo Canyon, 12 females, June, 1951 and 1957; five females, July, 1957; *Mus musculus*, Lehi, two females, one deutonymph, January, 1951; *Thomomys talpoides*, Provo Canyon, one female, July, 1956. Wasatch Co.: *C. armatus*, Currant Creek, two males, five females, June, 1953; Soldier's Summit, two females, June, 1951; Strawberry Reservoir, nine females, June, 1951.

Comments. Apparently this mite prefers the squirrel *Citellus armatus* as its host.

In five of 17 collections, *H. invaginatus* was the only mite on its host. In five collections it was associated with other species of *Hirstionyssus*.

Type data. Holotype female, B.Y.U. collection no. 4117. Taken from *Citellus armatus* 3 mi west of Big Tree Camp, Provo Canyon, Utah Co., Utah, 22 July 1956, by Dorald M. Allred. In the acarology collection of the Department of Zoology and Entomology, Brigham Young University, Provo, Utah. The trivial name *invaginatus* refers to the extreme invagination of the posterior border of the sternal plate.

Female

Gnathosoma. Greatest width at base, 92; length to base of palpal trochanter, 73. All setae nude. Cheliceral digits 48 from base of moveable digit, moderately developed, lack teeth.

Legs. Length from distal edge of coxa to base of pretarsus: I, 345; II, 298; III, 275; IV, 375. Width of genua: I and II, 55; III and IV, 43. Tarsus II has pair of medium-sized, slightly curved apical spurs. Coxa I has two setae: distal one 22 long, proximal one 30. Coxa II has two spurs: usual anterocaudal spur sharply pointed, 25 long; inner spur sharply pointed, 23 long and 20 wide. Coxa III has two spurs: outer posterior one sharply pointed, 10 long and 6 wide; inner spur sharply pointed, 20 long and 10 wide. Coxa IV has posterocaudal spur, 12 long and 6 wide.

Dorsal plate. Elliptical, covers most of dorsum except sides and posterior corners; lateral margins parallel, straight or slightly concave, with distinct thickened border; tapers to blunt tip; 554 long; greatest width 304; has 25 pairs of setae, those on periphery largest; peripheral setae 20 to 25 long, terminal pair 30 long, medial setae 10 to 13 long.

Sternal plate. Almost seven times as wide as long (width measured between outer edges of third sternal setae); anterior border slightly convex; posterior border concave, invaginated to level slightly anterior to second pair of setae; lateral margins straight; anterior and posterior borders of plate slightly darkened; anterior corners sharply pointed, extend between coxae I and II; posterior corners sharply pointed, extend laterally between coxae II and III; has three pairs of subequal setae, 37 to 40 long; distance between posterior pair of setae two and one-half times as great as distance between first pair; first pair of setae on anterior edge of plate; second pair set in from sides; third pair near edge of posterior corners.

Genitoventral plate. Width 93 (measured between outer edges of genitoventral setae); length 120 (from anterior edge of genitoventral setae to posterior tip of plate); slightly expanded behind genitoventral setae, tapers abruptly (almost straight) to blunt, rounded tip; has distinct internal ridges and light border edged inwardly with darkened line; setae 25 long, situated at level about midway opposite coxa IV.

Anal plate. Suboval, sides and anterior edge broadly rounded; tapers to broadly rounded tip. Cribum 17 long. Length 68 (from base of postanal seta to anterior edge of plate); greatest width 72; has distinct dark border. Adanal setae 28 long; postanal seta heavier, 30 long; adanal setae situated at level opposite middle of anus.

Unsclerotized part of venter. Has 12 pairs of setae between level of genitoventral setae and posterior tip of anal plate, not counting peripheral setae; setae subequal, 20 to 30 long.

Peritreme. Sinuous, curved, wider at base, tapers gradually to moderate width; extends to middle of coxa I.

Hirstionyssus cutamiae, new species

Figs. 19, 128, 228, 279, 451, 469, 482, 555, 609

Hirstionyssus occidentalis (Ewing) of Utah records (in part).

Utah records. Utah Co.: *Eutamias quadrivittatus*, Rock Canyon, Provo, one female, October, 1956; Sco-

field Reservoir, eight females, June, 1957; *Reithrodontomys megalotis*, Cedar Valley, one female, November, 1952.

Type data. Holotype female, B.Y.U. collection no. 4778. Taken from *Eutamias* sp., Aspen Grove, Utah Co., Utah, 16 October 1956, by Lawrence Tseu. In the acarology collection of the Department of Zoology and Entomology, Brigham Young University, Provo, Utah. The trivial name *eutamiae* refers to the generic name of the type host.

Female

Gnathosoma. Greatest width at base, 90; length to base of palpal trochanter, 72. All setae nude. Cheliceral digits 78 from base of moveable digit, strongly developed, lack teeth.

Legs. Length from distal edge of coxa to base of pretarsus: I, 308; II and III, 264; IV, 352. Width of genua: I, 48; II, 50; III, 40; IV, 38. Tarsus II has small pair of apical claws. Coxa I has two subequal setae, 22 long. Coxa II has two spurs: usual anterocaudal spur sharply pointed, about 22 long; inner spur sharply pointed, 10 long and 8 wide. Coxa III has two spurs: outer posterior one sharply pointed, 10 long and 5 wide; inner spur sharply pointed, 12 long and 10 wide. Coxa IV has posteromarginal spur, 5 long and 5 wide, which may be branched or double in some specimens.

Dorsal plate. Covers all of dorsum except posterior corners; sides parallel for two-thirds length; tapers to blunt tip; 524 long; greatest width 334; has distinct light border; has about 26 pairs of delicate setae, those on periphery and posterior tip of plate largest: medial setae 12 to 18, peripheral setae 20 to 30.

Sternal plate. Slightly more than three and one-half times as wide as long (width measured between outer edges of third sternal setae); anterior border convex; blunt projection tapers anteriorly from first pair of setae; posterior border concave, invaginated to level almost equal with second pair of setae; lateral margins straight, with darkened borders; anterior corners sharply pointed, extend between coxae I and II; posterior corners sharply pointed, extend between coxae II and III. Has three pairs of subequal setae, 35 to 38 long; distance between posterior pair two and one-half times as great as distance between first pair; first pair of setae on anterior edge of plate, second pair set in from edge, third pair slightly in from edges of posterior corners.

Genitoventral plate. Width 95 (measured between outer edges of genitoventral setae); length 113 (from anterior edge of genitoventral setae to posterior tip of plate); slightly expanded behind genitoventral setae; tapers abruptly to blunt tip; has prominent internal ridges; setae 25 long, situated at level near posterior border of coxae IV.

Anal plate. Suboval, sides and anterior edge broadly rounded; tapers to blunt tip. Cribum 21 long. Length 73 (from base of postanal seta to anterior edge of plate); greatest width 67; has distinct dark border. Adanal and postanal setae subequal, 28 long; adanal setae situated at level opposite middle of anus.

Unsclerotized part of venter. Has 11 pairs of setae between level of genitoventral setae and posterior end of anal plate, not counting peripheral setae; setae subequal, 25 to 27 long.

Peritreme. Sinuous, narrow, extends to anterior edge of coxa II.

Hirstionyssus utahensis, new species

Figs. 20, 88, 129, 187, 229, 264, 334, 355, 450, 470, 486, 489, 495, 501, 516, 524, 557, 610

Hirstionyssus occidentalis (Ewing) of Utah records (in part).

Distribution. UTAH: Every county except Cache, Davis, Grand, Juab, Millard, Rich, Salt Lake, Sanpete and Wasatch: *Peromyscus maniculatus* (Allred, 1957c). Juab Co.: *Neotoma lepida* (Howell, Allred, and Beck, 1957). San Juan Co.: *Peromyscus crinitus* (Allred, 1957c). Tooele Co.: *Dipodomys microps, Dipodomys ordii* (Ho, 1962); *N. lepida, P. crinitus, Peromyscus truei* (Woodbury, 1956b). Utah Co.: *D. microps, D. ordii*, (Ho, 1962); *P. maniculatus* (Elzinga, 1960); *Reithrodontomys megalotis* (Elzinga and Rees, 1964). Washington Co.: *Peromyscus eremicus;* Wayne Co.: *P. crinitus* (Allred, 1957c).

Other Utah records. Beaver Co.: *Citellus lateralis*. Carbon Co.: *C. lateralis, R. megalotis*. Daggett Co.: *Eutamias quadrivittatus*. Duchesne Co.: *Citellus tridecemlineatus, Eutamias minimus, E. quadrivittatus*. Juab Co.: *P. maniculatus*. Kane Co.: *N. lepida, Peromyscus longimembris, P. crinitus, P. truei*. San Juan Co.: *D. ordii, E. minimus, E. quadrivittatus, P. truei*. Sanpete Co.: *Citellus armatus, E. quadrivittatus*. Sevier Co.: *E. minimus, E. quadrivittatus*. Summit Co.: *C. armatus, C. lateralis, E. minimus, E. quadrivittatus*. Uintah Co.: *D. ordii*. Utah Co.: *C. armatus, C. lateralis, E. quadrivittatus, Thomomys talpoides*. Wasatch Co.: *C. armatus*. Wayne Co.: *Eutamias* sp., *P. truei*.

Seasonal occurrence. Totals of 55 males, 465 females and 33 deutonymphs were taken. Males were found in June, August, and October, mostly in June; females from March through August and in October, mostly in June; deutonymphs about equally in June and August. Each of two females in June contained an egg.

Comments. Mites of *H. utahensis* are widely distributed over the state, and are known from 23 counties.

This species is known from a variety of rodents but apparently prefers squirrels (*Citellus* spp.) and chipmunks (*Eutamias* spp.)

In 21 of 72 collections, *H. utahensis* was the only mite on its host. In 15 collections it was associated with other species of *Hirstionyssus*.

At the time of Allred's (1957c) work on this group, there was some doubt as to the placement of specimens tentatively identified as *H. occidentalis*. Further study of these by the senior author has led us to erect three species, *H. invaginatus*, *H. eutamiae*, and *H. utahensis*, to represent this complex heretofore reported as *H. occidentalis*. *Hirstionyssus utahensis* represents by far the majority of collections previously identified as *H. occidentalis*.

Type data. Holotype female, B.Y.U. collection no. 4224. Taken from *Eutamias quadrivittatus*, one-half mile east of Bald Mtn., Summit Co., Utah, 8 August 1957, by Dorald M. Allred and Merlin Killpack. In the acarology collection of the Department of Zoology and Entomology, Brigham Young University, Provo, Utah. Allotype male, taken from *Peromyscus maniculatus*, Pleasant Grove, Utah Co., Utah, 7 October 1961, by Donald Ash. Same depository as holotype. The trivial name *utahensis*, referring to the state of Utah, was given because of the common occurrence and wide geographic distribution of this species in Utah.

Female

Gnathosoma. Greatest width at base, 93; length to base of palpal trochanter, 72. All setae nude. Cheliceral digits 75 from base of moveable digit, moderately developed, lack teeth.

Legs. Length from distal edge of coxa to base of pretarsus: I, 303; II, 242; III, 237; IV, 293. Width of genua: I and II, 47; III and IV, 35. Tarsus II has pair of small, slightly curved apical spurs. Coxa I has two subequal setae, 25 long. Coxa II has two spurs: usual anterocaudal spur sharply pointed, about 20 long; inner spur sharply pointed, 7½ long and 7½ wide. Coxa III has two spurs: outer posterior one sharply pointed, 7½ long and 4 wide; inner spur sharply pointed, 12½ long and 8 wide. Coxa IV has caudomarginal spur, 10 long and 8 wide.

Dorsal plate. Elliptical, covers most of dorsum except sides and posterior corners; sides parallel for only short distance; tapers to blunt tip; 515 long; greatest width 290; has distinct light border; has 25 pairs of delicate setae, those on periphery only slightly larger than medial setae, except on anterior and posterior ends of plate; medial and mediolateral setae 12 to 15 long; anterior and posterior setae 22 to 27.

Sternal plate. Four and one-half times as wide as long (width measured between outer edges of third sternal setae); anterior border slightly and evenly convex; posterior border concave, invaginated to level almost even with second sternal setae; lateral margins almost straight, with slightly darkened borders; anterior corners sharply pointed, elongate, project between coxae I and II; posterior corners sharply pointed, extend laterally between coxae II and III; has three pairs of subequal setae 32 to 35 long; distance between posterior pair of setae three times as great as distance between first pair; first pair of setae on anterior edge of plate, second pair set in from edge, third pair slightly in from edges of posterior corners.

Genitoventral plate. Width 87 (measured between outer edges of genitoventral setae); length 110 (from anterior edge of genitoventral seta to posterior tip of plate); slightly expanded behind genitoventral setae, curves gradually to rounded tip; has prominent internal ridges and distinct, light border; setae 28 long, situated at level near posterior border of coxa IV.

Anal plate. Suboval, sides and anterior edge broadly rounded; tapers to bluntly pointed tip. Cribum 15 long. Length 70 (from base of postanal seta to anterior edge of plate); greatest width 63; has distinct dark border. Adanal and postanal setae subequal, 23 to 28 long; adanal setae situated at level opposite middle of anus.

Unsclerotized part of venter. Has 12 pairs of setae between level of genitoventral setae and posterior end of anal plate, not counting peripheral setae; setae subequal, 23 to 25 long.

Peritreme. Slightly sinuous, curved, of normal width, extends to middle of coxa I.

Male

Gnathosoma. Greatest width at base, 86; length to base of palpal trochanter, 58. All setae nude. Cheliceral digits 50 long from base of moveable digit; moderately thick; lack teeth.

Legs. Length from distal edge of coxa to base of pretarsus: I, 257; II, 228; III, 226; IV, 317. Width of genua: I, 53; II, 58; III and IV, 46. Tarsus II has pair of apical spurs. Coxa I has two subequal setae, 22 long. Coxa II has

two spurs: anterocaudal one sharply pointed, 19 long and 9 wide; inner medial spur represented only by bluntly pointed, minute projection about 2 long. Coxa III has two spurs: outer posterior one sharply pointed, 10 long and 5 wide; inner spur sharply pointed, 7 long and 5 wide. Coxa IV has narrow, sharply pointed spur, 12 long and 4 wide.

Dorsal plate. Elliptical; tapers posteriorly to blunt tip; 447 long; greatest width 265. Has 27 or 28 pairs of setae: anterior, anterolateral, and posterior setae largest, 19 to 31 long; posterolateral and medial setae smaller, 7 to 12 long.

Holoventral plate. Three usual ventral plates fused into one; 351 long; 131 wide at level of coxa III. Has eight pairs of subequal setae plus three anal setae, 19 long.

Unsclerotized part of venter. Has seven or eight pairs of subequal setae anterior to posterior edge of holoventral plate, 24 long.

Peritreme. Narrow, sinuous, ends at middle of coxa I.

Deutonymph

Gnathosoma. Greatest width at base, 82; length to base of palpal trochanter, 62. All setae nude. Cheliceral digits 43 long from base of moveable digit; slender; lack teeth.

Legs. Length from distal edge of coxa to base to pretarsus: I, 218; II, 214; III, 209; IV, 250. Width of genua: I, 48; II, 53; III, 46; IV, 43. Tarsus II lacks apical spurs. Coxa I has two subequal setae, 19 long. Coxa II has two spurs: anterocaudal one sharply pointed, 12 long and 7 wide; inner medial spur sharply pointed, 7 long and 5 wide. Coxa III has medial spur, sharply pointed, 10 long and 8 wide. Coxa IV lacks spur.

Dorsal plate. Elliptical; tapers to blunt tip posteriorly; 329 long; greatest width 173. Has 24 pairs of setae: posterior pair largest, 34 long; anterior and anterolateral setae subequal, 12 to 14 long; other setae smaller, 5 to 7 long.

Sterno-genitoventral plate. Ends at level opposite mid coxa IV; length 149; greatest width at level of coxa II, 96. Has four pairs of setae: anterior pair largest, 16 long; posterior pair smallest, 11 long.

Anal plate. Length 36 (from base of postanal seta to anterior margin of plate); greatest width 38. Cribum, 12 long. Anal setae subequal, 14 long; adanal setae near anterior level of anus.

Unsclerotized part of venter. Has 17 or 18 pairs of subequal setae, 7 to 17 long.

Peritreme. Narrow, slightly sinuous, extends to anterior fourth of coxa II.

Hirstionyssus angustus, new species
Figs. 21, 132, 233, 294, 449, 472, 565, 611

Utah records. Utah Co.: *Citellus armatus*, Colton, one female, July, 1960.

Type data. Holotype female, B.Y.U. collection no. 6516. Taken from *Citellus armatus*, Colton, Spanish Fork Canyon, Utah Co., Utah, 7 July 1960, by D Elden Beck. In the acarology collection of the Department of Zoology and Entomology, Brigham Young University, Provo, Utah. The trivial name *angustus* is Latin for "narrow" which refers to the strongly curved, narrow peritreme.

Female

Gnathosoma. Greatest width at base, 79; length to base of palpal trochanter, 72. All setae nude. Cheliceral digits 47 long from base of moveable digit, moderate in thickness, lack teeth.

Legs. Length from distal edge of coxa to base of pretarsus: I, 270; II, 248; III, 242; IV, 345. Width of genua: I and II, 50; III, 40; IV, 39. Tarsus II has apical claws of medium size and slightly curved. Coxa I has two subequal setae, 20 to 25 long. Coxa II has two spurs: usual anterocaudal spur sharply pointed, about 25 long; inner spur sharply pointed, 18 long and 13 wide. Coxa III has two spurs: outer posterior one sharply pointed, 10 long and 5 wide; inner spur sharply pointed, 23 long and 14 wide. Coxa IV has minute, sharply pointed spur on posterocaudal border; at the base of the spur, coxal border forms a small, somewhat conspicuous, rounded prominence.

Dorsal plate. Covers most of dorsum; sides almost parallel, slightly concave for two-thirds length; tapers to blunt tip; 519 long; greatest width 281; has distinct light border; has 25 pairs of delicate setae, those on periphery and posterior tip of plate largest: medial setae 13, peripheral setae 18, terminal setae 28.

Sternal plate. Slightly more than five times as wide as long (width measured between outer edges of third sternal setae); anterior border slightly convex; posterior border concave, invaginated to level of median sternal setae; lateral margins straight; anterior corners bluntly pointed, extend between coxae I and II; posterior corners sharply pointed, extend laterally between coxae II and III. Has three pairs of

subequal setae, 30 long; distance between posterior pair two and one-third times as great as distance between first pair; first pair setae on anterior edge of plate, second pair set in from sides, third pair in extreme posterior corners.

Genitoventral plate. Width 80 (measured between outer edges of genitoventral setae); length 107 (from anterior edge of genitoventral seta to posterior tip of plate); moderately rounded; has prominent internal ridges; has distinct light border; setae 23 long, situated at level near posterior edge of coxa IV.

Anal plate. Suboval, sides and anterior edge broadly rounded; tapers to blunt tip. Crib um 20 long. Length 68 (from base of postanal seta to anterior edge of plate); greatest width 65; has distinct border effect of about same density as plate proper, separated on anterior half of plate by dark line. Adanal and postanal setae subequal, 25 to 30 long; adanal setae situated at level slightly posterior to middle of anus.

Unsclerotized part of venter. Has 12 or 13 pairs of setae between level of genitoventral setae and posterior end of anal plate, not counting peripheral setae; setae nearest genitoventral plate shortest, 23 long, distal ones longest, 33 long.

Peritreme. Sinuous and strongly curved, narrow, ends at mid-coxa I.

Hirstionyssus femuralis Allred, 1957

Figs. 22, 71, 135, 190, 232, 288, 332, 357, 448, 471, 490, 491, 499, 517, 526, 540, 554, 612

Distribution. UTAH: Juab Co.: *Neotoma lepida* (Howell, Allred, and Beck, 1957). Tooele Co.: *N. lepida* (Allred and Roseoe, 1957). Washington Co.: *Peromyscus* (probably) *eremicus* (Allred, 1957c).

Other Utah records. Iron Co.: *Mustella frenata.* Juab Co.: *Thomomys bottae, Thomomys talpoides.* Kane Co.: *T. bottae.* Salt Lake Co.: *Citellus armatus.* San Juan Co.: *T. bottae.* Sanpete Co.: *T. talpoides.* Utah Co.: *T. bottae.* Washington Co.: *T. bottae.*

Seasonal occurrence. Five males, 26 females and nine deutonymphs were taken. Males were found in April, October and December; females from April through December, except in June and October; and deutonymphs in April, September, October and December. Greatest numbers were taken in April and December .

Comments. Mites of *H. femuralis* were found most commonly in the Great Basin. They are known from nine counties.

This species apparently prefers pocket gophers of the genus *Thomomys* as its host.

In seven of its 11 collections, *H. femuralis* was the only mite on its host. In four collections it was associated with *Haemolaelaps* spp.

Hirstionyssus longichelae, new species

Figs. 23, 126, 234, 290, 447, 473, 567, 613

Utah records. Duchesne Co.: *Thomomys talpoides,* Timber Canyon, Strawberry River, two females, August, 1957. Summit Co.: *Ochotona princeps,* Bald Mtn., one female, August, 1957; *T. talpoides,* same locality, one female, August 1957. Utah Co.: *T. talpoides,* Palmyra Forest Camp, Diamond Fork Canyon, 14 females, June, 1951; Provo Canyon, one female, July, 1956.

Type data. Holotype female, B.Y.U. collection no. 926. Taken from *Thomomys* sp., Palmyra Forest Camp, Diamond Fork Canyon, Utah Co., Utah, 26 June 1951, by Dorald M. Allred. In the acarology collection of the Department of Zoology and Entomology, Brigham Young University, Provo, Utah. The trivial name *longichelae* refers to the very long digits of the chelicerae.

Female

Gnathosoma. Greatest width at base, 84; length to base of palpal trochanter, 70. All setae nude. Cheliceral digits long and slender, 108 long from base of moveable digit; lack teeth.

Legs. Length from distal edge of coxa to base of pretarsus: I, 245; II and III, 221; IV, 258. Width of genua: I and II, 50; III and IV, 36. Tarsus II has pair of apical, slightly curved spurs, 5 long. Coxa I has usual two setae of equal size. Coxa II has three spurs: usual anterocaudal one long, narrow and acutely pointed; posterocaudal one bluntly pointed, 10 long and 14 wide; inner spur broadly rounded, 19 long and 17 wide. Coxa III has two spurs: outer posterior one bluntly pointed, 7 long and 7 wide; inner posterior one broadly rounded, almost truncate at tip, 24 long and 19 wide. Coxa IV lacks spur.

Dorsal plate. Anterolateral margins slightly concave; medial and posterior margins straight or slightly convex; tapers to broad, blunt point; 452 long; greatest width 254. Has 26 pairs of setae; most anterior pair 10 long, anteromedial setae 19 long, medial setae 10 long, posterior ones 24 long.

Sternal plate. One and nine-tenths as wide as long (width measured between outer edges of third sternal setae); anterior and posterior borders slightly sinuous but generally convex; posterior margin at level behind third pair of setae; lateral margins moderately concave; an-

terior corners bluntly pointed; posterior corners rounded, not extended. Has three pairs of subequal setae; distance between posterior pair of setae 2.4 times as great as distance between first pair; first pair of setae set back from anterior margin of plate, third pair at extreme posterior corners, second pair set in from lateral margins.

Genitoventral plate. Width 84 (measured at outer edges of genitoventral setae); length 86 (from anterior edge of genitoventral seta to posterior border of plate); lacks conspicuous internal ridges; has light border effect; lightly punctate. Setae 22 long, situated at level of posterior edge of coxa IV.

Anal plate. Elongate oval; evenly convex, but more strongly tapered posteriorly. Has cribum. Length 62 (from base of postanal seta to anterior edge of plate); greatest width 22; has light border completely encircling plate; lightly punctate. Adanal setae and postanal seta subequal, about 17 long; adanal setae situated opposite middle of anus.

Unsclerotized part of venter. Has 10 pairs of setae posterior to genitoventral setae (not counting those on borders); all setae about equal, 22 long.

Peritreme. Slightly sinuous; ends at middle of coxa I; granulo-punctations faintly distinct only for half of width and length; very narrow, less than 2.5 wide for entire length.

Hirstionyssus thomomys, new species

Figs. 24, 70, 80, 133, 188, 230, 289, 336, 360, 446, 465, 494, 506, 507, 518, 527, 576, 614

Utah records. San Juan Co.: *Thomomys talpoides*, Kigalia Ranger Station, one male, June, 1955. Summit Co.: *T. talpoides*, Bald Mtn., four females, eight deutonymphs, August, 1957. Utah Co.: *T. talpoides*, Provo Canyon, one female, July, 1956.

Type data. Holotype female, B.Y.U. collection no. 4218. Taken from *Thomomys talpoides*, East of Bald Mtn., Summit Co., Utah, 8 August 1957, by Dorald M. Allred and Merlin Killpack. In the acarology collection of the Department of Zoology and Entomology, Brigham Young University, Provo, Utah. Allotype male, B.Y.U. collection no. 4020. Taken from *Thomomys talpoides*, Kigalia Ranger Station, San Juan Co., Utah, 9 June 1955, by D Elden Beck. Same depository as holotype. The trivial name *thomomys* refers to the generic name of the host from which the holotype was taken.

Female

Gnathosoma. Greatest width at base, 94; length to base of palpal trochanter, 70. All setae nude. Cheliceral digits slender, 74 long from base of moveable digit; lack teeth.

Legs. Length from distal edge of coxa to base of pretarsus: I, 281; II, 238; III, 265; IV, 359. Width of genua: I and II, 58; III and IV, 46. Tarsus II has pair of apical, slightly curved spurs, 7 to 9 long. Coxa I has usual two setae, proximal one larger. Coxa II has three spurs: usual anterocaudal one long, narrow, acutely pointed; posterocaudal one bluntly pointed, 12 long and 14 wide; inner spur bluntly pointed, 17 long and 16 wide. Coxa III has two spurs: outer posterior one bluntly pointed, 11 long and 7 wide; inner posterior one sharply pointed, 22 long and 16 wide. Coxa IV lacks spur.

Dorsal plate. Anterolateral and posterolateral margins concave; mediolateral sides straight or slightly convex; tapers to blunt point; 507 long; greatest width 261; moderately punctate. Has 26 pairs of setae, posterior pair having one or both setae off plate; most anterior pair 14 long, anteromedial setae 39 to 41 long, medial setae 36 long, posterior setae 39.

Sternal plate. Two and one-half times as wide as long (width measured between outer edges of third sternal setae); anterior and posterior borders slightly sinuous; posterior border invaginated only to level of third pair of setae; lateral borders strongly concave; anterior corners bluntly pointed; posterior corners narrowly extend along anterior edges of coxae III. Has three pairs of subequal setae, third pair only slightly shorter than first and second; distance between posterior pair of setae 2.4 times as great as distance between first pair; first pair of setae on extreme anterior edge of plate, third pair on extreme posterior edge, second pair set in from lateral margins.

Genitoventral plate. Width 101 (measured at outer edges of genitoventral setae); length 108 (from anterior edge of genitoventral seta to posterior border of plate); lacks internal ridges; has light border effect; lightly punctate. Setae 41 long, situated at level of mid-coxa IV.

Anal plate. Elongate oval; evenly convex but more strongly tapered posteriorly. Has cribum. Length 70 (from base of postanal seta to anterior edge of plate); greatest width 60; has light anterior and lateral border; moderately punctate. Adanal setae 29 long, slightly longer

than postanal seta, situated opposite middle of anus.

Unsclerotized part of venter. Has 13 pairs of setae posterior to genitoventral setae (not counting those on borders); anterior setae 41 long, posterior setae 36.

Peritreme. Slightly sinuous; ends at anterior fourth of coxa I; granulo-punctate for entire width and length; 7 wide at level of coxa III, 5 wide for remaining length.

Male

Gnathosoma. Greatest width at base, 82; length to base of palpal trochanter, 58. All setae nude. Cheliceral digits 72 long from base of moveable digit; lack teeth.

Legs. Length from distal edge of coxa to base of pretarsus: I, 254; II, 199; III, 228; IV, 329. Width of genua: I, 50; II, 60; III and IV, 53. Tarsus II has pair of apical claws. Coxa I has two setae: basal one 25 long, distal one 16 long. Coxa II has three spurs: anterocaudal one approximately 17 long, narrow, sharply pointed; inner medial spur short and bluntly pointed, 7 long and 9 wide; posterocaudal spur represented only by slight, bluntly pointed bulge. Coxa III has two spurs: outer posterior one sharply pointed, 13 long and 7 wide; medial one sharply pointed, 18 long and 18 wide. Coxa IV has posterior spur, sharply pointed, 11 long and 5 wide.

Dorsal plate. Almost oval; tapers posteriorly to blunt tip; covers most of dorsal surface of body; 468 long; greatest width 254. Has 29 or 30 pairs of setae; some anterior and anterolateral setae largest, 25 to 30 long; other setae smaller, 19 to 22 long, subequal to setae on unsclerotized portion of body.

Holoventral plate. Three ventral plates usually fused into one; 335 long; 148 wide at level of coxa III. Has eight pairs of setae plus three anal setae, 22 to 36 long, posterior pairs longest.

Unsclerotized part of venter. Has eight or nine pairs of subequal setae anterior to posterior edge of holoventral plate, 36 long.

Peritreme. Narrow, slightly sinuous, extends to anterior fourth of coxa I.

Deutonymph

Gnathosoma. Greatest width at base, 77; length to base of palpal trochanter, 54. All setae nude. Cheliceral digits 77 long from base of moveable digit; slender; lack teeth.

Legs. Length from distal edge of coxa to base of pretarsus: I, 281; II, 242; III, 235; IV, 346. Width of genua: I, 50; II, 53; III, 46; IV, 48. Tarsus II lacks apical spurs. Coxa I has two subequal setae 25 long. Coxa II has three spurs: anterocaudal one angled, sharply pointed, 10 long and 7 wide; medial spur represented only by small, rounded knob; posterocaudal spur represented only by slight, bluntly pointed bulge. Coxa III has small, bluntly pointed spur, 5 long and 15 wide. Coxa IV lacks spur.

Dorsal plate. Elliptical; has slightly concave margins anterolaterally and posterolaterally; 305 long; greatest width 158. Has approximately 23 pairs of setae: anterior pair smallest, 11 long; posterior pair largest, 43 long; others subequal, 19 to 24 long.

Sterno-genitoventral plate. Ends at level opposite mid-coxa IV; length 132; greatest width at level of coxae II, 84. Has four pairs of setae: anterior pair largest, 41 long; posterior pair smallest, 22 long.

Anal plate. Length 43 (from base of postanal setae to anterior margin of plate); greatest width, 49. Cribum, 12 long. Anal setae subequal, 20 long; adanal setae situated slightly anterior of mid-anal position.

Unsclerotized part of venter. Has 15 to 18 pairs of subequal setae, 17 long.

Peritreme. Narrow, sinuous, extends to anterior third of coxa II.

Hirstionyssus torus, new species

Figs. 25, 76, 134, 185, 235, 291, 335, 356, 445, 474, 487, 492, 504, 512, 520, 529, 571

Utah records. San Juan Co.: *Sciurus aberti*, Devil's Canyon, nine miles north of Blanding, six males, 23 females (two with an egg), seven deutonymphs, May, 1951.

Type data. Holotype female, B.Y.U. collection no. 727. Taken from *Sciurus aberti*, 9 mi north of Blanding, San Juan Co., Utah, 6 May 1951, by Dorald M. Allred and D Elden Beck. In the acarology collection of the Department of Zoology and Entomology, Brigham Young University, Provo, Utah. Allotype male, same data and depository as holotype. The trivial name *torus* is Latin for "protuberance," which refers to the coxa II spur which is represented only by a small hump.

Female

Gnathosoma. Greatest width at base, 80; length to base of palpal trochanter, 72. All setae

nude. Cheliceral digits 72 long from base of moveable digit; moderate in thickness; lack teeth.

Legs. Length from distal edge of coxa to base of pretarsus: I, 293; II, 230; III, 243; IV, 303. Width of genua: I, 43; II, 45; III and IV, 35. Tarsus II lacks apical spurs. Coxa I has two subequal setae, 23 long. Coxa II has two spurs: usual anterocaudal one approximately 20 long, sharply pointed; inner spur represented by rounded, slightly raised hump. Coxa III has two spurs: outer posterior one narrow, sharply pointed, 13 long and 5 wide; inner posterior one wider, sharply pointed, 15 long and 11 wide. Coxa IV has spur, 7 long and 5 wide.

Dorsal plate. Elliptical, with slightly curved sides; tapers gradually to blunt tip posteriorly; 532 long; greatest width 160. Has 25 or 26 pairs of delicate setae; those around periphery of plate largest, 13 to 18 long, except two terminal pairs which are 21 to 23 long; medial setae less than 8 long except for anteromedial pairs which are 13 long.

Sternal plate. Four and one-third times as wide as long (width measured between outer edges of third sternal setae); anterior border slightly convex; posterior border concave, invaginated almost to level of median sternal setae; lateral margins strongly concave, with thickened borders; anterior corners bluntly pointed, extend between coxae I and II; posterior corners sharply pointed, extend laterally between coxae II and III. Has three pairs of setae: anterior two pairs 28 long, posterior pair 30 long; distance between posterior pair of setae slightly more than three times distance between anterior pair; first pair of setae on anterior edge of plate, second pair set in from lateral edges, third pair in extreme corners of plate.

Genitoventral plate. Width 95 (measured between outer edges of genitoventral setae); length 125 (from anterior edge of genitoventral setae to posterior border of plate); has prominent internal ridges; has distinct light border which is evident almost whole distance along sides and posterior edge of plate; setae 23 long, situated at level opposite middle of coxa IV.

Anal plate. Oval, somewhat evenly convex; tapers posteriorly to blunt tip. Has distinct large cribum, 20 long. Length 74 (from base of postanal seta to anterior edge of plate); greatest width 67; has distinct darkened border; adanal and postanal setae subequal, 23 long; adanal setae situated opposite middle of anus.

Unsclerotized part of venter. Has 11 or 12 pairs of setae between level of genitoventral setae and posterior end of anal plate, not counting peripheral setae; setae subequal, 23 to 25 long.

Peritreme. Slightly sinuous, narrow, extends to middle of coxa I.

Male

Gnathosoma. Greatest width at base, 38; length to base of palpal trochanter, 46. All setae nude. Cheliceral digits 69 long from base of moveable digit; lack teeth.

Legs. Length from distal edge of coxa to base of pretarsus:I, 247; II, 206; III, 213; IV, 300. Width of genua: I, 38; II, 41; III and IV, 34. Tarsus II has pair of apical spurs. Coxa I has two normal setae: basal one 19 long, distal one 11 long. Coxa II has two spurs: anterocaudal one approximately 22 long, sharply pointed; ventromedial spur represented by rounded, slightly raised hump. Coxa III has two spurs: outer posterior one narrow and sharply pointed, 12 long and 4 wide; inner posterior one wider and sharply pointed, 11 long and 10 wide. Coxa IV has long, narrow spur, 13 long and 5 wide.

Dorsal plate. Elliptical; has slightly curved sides that taper gradually to blunt tip posteriorly; 417 long; greatest width 250. Has approximately 25 pairs of setae; anterolateral setae and terminal two pairs about equal in size to setae on unsclerotized portion of body, 22 to 33 long; posterolateral and medial setae tiny, about 5 long.

Holoventral plate. Sternal, genitoventral and anal plates fused into one; 324 long; 117 wide at level of coxa III. Has seven pairs of setae, plus three anal setae, 13 to 22 long, posterior ones longest.

Unsclerotized part of venter. Has seven pairs of subequal setae anterior to posterior edge of holoventral plate, 29 long.

Peritreme. Narrow, slightly sinuous, extends to middle of coxa I.

Deutonymph

Gnathosoma. Greatest width at base, 58; length to base of palpal trochanter, 53. All setae nude. Cheliceral digits 54 long from base of moveable digit; moderate in thickness; lack teeth.

Legs. Length from distal edge of coxa to base of pretarsus: I, 171; II, 164; III, 182; IV, 235. Width of genua: I, 36; II, 38; III and IV, 35. Tarsus II lacks apical spurs. Coxa I has two subequal setae, 14 long. Coxa II has two spurs:

usual anterocaudal one approximately 10 long, sharply pointed; inner spur represented by small, rounded protuberance. Coxa III has inner, posterior spur, 6 long and 7 wide. Coxa IV lacks spur.

Dorsal plate. Elliptical; has slightly curved sides that taper gradually to blunt tip posteriorly; 326 long; greatest width 185. Has approximately 23 pairs of setae: anterior and anterolateral ones subequal to those on unsclerotized portion of body, 7 to 11 long; terminal pair 36 long, others tiny, 5 long.

Sterno-genitoventral plate. Ends at level with posterior borders of coxa IV; length 158; greatest width at level of coxa II, 79. Has four pairs of subequal setae, 12 to 16, anterior pairs longest.

Anal plate. Length 55 (from base of postanal seta to anterior edge of plate); greatest width 40; has slightly darkened border. Cribum 8 long. Adanal setae 16 long, situated slightly anterior of mid-anal position; postanal seta 13 long.

Unsclerotized part of venter. Has 12 or 13 pairs of subequal setae, 12 long.

Peritreme. Narrow, slightly sinuous, extends to anterior edge of coxa II.

Hirstionyssus neotomae
(Eads and Hightower), 1951

Figs. 26, 77, 81, 82, 136, 181, 236, 237, 292, 331, 358, 361, 363, 444, 475, 488, 493, 498, 500, 502, 503, 505, 510, 513, 514, 523, 528, 570

In the Utah series there are two distinct forms. In one the sternal, dorsal and holoventral plates are smaller than in the other. Occasionally there is an extra pair of setae on the genitoventral pate of the female in both forms.

Distribution. ? locality from *Neotoma albigula, Neotoma fuscipes, Neotoma micropus* (Strandtmann and Wharton, 1958). NEVADA: *Neotoma lepida* (Allred and Goates, 1964b). TEXAS: *Liomys* sp., *N. micropus, Perognathus hispidus* (Eads and Hightower, 1951; Eads Trevino and Campos, 1965).

Utah records. Carbon Co.:*Thomomys talpoides*. Daggett Co.: *Neotoma cinerea*. Duchesne Co.: *N. cinerea*. Juab Co.: *Perognathus parvus*. Kane Co.: *N. lepida, P. parvus, Peromyscus maniculatus, Peromyscus truei*. San Juan Co.: *Dipodomys ordii, P. truei*.

Seasonal occurrence. Twenty males, 109 females, four protonymphs and 11 deutonymphs were collected from May through August. Greatest numbers were taken in June; only 11 were taken in other months. Males were found in June and July, females each month, and nymphs only in June.

Comments. Mites of *H. neotomae* are known from northern and southern Utah, but were taken more commonly from the Upper Colorado River Basin. They are known from six counties.

This mite apparently prefers wood rats (*Neotoma* spp.) as its hosts, although it has commonly been found on *Peromyscus* spp.

In four of 28 collections *H. neotomae* was the only mite found on its host. In 10 collections it was associated with other species of *Hirstionyssus*.

Hirstionyssus bisetosus Allred, 1957

Figs. 36, 68, 137, 184, 239, 299, 338, 366, 443, 466, 496, 509, 511, 519, 535, 566

Distribution. NEVADA:*Neotoma lepida* (Allred and Goates, 1964b). UTAH: Tooele Co.: *N. lepida* (Allred, 1957a).

Other Utah records. None.

Comments. This species likely is an inhabitant of the nests of wood rats. It is seldom found on the body of its host.

Hirstionyssus isabellinus
(Oudemans), 1913

Figs. 34, 91, 138, 183, 240, 295, 339, 441, 476, 521, 525, 574

Distribution. ? locality from variety of rodents (Strandtmann and Wharton, 1958). CALIFORNIA: *Microtus* sp. (Jameson and Brennan, 1957). OREGON: *Microtus longicaudus, Microtus montanus, Scapanus* sp., *Sorex vagrans* (Fonseca, 1948; Hansen, 1964). UTAH: Garfield Co.: *Peromyscus maniculatus* (Allred, 1957c). Tooele Co.: ? host (Woodbury, 1956a).

Other Utah records. Carbon Co.: *M. longicaudus, Thomomys talpoides*. Kane Co.: *P. maniculatus*. Morgan Co.: *Microtus* sp. Rich Co.: *Citellus armatus*. San Juan Co.: *M. longicaudus*. Summit Co.: *M. longicaudus, Ochotona princeps, Phenacomys intermedius*. Utah Co.: *Eutamias quadrivittatus, M. montanus, Microtus pennsylvanicus, Reithrodontomys megalotis, T. talpoides*. Washington Co.: *Onychomys torridus*.

Seasonal occurrence. One male, 40 females, one protonymph and five deutonymphs were taken from April through August and in February. A gravid female containing a larva was taken in August. The protonymph was collected in June, and the deutonymphs in May, July and August.

Comments. Mites of *H. isabellinus* are distributed over the state in 10 counties.

This species apparently prefers voles of the genus *Microtus*.

In three of 17 collections *H. isabellinus* was the only mite on its host. In four collections it was associated with other *Hirstionyssus* spp. In eight collections it was associated with *Laelaps* spp. which are commonly found on voles.

Hirstionyssus triacanthus
(Jameson), 1950

Figs. 38, 141, 241, 296, 442, 477, 569

Distribution. NEVADA: *Dipodomys merriami, Dipodomys microps, Onychomys torridus* (Jameson, 1950b; Allred, 1962; Goates, 1963). OREGON: *Dipodomys* sp. (Jameson, 1950b). TEXAS: *Dipodomys ordii* (Eads, Menzies and Miles, 1952). UTAH: Tooele Co.: *Ammospermophilus leucurus* (Woodbury, 1956b); *D. microps, D. ordii* (Keegan, 1953); *Lepus californicus, Perognathus formosus, Peromyscus maniculatus, Reithrodontomys megalotis* (Woodbury, 1956b). Utah Co.: *Citellus leucurus, D. microps, D. ordii, P. maniculatus, R. megalotis* (Elzinga, 1960).

Other Utah records. Beaver Co.: *D. ordii.* Box Elder Co.: *D. microps, D. ordii, P. maniculatus.* Daggett Co.: *D. ordii.* Duchesne Co.: *D. ordii.* Emery Co.: *D. ordii, Peromyscus crinitus.* Juab Co.: *D. microps, D. ordii, P. maniculatus.* Kane Co.: *D. ordii, Perognathus longimembris.* Millard Co.: *D. microps, D. ordii.* San Juan Co.: *D. ordii.* Sanpete Co.: *D. microps, D. ordii, Neotoma lepida.* Uintah Co.: *D. ordii.* Utah Co.: *Rattus norvegicus.* Washington Co.: *Dipodomys merriami, D. microps, D. ordii, Peromyscus cremicus.*

Seasonal occurrence. The 389 females were collected every month except November, mostly in June. Each of two females in July, three in August and two in October contained an egg.

Comments. Mites of *H. triacanthus* are known from 14 counties.

Although known from a variety of hosts, this species apparently prefers kangaroo rats, especially *D. microps*, as its hosts. The parasite index was five to eight on kangaroo rats and only one or two on other hosts.

In 19 of 75 collections, *H. triacanthus* was the only mite on its host. In 40 collections it was associated with *Hirstionyssus incomptus.*

The frequent occurrence of *H. incomptus* with *triacanthus* is unusual. In the collections of *incomptus*, more than 17% of the adults are males, whereas not a single male *triacanthus* was taken. As far as is known, the male of *triacanthus* has never been described or even found. These data lead us to suspect that *triacanthus* is a morphological variant of *incomptus*, representing either autogamous or thelytokous parthenogenesis.

Hirstionyssus hilli (Jameson), 1950

Figs. 33, 41, 139, 140, 242, 244, 297, 298, 439, 440, 478, 480, 568, 573

One specimen from *Perognathus parvus* varies from typical *H. hilli* in the shape and dimension of the ventral plates, dorsal plate, peritreme, and coxae II and III. Although this may represent a new species, it is retained here for the present.

Distribution. CALIFORNIA: *Perognathus parvus;* KANSAS: *Perognathus hispidus* (Jameson, 1950b). NEVADA: *P. parvus, Perognathus formosus* (Allred, 1963). UTAH: Kane Co.: *Peromyscus maniculatus;* Sevier Co.: *P. maniculatus* (Allred, 1957c). Tooele Co.: *Dipodomys ordii, Neotoma lepida* (Keegan, 1953); *Onychomys leucogaster* (Ho, 1962); *P. maniculatus* (Keegan, 1953). Utah Co.: *D. ordii, O. leucogaster, P. maniculatus* (Elzinga, 1960). Washington Co.: *Peromyscus cremicus* (Allred, 1957c).

Other Utah records. Carbon Co.: *P. parvus.* Juab Co.: *P. parvus.* Kane Co.: *O. leucogaster, P. parvus.* San Juan Co.: *Perognathus flavus.* Utah Co.: *P. parvus.* Washington Co.: *Perognathus longimembris.* Wayne Co.: *Perognathus* sp.

Seasonal occurrence. Two females were taken in April, one in May, 22 in June and one in October. One male and one deutonymph were taken in June. Each of three females in June contained an egg.

Comments. Apparently this mite prefers species of *Perognathus* as its host.

Hirstionyssus incomptus
(Eads and Hightower), 1952

Figs. 39, 92, 142, 186, 245, 293, 337, 364, 438, 481, 497, 508, 515, 522, 534, 575

Distribution. TEXAS: *Dipodomys ordii, Perognathus* sp. (Eads and Hightower, 1952). UTAH: Carbon Co.: *Peromyscus maniculatus;* San Juan Co.: *Peromyscus crinitus, P. maniculatus* (Allred, 1957c). Tooele Co.: *Ammospermophilus leucurus, Dipodomys microps, D. ordii* (Woodbury, 1956b); *Neotoma lepida* (Allred and Roscoe, 1957); *P. maniculatus, Reithrodontomys megalotis* (Ho, 1962). Utah Co.: *Citellus leucurus, D. ordii,* (Elzinga, 1960); *P. maniculatus, R. megalotis* (Ho, 1962).

Other Utah records. Box Elder Co.: *D. ordii.* Carbon Co.: *D. ordii.* Daggett Co.: *D. ordii.* Duchesne Co.: *D. ordii.* Emery Co.: *D. ordii.* Garfield Co.: *Microtus longicaudus.* Grand Co.: *Dipodomys* sp. Juab Co.: *D. microps, D. ordii, P. maniculatus.* Kane Co.: *D. ordii, Perognathus longimembris.* San Juan Co.: *D. ordii.* Sanpete Co.: *D. ordii.* Sevier Co.: *D. ordii.* Utah Co.: *D. microps, D. ordii, N. lepida, Rattus norvegicus.* Washington Co.: *Citellus variegatus, Dipodomys merriami, D. microps, D. ordii, Perognathus parvus, Peromyscus cremicus, R. megalotis.* Wayne Co.: *D. ordii, P. maniculatus.*

Seasonal occurrence. Totals of 96 males, 455 females and 53 deutonymphs were taken. Females were collected every month except November, mostly in April, May and June; males from February through October except in September, mostly in April and May; deutonymphs from March through July and in October, mostly in April and May. Gravid females were found, each with one egg, from February through August and in December, mainly in April and

May. Each of two females in April contained a larva.

Comments. Mites of *H. incomptus* are distributed over the state, although apparently they are more common in the southern part in the Upper Colorado River Basin. They are known from 16 counties.

This mite apparently prefers kangaroo rats as its hosts, especially *D. ordii*. On this host the mite population index was seven as compared to three or less for other hosts.

In 25 of 101 collections, *H. incomptus* was the only mite on its host. In 26 collections it was associated with *Haemolaelaps glasgowi*, and in 40 collections with *Hirstionyssus triacanthus*. The frequent occurrence of *H. incomptus* with *H. triacanthus* was significantly more common than between other mite species. It is unusual that two species of the same genus commonly occur on the same host with such a frequency.

Hirstionyssus bacoti

This species was listed by Elzinga (1960) from *Dipodomys microps* from Utah County and by Ho (1962) from *D. microps* and *Peromyscus maniculatus* from Tooele Co. No such species can be found listed in the literature. Perhaps their designations were meant to be *Ornithonyssus bacoti*.

Hirstionyssus carnifex (Koch), 1839

Distribution. ? localities from bats, *Clethrionomys* sp., *Mus* sp., *Peromyscus maniculatus, Rattus* sp., *Sorex* sp., and others (Strandtmann and Wharton, 1958). NEVADA: *Peromyscus crinitus* (Allred and Goates, 1964a). OREGON: House mouse; UTAH: Tooele Co.: *P. maniculatus* (Keegan, 1953). ? locality: *Citellus armatus* (Jenkins, 1965).

Other Utah records. None.

Comments. We believe that the Utah records of *H. carnifex* are misidentifications, and doubt that this species occurs in Utah, probably not even in the United States.

Hirstionyssus geomydis (Keegan), 1946

Distribution. COLORADO: *Geomys bursarius, Thomomys talpoides, Thomomys umbrinus* (Miller and Ward, 1960). KANSAS: *G. bursarius* (Keegan, 1946). UTAH: Tooele Co.: *Neotoma lepida* (Allred and Roscoe, 1957).

Other Utah records. None.

Comments. We believe the above records for Utah are misidentifications, and doubt that this species has been taken in Utah.

Hirstionyssus obsoletus Jameson, 1950

Distribution. CALIFORNIA: *Clethrionomys californicus, Neurotrichus gibbsii, Peromyscus maniculatus, Sorex trowbridgii* (Jameson, 1950a). OREGON: *P. maniculatus* (Hansen, 1964). UTAH: Piute Co.: *P. maniculatus* (Allred, 1957a).

Other Utah records. None.

Comments. We believe the above records for Utah are misidentifications, and doubt that this species has been taken in Utah.

Ichoronyssus robustipes (Ewing), 1925

Figs. 40, 83, 143, 171, 248, 300, 362, 412, 418, 536, 537, 572

Chiroptonyssus robustipes of authors.

Distribution. ARIZONA: Bats (Bradshaw and Ross, 1961). ? locality from bats (Strandtmann and Wharton, 1958).

Utah records. Washington Co.: *Tadarida mexicana*.

Seasonal occurrence. Three males and 16 females were taken in February.

KEY TO SPECIES OF FEMALE *Dermanyssus*

1. Two dorsal plates, posterior one small (Fig. 28) ..... *sanguineus*, page 32
   One dorsal plate (Fig. 27) 2
2. Dorsal plate rounded posteriorly, widest near middle (Fig. 27) ..... *hecki*, page 32
   Dorsal plate truncate posteriorly, widest near anterior end (Fig. 29) ..... *gallinae*, page 32

Dermanyssus sanguineus Hirst, 1914
Figs. 28, 144, 250, 301

Allodermanyssus sanguineus of authors (Krantz, 1959).

Distribution. ARIZONA, CONNECTICUT, ILLINOIS, INDIANA, MARYLAND, MASSACHUSETTS, NEW YORK, PENNSYLVANIA: domestic mice and rats (Pratt and Good, 1954). UTAH: Salt Lake Co.: *Rattus norvegicus* (Pratt, Lane and Harmston, 1949). Washington Co.: *Peromyscus eremicus* (Allred, 1957c). WASHINGTON, D.C.: ? host (Pratt, Lane and Harmston, 1949).

Other Utah records. None.

Dermanyssus hecki Allred, 1957
Figs. 27, 67, 84, 93, 101, 149, 174, 251, 308, 342, 345, 367, 389, 582

Distribution. NEVADA: *Neotoma lepida, Peromyscus crinitus* (Allred and Goates, 1964a, 1964b). UTAH: Box Elder Co.: *Peromyscus maniculatus;* Millard Co.: *P. crinitus;* San Juan Co.: *Peromyscus boylii, P. crinitus, P. maniculatus;* Washington Co.: *P. crinitus, Peromyscus eremicus, P. maniculatus;* Wayne Co.: *P. crinitus* (Allred, 1957c).

Other Utah records. Emery Co.: *P. crinitus.* Garfield Co.: *P. crinitus, P. maniculatus.* Grand Co.: *N. lepida.* Juab Co.: *N. lepida.* Kane Co.: *N. lepida, P. crinitus, P. maniculatus, Peromyscus truei.* San Juan Co.: *Eutamias quadrivittatus, Neotoma albigula, N. lepida, P. truei.* Sanpete Co.: *Marmota flaviventris.* Washington Co.: *Lepus californicus, N. lepida.* Wayne Co.: *P. maniculatus, P. truei.*

Seasonal occurrence. Eleven males, 14 females, 28 protonymphs and 29 deutonymphs were collected in February, May through September, and in December. Males were found in May, August and September; females from May through September and in December; protonymphs in February and from May through September; and deutonymphs in May, June, July, August and December.

Comments. Mites of *D. hecki* are most common in the southern part of Utah in the Upper Colorado River Basin. They are known from 11 counties.

This species apparently prefers wood rats (*Neotoma* spp.) and white-footed mice (*Peromyscus* spp.)

In 16 of 34 collections, *D. hecki* was the only mite on its host.

The mites reported by Keegan (1953), Woodbury (1956b), and Allred and Roscoe (1957) as *Dermanyssus* sp. from *N. lepida* and *P. crinitus* likely are *D. hecki.*

Dermanyssus gallinae
(DeGeer), 1778
Figs. 29, 145, 247, 302

Distribution. UTAH: Tooele Co.: *Neotoma lepida, Onychomys leucogaster, Peromyscus crinitus* (Ho, 1962). Utah Co.: *O. leucogaster* (Elzinga, 1960).

Other Utah records. None.

Comments. Mites of this species are usual parasites of birds, although mammals occasionally are attacked.

Steatonyssus antrozoi
Radovsky and Furman, 1963
Figs. 32, 35, 150, 253, 312, 421, 578

Distribution. ALABAMA, ARIZONA, CALIFORNIA, GEORGIA, ILLINOIS, NEW YORK, OKLAHOMA, OREGON, SOUTH CAROLINA, TEXAS: Various bats (Radovsky and Furman, 1963).

Utah records. San Juan Co.:*Corynorhinus rafinesque.*

Seasonal occurrence. Five females, each of three with an egg, were taken in May.

KEY TO SPECIES OF FEMALE *Ornithonyssus*

1. With two dorsal plates (Fig. 37) . . . . . *aridus*, page 33
   With one dorsal plate (Fig. 54) 2

2. Sternal plate with three pairs of setae (Fig. 254) . . . . . *bacoti*, page 33
   Sternal plate with two pairs of setae (Fig. 257) . . . . . *sylvianum*, page 33

KEY TO SPECIES OF MALE *Ornithonyssus*

1. Dorsal plate narrow, covers less than half of dorsal surface of body (Fig. 86) . . . . . *bacoti*, page 33
   Dorsal plate covers half or more of dorsal surface of body 2

2. Dorsal plate abruptly invaginated near posterior tip *sylviarum*

Dorsal plate evenly tapered posteriorly from about midpoint (Fig. 85) ..... *aridus*

Ornithonyssus aridus
Furman and Radovsky, 1963
Figs. 37, 85, 94, 152, 256, 314, 369, 401, 427, 539, 581

Distribution. CALIFORNIA, NEVADA: *Ammospermophilus leucurus;* UTAH: Washington Co.: *A. leucurus* (Furman and Radovsky, 1963).

Other Utah records. None.

Ornithonyssus bacoti (Hirst), 1913
Figs. 54, 86, 95, 146, 176, 254, 303, 346, 372, 587

Distribution. Southeastern United States: Domestic rats (Pratt and Good, 1954). ALABAMA: *Didelphis* sp., *Peromyscus nuttallii, Rattus norvegicus, Sigmodon* sp. (Hays and Guyton, 1958). MARYLAND: *Microtus pennsylvanicus, Peromyscus leucopus* (Drummond, 1957). OKLAHOMA: *Peromyscus* spp. (Ellis, 1960). TEXAS: *Didelphis* sp., *Liomys* sp., *Neotoma floridana, Mus musculus, Neotoma micropus, R. norvegicus, Sigmodon* sp. (Randolph and Eads, 1946; Eads, Menzies and Miles, 1952; Eads, Trevino and Campos, 1965). UTAH: Beaver Co.: *Peromyscus maniculatus;* Carbon Co.: *P. maniculatus;* Daggett Co.: *Peromyscus crinitus;* Duchesne Co.: *P. maniculatus, Peromyscus truei;* Emery Co.: *P. maniculatus;* Garfield Co.: *P. maniculatus;* Iron Co.: *Peromyscus eremicus* (Allred, 1957c). Juab Co.: *Neotoma lepida, P. maniculatus* (Allred, 1957c; Howell, Allred and Beck, 1957). Kane Co.: *P. maniculatus, P. truei;* Millard Co.: *P. maniculatus;* San Juan Co.: *Peromyscus boylii, P. maniculatus;* Sanpete Co.: *P. maniculatus* (Allred, 1957c). Tooele Co.: *Citellus townsendii* (Ho, 1962); *Eutamias minimus* (Woodbury, 1956b); *N. lepida* (Allred and Roscoe, 1957); *P. crinitus, P. maniculatus, P. truei* (Woodbury, 1956b). Uintah Co.: *P. maniculatus* (Allred, 1957c); Utah Co.: *C. townsendii, P. maniculatus* (Elzinga, 1960); *P. truei* (Allred, 1957c); *R. norvegicus* (Myklebust, 1951). Washington Co.: *P. eremicus, P. maniculatus* (Allred, 1957c).

Other Utah records. Beaver Co.: *Perognathus* sp. Daggett Co.: *P. maniculatus.* Duchesne Co.: *E. minimus.* Garfield Co.: *P. truei.* Juab Co.: *Perognathus parvus, P. truei.* Kane Co.: *P. parvus.* San Juan Co.: *Dipodomys ordii, P. crinitus, P. truei.*

Seasonal occurrence. Seventeen males, 56 females and 115 protonymphs were taken. Males were found in March, June and August; females in May, June, August, September and November; protonymphs from February through November, except in April and October.

Comments. Mites of *O. bacoti* are distributed over the state, although apparently they are more common in the southern parts in the Upper Colorado River Basin. They are known from 15 counties.

This species apparently prefers *P. truei* as its host. Its frequency of occurrence was greatest on *P. truei* and *R. norvegicus.* Population indices were three to four for *Peromyscus* spp., seven for *Rattus,* and one for other hosts.

In 24 of 56 collections, *O. bacoti* was the only mite on its host.

Ornithonyssus sylviarum
(Canestrini and Fanzago), 1877
Figs. 30, 31, 151, 257, 259, 304, 311, 386, 415, 577, 583

Some variations were noted in the Utah series. The Utah specimens have a small pair of penultimate setae on the dorsal plate contrary to Furman's and Radovsky's (1963) diagnosis of the genus. The third pair of sternal setae are off the plate more frequently than on. They vary in position from the edge of the plate to a considerable distance from it.

Distribution. ? locality, mostly birds; *Eutamias* sp., *Mus* sp. (Strandtmann and Wharton, 1958). MARYLAND: *Mus musculus* (Drummond, 1957). TEXAS: *Eptesicus fuscus, Myotis velifer* (George and Strandtmann, 1960).

Utah records. Beaver Co.: *Marmota flaviventris.* Utah Co.: *Sylvilagus nuttallii.*

Seasonal occurrence. One female was taken in April and five in June.

Comments. Principally a parasite of birds, *O. sylviarum* infrequently attacks other animals in its environs.

Laelaptidae Berlese, 1892

Most mites of this family are parasitic on both invertebrates and vertebrates. They are worldwide in distribution, and are commonly found on mammals.

KEY TO GENERA OF FEMALE LAELAPTIDAE

1. Femur II with large thumb-like spur (Fig. 541) ..... *Androlaelaps*

   Femur II lacks spur 2

2. Genitoventral plate with more than one pair of setae (Fig. 309) ..... *Laelaps*, page 35

   Genitoventral plate with only usual pair of setae (Fig. 313) 3

3. Body circular; legs I and II subequal; setae of sternal plate and coxae thick, almost spine-like (Fig. 271) ..... *Eubrachylaelaps*, page 37

   Body oval; leg I distinctly longer and thinner than II; setae of sternal plate and coxa moderately slender (Fig. 280) 4

4. Sternal plate about as long as wide, distance between first and third setae about same as between third pair (Fig. 277) ..... *Hypoaspis*, page 39

   Sternal plate wider than long, distance between first and third setae about half as great as between third pair (Fig. 280) ..... *Haemolaelaps*, page 39

KEY TO GENERA OF MALE LAELAPTIDAE

1. Dorsal setae expanded distally, blade-like (Fig. 424) ..... *Hypoaspis*, page 39

   Dorsal setae normal 2

2. Femur II with large spur (Fig. 541) ..... *Androlaelaps*

   Femur II lacks spur 3

3. Leg I more slender and much longer than leg II ..... *Haemolaelaps*, page 39

   Legs I and II subequal 4

4. Setae of holoventral plate thick, heavy, almost spine-like (Fig. 368) ..... *Laelaps*, page 35

   Setae of holoventral plate of normal dimensions (Fig. 365) ..... *Eubrachylaelaps*, page 37

Till (1963) considers *Haemolaelaps* as a synonym of *Androlaelaps*. However, for the present we recognize these as separate genera.

Androlaelaps leviculus Eads, 1951
Figs. 158, 260, 305, 541, 585

Hypoaspis leviculus of some authors.

Mites collected in this study vary slightly in size and morphology from the description of the type. In the Utah specimens there are one large and three or four small pairs of metapodal plates on the female. The peritreme ends at the anterior fourth of coxa I.

Distribution. NEVADA: *Onychomys torridus, Perognathus formosus, Perognathus longimembris, Peromyscus* sp. (Allred, 1962, 1963; Allred and Goates, 1964a). TEXAS: *O. leucogaster, Perognathus hispidus, Sigmodon hispidus* (Eads, 1951). UTAH: Box Elder Co.: *Peromyscus maniculatus* (Allred, 1958). Tooele Co.: *O. leucogaster, Perognathus parvus, Peromyscus crinitus, P. maniculatus* (Keegan, 1953). ? locality: *Citellus lateralis* (Jenkins, 1965).

Other Utah records. Beaver Co.: *Dipodomys* sp., *P. crinitus*. Box Elder Co.: *P. parvus*. Daggett Co.: *Dipodomys ordii*. Emery Co.: *P. maniculatus*. Iron Co.: *D. ordii*. Juab Co.: *P. formosus, P. parvus*. Kane Co.: *P. formosus*. San Juan Co.: *O. leucogaster, Perognathus apache*. Sanpete Co.: *Citellus armatus*. Uintah Co.: *Citellus lateralis*. Washington Co.: *Onychomys* sp., *P. parvus*.

Seasonal occurrence. The 47 females were taken from April through October. Greatest numbers were found in July and September.

Comments. Mites of *A. leviculus* apparently are more common in the southern part of Utah. They are known from 12 counties.

This mite apparently is more commonly associated with grasshopper mice (*Onychomys* spp.) and pocket mice (*Perognathus* spp.) than with other rodents.

In nine of 19 collections, *A. leviculus* was the only mite on its host.

It is unusual that this species has not been recorded from a wider geographic area. Furman (1954b) indicated that this and four other species have been taken in the Nearctic and Neotropical realms on rodents of the families Muridae, Cricetidae and Heteromyidae. Woodbury's (1956b) record of *Androlaelaps* sp. from *O. leucogaster* in Tooele County likely is *A. leviculus*.

KEY TO SPECIES OF FEMALE *Laelaps*

1. Posterior border of sternal plate invaginated to level at least midway between first and second pairs of sternal setae (Fig. 265) ..... *kochi*

   Posterior border of sternal plate almost straight, never invaginated beyond third pair of sternal setae (Fig. 263) 2

2. Adanal setae reaching almost to or beyond base of postanal seta (Fig. 159) 3

   Adanal setae very short, tips far from base of postanal seta (Fig. 153) ..... *multispinosus*

3. Genitoventral plate with slit-like invagination at level of usual pair of genitoventral setae, expanding abruptly immediately posterior to setae (Fig. 307) ..... *incilis*, page 36

   Genitoventral plate not as above (Fig. 315) ..... *nuttalli*, page 37

Laelaps kochi Oudemans, 1936

Figs. 55, 72, 96, 154, 172, 178, 189, 265, 309, 340, 347, 370, 531, 580

Distribution. ALABAMA: *Pitymys* sp. (Hays and Guyton, 1958). CALIFORNIA: *Microtus* sp. (Jameson and Brennan, 1957). DELAWARE: *Microtus pennsylvanicus* (Florschutz and Darsie, 1960). ILLINOIS: *Microtus coragaster* (Tipton, 1960). MARYLAND: *Blarina brevicauda*, *M. pennsylvanicus*, *Peromyscus leucopus*, *Pitymys pinetorum* (Drummond, 1957). NEW YORK: *Microtus chrotorrhinus*; PENNSYLVANIA: *Microtus* sp.; UTAH: Utah Co.: *Microtus montanus* (Tipton, 1960).

Other Utah records. Beaver Co.: *M. montanus*. Carbon Co.: *Microtus longicaudus*. Daggett Co.: *M. longicaudus*. Iron Co.: *Eutamias minimus*. Kane Co.: *Dipodomys ordii*. Rich Co.: *Microtus* sp. San Juan Co.: *M. longicaudus*. Sanpete Co.: *Microtus* sp. Sevier Co.: *D. ordii*. Summit Co.: *Phenacomys intermedius*. Utah Co.: *Eutamias quadrivittatus*, *M. pennsylvanicus*.

Seasonal occurrence. Totals of 34 males, 61 females, three protonymphs and 13 deutonymphs were taken. Males were found from March through June and in August and October, mostly in May and June; females from March through December except September, mainly in May and June; protonymphs in March, April and June; and deutonymphs in May, June and October. Each of two females in March, four in May, one in July and one in August contained a larva.

Comments. Mites of *L. kochi* are distributed over the state in 11 counties.

The preferred hosts of mites of this species apparently are voles (*Microtus* spp.)

In two of 25 collections, *L. kochi* was the only mite on its host. In four collections it was associated with another species of *Laelaps*.

Laelaps multispinosus Banks, 1909

Figs. 56, 175, 180, 263, 310, 343, 348, 368, 532, 588

Distribution. ALABAMA: *Ondatra* sp. (Hays and Guyton, 1958; Tipton, 1960). NEBRASKA: *Ondalia [sic.] zibethicus* (Rapp, 1962). NEW YORK: *Ondatra zibethica*; TEXAS: *Ondatra* sp. (Tipton, 1960). UTAH: Salt Lake Co.: *Peromyscus maniculatus* (Allred, 1957d); Utah Co.: *O. zibethica* (Tipton, 1960).

Other Utah records. Summit Co.: *O. zibethica*.

Seasonal occurrence. Totals of 59 males, 218 females, 29 protonymphs and 44 deutonymphs were taken. Males were taken in January, February, October and December; females the same months; protonymphs in February and December; and deutonymphs in January, February and December. Each of 18 females in January, seven in February and six in December contained an egg. Each of 25 in January and three in February contained a larva. The developing deutonymphal integument is visible in six protonymphs in February, and the adult integument in eight deutonymphs in January and February.

Comments. Mites of this species likely are found wherever their preferred host, the muskrat (*O. zibethica*) occurs. They are known in Utah from only two counties.

In all eight collections this mite was the only species found on its host.

Laelaps incilis, new species

Figs. 61, 155, 266, 307, 533, 579

Utah records. Beaver Co.: *Microtus montanus,* Delano Ranger Station, five females, June, 1957; *Peromyscus maniculatus,* same locality and date, five females. Carbon Co.: *Microtus longicaudus,* three miles south of Scofield, one female, July, 1960. Emery Co.: *Microtus* sp., six miles north of Huntington, one female, July, 1959. Rich Co.: *Microtus* sp., Laketown, nine females, August, 1952. Utah Co.: *Eutamias quadrivittatus,* Provo, one female, October, 1956.

Comments. In one of nine collections, *L. incilis* was the only mite on its host. In five collections it was associated with *Laelaps kochi.*

Type data. Holotype female, B.Y.U. collection no. 4777. Taken from *Eutamias quadrivittatus,* Rock Canyon, Utah Co., Utah, 19 October 1956, by R. Kent Utley. In the acarology collection of the Department of Zoology and Entomology, Brigham Young University, Provo, Utah. The trivial name *incilis* is Latin for "cut in," which refers to the slit-like invaginations of the genitoventral plate.

Female

Gnathosoma. Greatest width at base, 105; length to base of palpal trochanter, 95. All setae nude. Three pairs of ventral setae on base of gnathosoma: anteroexternal pair shortest, 20 long; anteromedial pair longest, 50 long; posterior pair 27 long. Moveable digit of chelicera 30 long from base to tip, with two teeth and terminal hooked tip; fixed digit slightly shorter than moveable one, with one tooth and slightly hooked tip, and modified seta.

Idiosoma. 699 long, 545 wide.

Legs. Length from distal edge of coxa to base of pretarsus: I, 300; II, 285; III, 270; IV, 460. Width of genua: I, 57; II, 62; III, 50; IV, 42. Elongate setae of femora I and II of moderate length, approximately 63 long. Coxa I has inner, distal blunt spine 38 long, and inner proximal seta 48 long. Coxa II has inner blunt spine 43 long. Coxa III has inner blunt spine 33 long. Coxa IV has smaller, more pointed spine 28 long.

Dorsal plate. Elliptical; covers most of idiosoma except small part of lateral and posterior parts; 616 long and 431 wide. Has 37 pairs of setae, those anteromedially smaller than ones laterally and posteriorly; setae at level of sternal plate, 32 long; at posterior level of genitoventral plate, 55 to 60 long; mediopenultimate pair 42 long; terminal pair 113 long.

Sternal plate. Length 102; width 167; ratio 1:1.7 (width measured between outer edge of third sternal setae); anterior border slightly convex; posterior border with abrupt invagination to level of third pair of setae. Has three pairs of subequal setae: anterior pair 93 long, reach almost to posterior border of plate; medial and posterior pairs 98 long; distance between anterior pair, 75; between median pair, 145; between posterior pair, 155. Has two pairs of slit-like pores: anterior pair immediately behind first pair of setae, slightly angled, with outer end situated more anteriorly; posterior pair midway between second and third setae, almost parallel with transverse axis of plate.

Genitoventral plate. Width at point slightly behind usual genitoventral setae, 224; length from anterior edge of usual genitoventral setae to posterior border, 147. Edges of plate at level of usual genitoventral setae with narrow invagination which is present in some specimens only as distinct suture. Has usual pair of setae situated at level opposite posterior border of coxae IV, and three pairs of accessory setae along latero-posterior border of plate. Usual genitoventral setae 98 long, hardly reaching to bases of middle pair of accessory setae. Distance between usual genitoventral setae, 115; between third pair of accessory setae, 60. Length of accessory setae, 100.

Anal plate. Anterior and lateral edges slightly convex with evenly tapering sides except for point opposite anus which is slightly indented; length 125; width 107. Adanal setae 60 long, situated opposite posterior border of anus; post-

anal seta 100 long, almost twice as thick as adanal setae.

Unsclerotized part of venter. Has 19 pairs of setae including those on posterior border; those nearest genitoventral plate almost peg-like, 57 long; those more posteriorly longer and more slender; terminal pair longest, 125 long.

Peritreme. Slightly sinuous with abrupt curve at level of coxa II; extends to posterior edge of coxa I.

Comments. *Laelaps incilis* is similar in most respects to the *alaskensis*, *clethrionomydis* and *lemmi* complex. It may be separated from *alaskensis* on the basis of its 37 pairs of dorsal plate setae, the greater number of setae on the unsclerotized portion of the venter, the longer anal plate, and the placement of the adanal setae. It differs from *clethrionomydis* in the shape of the peritreme, its larger anal plate, and the longer adanal setae. It can be distinguished from *lemmi* on the basis of its smaller size, fewer number of dorsal plate setae, greater number of ventral setae, placement and length of the adanal setae, and lengths of postanal seta and peritreme.

Laelaps nuttalli Hirst, 1916

Figs. 90, 153, 159, 268, 315

Distribution. Southeastern United States from domestic rats (Pratt and Good, 1954). ALABAMA: *Rattus norvegicus*, *Rattus rattus* (Hays and Guyton, 1958). GEORGIA: ? host; TEXAS: Rat (Tipton, 1960). UTAH: Duchesne Co.: *Peromyscus maniculatus* (Allred, 1957d).

Other Utah records. None.

Comments. Lack of additional records suggests some doubt as to the validity of the above records from Utah.

KEY TO SPECIES OF FEMALE *Eubrachylaelaps*

1. Sternal plate twice as wide as long; first sternal setae not reaching posterior border of plate (Fig. 269) ..... *crowei*

   Sternal plate three or more times as wide as long; first sternal setae reaching almost to or beyond posterior border of plate (Fig. 271) 2

2. Postanal seta barely extending beyond apex of cribum; anterior edge of anal plate with two distinct humps (Fig. 160) ..... *hollisteri*, page 38

   Postanal seta extending for half or more of its length beyond apex of cribum; anterior edge of anal plate almost evenly convex (Fig. 163) 3

3. Unsclerotized portion of venter posterior to genitoventral plate with nine pairs of setae arranged in 4:4:1 sequence (Fig. 198); posterior border of sternal plate invaginated to level about midway between second and third sternal setae (Fig. 272) ..... *circularis*, page 38

   Unsclerotized portion of venter posterior to genitoventral plate with seven pairs of setae arranged in 3:4 sequence (Fig. 196); posterior border of sternal plate invaginated almost to level of second sternal setae (Fig. 275) ..... *debilis*, page 38

Eubrachylaelaps crowei Jameson, 1947

Figs. 62, 157, 195, 269, 306, 584

According to Furman (1955), there is considerable variation in the anal and sternal plates, and the anal and dorsal setae.

Distribution. COLORADO: *Onychomys leucogaster* (Furman, 1955). KANSAS: *O. leucogaster* (Jameson, 1947). OREGON: *Microtus montanus* (Hansen, 1964). TEXAS: *Dipodomys spectabilis*, *O. leucogaster* (Eads, Menzies and Miles, 1952). UTAH: San Juan Co.: *O. leucogaster* (Furman, 1955); Tooele Co.: *O. leucogaster* (Keegan, 1953).

Other Utah records. Grand Co.: *O. leucogaster*, *Perognathus* sp.

Seasonal occurrence. Eight females of *E. crowei* were collected in May and August, and three females taken in August were gravid.

Comments. The grasshopper mouse, *O. leucogaster*, apparently is the preferred host of this mite.

Eubrachylaelaps hollisteri
(Ewing), 1925
Figs. 60, 160, 197, 271, 320, 586

Distribution. CALIFORNIA: *Neotoma* sp., *Perognathus californicus, Peromyscus californicus, Peromyscus crinitus, Peromyscus maniculatus, Thomomys bottae* (Furman, 1955; Strandtmann and Wharton, 1958). NEVADA: *P. crinitus* (Allred and Goates, 1964a). UTAH: Beaver Co.: *P. crinitus, P. maniculatus, Peromyscus truei;* Box Elder Co.: *P. crinitus, P. maniculatus;* Emery Co.: *P. maniculatus;* Juab Co.: *P. truei;* Kane Co.: *P. crinitus, P. maniculatus* (Allred, 1958). Tooele Co.: *P. crinitus, P. maniculatus* (Woodbury, 1956b). Washington Co.: *Peromyscus eremicus* (Allred, 1958).

Other Utah records. Daggett Co.: *P. maniculatus.* Duchesne Co.: *P. crinitus, P. maniculatus.* Juab Co.: *Perognathus parvus.* Kane Co.: *Neotoma lepida, P. parvus.* San Juan Co.: *P. crinitus.* Sanpete Co.: *P. crinitus.* Sevier Co.: *P. maniculatus.*

Seasonal occurrence. The 158 female *E. hollisteri* were collected from April through August and in November and December. Greatest numbers were taken in June and August. Six females in June and seven in August each contained a larva. No males or immature stages were taken; they likely are nest dwellers.

Comments. Mites of *E. hollisteri* are equally distributed over Utah in the Great and Upper Colorado River basins in 12 counties.

This species is closely associated with the canyon mouse, *P. crinitus*. Eighty-four percent of its collections were from *Peromyscus* spp.—42% from *P. crinitus* and 36% from *P. maniculatus*.

In 14 of its 21 collections, *E. hollisteri* was the only mite on its host. It was associated with *Eubrachylaelaps circularis* in one collection.

Eubrachylaelaps circularis
(Ewing), 1933
Figs. 63, 87, 89, 97, 105, 164, 165, 177, 198, 272, 322, 341, 349, 365, 530, 589

Allred (1954a, 1957f) discussed some of the morphological variations of this species in Utah. Specimens of a northern distribution have a larger dorsal plate, fewer dorsal setae and better developed metapodal plates than those from southern Utah. Variations between specimens of northern and southern distribution were discussed by Furman (1955) with reference to the sternal and anal plates, and anal setae.

Distribution. ARIZONA. *Peromyscus* sp., CALIFORNIA: *Peromyscus boylii* (Jameson and Brennan, 1957); *Peromyscus californicus, Peromyscus maniculatus;* COLORADO: *Neotoma mexicana* (Furman, 1955). NEVADA: *Peromyscus truei* (Allred and Goates, 1964a). UTAH: Beaver Co.: *P. truei;* Daggett Co.: *P. maniculatus, P. truei;* Davis Co.: *P. maniculatus;* Duchesne Co.: *P. truei;* Grand Co.: *P. boylii* (Allred, 1958). Juab Co.: *Neotoma lepida* (Howell, Allred and Beck, 1957). Kane Co.: *P. boylii;* Piute Co.: *P. maniculatus, P. truei;* Salt Lake Co.: *P. boylii, P. maniculatus;* San Juan Co.: *P. boylii, Peromyscus crinitus, P. truei* (Allred, 1958). Sevier Co.: *P. truei* (Ewing, 1933). Tooele Co.: *P. truei* (Keegan, 1953); *P. maniculatus* (Allred, 1954a); *N. lepida* (Allred and Roscoe, 1957). Utah Co.: *P. boylii, P. crinitus, P. maniculatus, P. truei;* Washington Co.: *Peromyscus eremicus, P. maniculatus* (Allred, 1954a).

Other Utah records. Duchesne Co.: *P. maniculatus.* Emery Co.: *P. truei.* Garfield Co.: *P. maniculatus, P. truei.* Juab Co.: *Sylvilagus audubonii.* Kane Co.: *P. maniculatus, P. truei.* San Juan Co.: *P. maniculatus.* Sanpete Co.: *P. crinitus.* Tooele Co.: *Perognathus parvus.* Washington Co.: *Lepus californicus, N. lepida, Perognathus longimembris, P. crinitus.* Wayne Co.: *P. maniculatus, P. truei.*

Seasonal occurrence. A total of 620 females was taken. Mites were collected every month except September and December. Gravid females were found every month except March, July, September and December. Apparently this species reproduces all year round, although the principal periods are June and August. Males and immature stages were not taken. These likely are nest dwellers as suggested by Allred (1957f).

Comments. Mites of *E. circularis* are more common in southern than in northern Utah. They were found about equally in the Upper Colorado River and Great basins, and are known from 18 counties.

This species is most closely associated with the Pinyon Mouse (*P. truei*) which accounts for its more southerly distribution. Its association with *P. maniculatus* likely accounts for its northerly extension of range. Ninety-three percent of its collections were from *Peromyscus* spp.—48% from *P. truei* and 33% from *P. maniculatus*.

In 32 of its 78 collections, *E. circularis* was the only mite found on its host. In three collections it was found with *Eubrachylaelaps debilis*.

Eubrachylaelaps debilis
Jameson, 1950
Figs. 64, 163, 196, 275, 321, 590

Furman (1955) pointed out intraspecific variation in the sternal and anal plates, second pair of sternal pores, and anal and dorsal setae. Occasionally the anterior pair of sternal setae are not on the plate.

Distribution. CALIFORNIA: *Microtus longicaudus, Peromyscus maniculatus* (Keegan, 1953; Furman, 1955). NEVADA: *Peromyscus crinitus, Peromyscus truei* (Allred and Goates, 1964a). OREGON: *P. maniculatus* (Keegan, 1953). UTAH: All counties except Box Elder, Cache, Davis, Kane, Morgan, Salt

Lake and Weber: *P. maniculatus;* Iron Co.: *Peromyscus eremicus;* San Juan Co.: *P. crinitus* (Allred, 1958). Tooele Co.: *P. crinitus* (Keegan, 1953); *P. truei, Reithrodontomys megalotis* (Woodbury, 1956b). Washington Co.: *P. eremicus;* ? County: *P. truei* (Allred, 1958).

Other Utah records. Garfield Co.: *Microtus longicaudus.* San Juan Co.: *Corynorhinus rafinesquii.* Sanpete Co.: *P. crinitus.*

Seasonal occurrence. Fifty-two females of *E. debilis* were collected from March through August and in November. Greatest numbers were found in June and July. One female in July and one in November contained an egg and larva, respectively. Males and immature stages of this species likely are nest dwellers.

Comments. Mites of *E. debilis* are equally distributed throughout northern and southern Utah in both the Great and Upper Colorado River basins. They are known from 22 counties.

Eighty-five percent of its collections were from *Peromyscus* spp., and 53% from *P. maniculatus.* Its broad distribution over the state likely is related to the extensive distribution and variety of habitats of its preferred hosts.

In 12 of its 21 collections *E. debilis* was the only mite found on its host. In three collections it was associated with *Eubrachylaelaps circularis.*

KEY TO SPECIES OF FEMALE *Hypoaspis*

Anterolateral corners of sternal plate not extended, or when extended, with only narrow projections (Fig. 274) ..... *lubrica*

Anterolateral corners of sternal plate broadly extended (Fig. 277) ..... *gurabensis*

Hypoaspis lubrica Oudemans and Voigts, 1904

Figs. 57, 166, 274, 317, 591

Hypoaspis murinis Strandtmann and Menzies, of authors.

Utah records. Duchesne Co.: *Citellus lateralis, Peromyscus maniculatus.* Juab Co.: *P. maniculatus.* San Juan Co.: *Citellus spilosoma.* Summit Co.: *P. maniculatus.* Utah Co.: *P. maniculatus, Rattus norvegicus, Thomomys bottae.*

Seasonal occurrence. Twelve females were taken during February, May, June, August and November.

Comments. There is considerable variation in the Utah series, suggesting at least three different forms. These likely represent only variants of one species (Strandtmann, personal correspondence).

Hypoaspis gurabensis (Fox), 1946

Figs. 58, 161, 277, 313, 424

Distribution. ? locality: *Rattus norvegicus, Rattus rattus* (Thurman, Mulrennan and Branch, 1949). OKLAHOMA: *Sigmodon hispidus* (Ellis, 1960). UTAH: Daggett Co.: *Peromyscus maniculatus;* Kane Co.: *P. maniculatus* (Allred, 1957d). Tooele Co.: *P. maniculatus* (Woodbury, 1956b).

Other Utah records. Utah Co.: *Thomomys talpoides.*

Seasonal occurrence. Six females were taken in May, June and November.

Comments. Woodbury (1956b) reported *Hypoaspis* sp. from *Onychomys leucogaster* in Tooele Co., and Elzinga (1960) reported *Hypoaspis* sp. from Utah Co., host not designated. It is not known whether these belong to *H. gurabensis* or *H. lubrica.*

KEY TO SPECIES OF FEMALE *Haemolaelaps*

1. Genitoventral plate broadly expanded, almost touching anal plate (Fig. 318) ..... *casalis*, page 40

   Genitoventral plate normally expanded, distance between it and anal plate at least as great as length of anus (Fig. 323) 2

2. Anal plate about as broad as long, somewhat triangular in shape (Fig. 167) ..... *glasgowi*, page 40

   Anal plate longer than broad, pear-shaped (Fig. 162) ..... *geomys*, page 41

Haemolaelaps casalis
(Berlese), 1887
Figs. 65, 103, 168, 278, 318, 333, 592

Haemolaelaps megaventralis of authors (Strandtmann and Wharton, 1958).

Distribution. ARKANSAS, COLORADO, FLORIDA, GEORGIA, MONTANA, OHIO, PENNSYLVANIA, SOUTH CAROLINA, VIRGINIA: Variety of birds and rodents (Strandtmann and Wharton, 1958). NEVADA: *Neotoma lepida* (Allred and Goates, 1964b). OREGON: *Microtus montanus, N. lepida, Onychomys leucogaster* (Hansen, 1964). TEXAS: *Rattus norvegicus* (Eads, Menzies and Miles, 1952). UTAH: Daggett Co.: *Peromyscus maniculatus;* Emery Co.: *P. maniculatus;* Grand Co.: *P. maniculatus* (Allred, 1958). Juab Co.: *N. lepida* (Howell, Allred and Beck, 1957). Piute Co.: *Peromyscus truei;* San Juan Co.: *P. maniculatus* (Allred, 1958). Tooele Co.: *N. lepida* (Allred and Roscoe, 1957); *P. maniculatus* (Woodbury, 1956b). Uintah Co.: *P. maniculatus;* Utah Co.: *P. maniculatus, P. truei* (Allred, 1958).

Other Utah records. Beaver Co.: *Thomomys bottae.* Carbon Co.: *P. maniculatus, Spermophilus lateralis.* Emery Co.: *Peromyscus crinitus.* Kane Co.: *N. lepida, P. maniculatus.* San Juan Co.: *Peromyscus boylii, T. bottae.* Tooele Co.: *T. bottae.* Utah Co.: *Mus musculus, Rattus norvegicus, T. bottae, Thomomys talpoides.* Washington Co.: *Dipodomys merriami, N. lepida.*

Seasonal occurrence. Totals of 54 females and four deutonymphs were collected from April through December except in August. Females were taken in each of the months, and nymphs only in May. Each of two females in May and three in October contained a larva, and one female in October contained an egg.

Comments. Mites of this species are distributed over the state in both the Great and Upper Colorado River basins in 13 counties.

This species was taken from a variety of rodents, but was associated commonly with white-footed mice and gophers. *Peromyscus boylii* and *Thomomys umbrinus* (= *bottae*).

In nine of 22 collections *H. casalis* was the only mite on its host. It was associated with *Haemolaelaps glasgowi* in only four collections.

Haemolaelaps glasgowi
(Ewing), 1925
Figs. 66, 75, 98, 104, 167, 173, 280, 323, 344, 350, 371, 434, 593

Furman (1966) indicated synonymy of *Haemolaelaps fahrenholzi* Berlese, 1911 and *H. glasgowi.* However, for the purposes of this paper we prefer to retain the use of *H. glasgowi.*

Distribution. A variety of hosts from many states (Strandtmann, 1949; Pratt and Good, 1954; Strandtmann and Wharton, 1958). ALABAMA: Variety of rodents (Hays and Guyton, 1958). NEBRASKA: *Blarina brevicauda, Citellus tridecemlincatus, Pedomys orchrogaster, Peromyscus leucopus, Peromyscus maniculatus* (Rapp, 1962). NEVADA: *Dipodomys merriami, Dipodomys microps, Onychomys torridus, Perognathus* spp., *P. maniculatus, Peromyscus truei, Thomomys umbrinus* (Allred, 1962, 1963; Goates, 1963; Allred and Goates, 1964a). OKLAHOMA: *Perognathus hispidus, Pitymys* sp., *Sigmodon* sp. (Ellis, 1960). OREGON: Variety of rodents (Hansen, 1964). TEXAS: Variety of rodents (Eads, Menzies and Miles, 1952). UTAH: All counties except Juab and Millard: *P. maniculatus;* Duchesne Co.: *P. truei* (Allred, 1958). Juab Co.: *Neotoma lepida* (Howell, Allred and Beck, 1957). Salt Lake Co.: *Peromyscus boylii* (Allred, 1958). Summit Co.: *Marmota flaviventris* (Allred, 1961). Tooele Co.: *Citellus leucurus, D. microps, Dipodomys ordii, Eutamias minimus, N. lepida* (Ho, 1962); *Onychomys leucogaster* (Keegan, 1953); *Perognathus parvus* (Ho, 1962); *Peromyscus crinitus, P. maniculatus, Reithrodontomys megalotis* (Keegan, 1953); *N. lepida, P. parvus, P. truei* (Woodbury, 1956b). Utah Co.: *Citellus leucurus* (Elzinga, 1960); *D. microps, D. ordii* (Ho, 1962); *Rattus norvegicus* (Myklebust, 1951); *P. boylii* (Allred, 1958); *P. maniculatus* (Ho, 1962); *P. truei* (Allred, 1958); *R. megalotis* (Elzinga and Rees, 1964); *Vulpes macrotis* (Ho, 1962). Washington Co.: *P. crinitus, Peromyscus eremicus* (Allred, 1958). ? locality: *Citellus armatus, Citellus lateralis, Citellus variegatus* (Jenkins, 1965).

Other Utah records. Beaver Co.: *C. lateralis, C. leucurus, D. ordii.* Box Elder Co.: *D. ordii, E. minimus, Lepus californicus, Microtus longicaudus, P. parvus, O. leucogaster.* Cache Co.: *C. armatus, Microtus* sp. Carbon Co.: *C. armatus, C. lateralis, E. minimus, Eutamias quadrivittatus, M. longicaudus, P. parvus, Zapus princeps.* Daggett Co.: *C. lateralis, Citellus richardsoni, D. ordii, Microtus* sp. Duchesne Co.: *C. lateralis, C. leucurus, C. tridecemlineatus, Cynomys leucurus, D. ordii, E. minimus, M. flaviventris, P. parvus, Ochotona princeps.* Emery Co.: *C. variegatus, P. crinitus, P. truei.* Garfield Co.: *M. longicaudus, Perognathus formosus, P. parvus.* Grand Co.: *Citellus leucurus, C. variegatus, Geomys leucurus, D. ordii, Perognathus* sp., *O. leucogaster, Thomomys bottae.* Iron Co.: *Citellus townsendii, D. ordii, P. eremicus.* Juab Co.: *C. variegatus, D. microps, D. ordii, P. parvus, P. maniculatus, R. megalotis, Sylvilagus auduboni, T. bottae.* Kane Co.: *C. lateralis, C. variegatus, D. ordii, N. lepida, P. formosus, Perognathus longimembris, P. parvus, O. leucogaster, P. truei.* Piute Co.: *C. variegatus, N. lepida.* Rich Co.: *Microtus* sp., Salt Lake Co.: *C. armatus, Microtus montanus.* San Juan Co.: *Citellus leucurus, D. ordii, E. minimus, M. longicaudus, Perognathus* sp., *O. leucogaster, P. boylii, P. truei.* Sanpete Co.: *C. armatus, C. lateralis, C. variegatus.* Sevier Co.: *D. ordii, Microtus* sp., *P. parvus.* Summit Co.: *C. armatus, C. lateralis.* Uintah Co.: *Citellus leucurus, Cynomys* sp., *C. tridecemlincatus, D. ordii,* Utah Co.: *C. armatus, C. lateralis, C. variegatus, M. longicaudus, M. montanus, Microtus pennsylvanicus, Mus musculus, Neotoma cinerea, P. parvus, Tamiasciurus hudsonicus, Thomomys talpoides.* Wasatch Co.: *C. armatus, C. lateralis.* Washington Co.: *C. leucurus, C. variegatus, D. merriami, D. microps, L. californicus, N. lepida, P. formosus, O. torridus, Thomomys* sp. Wayne Co.: *C. variegatus,* "chipmunk." *N. lepida, Perognathus* sp., *P. truei.*

Seasonal occurrence. Totals of 106 males, 1987 females, 39 protonymphs and 146 deutonymphs were taken. Mites were collected every

month of the year, although greatest numbers were taken in June. Females were taken each month, mainly in June; males from March through December, mostly in June and December; protonymphs from February through August and in November, mostly in February and June; and deutonymphs from February through August and in November and December, mainly in April, June and July. Each of 235 females contained an egg, and 91 contained a larva. Gravid females with eggs were taken from March through December, whereas those with larvae were taken from November through August except January. Gravid mites were taken mostly from March through July.

Comments. Mites of *H. glasgowi* are widely distributed over the state and are known from every county except Davis, Millard and Weber.

This species was taken from a variety of rodents, although it was found most commonly on squirrels (*Citellus* spp.), kangaroo rats (*Dipodomys* spp.), white-footed mice (*Peromyscus* spp.) and voles (*Microtus* spp.). The highest parasite indices occurred on *O. torridus*, *M. pennsylvanicus*, *R. norvegicus*, *C. variegatus* and *Cynomys leucurus*, with ratings of 36, 28, 21, 13 and 11, respectively. Other hosts had mite indices of nine or less.

In 202 of 428 collections, *H. glasgowi* was the only mite on its host.

Haemolaelaps geomys
Strandtmann, 1949
Figs. 162, 285, 316

Distribution. CALIFORNIA, FLORIDA, ILLINOIS, OREGON, TEXAS: *Cratogeomys* sp., *Geomys* sp., *Neotoma* sp., *Peromyscus* sp., *Thomomys sp.*; GEORGIA: *Geomys* sp. (Strandtmann, 1949). NEBRASKA: *Geomys bursarius* (Rapp, 1962). UTAH: Tooele Co.: *Onychomys leucogaster* (Woodbury, 1956b).

Other Utah records. None.

Comments. We doubt the validity of the Utah record above. The record likely was of *Haemolaelaps glasgowi* or *H. casalis*.

Listrophoridae Canestrini, 1892

Mites of this family are found clinging to the hair of small mammals. Occasionally they attack the skin and cause a type of mange. They are worldwide in distribution.

KEY TO GENERA OF LISTROPHORIDAE

Legs III and IV modified as clasping organs (Fig. 597) ..... *Myocoptes*

Legs III and IV not as above, similar to legs I and II (Fig. 599) ..... *Listrophorus*

Myocoptes sp.
Fig. 597

Distribution. COLORADO: *Geomys bursarius* (Miller and Ward, 1960). MARYLAND: *Microtus pennsylvanicus, Mus musculus, Peromyscus leucopus* (Drummond, 1957). UTAH: Utah Co.: *Peromyscus maniculatus, Reithrodontomys megalotis* (Elzinga and Rees, 1964).

Other Utah records. None.

Comments. Only superficial examination of the host and debris likely accounts for the few Utah records of these very small mites.

Listrophorus sp.
Fig. 599

Distribution. DELAWARE: *Microtus pennsylvanicus, Peromyscus leucopus* (Florschutz and Darsie, 1960). MARYLAND: *Blarina brevicauda, M. pennsylvanicus, P. leucopus, Pitymys pinetorum* (Drummond, 1957). NEVADA: *Dipodomys merriami, Dipodomys microps* (Goates, 1963). UTAH: Garfield Co.: *Peromyscus maniculatus;* Salt Lake Co.: *P. maniculatus* (Allred, 1957d). Tooele Co.: *Dipodomys ordii, Perognathus longimembris* (Woodbury, 1956b). Utah Co.: *P. longimembris, P. maniculatus* (Elzinga, 1960). TEXAS: *Liomys* sp., *Sylvilagus floridanus* (Randolph and Eads, 1946; Eads, Trevino, and Campos, 1965).

Other Utah records. Tooele Co.: *Perognathus formosus.*

Seasonal occurrence: A single mite was taken in March.

Comments. Elzinga (1960) listed *L. dipodomius* from Utah County, but did not designate a host, although he indicated *Listrophorus* sp. from two hosts (see Distribution above).

It is likely that this species is more common in Utah than suspected. The few specimens represented may be due to superficial collecting techniques. Eads, Trevino, and Campos (1965) reported that in Texas half of the mice (*Liomys* sp.) examined were infested, one so heavily that there were several mites on most hairs on its back. Jameson (1950) indicated that *Listrophorus* sp. was the most numerous ectoparasite on shrews, as abundant as 500 per animal.

MYOBIIDAE Megnin, 1877

Myobiids are worldwide in distribution, found clinging to the hairs of small mammals. Their association with hair follicles may result in local dermatitis and secondary infection. Although usually not considered parasitic, Wharton and his associates demonstrated that myobiids do suck body fluids (Strandtmann, personal correspondence).

KEY TO GENERA OF MYOBIIDAE

Tarsus II with single claw ..... *Myobia*
Tarsus II with paired claws ..... *Radfordia*

Myobia sp.

Distribution. UTAH: Tooele Co.: *Neotoma lepida* (Allred and Roscoe, 1957).

Other Utah records. None.

Comments. It is unusual that more specimens of fur mites are not represented in Utah collections. Collection techniques may be at fault.

KEY TO SPECIES OF FEMALE *Radfordia*

1. Dorsolateral seta I hooked near tip (Fig. 595) ..... *bachai*
   Dorsolateral seta I not hooked 2
2. Submedian seta I as long as submedian III (Fig. 10) ..... *lemnina*
   Submedian seta I about one-half as long as submedian III (Fig. 9) ..... *subuliger*

Radfordia bachai Howell and Elzinga, 1962

Figs. 99, 595

Distribution. UTAH: Tooele Co., Utah Co.: *Dipodomys ordii* (Howell and Elzinga, 1962).

Other Utah records. None.

Radfordia lemnina (Koch), 1841

Figs. 10, 596

Distribution. MARYLAND: *Microtus pennsylvanicus, Pitymys pinetorum* (Drummond, 1957). UTAH: Garfield Co.: *Peromyscus maniculatus* (Allred, 1957d).

Other Utah records. None.

Radfordia subuliger Ewing, 1938

Fig. 9

Distribution. MARYLAND: *Peromyscus leucopus* (Drummond, 1957). UTAH: Tooele Co.: *Peromyscus maniculatus* (Woodbury, 1956b). Utah Co.: *P. maniculatus* (Allred, 1957d); *Reithrodontomys megalotis* (Elzinga and Rees, 1964).

Other Utah records. None.

TROMBICULIDAE Ewing, 1944

Mites of this family in the larval stage are important parasites of vertebrates the world over. They are commonly found attached to the integument of mammals where they appear as a single engorged mite or as small red, yellow, orange, or white patches in the ears, around the vibrissae, genitalia, thighs and axillary regions.

KEY TO GENERA OF LARVAL TROMBICULIDAE

1. Leg I with seven segments; coxa I with one seta 2
   Leg I with six segments; coxa I with two setae 3

2. Two anteromedian scutal setae (Fig. 435) ..... *Bernia*
   One or no anteromedian scutal seta (Figs. 381, 437) 6

3. Scutum with anteromedian projection (Fig. 373) 4
   Scutum without anteromedian projection (Fig. 379) 5

4. Cheliceral blade with dorsal and/or ventral row of teeth (Fig. 4); spiracles and tracheae present ..... *Odontacarus*, page 44
   Cheliceral blade without dorsal or ventral teeth; spiracles and tracheae absent ..... *Leeuwenhoekia*, page 45

5. Cheliceral blade with distinct row of teeth (Fig. 4); spiracles and tracheae present ..... *Whartonia*, page 45
   Cheliceral blade with tricuspid cap (Fig. 6); spiracles and tracheae absent ..... *Chatia*, page 45

6. Anteromedian scutal seta present (Fig. 381) 7
   Anteromedian scutal seta absent (Fig. 437) ..... *Gahrliepia*, page 46

7. Sensilla flagelliform (Fig. 381) ..... *Trombicula*, page 46
   Sensilla expanded (Fig. 409) 8

8. Legs II and III with six segments ..... *Cheladonta*, page 50
   Legs II and III with seven segments ..... *Euschoengastia*, page 51

Bernia, new genus

Eyes present. Chelicera has tricuspid cap. Palpal claw trifurcate. Each tarsus has two claws and a claw-like empodium. Coxa III has three setae. Scutum has three pairs of setae similar in form: anteromedians, anterolaterals, and posterolaterals; anteromedians surrounded by distinct suture isolating the pair from rest of scutum; no anterior median projection; sensilla flagelliform, situated near posterior margin of scutum.

Genotype: *Bernia marita*, new species.

This distinctive genus is named in honor of the senior author's wife, Berna.

The paired, anterior median scutal setae relate this genus to the subfamily Apoloniinae which includes the genera *Womersia*, *Apolonia* and *Sauracarella*. However, some members of the subfamily Trombiculinae show considerable variation, especially in the AM setae. Members of the Apoloniinae are known principally from the southern hemisphere from reptiles and birds, and the only known North American representative is a species from a pelican in Texas. On the basis of its only known host, it seems reasonable to tentatively place *Bernia* with the Trombiculinae.

We realize the inadvisability of designating a new genus and species on the basis of only one specimen, but we feel that it is distinctive enough to warrant separation from other known genera and species.

Bernia marita, new species
Fig. 435

Type data. Larval holotype, University of Utah Institute of Environmental Biological Research specimen no. 1365:OOX. Taken from a female *Perognathus longimembris*, specimen no. ER2865, five miles N of Wig Mountain, Tooele

Co., Utah, in sand dunes associated with grasses, 24 June 1953, by Dale Parker and John Smith. In the acarology collection of the Department of Zoology and Entomology, Brigham Young University, Provo, Utah. The trivial name *marita* is Latin for "wife," referring to the source of the generic name.

Larva

Body. Almost round; small, width 204; length (including capitulum) 228; one pair eyes, ocular plate lacking.

Gnathosoma. Cheliceral blade slightly curved, with prominent tricuspid cap; basal segment of chelicera longer than wide. Punctae absent. Palpal setae: femoral seta heavily branched; genual seta branched; ventral tibial seta branched on left side, forked on right side; lateral and dorsal tibial setae nude. Tarsus has tarsala, two nude and three or four branched setae; palpotibial claw trifurcate. Galeal seta with four or five branches.

Scutum. Roughly trapezoidal, three times as wide as long. Anterior margin concave, posterior margin convex, lateral margins slightly convex with posterior lateral corners somewhat pointed. Scutum impunctate. Sensillary bases situated on posterior edge of scutum, posterior to level of PL's; separated little wider than distance from SB to PL. Sensilla with 10 to 14 branches on distal half, proximal half with short barbs. Scutal setae plumose; AM posterior to AL; AM equals AL but shorter than PL; AM surrounded by prominent ridge. Prominent ridge along posterior border posterior to and ending lateral to SB.

Legs. Coxae punctate. Setae on legs as follows: I—coxa: 1 branched; trochanter: 1 branched; basifemur: 1 branched; telofemur: 5 branched; genu: 2 genualae, 1 microgenuala, 4 branched; tibia: 2 tibialae, 1 microtibiala, 8 branched; tarsus: tarsala, microtarsala, subterminala, parasubterminala, pretarsala, empodium, and about 14 branched. II—coxa: 1 branched; trochanter: 1 branched; basifemur: 2 branched; telofemur: 4 branched; genu: 1 genuala, 4 branched; tibia: 2 tibialae, 8 branched; tarsus: tarsala, microtarsala, pretarsala, empodium, and about 14 branched. III—coxa: right side 4 branched, left side 3 branched; trochanter: 1 branched; basifemur: 2 branched; telofemur: 3 branched; genu: 1 genuala, 3 branched; tibia: 1 tibiala, 6 branched; tarsus: 1 mastitarsala, empodium, and about 11 branched.

Body Setae. Single humeral seta on each shoulder; about 26 dorsal setae, the first post humeral row with 8 setae; two pairs sternal setae; about 10 ventral setae posterior to sternals.

KEY TO SPECIES OF LARVAL *Odontacarus*

1. Sensilla nude (Fig. 378) 2
   Sensilla branched (Fig. 376) ..... *linsdalei*
2. Two genulae I (Fig. 2) ..... *hirsutus*, page 45
   One genuala I ..... *micheneri*

Odontacarus linsdalei
(Brennan and Jones), 1954
Fig. 376

Distribution. CALIFORNIA: *Citellus beecheyi, Dipodomys agilis, Perognathus californicus* (Brennan and Jones, 1954; Loomis and Bunnell, 1962). NEVADA: *Dipodomys merriami, Dipodomys microps, Neotoma lepida, Onychomys torridus, Perognathus formosus, Perognathus longimembris, Perognathus parvus, Peromyscus maniculatus* (Allred, 1962, 1963; Goates, 1963; Allred and Goates, 1964a, 1964b). UTAH: Beaver Co.: *D. microps* (Brennan and Beck, 1955); *Dipodomys ordii, P. parvus* (Brennan and Jones, 1954). Juab Co.: *P. formosus* (Brennan and Beck, 1955); *P. parvus* (Brennan and Jones, 1954). Tooele Co.: *D. ordii* (Woodbury, 1956b); *P. parvus* (Brennan and Jones, 1954); *P. maniculatus* (Woodbury, 1956b). Utah Co.: *P. parvus* (Brennan and Jones, 1954). Washington Co.: *N. lepida* (Brennan and Beck, 1955).

Other Utah records. Utah Co.: *D. ordii.*

Seasonal occurrence. Fourteen mites were taken in April, July, August, September and December.

Comments. In three of the seven collections, *O. linsdalei* was the only mite on its host.

Odontacarus micheneri
Greenberg, 1952
Fig. 375

Distribution. COLORADO: *Neotoma cinerea* (Greenberg, 1952). NEVADA: Lizards (Allred and

Beck, 1962). UTAH: Box Elder Co.: *Neotoma lepida, Sylvilagus* sp.; Garfield Co.: *N. lepida, Perognathus parvus;* Grand Co.: *N. lepida;* Piute Co.: *N. lepida;* Tooele Co.: *N. lepida, N. cinerea;* Washington Co.: *N. lepida* (Brennan and Beck, 1955).

Other Utah records. Kane Co.: *N. lepida.* Washington Co.: *Onychomys torridus.*

Seasonal occurrence. Fifty-four mites were taken, mostly in June, but also in July and August.

Comments. Mites of *O. micheneri* were more common in the southern part of Utah, and are known from seven counties.

This species apparently has a preference for wood rats (*Neotoma* spp.).

In ten of 13 collections, *O. micheneri* was the only mite on its host.

Odontacarus hirsutus (Ewing), 1931

Fig. 378

Distribution. CALIFORNIA: *Aplodontia rufa, Citellus beecheyi, Citellus lateralis, Dipodomys venustus, Eutamias* sp., *Microtus californicus, Neotoma fuscipes, Perognathus californicus, Sylvilagus* sp., *Thomomys bottae* (Brennan and Jones, 1954; Gould, 1956; Jameson and Brennan, 1957). NEVADA: *Bassariscus astutus* (Allred and Goates, 1964a). UTAH: Grand Co.: *Neotoma* sp. (Brennan and Beck, 1955). Tooele Co.: ? host (Woodbury, 1956b).

Other Utah records. Grand Co.: *Neotoma lepida.* Kane Co.: *N. lepida.* Tooele Co.: *Neotoma cinerea.* Utah Co.: *Mus musculus, N. cinerea.*

Seasonal occurrence. Forty-eight mites were taken in February, May and July.

Comments. In the six collections, *O. hirsutus* was found alone twice, and with *Chatia ochotona* once.

The variations of the palpal claw, galeal and laterotibial setae in this species indicates a close relationship with *Odontacarus chiapanensis.*

Leeuwenhoekia americana (Ewing), 1942

Fig. 373

Distribution. ALABAMA: Cotton mouse; CALIFORNIA: *Citellus beecheyi, Microtus californicus, Peromyscus maniculatus, Sorex pacificus, Sorex trowbridgii, Sorex vagrans, Thomomys bottae* (Brennan and Jones, 1954; Gould, 1956). COLORADO: *Neotoma cinerea, Neotoma mexicana;* KANSAS: *P. maniculatus, Reithrodontomys megalotis* (Loomis, 1956). NEVADA: *Neotoma lepida* (Allred and Goates, 1964b). OREGON: Western mole (Gould, 1956). UTAH: Utah Co.: *P. maniculatus* (Ash, 1963).

Other Utah records. None.

Whartonia perplexa (Brennan), 1947

Fig. 379

Distribution. ARIZONA: Bats (Bradshaw and Ross, 1961). CALIFORNIA: *Antrozous pacificus, Pipistrellus hesperus* (Gould, 1956). MONTANA: *Eptesicus fuscus* (Brennan, 1947). NEVADA: *Antrozous pallidus* (Allred and Goates, 1964a). UTAH: Salt Lake Co.: *A. pallidus;* San Juan Co.: *Myotis californicus* (Brennan and Beck, 1955).

Other Utah records. Millard Co.: Bat.

Seasonal occurrence. The 30 mites were taken in August.

KEY TO SPECIES OF LARVAL *Chatia*

Genuala III and empodium present (Fig. 2) ..... *ochotona*

Genuala III and empodium absent ..... *setosa*

Chatia setosa Brennan, 1946

Fig. 384

Distribution. CALIFORNIA: *Eutamias townsendii, Peromyscus maniculatus* (Gould, 1956). IDAHO: *Citellus lateralis, P. maniculatus* (Brennan, 1946b). MONTANA: *C. lateralis, Neotoma cinerea, Ochotona princeps, P. maniculatus, Tamiasciurus hudsonicus* (Brennan, 1946b). UTAH: Cache Co.: *P. maniculatus* (Brennan and Beck, 1955). Utah Co.: *P. maniculatus* (Ash, 1963). WASHINGTON: ? host (Brennan and Beck, 1955).

Other Utah records. Utah Co.: *O. princeps.*

Seasonal occurrence. Nine chiggers were taken in June and August.

Comments. Chiggers of *C. setosa* were taken most commonly from deer mice (*Peromyscus maniculatus*) from two counties in Utah.

This mite was associated with other chiggers in two collections, and was found alone twice.

Chatia ochotona (Radford), 1942

Fig. 382

Shunsennia ochotona (Radford) of authors (Traub and Nadchatram, 1966).

Distribution. CALIFORNIA: *Clethrionomys californicus, Microtus longicaudus, Ochotona schisticeps, Peromyscus boylii, Peromyscus maniculatus, Sorex trow-*

bridgii (Gould, 1956; Jameson and Brennan, 1957). IDAHO: ? host (Brennan and Beck, 1955). MONTANA: *Ochotona* sp. (Gould, 1956). NEVADA: ? host (Brennan and Beck, 1955). UTAH: Cache Co.: *P. maniculatus* (Brennan and Beck, 1955). Millard Co.: *P. maniculatus* (Allred, 1957d). Tooele Co.: *Neotoma cinerea* (Brennan and Beck, 1955). Utah Co.: *P. maniculatus* (Ash, 1963).

Other Utah records. None.

Seasonal occurrence. A total of 39 mites was taken from May through August, and in January and November.

Comments. In seven of 18 collections, *C. ochotona* was the only mite on its host. It was associated with chiggers of other species in six collections.

Gahrliepia americana Ewing, 1942
Fig. 437

Walchia americana of authors (Brennan and Jones, 1959).

Distribution. CALIFORNIA: "Gray squirrel"; FLORIDA: "Cotton mouse" (Gould, 1956). IOWA: *Peromyscus leucopus;* KANSAS: *Neotoma micropus, P. leucopus, Sciurus carolinensis, Sciurus niger, Sylvilagus floridanus* (Loomis, 1956). MARYLAND: *P. leucopus* (Drummond, 1957). NEBRASKA: *S. carolinensis, S. niger;* OKLAHOMA: *Neotoma floridana, P. leucopus* (Loomis, 1956). UTAH: Garfield Co.: *Eutamias umbrinus;* WISCONSIN: ? host (Brennan and Beck, 1955).

Other Utah records. None.

KEY TO SPECIES OF LARVAL *Trombicula*

1. Sensilla nude (Fig. 385) ..... *californica*, page 47
   Sensilla branched (Fig. 387) 2
2. Palpal claw trifurcate (Fig. 6) 3
   Palpal claw bifurcate; accessory prong inner and ventral ..... *belkini*, page 47
3. One pair of humeral setae (Fig. 2) 4
   Two pairs of humeral setae ..... *hoplae*, page 48
4. Palpal femoral, genual, laterotibial, and ventrotibial setae nude; galeal setae branched; two genuala I 5
   Without this combination of characters 7
5. Palpal dorsotibial setae branched (Fig. 6) ..... *myotis*, page 48
   Palpal dorsotibial setae nude 6
6. Spur on tarsus I longer than on tarsus II; palpal genual, laterotibial, and ventrotibial setae occasionally forked ..... *potosina*, page 48
   Spur on tarsus I equal to one on tarsus II ..... *panamensis*, page 48
7. Mastitibiala III present (Fig. 2) 8
   Mastitibiala III absent 11
8. Two mastitarsalae III; mastifemorala present (Fig. 2) 9
   Three mastitarsalae III; mastifemorala III absent ..... *subsignata*, page 48
9. Galeal seta nude (Fig. 6) ..... *harperi*, page 49
   Galeal seta branched 10
10. Palpal femoral and genual setae branched (Fig. 6) ..... *jewetti*, page 49
    Palpal femoral and genual setae nude ..... *harperi*, page 49

11. Scutum pentagonal with acute posterior angle (Fig. 398); sensillae branched or barbed the entire length (Fig. 398); coxa III with two or more setae; with three genualae I 12

Without this combination of characters 13

12. Coxa III with two setae ..... *sargenti*, page 49

Coxa III with five setae ..... *esoensis*, page 49

13. Mastitarsala III present (Fig. 2) 15

Mastitarsala III absent 14

14. Sensillae heavily branched and rebranched (Fig. 393) *univari*, page 49

Sensillae simply branched (Fig. 403) ..... *kardosi*, page 49

15. Two mastitarsalae III (Fig. 2) 18

One mastitarsala III 16

16. Coxa III with one seta (Fig. 5); palpal dorsotibial seta branched (Fig. 6) ..... *bakeri*, page 49

Coxa III with three or four setae; palpal dorsotibial seta nude 17

17. Dorsal formula begins 2-8-8; cheliceral bases punctate ..... *arenicola*, page 50

Dorsal formula begins 2-6-6; cheliceral bases impunctate ..... *montanensis*, page 50

18. Palpal dorsotibial and laterotibial setae nude; about 100 dorsal setae; no distinct humerals ..... *doremi*, page 50

Palpal dorsotibial and laterotibial setae branched; about 28 dorsal setae, one pair distinct humerals ..... *alliedi*, page 50

A number of workers have proposed that none of the Utah species of chiggers belong to the genus *Trombicula, sensu stricto,* as currently defined. However, for the purposes of our study we have retained in *Trombicula, sensu lato,* those species which belong to the subfamily Trombiculinae and possess a flagelliform sensilla.

Trombicula californica Ewing, 1942

Fig. 385

Distribution. CALIFORNIA: Variety of rodents (Brennan and Wharton, 1950; Brennan and Jones, 1954; Gould, 1956; Jameson and Brennan, 1957). IDAHO: *Citellus lateralis;* MONTANA: *Sylvilagus nuttallii, Tamiasciurus hudsonicus* (Brennan and Wharton, 1950). UTAH: Cache Co.: *Peromyscus maniculatus;* Rich Co.: *Clethrionomys gapperi, Microtus longicaudus* (Brennan and Beck, 1955). Salt Lake Co.: *P. maniculatus* (Allred, 1957d). Sanpete Co.: *Citellus armatus* (Brennan and Beck, 1955).

Other Utah records. Utah Co.: *C. armatus, Zapus princeps.*

Seasonal occurrence. Ninety-four mites were taken in June and August.

Comments. Mites of this species were found only in five counties in northwestern Utah in the Great Basin.

In three of its six collections, *T. californica* was the only mite on its host. In one collection it was associated with a chigger of another species.

Trombicula belkini Gould, 1950

Fig. 381

Distribution. ARIZONA: ? host; CALIFORNIA: *Citellus beecheyi, Marmota flaviventris, Mus musculus, Perognathus californicus, Peromyscus truei,* reptiles (Gould, 1950, 1956; Brennan and Jones, 1954). NEVADA: *Neotoma lepida, Perognathus longimembris,* reptiles (Allred and Beck, 1962, 1964; Allred, 1963;

Allred and Goates, 1964b). UTAH: Duchesne Co.: *Citellus leucurus;* Emery Co.: *Crotaphytus collaris;* Garfield Co.: *C. collaris;* Grand Co.: *Cnemidorphorus tigris, C. collaris;* Juab Co.: *Gambelia wislizenii, P. truei* (Brennan and Beck, 1955); *Pituophis catenifer* (Gould, 1956); *Uta stansburiana;* Millard Co.: *Sceloporus graciosus;* Sevier Co.: *Citellus lateralis;* Utah Co.: S. *graciosus* (Brennan and Beck, 1955).

Other Utah records. Duchesne Co.: *Dipodomys ordii.* Rich Co.: *Clethrionomys gapperi.*

Seasonal occurrence. Seven mites were taken in June, July and August.

Comments. Mites of this species commonly are found on lizards. They occasionally infest rodents, but in such cases their population index is usually low. This species is known from nine counties.

In its five collections, *T. belkini* was the only mite on its host.

Trombicula hoplai Loomis, 1954

Fig. 388

Distribution. CALIFORNIA: *Perognathus californicus, Peromyscus californicus, Peromyscus maniculatus* (Brennan and Jones, 1954; Loomis, 1956). COLORADO: *Neotoma lepida, Neotoma mexicana,* (Loomis, 1954; Finley, 1958). KANSAS: *Antrozous bunkeri, Cynomys ludovicianus, Neotoma micropus, Peromyscus leucopus, Sylvilagus floridanus;* NEW MEXICO: *Neotoma mexicana, Perognathus flavus;* TEXAS: *Citellus tridecemlineatus* (Loomis, 1954, 1956). UTAH: Juab Co.: *Peromyscus truei;* San Juan Co.: *Perognathus apache* (Brennan and Beck, 1955). Tooele Co.: *P. truei* (Woodbury, 1956b). Utah Co.: ? host (Elzinga, 1960), *N. lepida* (Ho, 1962).

Other Utah records. Kane Co.: *Perognathus parvus.* San Juan Co.: *P. truei.* Uintah Co.: *Citellus leucurus.*

Seasonal occurrence. The 14 mites were taken in June, August and September.

Trombicula myotis Ewing, 1929

Fig. 387

Distribution. ARIZONA: Bats (Bradshaw and Ross, 1961). ARKANSAS: *Sylvilagus floridanus* (Loomis, 1956). CALIFORNIA: ? host (Brennan and Beck, 1955). IOWA: *Microtus pinetorum, Peromyscus leucopus;* KANSAS: *Elaphe obsoleta, Neotoma micropus;* MAINE: *Myotis lucifugus;* MISSOURI: *Eptesicus fuscus;* MONTANA: *E. fuscus;* NEBRASKA: *P. leucopus, Sciurus niger* (Loomis, 1956). NEW MEXICO: *Sigmodon* sp.; NEW YORK: ? host (Brennan and Beck, 1955). OKLAHOMA: *Neotoma floridana;* PENNSYLVANIA: *E. fuscus* (Loomis, 1956). UTAH: Daggett Co.: *Peromyscus maniculatus* (Allred, 1957d). Tooele Co.: Bat (Woodbury, 1956b). Utah Co.: *Myotis californicus* (Brennan and Beck, 1955). VIRGINIA: *E. fuscus;* WEST VIRGINIA: *E. fuscus, M. lucifugus* (Yunker, 1958).

Other Utah records. Beaver Co.: *Myotis* sp. Box Elder Co.: *Myotis* sp. Rich Co.: *P. maniculatus.* Tooele Co.: *Myotis* sp.

Seasonal occurrence. The 83 mites were taken in June and July, mostly in June.

Comments. Mites of this species were taken commonly in the northern part of the state in the Great Basin. They are known from six counties.

This species occurs frequently on bats, but also attaches regularly to rodents.

In six of its seven collections, *T. myotis* was the only mite on its host.

Trombicula potosina Hoffman, 1950

Fig. 391

Distribution. COLORADO: *Neotoma albigula, Neotoma cinerea, Neotoma lepida, Neotoma mexicana* (Finley, 1958). UTAH: Beaver Co.: *Perognathus parvus;* Iron Co.: *Neotoma lepida;* Juab Co.: *N. lepida;* Millard Co.: *N. lepida;* San Juan Co.: *Neotoma* sp.; Sanpete Co.: *Microtus longicaudus;* Tooele Co.: *N. lepida;* Washington Co.: *N. lepida* (Brennan and Beck, 1955).

Other Utah records. None.

Trombicula panamensis Ewing, 1925

Fig. 390

Distribution. NEVADA: *Neotoma lepida* (Allred and Goates, 1964b).

Utah records. Beaver Co.: *Peromyscus maniculatus.* Kane Co.: *N. lepida, P. maniculatus.*

Seasonal occurrence. The 22 mites were taken in June, August and September.

Comments. In two of five collections, *T. panamensis* was the only mite on its host. In one collection it was associated with *Odontacarus micheneri.*

Trombicula subsignata Brennan and Wharton, 1950

Fig. 392

Distribution. CALIFORNIA: *Citellus beldingi, Marmota flaviventris* (Gould, 1956). COLORADO: *Citellus lateralis* (Brennan and Wharton, 1950). MISSOURI: *Capella gallinago* (Kardos, 1954). MONTANA: *C. lateralis, M. flaviventer;* NEW YORK: *Microtus pennsylvanicus, Zapus hudsonicus;* NORTH DAKOTA: *Sylvilagus floridanus;* PENNSYLVANIA: *M. pennsylvanicus, Sciurus motacilla* (Brennan and Wharton, 1950). WYOMING: *Zapus princeps* (Kardos, 1954).

Utah records. Juab Co.: *Reithrodontomys megalotis.*

Seasonal occurrence. A single chigger was taken in June.

Trombicula harperi Ewing, 1928
Fig. 394

Gould (1956) indicated that the variations in *Trombicula harperi* and *Trombicula microti* are great. He discussed them as representatives of a single polymorphic species, *T. harperi* having priority. Our collections agree with Gould's descriptions, especially in the variability of the galeal and humeral setae. Consequently, records of *T. microti* are included here.

Distribution. ARIZONA, CALIFORNIA, COLORADO, IDAHO, MAINE, MICHIGAN, MONTANA, NEW MEXICO, NEW YORK, OREGON, PENNSYLVANIA, VERMONT, WASHINGTON, WYOMING: Variety of rodents (Brennan and Wharton, 1950; Kardos, 1954; Brennan and Beck, 1955; Gould, 1956; Jameson and Brennan, 1957; Finley, 1958). UTAH: Beaver Co.: *Ochotona princeps;* Duchesne Co.: *O. princeps;* Iron Co.: *O. princeps* (Brennan and Beck, 1955); *Peromyscus maniculatus* (Allred, 1957d). Juab Co.: *Gambelia* sp., *Neotoma lepida;* Sanpete Co.: *Citellus armatus, Clethrionomys gapperi, Marmota flaviventer, Microtus longicaudus* (Brennan and Beck, 1955); *P. maniculatus* (Allred, 1957d); *Zapus princeps;* Sevier Co.: *Microtus* sp. (Brennan and Beck, 1955). Summit Co.: *O. princeps* (Kardos, 1954). Tooele Co.: *Melospiza lincolni* (Brennan and Beck, 1955). Utah Co.: *Marmota flaviventris* (Allred, 1961); *O. princeps;* Wasatch Co.: *O. princeps, Z. princeps;* Wayne Co.: *O. princeps* (Brennan and Beck, 1955).

Other Utah records. Beaver Co.:*Microtus longicaudus.* Carbon Co.: *Citellus lateralis.* Daggett Co.: *P. maniculatus.* Iron Co.: *C. lateralis.* Salt Lake Co.: *C. gapperi.* San Juan Co.: *Onychomys leucogaster.* Summit Co.: *Eutamias minimus.* Uintah Co.: *Homo sapiens, M. longicaudus.* Utah Co.: *Microtus montanus, O. princeps, Perognathus parvus, Z. princeps.* Washington Co.: *Microtus montanus.*

Seasonal occurrence. A total of 2,242 chiggers was taken. Mites were most abundant in August, although small numbers were found in March, May, June, July, September and November.

Comments. Mites of *T. harperi* occur generally over the state. They are known from 17 counties.

This species apparently prefers the pika, *Ochotona princeps,* as its host, although it has been commonly found on jumping mice and voles. Its population index was 107 on pikas, 6 on jumping mice, 11 to 126 on voles, and from 1 to 59 on other rodents.

In 44 of 68 collections, *T. harperi* was the only mite on its host. In 13 collections it was associated with chiggers of other species.

Trombicula jewetti
Brennan and Wharton, 1950
Fig. 395

Distribution. CALIFORNIA: Variety of rodents (Brennan and Wharton, 1950; Brennan and Jones, 1954; Jameson and Brennan, 1957). OREGON: *Microtus townsendii* (Brennan and Wharton, 1950). UTAH: Duchesne Co.: *Peromyscus maniculatus* (Allred, 1957d).

Other Utah records. None.

Trombicula sargenti Brennan, 1952
Fig. 398

Distribution. UTAH: Juab Co.: *Neotoma lepida* (Brennan, 1952; Brennan and Beck, 1955). Utah Co.: *N. lepida* (Allred and Beck, 1953a).

Other Utah records. None.

Trombicula esoensis Sasa
and Ogata, 1953
Fig. 397

The Utah record below was described as a new species, *T. reesi,* by Allred (1957d). Brennan and Jones (1959) placed this into synonymy with *T. esoensis.*

Distribution. MICHIGAN, MONTANA: ? host (Brennan and Jones, 1959). UTAH: Salt Lake Co.: *Peromyscus maniculatus* (Allred, 1957d).

Other Utah records. None.

Trombicula univari Brennan, 1965
Fig. 393

Distribution. ARIZONA: *Antrozous pallidus, Pipistrellus hesperus, Plecotus townsendii* (Brennan, 1965).

Utah records. San Juan Co.: *P. hesperus.*

Seasonal occurrence. Two mites were taken in September.

Trombicula kardosi Loomis, 1954
Fig. 403

Distribution. KANSAS: *Elaphe obsoleta, Sciurus niger;* UTAH: Garfield Co.: *Eutamias umbrinus* (Loomis, 1954).

Other Utah records. None.

Trombicula bakeri Ewing, 1946
Fig. 399

Distribution. Apparently not known heretofore from the United States.

Utah records. Kane Co.: *Peromyscus maniculatus.* Utah Co.: *Citellus armatus, Dipodomys ordii.*

Seasonal occurrence. Only three mites were taken—one each in June, July and August.

Trombicula arenicola Loomis, 1954

Fig. 406

Distribution. COLORADO: *Dipodomys ordii, Neotoma albigula;* KANSAS: *D. ordii, Muscivora forficata, Perognathus hispidus* (Loomis, 1954). NEVADA: *Dipodomys merriami, Dipodomys microps, Onychomys torridus, Perognathus formosus, Perognathus longimembris,* reptiles, *Sorex tenellus, Spermophilus tereticaudus* (Allred, 1962, 1963; Goates, 1963; Allred and Beck, 1964; Allred and Goates, 1964a). NEW MEXICO: *D. ordii, Perognathus flavus* (Loomis, 1954). UTAH: Box Elder Co.: *Dipodomys* sp., *Neotoma lepida, Perognathus* sp.; Daggett Co.: *Perognathus parvus;* Garfield Co.: *Cynomys parvidens;* Grand Co.: *Perognathus* sp.; Juab Co.: *D. microps, P. formosus;* Millard Co.: *D. microps;* Sanpete Co.: *Peromyscus maniculatus;* Sevier Co.: *D. ordii* (Brennan and Beck, 1955). Tooele Co.: *D. microps, D. ordii* (Loomis, 1954); *P. formosus* (Brennan and Beck, 1955); *P. longimembris* (Woodbury, 1956b); *P. parvus* (Loomis, 1954); *P. maniculatus* (Woodbury, 1956b); snakes; Uintah Co.: *D. ordii* (Brennan and Beck, 1955). Utah Co.: *Citellus leucurus* (Ho, 1962); *D. ordii, P. parvus* (Brennan and Beck, 1955); *P. maniculatus, Reithrodontomys megalotis* (Elzinga and Rees, 1964). Washington Co.: *P. formosus, P. longimembris;* Wayne Co.: *D. ordii* (Brennan and Beck, 1955.

Other Utah records. Beaver Co.: *Perognathus* sp. Box Elder Co.: *Perognathus* sp. Grand Co.: *Perognathus* sp. Juab Co.: *P. parvus.* Kane Co.: *Peromyscus truei.* San Juan Co.: *Citellus spilosoma, D. ordii.* Washington Co.: *Dipodomys merriami.*

Seasonal occurrence. The 653 mites were taken from February through October, except in March. Most were found in August, with about half as many taken in July and October. Few were taken during the other months.

Comments. Mites of *T. arenicola* are common in the southern part of Utah, and about equally distributed in the Great and Upper Colorado River basins. They are known from 16 counties.

This species apparently prefers pocket mice of the genus *Perognathus* as its hosts, although mites were taken frequently on kangaroo rats, particularly *D. microps.* The population index was 11 to 14 on kangaroo rats, 5 to 21 on pocket mice, and 1 to 4 on other animals.

In 53 of 68 collections, *T. arenicola* was the only mite on its host. It was associated with chiggers of other species in seven collections.

Trombicula montanensis Brennan, 1946

Fig. 402

Distribution. CALIFORNIA: *Citellus beldingi, Citellus lateralis, Dipodomys heermani* (Gould, 1956). COLORADO: ? host (Brennan and Beck, 1955; Loomis, 1956). KANSAS: Variety of rodents, birds, and reptiles (Loomis, 1956). MONTANA: *Cynomys ludovicianus, Sylvilagus nuttallii* (Brennan, 1946a). NEBRASKA: ? host (Brennan and Beck, 1955; Loomis, 1956). OKLAHOMA: *Heterodon platyrhinos, Tadarida mexicana* (Loomis, 1956). TEXAS: *C. ludovicianus* (Eads, Menzies, and Miles, 1952). UTAH: Duchesne Co.: *Cynomys leucurus* (Brennan and Beck, 1955). Kane Co.: *Peromyscus truei;* Rich Co.: *Peromyscus maniculatus;* Sanpete Co.: *P. maniculatus* (Allred, 1957d). Tooele Co.: *Peromyscus crinitus* (Woodbury, 1956b).

Other Utah records. Box Elder Co.: *C. lateralis.*

Seasonal occurrence. The single mite was taken in June.

Trombicula doremi Brennan and Beck, 1955

Fig. 404

Distribution. UTAH: Kane Co.: *Perognathus longimembris* (Brennan and Beck, 1955). Utah Co.: ? host (Elzinga, 1960), *Dipodomys ordii* (Ho, 1962). Washington Co.: *Dipodomys merriami* (Brennan and Beck, 1955).

Other Utah records. Beaver Co.: *Perognathus* sp.

Seasonal occurrence. The single mite was taken in August.

Comments. According to Loomis (personal correspondence) this specimen is aberrant, having duplicated PL setae on both sides. It agrees generally with the type description and compares favorably with a paratype.

Trombicula allredi Brennan and Beck, 1955

Fig. 405

Distribution. CALIFORNIA: *Neotoma* sp., *Sigmodon hispidus* (Gould, 1956). NEVADA: *Dipodomys merriami, Dipodomys microps, Neotoma lepida* (Goates, 1963; Allred and Goates, 1964b). TEXAS: *Liomys* sp. (Eads, Trevino, and Campos, 1965). UTAH: Washington Co.: *N. lepida* (Brennan and Beck, 1955).

Other Utah records. None.

Cheladonta crossi Lipovsky, Crossley and Loomis, 1955

Distribution. UTAH: Cache Co.: *Peromyscus maniculatus* (Lipovsky, Crossley and Loomis, 1955).

Other Utah records. None.

KEY TO SPECIES OF LARVAL *Euschoengastia*

1. Tibiala III present (Fig. 2) 2
   Tibiala III absent 9

2. Subterminala and parasubterminala present (Fig. 2) 5
   Subterminala and parasubterminala absent 3

3. Genualae II and III absent ..... *lacerta*, page 52
   Genualae II and III present 4

4. One pair of humeral setae (Fig. 2) ..... *hoffmanmae*, page 52
   Two pairs of humeral setae ..... *furmani*, page 52

5. Genualae II and III present 6
   Genualae II and III absent ..... *utahensis*, page 52

6. Sternal setae 2:2 (Fig. 5); palpal claw five-pronged 7
   Sternal setae 2:4 or 2:6; palpal claw trifurcate (Fig. 6) 8

7. Palpal laterotibial seta nude (Fig. 6) ..... *soricinus*, page 52
   Palpal laterotibial seta branched ..... *oregonensis*, page 53

8. Sternal setae 2:4 ..... *cordiremus*, page 53
   Sternal setae 2:6 ..... *cynomyicola*, page 53

9. Two genualae I (Fig. 2) 11
   One genuala I 10

10. Palpal claw trifurcate (Fig. 6); laterotibial seta nude or with 1 or 2 branches (Fig. 6) ..... *lanei*, page 53
    Palpal claw five-pronged; laterotibial seta branched ..... *deeipiens*, page 53

11. Genuala III present 13
    Genuala III absent 12

12. Palpal claw trifurcate (Fig. 6); galeal seta nude or forked (Fig. 6) ..... *luteodema*, page 54
    Palpal claw five-pronged; galeal seta branched (Fig. 4) ..... *pomerantzi*, page 54

13. Subterminala and parasubterminala present (Fig. 2) 14
    Subterminala and parasubterminala absent ..... *fassola*, page 54

14. One pair of humeral setae (Fig. 2) 15
    Two pairs of humeral setae ..... *rotunda*, page 54

15. Palpal claw trifurcate (Fig. 6) 16
    Palpal claw with four to seven prongs 19

16. Scutum and cheliceral bases punctate (Fig. 408) 17

Scutum and cheliceral bases impunctate (Fig. 417) 18

17. Sensilla capitate; AL equal to PL (Fig. 408) ..... *radfordi*, page 54

Sensilla pyriform; AL shorter than PL (Fig. 413) ..... *obesa*, page 55

18. Dorsal setae of two forms—majority narrow lanceolate, rest of usual form ..... *lanceolata*, page 55

Dorsal setae of usual form ..... *criceticola*, page 55

19. Sensilla capitate; AL equal to or greater than PL (Fig. 408) ..... *radfordi*, page 54

Sensilla cordate; AL shorter than PL; scutum and cheliceral bases impunctate (Fig. 422) ..... *sciuricola*, page 55

Euschoengastia lacerta
Brennan, 1948
Fig. 430

Distribution. CALIFORNIA: *Citellus beecheyi, Neotoma fuscipes, Perognathus californicus, Peromyscus boylii, Peromyscus maniculatus, Reithrodontomys* sp., *Sceloporus occidentalis, Sylvilagus audubonii* (Brennan, 1948; Brennan and Jones, 1954; Gould, 1956; Jameson and Brennan, 1957). COLORADO: *Neotoma albigula, Neotoma cinerea, Neotoma mexicana;* KANSAS: *Cynomys ludovicianus, Neotoma micropus, Sylvilagus floridanus* (Loomis, 1956). NEVADA: *Dipodomys microps* (Goates, 1963). TEXAS: *Liomys* sp. (Eads, Trevino and Campos, 1965). UTAH: Garfield Co.: *Neotoma lepida;* Tooele Co.: *N. lepida* (Brennan and Beck, 1955).

Other Utah records. Duchesne Co.: *Citellus lateralis.*

Seasonal occurrence. Five larvae were collected in July and August.

Comments. Chiggers of *E. lacerta* are known from both the Great and Upper Colorado River basins. They have been found in only three counties.

This species has been taken from a variety of hosts, but more commonly from *Neotoma* spp. than from others.

Euschoengastia hoffmannae
Gould, 1956
Fig. 433

Distribution. CALIFORNIA: *Citellus lateralis* (Gould, 1956). COLORADO: *Neotoma mexicana* (Finley, 1958). UTAH: Sevier Co.: *C. lateralis* (Brennan and Beck, 1955).

Other Utah records. Beaver Co.: *C. lateralis.* Sanpete Co.: *C. lateralis.* Summit Co.: *Ochotona princeps.*

Seasonal occurrence. A total of 105 larval *E. hoffmannae* was collected in June and August. Greatest numbers were found in June.

Comments. Specimens were found most commonly in southwestern Utah in the Great Basin. This species is known from only four counties.

Most collections and greatest numbers of *E. hoffmanae* were taken from the squirrel, *C. lateralis.*

In three of its five collections, *E. hoffmannae* was associated with chiggers of other species. In one collection it was the only mite on its host.

Euschoengastia furmani Gould, 1956
Fig. 432

Distribution. CALIFORNIA: *Citellus leucurus, Neotoma lepida, Perognathus californicus, Reithrodontomys megalotis* (Gould, 1956). UTAH: Washington Co.: *N. lepida* (Brennan and Beck, 1955).

Other Utah records. None.

Euschoengastia utahensis
Brennan and Beck, 1955
Fig. 426

Distribution. NEVADA: *Neotoma lepida* (Allred and Goates, 1964b). UTAH: Juab Co.: *N. lepida* (Brennan and Beck, 1955).

Other Utah records. Washington Co.: *Perognathus formosus.*

Seasonal occurrence. A single chigger was collected in April.

Euschoengastia soricinus
Gould, 1956
Fig. 425

Distribution. CALIFORNIA: *Sorex palustris, Sorex trowbridgii* (Gould, 1956).

Utah records. One chigger was taken from *Ochotona princeps* in Utah County in August.

Comments. Loomis (personal correspondence) indicated that the Utah specimen is similar to *soricinus* from California, but the sensilla is a different shape. This may represent an undescribed species, but is here tentatively relegated to *E. soricinus*.

Euschoengastia oregonensis
(Ewing), 1929
Fig. 428

Distribution. CALIFORNIA: *Citellus beldingi, Citellus lateralis, Eutamias townsendii, Microtus californicus* (Gould, 1956); *Neurotrichus* sp. (Jameson and Brennan, 1957); *Sorex pacificus, Sorex palustris, Sorex towbridgii, Tamiasciurus douglasii;* MONTANA: Pika; OREGON: Mole (Gould, 1956). UTAH: Cache Co.: *Peromyscus maniculatus;* Iron Co.: *Ochotona princeps, Sorex obscurus;* Sevier Co.: *Microtus* sp.; Utah Co.: *O. princeps;* Wayne Co.: *O. princips;* WASHINGTON: ? host (Brennan and Beck, 1955).

Other Utah records. Beaver Co.: *Microtus longicaudus. O. princeps.* Box Elder Co.: *M. longicaudus, Perognathus parvus.* Duchesne Co.: *P. maniculatus.* Sevier Co.: *Eutamias quadrivittatus.*

Seasonal occurrence. A total of 226 larval *E. oregonensis* was collected in June, July, August and November. Greatest numbers were taken in July.

Comments. Chiggers of this species are common in the Great Basin. They are known from eight counties.

This species is most closely associated with the pika, *O. princeps,* and other hosts such as shrews and voles living in a similar habitat.

In seven of 14 collections *E. oregonensis* was the only mite on its host. In five collections it was associated with chiggers of other species.

Euschoengastia cordiremus
Breman, 1948
Fig. 429

Distribution. CALIFORNIA: *Citellus beldingi, Marmota* sp. (Gould, 1956). MONTANA: *Citellus lateralis, Peromyscus maniculatus* (Brennan, 1948) NEVADA: ? host, *P. maniculatus* (Brennan and Beck, 1955; Allred and Goates, 1964a). UTAH: Cache Co.: *P. maniculatus* (Brennan and Beck, 1955). Utah Co.: *P. maniculatus* (Ash, 1963).

Other Utah records. Box Elder Co.: *C. lateralis, Perognathus parvus.*

Seasonal occurrence. Sixteen larval *E. cordiremus* were taken in June, July and October.

Comments. Mites of this species are known only from three counties in northwestern Utah in the Great Basin.

In its three collections, *E. cordiremus* was associated each time with mites of a different species of *Euschoengastia* and with other mesostigmatids.

Euschoengastia cynomyicola
Crossley and Lipovsky, 1954
Fig. 423

Distribution. NEBRASKA: *Cynomys ludovicianus;* KANSAS: *Citellus tridecemlineatus, C. ludovicianus, Perognathus hispidus* (Crossley and Lipovsky, 1954).

Utah records. San Juan Co.: *Citellus spilosoma.*

Seasonal occurrence. Nine mites were collected in May.

Euschoengastia lanei Brennan
and Beck, 1955
Fig. 419

Distribution. NEVADA: *Peromyscus maniculatus* (Allred and Goates, 1964a). UTAH: Box Elder Co.: *P. maniculatus, Reithrodontomys megalotis;* Uintah Co.: *P. maniculatus* (Brennan and Beck, 1955).

Other Utah records. Utah Co.: *Ochotona princeps.*

Seasonal occurrence. Two specimens were taken in July.

Comments. This species has been taken from both the Great and Upper Colorado River basins.

Euschoengastia decipiens
Gould, 1956
Fig. 431

This species is very similar to *Euschoengastia radfordi* and may prove to be synonymous with it. The two are differentiated by the presence of two genualae I on *radfordi* and one genuala I on *decipiens.* In a series of chiggers taken from *Lepus californicus* in southern Utah, four mites possess two genualae I and two have one genuala I.

Distribution. CALIFORNIA: *Perognathus parvus* (Gould, 1956). NEVADA: ? host, *Dipodomys merriami, Dipodomys microps, Perognathus formosus, Perognathus longimembris, P. parvus* (Brennan and Beck, 1955; Allred, 1963; Goates, 1963; Allred and Goates, 1964a). OREGON: ? host (Brennan and Beck, 1955). UTAH: Box Elder Co.: *Lepus californicus;* Cache Co.: *Peromyscus maniculatus;* Duchesne Co.: *Citellus lateralis;* Garfield Co.: *C. lateralis;* Tooele Co.: *Neotoma lepida;* Utah Co.: *Dipodomys ordii, P. parvus;* Washington Co.: *D. merriami, P. formosus, P. longimembris* (Brennan and Beck, 1955).

Other Utah records. Box Elder Co.: *P. maniculatus, Sylvilagus idahoensis.* Daggett Co.: *Peromyscus truei.* Juab Co.: *L. californicus, Sylvilagus audubonii.* Kane Co.: *D. ordii, N. lepida, P. parvus.* San Juan Co.: *P. maniculatus.* Sanpete Co.: *C. lateralis, Erethizon dorsatum.* Utah Co.: *D. microps, P. maniculatus, Sylviligus nuttallii.* Washington Co.: *L. californicus, Peromyscus crinitus, Peromyscus cremicus, S. audubonii.*

Seasonal occurrence. A total of 1,129 larval *E. decipiens* was collected. Mites were found during February through June, and in August and November. Greatest numbers were taken in February, March and April.

Comments. Mites of *E. decipiens* are known from the Great and Upper Colorado River Basins in 12 counties in Utah.

This species has been taken from a variety of rodents, but the majority of the collections were as follows: 28% from *Dipodomys* spp., 25% from rabbits, 24% from *Perognathus* spp., and 11% from *Peromyscus* spp. Twenty percent of the collections were from *D. ordii,* and 15% from *L. californicus.*

In 32 of 55 collections, *E. decipiens* was the only mite on its host. In only seven collections was it associated with other species of chigger mites.

Euschoengastia luteodema
Brennan, 1948

Fig. 420

Distribution. CALIFORNIA: *Marmota flaviventris* (Gould, 1956). IDAHO: *M. flaviventer* (Brennan, 1948). MONTANA: *Citellus columbianus, M. flaviventer, Tamiasciurus hudsonicus* (Brennan, 1948). UTAH: Beaver Co.: *M. flaviventris* (Allred, 1961). Cache Co.: *Peromyscus maniculatus* (Brennan and Beck, 1955). Utah Co.: *P. maniculatus* (Ash, 1963).

Other Utah records. Duchesne Co.: *Citellus lateralis.*

Seasonal occurrence. A total of 114 larval *E. luteodema* was collected during January, June, and from September through November. Greatest numbers were found in June.

Comments. Mites of this species have been found in both the Great and Upper Colorado River basins, but are more common at the northerly latitudes. They are known from only four counties.

In seven of its ten collections, *E. luteodema* was associated with chiggers of other species. In two instances it was apparently the only mite on its host.

Euschoengastia pomerantzi
Brennan and Jones, 1954

Fig. 416

Distribution. CALIFORNIA: *Citellus beecheyi, Citellus lateralis, Microtus californicus, Mus musculus, Neotoma fuscipes, Perognathus californicus, Peromyscus boylii, Peromyscus californicus, Peromyscus maniculatus, Peromyscus truei, Tamiasciurus douglasii* (Brennan and Jones, 1954; Gould, 1956). NEVADA: ? host; UTAH: Garfield Co.: *Eutamias umbrinus* (Brennan and Beck, 1955).

Other Utah records. Garfield Co.: *P. maniculatus, P. truei.*

Seasonal occurrence. The 49 mites were taken in June.

Comments. This species is known in Utah from only one county.

Euschoengastia fasolla
Brennan and Beck, 1955

Fig. 414

Distribution. NEVADA: *Eutamias dorsalis, Neotoma lepida, Perognathus parvus* (Allred, 1963; Allred and Goates, 1964a, 1964b). UTAH: Washington Co.: *N. lepida* (Brennan and Beck, 1955).

Other Utah records. None.

Euschoengastia rotunda
Brennan and Beck, 1955

Fig. 411

Distribution. UTAH: San Juan Co.: *Ochotona princeps* (Brennan and Beck, 1955). Utah Co.: *Peromyscus maniculatus* (Ash, 1963).

Other Utah records. None.

Euschoengastia radfordi
Brennan and Jones, 1954

Fig. 408

Euschoengastia decipiens (Gould, 1956) may be synonymous with this species. Refer to comments under *E. decipiens.*

Distribution. CALIFORNIA: Variety of rodents and birds (Brennan and Jones, 1954); Jameson and Brennan, 1957). IDAHO: ? host; MONTANA: ? host (Brennan and Beck, 1955). NEVADA: *Dipodomys merriami, Dipodomys microps, Neotoma lepida* (Goates, 1963; Allred and Goates, 1964b). OREGON: ? host; UTAH: Garfield Co.: *Erethizon dorsatum;* Tooele Co.: *Junco canicceps* (Brennan and Beck, 1955); *Peromyscus crinitus* (Woodbury 1956b). Utah Co.: *D. microps* (Ho, 1962); *Peromyscus maniculatus, Reithrodontomys megalotis* (Elzinga and Rees, 1964). Washington Co.: *N. lepida* (Brennan and Beck, 1955).

Other Utah records. Box Elder Co.: *Lepus californicus, Sylvilagus idahoensis.* Juab Co.: *D. microps.*

Tooele Co.: *N. lepida*. Utah Co.: *Dama hemionus, Dipodomys ordii*. Washington Co.: *Perognathus formosus, Peromyscus eremicus*.

Seasonal occurrence. A total of 97 larval mites was collected in February, March, April, May, June and December; they were most abundant in March.

Comments. Mites of this species are more common in the northern part of Utah, but were taken about equally from the Great and Upper Colorado River basins. They are known from six counties.

In four of its 12 collections, *E. radfordi* was the only mite on its host. In seven collections it was associated with chiggers of other species.

Euschoengastia obesa Brennan and Beck, 1955

Fig. 413

Distribution. NEVADA: *Neotoma lepida* (Allred and Goates, 1964b). UTAH: Duchesne Co.: *Cynomys leucurus;* Tooele Co.: *Perognathus formosus;* Utah Co.: *Peromyscus maniculatus;* Wayne Co.: *P. maniculatus* (Brennan and Beck, 1955).

Other Utah records. San Juan Co.: *P. maniculatus*. Tooele Co.: *P. maniculatus*.

Seasonal occurrence. The two collections in September and October totaled 66 mites.

Comments. Mites were taken from both the Great and Upper Colorado River basins. Mites of this species are known from five counties.

In both collections, *E. obesa* was the only mite found on its host.

Euschoengastia lanceolata Brennan and Beck, 1955

Fig. 417

Distribution. UTAH: Washington Co.: *Neotoma lepida, Peromyscus eremicus* (Brennan and Beck, 1955).

Other Utah records. None.

Euschoengastia criceticola Brennan, 1948

Fig. 409

In the specimens from Utah there is considerable variation in the shape of the scutum. This is true for mites taken from the same host.

Distribution. CALIFORNIA: Variety of rodents (Brennan and Jones, 1954; Gould, 1956; Jameson and Brennan, 1957; Loomis and Bunnell, 1962). COLORADO: Variety of rodents (Loomis, 1956; Finley, 1958). IDAHO: *Citellus lateralis* (Brennan, 1948). KANSAS: Variety of rodents (Loomis, 1956). MONTANA: *Peromyscus maniculatus* (Brennan 1948). NEVADA: *Neotoma lepida, Onychomys torridus, Perognathus formosus, Perognathus parvus, P. maniculatus, Sorex tenellus* (Allred, 1962, 1963; Allred and Goates, 1964a, 1964b). UTAH: Box Elder Co.: *P. maniculatus;* Carbon Co.: *P. maniculatus;* Daggett Co.: *P. maniculatus;* Duchesne Co.: *P. maniculatus;* Emery Co.: *P. maniculatus;* Garfield Co.: *P. maniculatus* (Allred, 1954a). Juab Co.: *N. lepida* (Brennan and Beck, 1955). Kane Co.: *P. maniculatus;* Sevier Co.: *P. maniculatus* (Allred, 1954a). Tooele Co.: *Dipodomys microps* (Ho, 1962); *N. lepida, P. formosus* (Woodbury, 1956b), *P. maniculatus* (Brennan and Beck, 1955). *P. truei* (Woodbury 1956b). *Reithrodontomys megalotis* (Ho. 1962). Utah Co.: *D. microps* (Ho, 1962); *Dipodomys ordii* (Brennan and Beck, 1955); *Peromyscus boylii, P. maniculatus* (Allred, 1954a); *R. megalotis* (Elzinga and Rees, 1964). Washington Co.: *N. lepida* (Brennan and Beck, 1955); *Peromyscus eremicus;* Wayne Co.: *P. maniculatus* (Allred, 1954a). WYOMING: Variety of rodents (Loomis, 1956).

Other Utah records. Beaver Co.: *Citellus lateralis*. Duchesne Co.: *C. lateralis*. Grand Co.: *P. maniculatus*. Kane Co.: *N. lepida*. Salt Lake Co.: *Citellus armatus*. San Juan Co.: *P. maniculatus*. Summit Co.: *Ochotona princeps*. Tooele Co.: *Citellus townsendii*. Utah Co.: *O. princeps*. Wasatch Co.: *P. maniculatus*.

Seasonal occurrence. A total of 263 larval *E. criceticola* was collected. Mites were found every month of the year, but were more frequently taken in May, June, August and December.

Comments. Chiggers of *E. criceticola* are distributed over the northern and southern parts of Utah and in the Great and Upper Colorado River basins. They are known from 19 counties of the state.

Peromyscus spp. were the hosts for this chigger in 66% of the samples, and 60% of these were from *P. maniculatus*.

In 24 of its 41 collections, *E. criceticola* was the only mite on its host. In 13 collections it was associated with chigger mites of other species.

Euschoengastia sciuricola (Ewing), 1925

Fig. 422

Distribution. CALIFORNIA: *Citellus beecheyi, Citellus lateralis, Eutamias townsendii, Lepus californicus, Marmota flaviventris,* "mouse," *Peromyscus maniculatus* (Gould 1956; Jameson and Brennan, 1957). IDAHO: ? host, "chipmunk" (Brennan and Beck, 1955; Farrell, 1956). MONTANA: ? host, *Sciurus hudsonicus* (Brennan and Beck, 1955. Gould, 1956). NEW MEXICO: ? host (Brennan and Beck, 1955). UTAH: Cache Co.: *Eutamias umbrinus;* Duchesne Co.: *Tamiasciurus hudsonicus* (Brennan and Beck, 1955). Garfield Co.: *P. maniculatus* (Allred, 1957d). Sanpete Co.: *Citellus*

armatus, C. lateralis; Sevier Co.: *C. lateralis* (Brennan and Beck, 1955). Tooele Co.: *P. maniculatus* (Allred, 1957d); *Reithrodontomys megalotis* (Woodbury, 1956b). Utah Co.: *Citellus variegatus* (Brennan and Beck, 1955).

Other Utah records. Beaver Co.: *C. lateralis, M. flaviventris.* Box Elder Co.: *C. lateralis.* Carbon Co.: *C. lateralis, M. flaviventris.* Duchesne Co.: *Ochotona princeps.* Summit Co.: *Eutamias minimus.* Utah Co.: *C. armatus, E. minimus, O. princeps, P. maniculatus.*

Seasonal occurrence. A total of 209 larval *E. sciuricola* was collected from May through September. Greatest numbers were found in June and July.

Comments. Chiggers of this species are common in northern Utah and in the Great Basin. They are known from 11 counties.

This species is most frequently associated with squirrels of the genus *Spermophilus* (= *Citellus*). Also they are found frequently on other rodents, such as chipmunks, pikas and marmots, which live at high elevations in mountainous areas.

In 11 of 22 collections, *E. sciuricola* was the only mite on its host. In all other collections except one it was associated with chiggers of other species.

TETRANYCHIDAE Donnadieu, 1875

Fig. 598

Mites of this family are important parasites and pests of plants. Their accidental occurrence on mammals in our studies likely resulted from the mammal's close association with plants.

CHEYLETIDAE Leach, 1814

Fig. 598

Mites of this family are predaceous, and likely are associated with the fauna in the nests of small mammals. They were found occasionally in our studies, but unlikely as parasites of the mammals.

TABLE 2. MITE-HOST RELATIONSHIPS IN UTAH.

Hosts indicated with an asterisk are those on which the mite was found most frequently. Where applicable, the percentage of animals infested is designated. Species not marked with an asterisk or percentage seldom were infested, represent previous records from Utah for which the infestation rate is not known, or were taken in insufficient numbers to warrant designation. Names of hosts are as indicated in collection records or literature references. For a revised listing of these, see Table 3.

Androlaelaps leviculus	
Citellus armatus	
Citellus lateralis	
Dipodomys ordii	
°*Onychomys leucogaster*	3%
°*Perognathus apache*	8%
°*Perognathus formosus*	3%
Perognathus parvus	
Peromyscus crinitus	
Peromyscus maniculatus	
Bernia marita	
Perognathus longimembris	
Brevisterna montanus	
Eutamias quadrivittatus	3%
Brevisterna utahensis	
Citellus variegatus	
Dipodomys merriami	
Lepus californicus	
°*Mus musculus*	5%
°*Neotoma cinerea*	12%
°*Neotoma lepida*	11%
Onychomys leucogaster	
Perognathus formosus	
°*Peromyscus boylii*	7%
Peromyscus crinitus	
Peromyscus eremicus	
Peromyscus maniculatus	
Peromyscus truei	
Chatia ochotona	
Neotoma cinerea	
Peromyscus maniculatus	
Chatia setosa	
Ochotona princeps	
Peromyscus maniculatus	
Dermanyssus becki	
Eutamias quadrivittatus	
Lepus californicus	
Marmota flaviventris	
Neotoma albigula	
°*Neotoma lepida*	8%
Peromyscus boylii	
°*Peromyscus crinitus*	5%
Peromyscus eremicus	
Peromyscus maniculatus	
Peromyscus truei	
Dermanyssus gallinae	
Neotoma lepida	
Onychomys leucogaster	

Peromyscus crinitus
Dermanyssus sanguineus
Peromyscus eremicus
Rattus norvegicus
Eubrachylaelaps circularis
Lepus californicus
Neotoma lepida
Perognathus longimembris
Perognathus parvus
°*Peromyscus boylii* 14%
Peromyscus crinitus
Peromyscus eremicus
Peromyscus maniculatus
°*Peromyscus truei* 23%
Sylvilagus audubonii
Eubrachylaelaps crowei
°*Onychomys leucogaster* 9%
Perognathus sp.
Eubrachylaelaps debilis
°*Corynorhinus rafinesque* 6%
Microtus longicaudus
Peromyscus crinitus
Peromyscus eremicus
Peromyscus maniculatus
Peromyscus truei
Reithrodontomys megalotis
Eubrachylaelaps hollisteri
Neotoma lepida
Perognathus parvus
°*Peromyscus crinitus* 6%
Peromyscus eremicus
Peromyscus maniculatus
Peromyscus truei
Eulaelaps stabularis
Citellus armatus
Microtus sp.
Peromyscus maniculatus
Rattus norvegicus
Euschoengastia cordiremus
Citellus lateralis
Perognathus parvus
Peromyscus maniculatus
Euschoengastia criceticola
Citellus armatus
Citellus lateralis
Citellus townsendii
Dipodomys microps
Dipodomys ordii
Neotoma lepida
Ochotona princeps
Perognathus formosus
°*Peromyscus boylii* 7%
Peromyscus eremicus
Peromyscus maniculatus
Peromyscus truei
Reithrodontomys megalotis
Euschoengastia cynomyicola
Citellus spilosoma
Euschoengastia decipiens
Citellus lateralis
Dipodomys merriami
Dipodomys microps
Dipodomys ordii
Erethizon epixanthum
Lepus californicus
Neotoma lepida
Perognathus formosus
°*Perognathus longimembris* 5%
Perognathus parvus
Peromyscus crinitus
Peromyscus eremicus
Peromyscus maniculatus
Peromyscus truei
°*Sylvilagus audubonii* 7%
°*Sylvilagus idahoensis* 12%
°*Sylvilagus nuttallii* 5%
Euschoengastia fasolla
Neotoma lepida
Euschoengastia furmani
Neotoma lepida
Euschoengastia hoffmanni
Citellus lateralis
Ochotona princeps
Euschoengastia lacerta
Citellus lateralis
Neotoma lepida
Euschoengastia lanei
Ochotona princeps
Peromyscus maniculatus
Reithrodontomys megalotis
Euschoengastia lanccolata
Neotoma lepida
Peromyscus eremicus
Euschoengastia luteodema
Citellus lateralis
Marmota flaviventris
Peromyscus maniculatus
Euschoengastia obesa
Peromyscus maniculatus
Euschoengastia oregonensis
Eutamias quadrivittatus
Microtus longicaudus
°*Ochotona princeps* 5%
Perognathus parvus
Peromyscus maniculatus
Sorex obscurus
Euschoengastia pomerantzi
Eutamias umbrinus
Peromyscus maniculatus
Peromyscus truei
Euschoengastia radfordi
Dama hemionus
Dipodomys microps
Dipodomys ordii
Erethizon dorsatum
Lepus californicus
Neotoma lepida
Perognathus formosus
Peromyscus crinitus
Peromyscus eremicus
Peromyscus maniculatus
Reithrodontomys megalotis
°*Sylvilagus idahoensis* 6%
Euschoengastia rotunda
Peromyscus maniculatus
Euschoengastia sciuricola
Citellus armatus
°*Citellus lateralis* 5%
Citellus variegatus
Eutamias minimus
Eutamias umbrinus
Marmota flaviventris
°*Ochotona princeps* 5%
Peromyscus maniculatus
Reithrodontomys megalotis
°*Tamiasciurus hudsonicus* 6%
Euschoengastia soricinus
Ochotona princeps

Euschoengastia utahensis
Neotoma lepida
Perognathus formosus
Galtriepia americana
Eutamias umbrinus
Haemogamasus alaskensis
Blarina brevicauda (probably *Sorex* sp.)
Microtus longicaudus
Ochotona princeps
Peromyscus maniculatus
Zapus princeps
Haemogamasus ambulans
Citellus armatus
Citellus lateralis
Clethrionomys gapperi
Dipodomys ordii
Eutamias umbrinus
Glaucomys sabrinus
Microtus longicaudus
Microtus montanus
Mus musculus
°*Neotoma cinerea* 12%
Neotoma lepida
Ochotona princeps
Onychomys leucogaster
Perognathus parvus
Peromyscus maniculatus
Peromyscus truei
Tamiasciurus hudsonicus
Thomomys bottae
°*Thomomys talpoides* 5%
°*Zapus princeps* 6%
Haemogamasus liponyssoides
Blarina brevicauda (probably *Sorex* sp.)
Microtus longicaudus
Haemogamasus longitarsus
Microtus longicaudus
Peromyscus maniculatus
Thomomys talpoides
Haemogamasus pontiger
Eutamias quadrivittatus
Neotoma lepida
°*Peromyscus boylii* 7%
Peromyscus eremicus
Peromyscus maniculatus
Haemolaelaps casalis
Citellus lateralis
Dipodomys merriami
°*Mus musculus* 5%
Neotoma lepida
°*Peromyscus boylii* 7%
Peromyscus crinitus
Peromyscus maniculatus
Peromyscus truei
Rattus norvegicus
°*Thomomys bottae* 10%
Thomomys talpoides
Haemolaelaps geomys
Onychomys leucogaster
Haemolaelaps glasgowi
°*Citellus armatus* 10%
°*Citellus lateralis* 15%
°*Citellus leucurus* 10%
Citellus richardsonii
Citellus townsendii
Citellus tridecemlineatus
°*Citellus variegatus* 24%
°*Cynomys leucurus* 35%
°*Dipodomys merriami* 10%
Dipodomys microps
Dipodomys ordii
Eutamias minimus
Eutamias quadrivittatus
Lepus californicus
Marmota flaviventris
°*Microtus longicaudus* 12%
Microtus mexicanus
°*Microtus montanus* 19%
Microtus pennsylvanicus
°*Mus musculus* 15%
Neotoma cinerea
°*Neotoma lepida* 10%
Ochotona princeps
°*Onychomys leucogaster* 33%
Onychomys torridus
Perognathus formosus
Perognathus longimembris
Perognathus parvus
Peromyscus boylii
Peromyscus crinitus
Peromyscus eremicus
Peromyscus maniculatus
°*Peromyscus truei* 10%
Rattus norvegicus
Reithrodontomys megalotis
Sylvilagus audubonii
Tamiasciurus hudsonicus
Thomomys bottae
Thomomys talpoides
Zapus princeps
Hirstionyssus affinis
Eutamias minimus
Perognathus formosus
Peromyscus truei
Hirstionyssus bisetosus
Neotoma lepida
Hirstionyssus femuralis
Citellus armatus
°*Mustela frenata* 10%
Neotoma lepida
Peromyscus eremicus
°*Thomomys bottae* 7%
Thomomys talpoides
Hirstionyssus geomydis
Neotoma lepida
Hirstionyssus hilli
Dipodomys ordii
Neotoma lepida
Onychomys leucogaster
Perognathus flavus
Perognathus longimembris
Perognathus parvus
Peromyscus eremicus
Peromyscus maniculatus
Hirstionyssus incomptus
Citellus variegatus
Citellus leucurus
Dipodomys merriami
°*Dipodomys microps* 6%
°*Dipodomys ordii* 9%
Microtus longicaudus
Neotoma lepida
Perognathus longimembris
Perognathus parvus
Peromyscus crinitus
Peromyscus eremicus
Peromyscus maniculatus
Rattus norvegicus

Reithrodontomys megalotis
Hirstionyssus isabellinus
Citellus armatus
Eutamias quadrivittatus
°*Microtus longicaudus* 4%
°*Microtus montanus* 6%
Microtus pennsylvanicus
Ochotona princeps
Onychomys torridus
Peromyscus maniculatus
Phenacomys intermedius
Reithrodontomys megalotis
Thomomys talpoides
Hirstionyssus neotomae
Dipodomys ordii
°*Neotoma cinerea* 6%
Neotoma lepida
Perognathus parvus
Peromyscus maniculatus
°*Peromyscus truei* 4%
Thomomys talpoides
*Hirstionyssus stafford*i:
Spilogale gracilis 10%
Hirstionyssus triacanthus
Citellus leucurus
Dipodomys merriami
°*Dipodomys microps* 10%
°*Dipodomys ordii* 6%
Lepus californicus
Neotoma lepida
Perognathus formosus
Perognathus longimembris
Peromyscus crinitus
Peromyscus eremicus
Peromyscus maniculatus
Rattus norvegicus
Reithrodontomys megalotis
Hirstionyssus thomomys
Thomomys talpoides 3%
Hirstionyssus longichelae
°*Thomomys talpoides* 3%
Ochotona princeps
Hirstionyssus punctatus
Eutamias minimus
Eutamias quadrivittatus
Glaucomys sabrinus
Peromyscus maniculatus
Hirstionyssus tarsalis
Peromyscus maniculatus
Hirstionyssus torus
Sciurus aberti
Hirstionyssus palustris
Sorex palustris
Hirstionyssus angustus
Citellus armatus
Hirstionyssus eutamiae
°*Eutamias quadrivittatus* 3%
Reithrodontomys megalotis
Hirstionyssus utahensis
Citellus armatus
Citellus lateralis
Citellus tridecemlineatus
Dipodomys ordii
°*Eutamias minimus* 5%
°*Eutamias quadrivittatus* 12%
Neotoma lepida
Perognathus longimembris
Peromyscus crinitus
Peromyscus maniculatus
Peromyscus truei
Reithrodontomys megalotis
Thomomys talpoides
Hirstionyssus invaginatus
°*Citellus armatus* 6%
°*Mus musculus* 5%
Thomomys talpoides
Hypoaspis gurabensis
Peromyscus maniculatus
Thomomys talpoides
Hypoaspis lubrica
Citellus lateralis
Citellus spilosoma
Peromyscus maniculatus
Rattus norvegicus
Thomomys bottae
Ichoronyssus robustipes
Tadarida mexicana
Ischyropoda armatus
Citellus variegatus
Dipodomys merriami
°*Dipodomys microps* 7%
Dipodomys ordii
Erethizon epixanthum
Lepus californicus
Myotis californicus
°*Onychomys leucogaster* 27%
Onychomys torridus
Perognathus flavus
°*Perognathus formosus* 5%
Perognathus longimembris
Perognathus parvus
Peromyscus maniculatus
Peromyscus truei
Ischyropoda furmani
Dipodomys ordii
Microdipodops megacephalus
Neotoma lepida
Onychomys leucogaster
Perognathus longimembris
Peromyscus maniculatus
Kleemania sp.
Citellus lateralis
Dipodomys microps
Dipodomys ordii
Eutamias minimus
°*Onychomys leucogaster* 9%
Perognathus formosus
Perognathus longimembris
Perognathus parvus
Peromyscus crinitus
Peromyscus maniculatus
Laelaps kochi
Dipodomys ordii
Eutamias minimus
Eutamias quadrivittatus
°*Microtus longicaudus* 6%
°*Microtus montanus* 13%
Microtus pennsylvanicus
Phenacomys intermedius
Laelaps multispinosus
Ondatra zibethicus
Peromyscus maniculatus
*Laelaps nuttalli*i
Peromyscus maniculatus
Laelaps incilis
Eutamias quadrivittatus
Microtus longicaudus
Microtus montanus

Peromyscus maniculatus
Leewenhoekia americana
Blarina sp. (probably *Sorex* sp.)
Peromyscus maniculatus
Scapanus sp. (probably *Sorex* sp.)
Listrophorus sp.
Dipodomys ordii
Perognathus formosus
Perognathus longimembris
Peromyscus maniculatus
Macrocheles sp.
Citellus armatus
Dipodomys ordii
Marmota flaviventris
°*Mus musculus* 5%
Onychomys torridus
Perognathus longimembris
Peromyscus maniculatus
Reithrodontomys megalotis
Thomomys bottae
Thomomys talpoides
Zapus princeps
Myobia sp.
Neotoma lepida
Myocoptes sp.
Peromyscus maniculatus
Reithrodontomys megalotis
Myonyssus montanus
Ochotona princeps
Odontacarus hirsutus
°*Mus musculus* 5%
°*Neotoma cinerea* 6%
Neotoma lepida
Odontacarus linsdalei
Dipodomys microps
Dipodomys ordii
Neotoma lepida
Perognathus formosus
Perognathus parvus
Peromyscus maniculatus
Odontacarus micheneri
Neotoma cinerea
°*Neotoma lepida* 7%
Onychomys torridus
Perognathus parvus
Sylvilagus sp.
Ornithonyssus aridus
Citellus leucurus
Ornithonyssus bacoti
Citellus townsendii
Dipodomys ordii
Eutamias minimus
Neotoma lepida
Perognathus parvus
Peromyscus boylii
Peromyscus crinitus
Peromyscus cremicus
Peromyscus maniculatus
°*Peromyscus truei* 10%
Rattus norvegicus
Ornithonyssus sylviarum
Marmota flaviventris
°*Sylvilagus nuttallii* 5%
Paraspinturnix globosus
Myotis sp.
Radfordia bachai
Dipodomys ordii
Radfordia lemnina
Peromyscus maniculatus
Radfordia subuliger
Peromyscus maniculatus
Reithrodontomys megalotis
Spinturnix orri
Antrozous pallidus
Steatonyssus antrozoi
Corynorhinus rafinesquii 6%
Trombicula allredi
Neotoma lepida
Trombicula arenicola
Citellus leucurus
Citellus spilosoma
Cynomys parvidens
Dipodomys merriami
°*Dipodomys microps* 5%
Dipodomys ordii
Neotoma lepida
°*Perognathus formosus* 20%
Perognathus longimembris
Perognathus parvus
Peromyscus maniculatus
Peromyscus truei
Reithrodontomys megalotis
Trombicula bakeri
Citellus armatus
Dipodomys ordii
Peromyscus maniculatus
Trombicula belkini
Citellus lateralis
Citellus leucurus
Clethrionomys gapperi
Dipodomys ordii
Peromyscus truei
Trombicula californica
Citellus armatus
Clethrionomys gapperi
Microtus longicaudus
Peromyscus maniculatus
Zapus princeps
Trombicula doremi
Perognathus longimembris
Dipodomys merriami
Dipodomys ordii
Trombicula esoensis
Peromyscus maniculatus
Trombicula harperi
Citellus armatus
Citellus lateralis
°*Clethrionomys gapperi* 6%
Eutamias minimus
Human
Marmota flaviventris
°*Microtus longicaudus* 5%
Microtus montanus
Neotoma lepida
°*Ochotona princeps* 26%
Onychomys leucogaster
Perognathus parvus
Peromyscus maniculatus
°*Zapus princeps* 6%
Trombicula hoplai
Citellus leucurus
Neotoma lepida
Perognathus apache
Perognathus parvus
Peromyscus truei
Trombicula jewetti
Peromyscus maniculatus
Trombicula kardosi

Eutamias umbrinus
Trombicula montanensis
Citellus lateralis
Cynomys leucurus
Peromyscus crinitus
Peromyscus truei
Peromyscus maniculatus
Trombicula myotis
Bat
Myotis californicus
Peromyscus maniculatus
Trombicula panamensis
Neotoma lepida
Peromyscus maniculatus
Trombicula potosina
Perognathus parvus
Neotoma lepida
Microtus longicaudus
Trombicula sargenti
Neotoma lepida
Trombicula subsignata
Reithrodontomys megalotis
Trombicula univari
Pipistrellus hesperus
Whartonia perplexa
Antrozous pallidus
Myotis californicus
Zumptiella bakeri
Citellus armatus
Eutamias quadrivittatus

TABLE 3. HOST-MITE RELATIONSHIPS IN UTAH.

Mites indicated with an asterisk are those which were found most frequently on the host. Where applicable, the order of those so marked is designated, number one being most common. Species not marked with an asterisk occurred about equally or with insufficient frequency on the host to warrant frequency designation. Names of hosts enclosed within parentheses are as designated by Hall and Kelson (1959).

Antrozous pallidus
Spinturnix orri
Whartonia perplexa
Bat
Trombicula myotis
Whartonia perplexa
Citellus armatus (= *Spermophilus armatus*)
Androlaelaps leviculus
Eulaelaps stabularis
Euschoengastia ericeticola
Euschoengastia sciuricola
Haemogamasus ambulans
°*Haemolaelaps glasgowi* 1
Hirstionyssus angustus
Hirstionyssus femuralis
°*Hirstionyssus invaginatus* 2
Hirstionyssus isabellinus
Hirstionyssus utahensis
Macrocheles sp.
Trombicula bakeri
Trombicula californica
Trombicula harperi
Zumptiella bakeri
Citellus lateralis (=*Spermophilus lateralis*)
Androlaelaps leviculus
Euschoengastia cordirenus
Euschoengastia ericeticola
Euschoengastia decipiens
Euschoengastia hoffmanni
Euschoengastia lacerta
Euschoengastia lutcodema
Euschoengastia sciuricola
Haemogamasus ambulans
Haemolaelaps casalis
°*Haemolaelaps glasgowi*
Hirstionyssus utahensis
Hypoaspis lubrica
Kleemania sp.
Trombicula belkini
Trombicula harperi
Trombicula montanensis
Citellus leucurus (=*Ammospermophilus leucurus*)
°*Haemolaelaps glasgowi*
Hirstionyssus incomptus
Hirstionyssus triacanthus
Ornithonyssus aridus
Trombicula arenicola
Trombicula belkini
Trombicula hoplai
Citellus richardsonii (=*Spermophilus richardsonii*)
Haemolaelaps glasgowi
Citellus spilosoma (=*Spermophilus spilosoma*)
Euschoengastia cynomyicola
Hypoaspis lubrica
Trombicula arenicola
Citellus townsendii (=*Spermophilus townsendii*)
Euschoengastia ericeticola
Haemolaelaps glasgowi
Ornithonyssus bacoti
Citellus tridecemlineatus (=*Spermophilus tridecemlineatus*)
°*Haemolaelaps glasgowi*
Hirstionyssus utahensis
Citellus variegatus (=*Spermophilus variegatus*)
Brevisterna utahensis
Euschoengastia sciuricola
°*Haemolaelaps glasgowi*
Hirstionyssus incomptus
Ischyropoda armatus
Clethrionomys gapperi
Haemogamasus ambulans
Trombicula belkini
Trombicula californica
Trombicula harperi
Corynorhinus rafinesquii (=*Corynorhinus townsendii*)
Eubrachylaelaps debilis
Steatonyssus antrozoi
Cynomys parvidens
Trombicula arenicola
Cynomys leucurus
°*Haemolaelaps glasgowi*
Trombicula montanensis
Dama hemionus
Euschoengastia radfordi
Dipodomys merriami

Brevisterna utahensis
Euschoengastia decipiens
Haemolaelaps casalis
°*Haemolaelaps glasgowi*
Hirstionyssus incomptus
Hirstionyssus triacanthus
Ischyropoda armatus
Trombicula arenicola
Trombicula doremi

Dipodomys microps
Euschoengastia cricetícola
Euschoengastia decipiens
Euschoengastia radfordi
Haemolaelaps glasgowi
Hirstionyssus incomptus
°*Hirstionyssus triacanthus*
Ischyropoda armatus
Kleemania sp.
Odontacarus linsdalei
Trombicula arenicola

Dipodomys ordii
Androlaelaps leviculus
Euschoengastia cricetícola
Euschoengastia decipiens
Euschoengastia radfordi
Haemogamasus ambulans
°*Haemolaelaps glasgowi* 2
Hirstionyssus hilli
°*Hirstionyssus incomptus* 1
Hirstionyssus neotomae
°*Hirstionyssus triacanthus* 3
Hirstionyssus utahensis
Ischyropoda armatus
Ischyropoda furmani
Kleemania sp.
Laelaps kochi
Listrophorus sp.
Macrocheles sp.
Odontacarus linsdalei
Ornithonyssus bacoti
Radfordia bachai
Trombicula arenicola
Trombicula bakeri
Trombicula belkini
Trombicula doremi

Erethizon epixanthum (= *Erethizon dorsatum*)
Euschoengastia decipiens
Euschoengastia radfordi
Ischyropoda armatus

Eutamias dorsalis
Hirstionyssus sp.

Eutamias minimus
Euschoengastia sciuricola
Haemolaelaps glasgowi
Hirstionyssus affinis
Hirstionyssus punctatus
Hirstionyssus utahensis
Kleemania sp.
Laelaps kochi
Ornithonyssus bacoti
Trombicula harperi

Eutamias quadrivittatus
Brevisterna montanus
Dermanyssus becki
Euschoengastia oregonensis
Haemogamasus pontiger
Haemolaelaps glasgowi
Hirstionyssus eutamiae
Hirstionyssus isabellinus
Hirstionyssus punctatus
°*Hirstionyssus utahensis*
Laelaps kochi
Laelaps incilis
Zumptiella bakeri

Eutamias umbrinus
Euschoengastia pomerantzi
Euschoengastia sciuricola
Gahrliepia americana
Haemogamasus ambulans
Trombicula kardosi

Glaucomys sabrinus
Haemogamasus ambulans
Hirstionyssus punctatus

Human
Trombicula harperi

Lepus californicus
Brevisterna utahensis
Dermanyssus becki
Eubrachylaelaps circularis
°*Euschoengastia decipiens*
Euschoengastia radfordi
Haemolaelaps glasgowi
Hirstionyssus triacanthus
Ischyropoda armatus

Marmota flaviventris
Dermanyssus becki
Euschoengastia hitcodema
Euschoengastia sciuricola
Haemolaelaps glasgowi
Macrocheles sp.
Ornithonyssus sylviarum
Trombicula harperi

Microdipodops megacephalus
Ischyropoda furmani

Microtus longicaudus
Eubrachylaelaps debilis
Euschoengastia oregonensis
Haemogamasus alaskensis
Haemogamasus ambulans
Haemogamasus liponyssoides
Haemogamasus longitarsus
Haemolaelaps glasgowi
Hirstionyssus incomptus
Hirstionyssus isabellinus
Laelaps kochi
Laelaps incilis
Trombicula californica
Trombicula harperi
Trombicula potosina

Microtus mexicanus
Haemolaelaps glasgowi

Microtus montanus
Haemogamasus ambulans
°*Haemolaelaps glasgowi* 1
Hirstionyssus isabellinus
°*Laelaps kochi* 2
Laelaps incilis
Trombicula harperi

Microtus pennsylvanicus
Haemolaelaps glasgowi
Hirstionyssus isabellinus
Laelaps kochi

Microtus sp.
Eulaelaps stabularis
Euschoengastia oregonensis
Haemogamasus ambulans
Haemogamasus liponyssoides
°*Haemolaelaps glasgowi*

Hirstionyssus isabellinus
Laelaps kochi
Laelaps incilis
Trombicula harperi
Mus musculus
Brevisterna utahensis
Haemogamasus ambulans
Haemolaelaps casalis
Haemolaelaps glasgowi
Hirstionyssus sp.
Hirstionyssus invaginatus
Macrocheles sp.
Odontacarus hirsutus
Mustela frenata
Hirstionyssus femuralis
Myotis californicus
Ischyropoda armatus
Trombicula myotis
Whartonia perplexa
Myotis sp.
Paraspinturnix globosus
Trombicula myotis
Neotoma albigula
Dermanyssus hecki
Neotoma cinerea
Brevisterna utahensis
Chatia ochotona
Haemogamasus ambulans
Haemolaelaps glasgowi
Hirstionyssus neotomae
Odontacarus hirsutus
Odontacarus linsdalei
Neotoma lepida
°*Brevisterna utahensis* 1
°*Dermanyssus hecki* 2
Eubrachylaelaps circularis
Eubrachylaelaps hollisteri
Euschoengastia cricetícola
Euschoengastia decipiens
Euschoengastia fasolla
Euschoengastia furmani
Euschoengastia lacerta
Euschoengastia lanceolata
Euschoengastia radfordi
Euchoengastia utahensis
Haemogamasus ambulans
Haemogamasus pontiger
Haemolaelaps casalis
Haemolaelaps glasgowi
Hirstionyssus bisetosus
Hirstionyssus femuralis
Hirstionyssus geomydis
Hirstionyssus hilli
Hirstionyssus incomptus
Hirstionyssus neotomae
Hirstionyssus triacanthus
Hirstionyssus utahensis
Ischyropoda furmani
Myobia sp.
Odontacarus hirsutus
Odontacarus linsdalei
°*Odontacarus micheneri* 3
Ornithonyssus bacoti
Trombicula allredi
Trombicula arenicola
Trombicula harperi
Trombicula hoplai
Trombicula panamensis
Trombicula potosina
Trombicula sargenti
Ochotona princeps
Chatia setosa
Euschoengastia cricetícola
Euschoengastia hoffmannae
Euschoengastia lanei
Euschoengastia oregonensis
Euschoengastia sciuricola
Euschoengastia soricinus
Haemogamasus alaskensis
Haemogamasus ambulans
Haemolaelaps glasgowi
Hirstionyssus isabellinus
Hirstionyssus longichelae
Myonyssus montanus
°*Trombicula harperi*
Ondatra zibethicus
Laelaps multispinosus
Onychomys leucogaster
Androlaelaps leviculus
Eubrachylaelaps crowei
Haemogamasus ambulans
Haemolaelaps geomys
°*Haemolaelaps glasgowi* 1
Hirstionyssus hilli
°*Ischyropoda armatus* 2
Ischyropoda furmani
Kleemania sp.
Trombicula harperi
Onychomys torridus
Haemolaelaps glasgowi
Hirstionyssus isabellinus
Ischyropoda armatus
Macrocheles sp.
Odontacarus micheneri
Perognathus apache
Androlaelaps leviculus
Trombicula hoplai
Perognathus flavus
Hirstionyssus hilli
Ischyropoda armatus
Perognathus formosus
Androlaelaps leviculus
Brevisterna utahensis
Euschoengastia decipiens
Euschoengastia cricetícola
Euschoengastia utahensis
Haemolaelaps glasgowi
Hirstionyssus affinis
Hirstionyssus triacanthus
Ischyropoda armatus
Kleemania sp.
Listrophorus sp.
Odontacarus linsdalei
°*Trombicula arenicola*
Perognathus longimembris
Bernia marita
Eubrachylaelaps circularis
Euschoengastia decipiens
Haemolaelaps glasgowi
Hirstionyssus hilli
Hirstionyssus incomptus
Hirstionyssus triacanthus
Hirstionyssus utahensis
Ischyropoda armatus
Ischyropoda furmani
Kleemania sp.
Listrophorus sp.
Macrocheles sp.

Trombicula arenicola
Trombicula doremi
Perognathus parvus
Androlaelaps leviculus
Eubrachylaelaps circularis
Eubrachylaelaps hollisteri
Euschoengastia cordiremus
Euschoengastia decipiens
Euschoengastia oregonensis
Haemogamasus ambulans
°*Haemolaelaps glasgowi*
Hirstionyssus hilli
Hirstionyssus incomptus
Hirstionyssus neotomae
Ischyropoda armatus
Kleemania sp.
Odontacarus linsdalei
Odontacarus micheneri
Ornithonyssus bacoti
Trombicula arenicola
Trombicula harperi
Trombicula hoplai
Trombicula potosina
Perognathus sp.
Eubrachylaelaps crowei
Ischyropoda furmani
Trombicula doremi
Peromyscus boylii
Brevisterna utahensis
Dermanyssus becki
Eubrachylaelaps circularis
Euschoengastia ericeticola
Haemogamasus pontiger
Haemolaelaps casalis
Haemolaelaps glasgowi
Ornithonyssus bacoti
Peromyscus crinitus
Androlaelaps leviculus
Brevisterna utahensis
Dermanyssus becki
Eubrachylaelaps circularis
Eubrachylaelaps debilis
°*Eubrachylaelaps hollisteri*
Euschoengastia decipiens
Euschoengastia radfordi
Haemolaelaps casalis
Haemolaelaps glasgowi
Hirstionyssus incomptus
Hirstionyssus triacanthus
Hirstionyssus utahensis
Kleemania sp.
Ornithonyssus bacoti
Trombicula montanensis
Peromyscus eremicus
Brevistrena utahensis
Dermanyssus becki
Eubrachylaelaps circularis
Eubrachylaelaps debilis
Eubrachylaelaps hollisteri
Euschoengastia ericeticola
Euschoengastia decipiens
Euschoengastia lanceolata
Euschoengastia radfordi
Haemogamasus pontiger
Haemolaelaps glasgowi
Hirstionyssus femuralis
Hirstionyssus hilli
Hirstionyssus incomptus
Hirstionyssus triacanthus
Ornithonyssus bacoti
Peromyscus maniculatus
Androlaelaps leviculus
Brevisterna utahensis
Chatia ochotona
Chatia sctosa
Dermanyssus becki
°*Eubrachylaelaps circularis* 2
Eubrachylaelaps debilis
Eubrachylaelaps hollisteri
Eulaelaps stabularis
Euschoengastia cordiremus
°*Euschoengastia ericeticola* 2
Euschoengastia decipiens
Euschoengastia lanei
Euschoengastia luteodema
Euschoengastia obesa
Euschoengastia oregonensis
Euschoengastia pomerantzi
Euschoengastia radfordi
Euschoengastia rotunda
Euschoengastia sciuricola
Haemogamasus alaskensis
Haemogamasus ambulans
Haemogamasus longitarsus
Haemogamasus pontiger
Haemolaelaps casalis
°*Haemolaelaps glasgowi* 1
Hirstionyssus hilli
Hirstionyssus incomptus
Hirstionyssus isabellinus
Hirstionyssus neotomae
Hirstionyssus punctatus
Hirstionyssus tarsalis
Hirstionyssus triacanthus
°*Hirstionyssus utahensis* 2
Hypoaspis gurabensis
Hypoaspis lubrica
Ischyropoda armatus
Ischyropoda furmani
Kleemania sp.
Laelaps multispinosus
Laelaps nuttallii
Laelaps incilis
Leeuwenhoekia americana
Listrophorus sp.
Macrocheles sp.
Myocoptes sp.
Odontacarus linsdalei
°*Ornithonyssus bacoti* 3
Radfordia lemnina
Radfordia subuliger
Trombicula arenicola
Trombicula bakeri
Trombicula californica
Trombicula esoensis
Trombicula harperi
Trombicula jewetti
Trombicula montanensis
Trombicula myotis
Trombicula panamensis
Peromyscus truei
Brevisterna utahensis
Dermanyssus becki
°*Eubrachylaelaps circularis* 1
Eubrachylaelaps debilis
Eubrachylaelaps hollisteri
Euschoengastia ericeticola
Euschoengastia decipiens

Euschoengastia pomerantzi
Haemogamasus ambulans
Haemolaelaps casalis
°*Haemolaelaps glasgowi* 2
Hirstionyssus affinis
Hirstionyssus neotomae
Hirstionyssus utahensis
Ischyropoda armatus
°*Ornithonyssus bacoti* 2
Trombicula arenicola
Trombicula belkini
Trombicula hoplai
Trombicula montanensis
Peromyscus sp.
Haemogamasus alaskensis
Phenacomys intermedius
Hirstionyssus isabellinus
Laelaps kochi
Pipistrellus hesperus
Trombicula univari
Rattus norvegicus
Eulaelaps stabularis
Haemolaelaps casalis
°*Haemolaelaps glasgowi*
Hirstionyssus incomptus
Hirstionyssus triacanthus
Hypoaspis lubrica
°*Onithonyssus bacoti*
Reithrodontomys megalotis
Eubrachylaelaps debilis
Euschoengastia cricetícola
Euschoengastia lanei
Euschoengastia radfordi
Euschoengastia sciuricola
°*Haemolaelaps glasgowi*
Hirstionyssus cutamiae
Hirstionyssus incomptus
Hirstionyssus isabellinus
Hirstionyssus triacanthus
Hirstionyssus utahensis
Macrocheles sp.
Myocoptes sp.
Radfordia subuliger
Trombicula arenicola
Trombicula subsignata
Sciurus aberti
Hirstionyssus torus
Sorex obscurus (=*Sorex vagrans*)
Euschoengastia oregonensis
Sorex palustris
Hirstionyssus palustris
Spilogale gracilis
Hirstionyssus staffordi
Sylvilagus audubonii
Eubrachylaelaps circularis
Euschoengastia decipiens
Haemolaelaps glasgowi
Sylvilagus idahoensis
Euschoengastia decipiens
Euschoengastia radfordi
Sylvilagus nuttallii
Euschoengastia decipiens
Ornithonyssus sylviarum
Sylvilagus sp.
Odontacarus micheneri
Tamiasciurus hudsonicus
Euschoengastia sciuricola
Haemogamasus ambulans
Haemolaelaps glasgowi
Thomomys bottae (=*Thomomys umbrinus*)
Haemogamasus ambulans
°*Haemolaelaps casalis*
Haemolaelaps glasgowi
°*Hirstionyssus femuralis*
Hypoaspis lubrica
Macrocheles sp.
Thomomys talpoides
°*Haemogamasus ambulans*
Haemogamasus longitarsus
Haemolaelaps casalis
Haemolaelaps glasgowi
Hirstionyssus femuralis
Hirstionyssus invaginatus
Hirstionyssus isabellinus
°*Hirstionyssus longichelae*
Hirstionyssus neotomae
Hirstionyssus thomomys
Hirstionyssus utahensis
Hypoaspis gurabensis
Macrocheles sp.
Zapus princeps
Haemogamasus alaskensis
°*Haemogamasus ambulans*
Haemolaelaps glasgowi
Macrocheles sp.
Trombicula californica
°*Trombicula harperi*

DISCUSSION

More than 9,000 small mammals representing 94 species of 51 genera were examined for ectoparasites. Approximately 13,000 mites were found on 4,015 of those examined. These, plus other previously listed records for Utah, represent 111 species of 34 genera of mites which include 12 new species in three genera, one genus being new.

During the sixteen-year period covered by this report, numerous individuals were involved with the collection of specimens. Even though standardized techniques were used, there likely was considerable variation in the efficiency of ectoparasite retrieval. Consequently, the incidence of ectoparasites as shown in Table I is relative only to the efficiency of our techniques. Hosts were collected by different methods, e.g., live-trapping, shooting, etc. and in almost all cases were examined in the field under varying conditions of weather, pressure of time, and lack of adequate facilities. It is likely that some ectoparasites were lost or overlooked, particularly those

requiring special techniques for their recovery. Nevertheless, over a period of years involving large numbers of specimens, we expect that each of the mite taxa would have been taken at least once.

The validity of host identification may be questionable in some instances, although for the most part identifications were made by a qualified mammalogist in the field, or representative specimens were returned to the reference museum at Brigham Young University for comparison and verification.

As shown in the listing of mite-host relationships (Table 2), the variety of hosts from which mites of a particular species were recovered may be correlated with the numbers of animals examined. For example, we examined more mice belonging to *Peromyscus maniculatus* than of any other species, and mites of more species were found on this mouse than on any other mammal studied. We assume that mites of almost any species occasionally are accidental symbionts of host animals living in the same habitat. Examination of large numbers of hosts increases the potential of finding such infestations. There is a tendency for host preference, and perhaps even for host specificity in some cases, whereas mites of some species are widely distributed geographically and occur on a variety of animals. For example, *Haemolaelaps glasgowi* is a widely distributed species and occurs on the greatest variety of mammals in Utah. This distribution and host relationship apparently is typical for this most cosmopolitan species.

Other surveys may reveal a frequency of occurrence of mites of a particular species different from that indicated by us (Table 3). We assume that mites of all species normally associated with a particular host have an equal opportunity of infesting that host, but the seasonal activity of different species may vary. Mites of one species may be more common on a host in summer, whereas those of another species may be more common in winter. In our field activities we collected the year round, but most mammals were taken in late spring, summer and early autumn.

Even though our data on mite-host relationships, relative abundance, frequency of occurrence and seasonal and geographic distribution may vary from other surveys, the information presented here should serve as a basis for further studies directed at specific localities or species. More work needs to be done on mammals that have been taken only in few numbers or only at certain times of the year.

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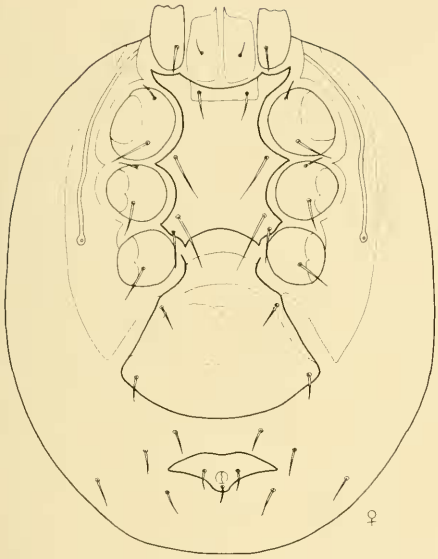
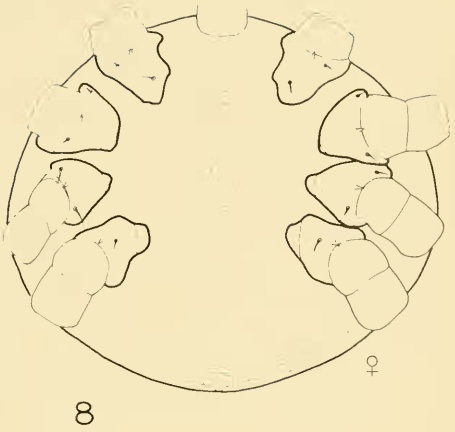
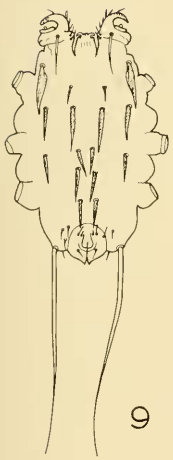
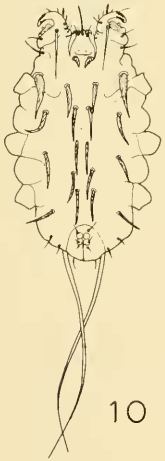
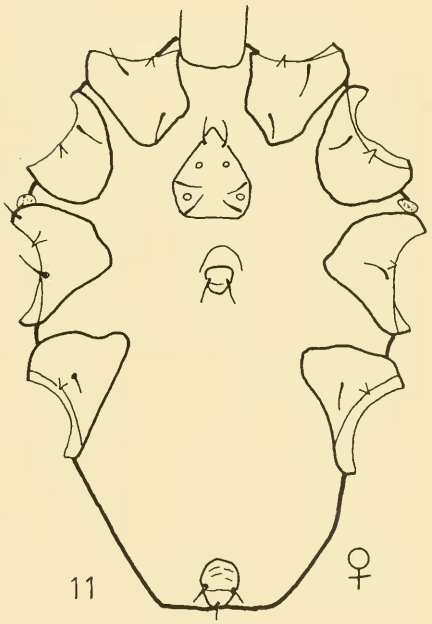


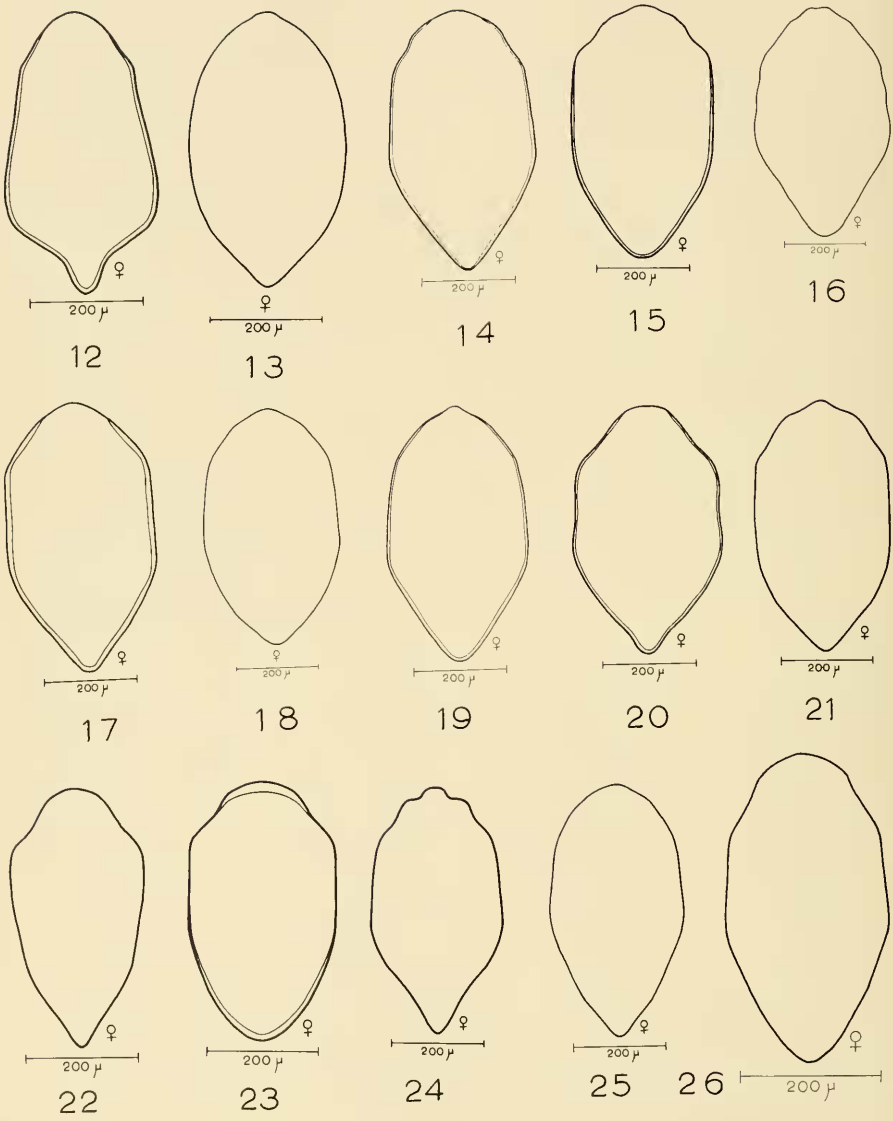




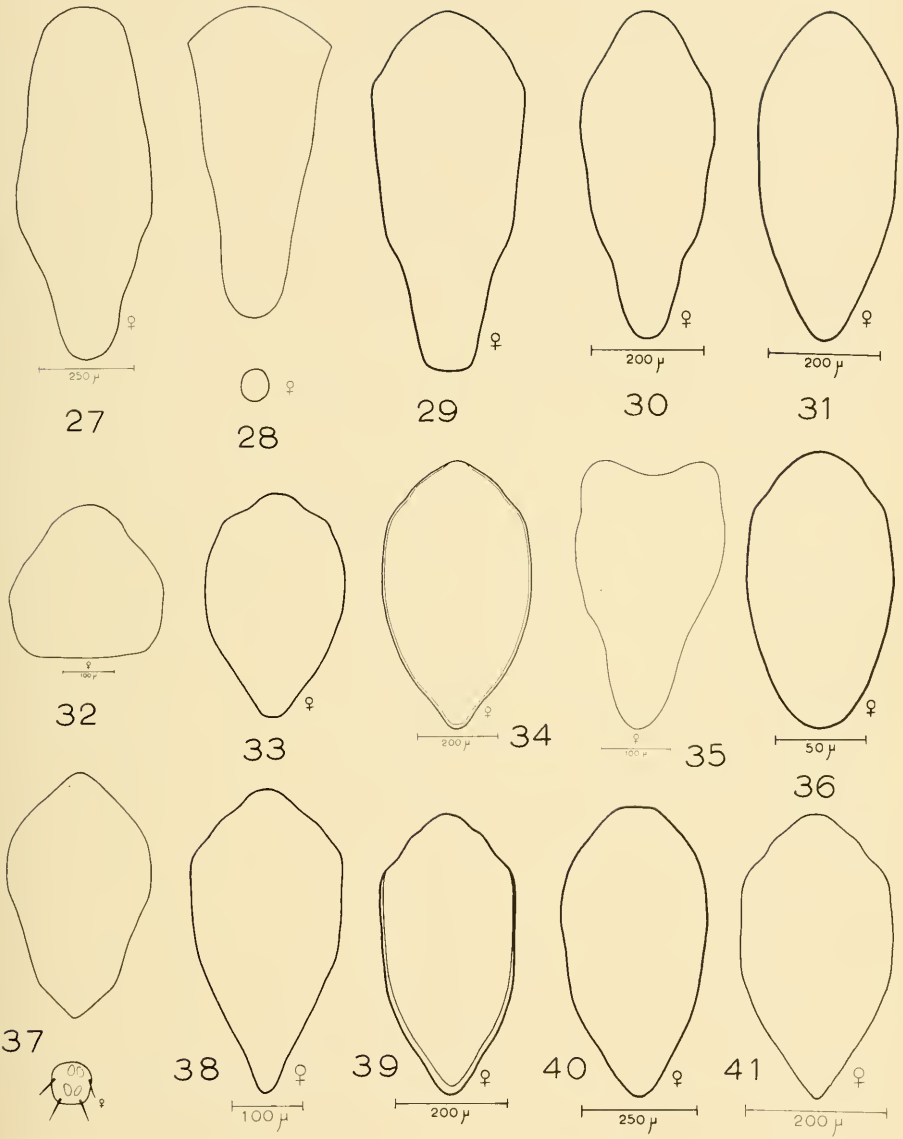




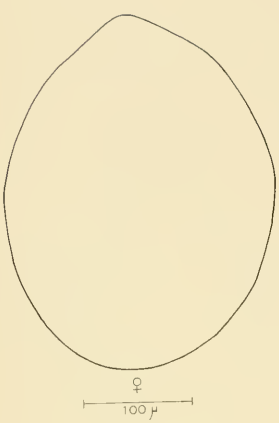
Figs. 7-11. 7, Pachylaelaptidae ventral; 8, *Paraspinturnix globus* ventral; 9, *Radfordia subliger* dorsal; 10, *Radfordia lemnina* dorsal; 11, *Spinturnix orri,* ventral.



Figs. 12-26. Dorsal plates of *Hirstionyssus*. 12, *staffordi*; 13, *tarsalis*; 14, *affinis*; 15, *palustris*; 16, *punctatus*; 17, *invaginatus*; 18, *invaginatus* variant; 19, *eutamiae*; 20, *utahensis*; 21, *angustus*; 22, *femuralis*; 23, *longichelae*; 24, *thomomys*; 25, *torus*; 26, *neotomae*.



Figs. 27-41. Dorsal plates. 27, *Dermanyssus becki;* 28, *D. sanguineus;* 29, *D. gallinae;* 30, *Ornithonyssus sylviarum;* 31, *O. sylviarum* variant; 32, *Steatonyssus antrozoi* anterior plate; 33, *Hirstionyssus hilli;* 34, *H. isabellinus;* 35, *S. antrozoi* posterior plate; 36, *H. bisetosus;* 37, *O. aridus;* 38, *H. triacanthus;* 39, *H. incomptus;* 40, *Ichoronyssus robustipes;* 41, *H. hilli* variant.



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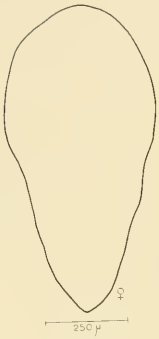

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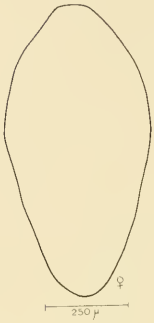

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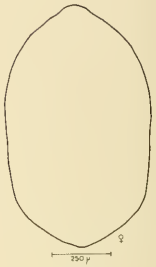

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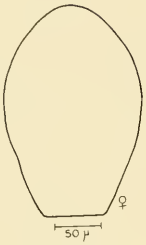

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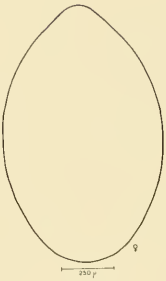

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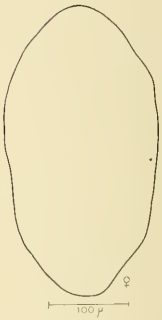

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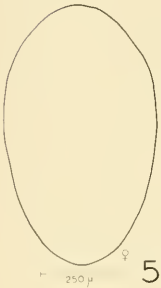

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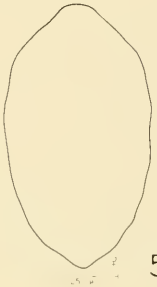

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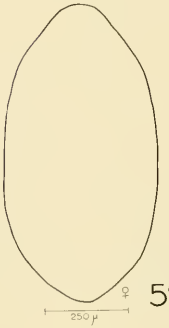

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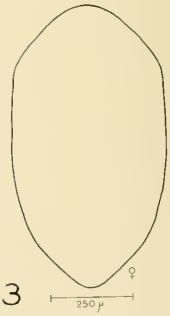

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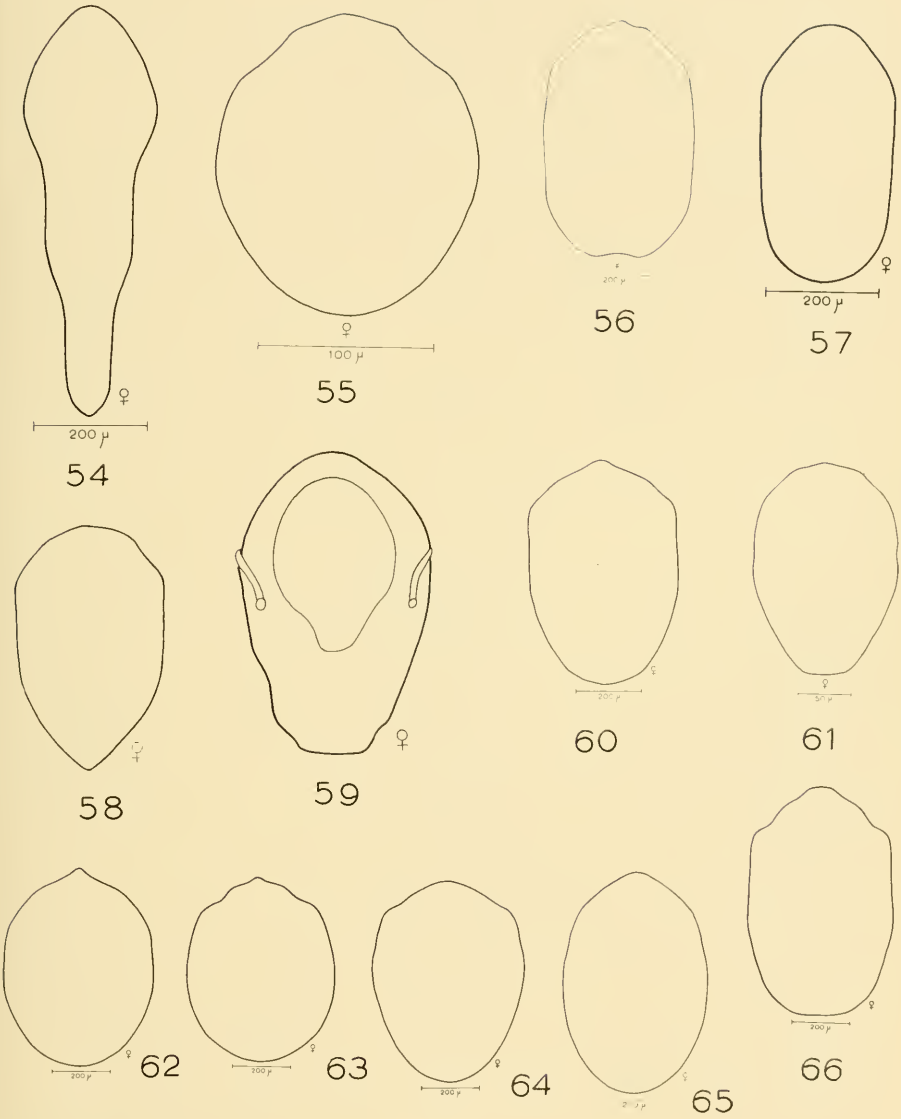
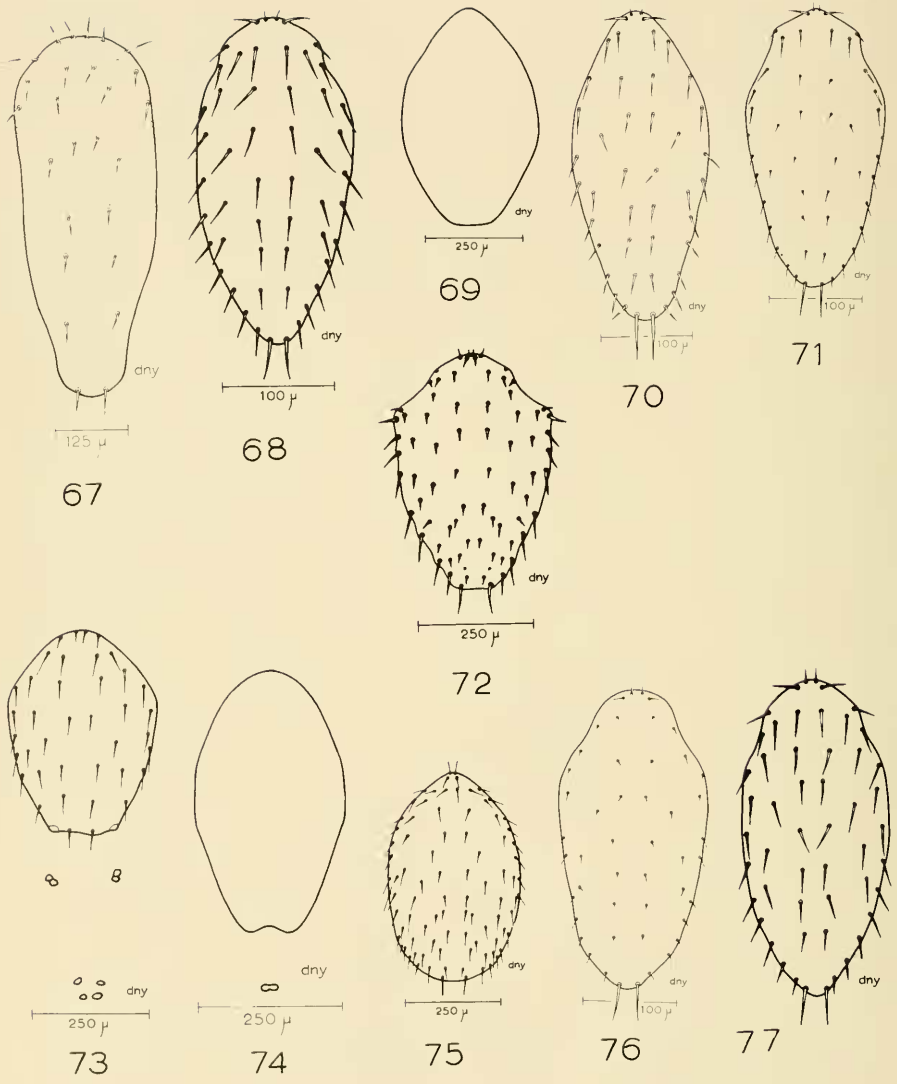
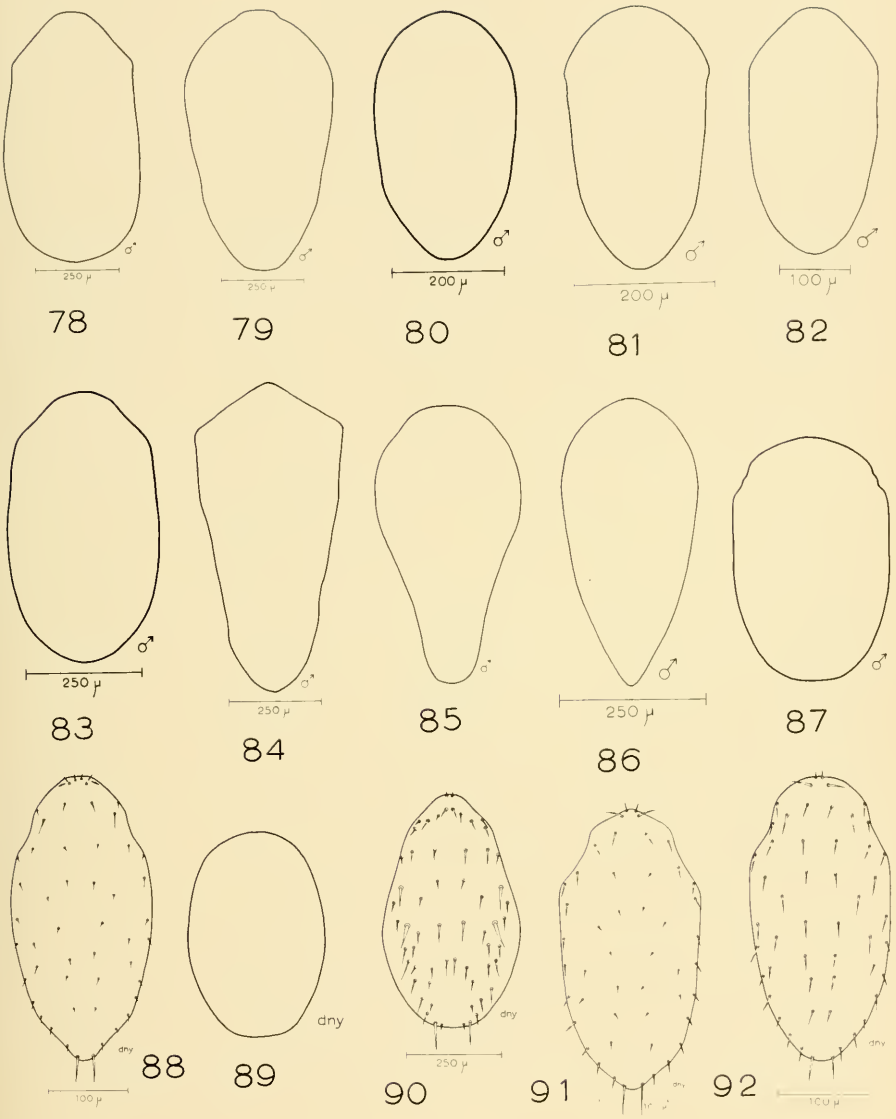
Figs. 42-53. Dorsal plates. 42, *Ischyropoda armatus;* 43, *Brevisterna montanus;* 44, *B. utahensis;* 45, *Haemogamasus alaskensis;* 46, *Zumpticlla bakeri;* 47, *I. furmani;* 48, *H. liponyssoides;* 49, *H. ambulans* form B; 50, *H. pontiger;* 51, *H. ambulans* form A; 52, *H. ambulans* form C; 53, *H. ambulans* form D.



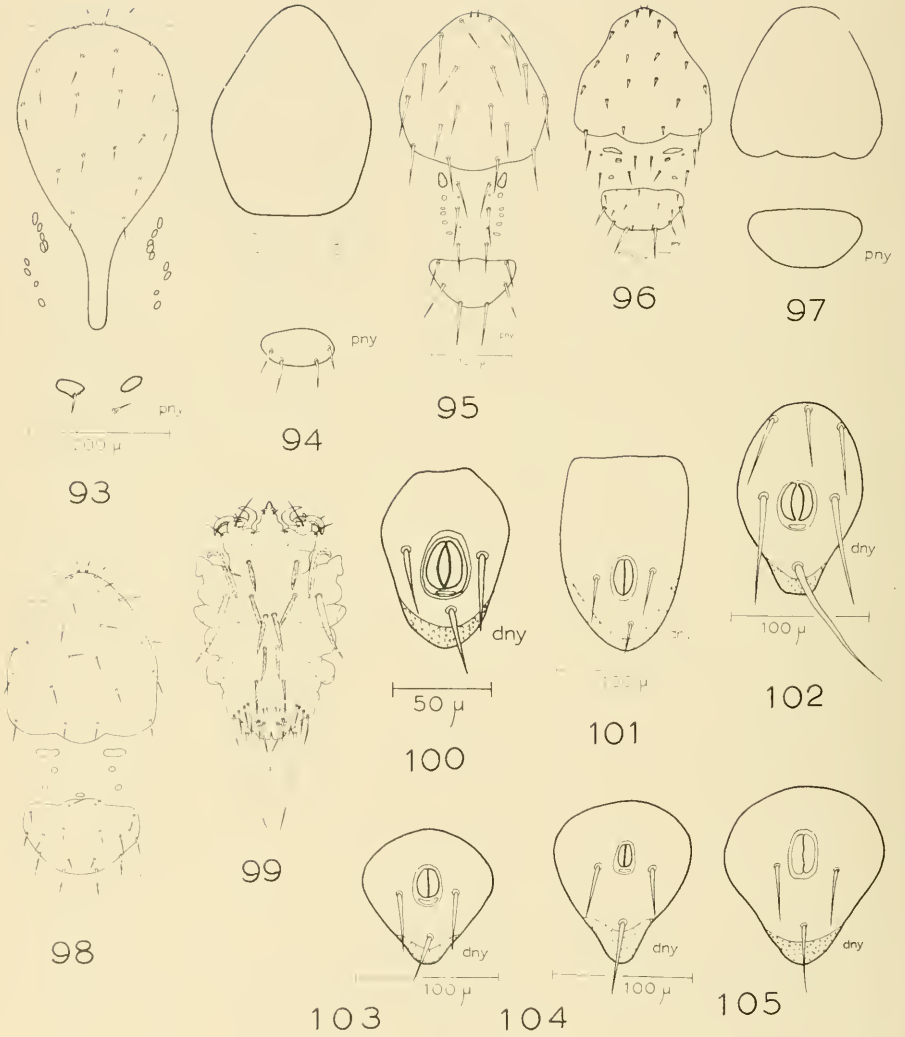
Figs. 54-66. Dorsal plates. 54, *Ornithonyssus bacoti*; 55, *Laelaps kochi*; 56, *L. multispinosus*; 57, *Hypoaspis lubrica*; 58, *H. gurabensis*; 59, *Spinturnix orri*; 60, *Eubrachylaelaps hollisteri*; 61, *L. incilis*; 62, *E. crowei*; 63, *E. circularis*; 64 *E. debilis*; 65, *Haemolaelaps casalis*; 66, *H. glasgowi*.



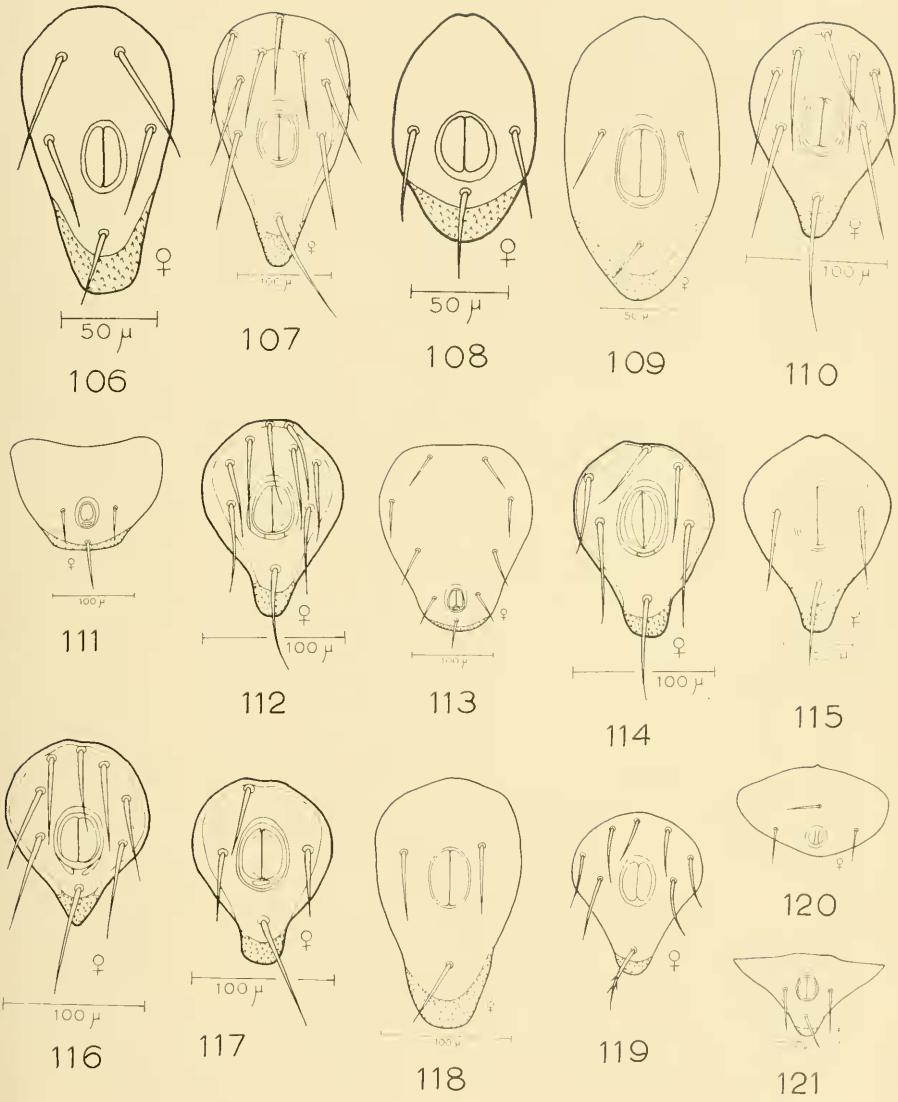
Figs. 67-77. Dorsal plates. 67, *Dermanyssus hecki;* 68, *Hirstionyssus bisetosus;* 69, *Ischyropoda armatus;* 70, *H. thomomys;* 71. *H. femuralis;* 72, *Laelaps kochi;* 73, *Brevisterna utahensis;* 74 *I. furmani;* 75, *Haemolaelaps glasgowi;* 76, *Hirstionyssus torus;* 77. *H. neotomae.*



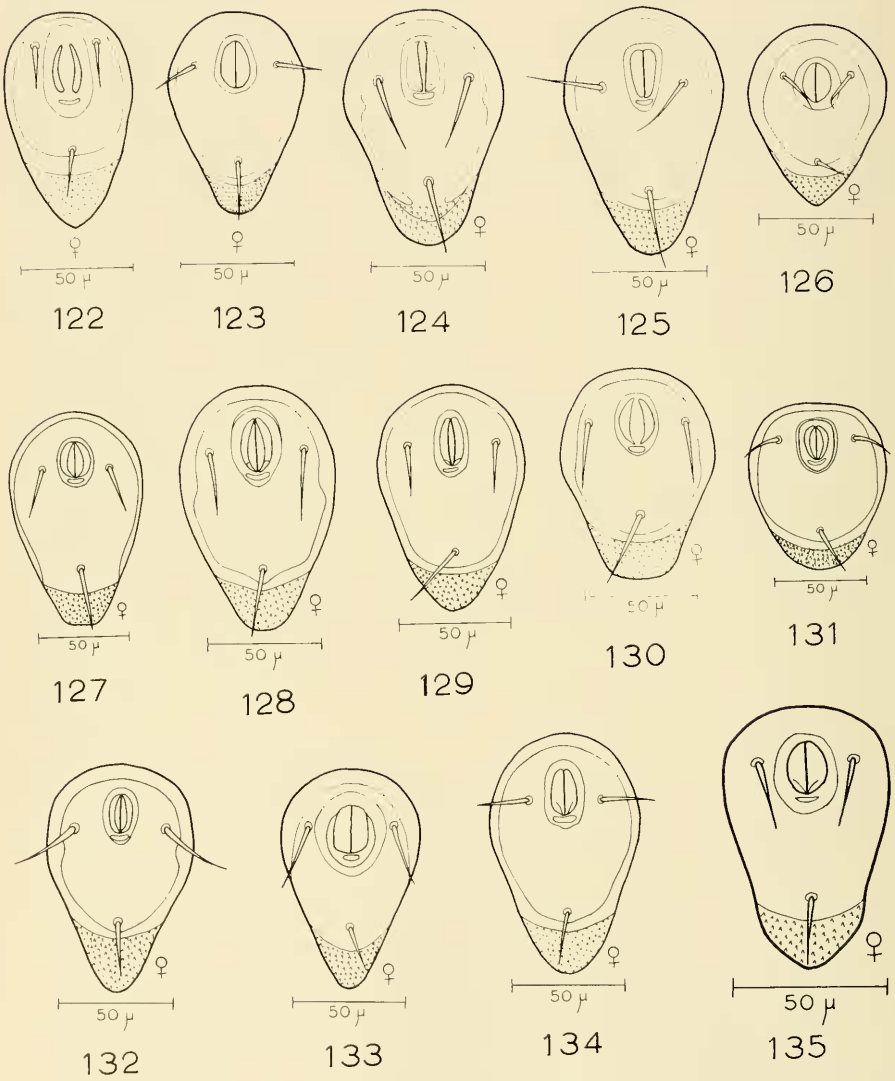
Figs. 78-92. Dorsal plates. 78. *Brevisterna utahensis;* 79, *Haemogamasus ambulans* form B; 80. *Hirstionyssus thomomys;* 81. *H. neotomae;* 82, *H. neotomae* variant A; 83, *Ichoronyssus robustipes;* 84. *Dermanyssus hecki;* 85, *Ornithonyssus aridus;* 86, *O. bacoti;* 87, *Eubrachylaelaps circularis;* 88, *Hirstionyssus utahensis;* 89, *E. circularis;* 90, *Laelaps multispinosus;* 91, *Hirstionyssus isabellinus;* 92. *H. incomptus.*



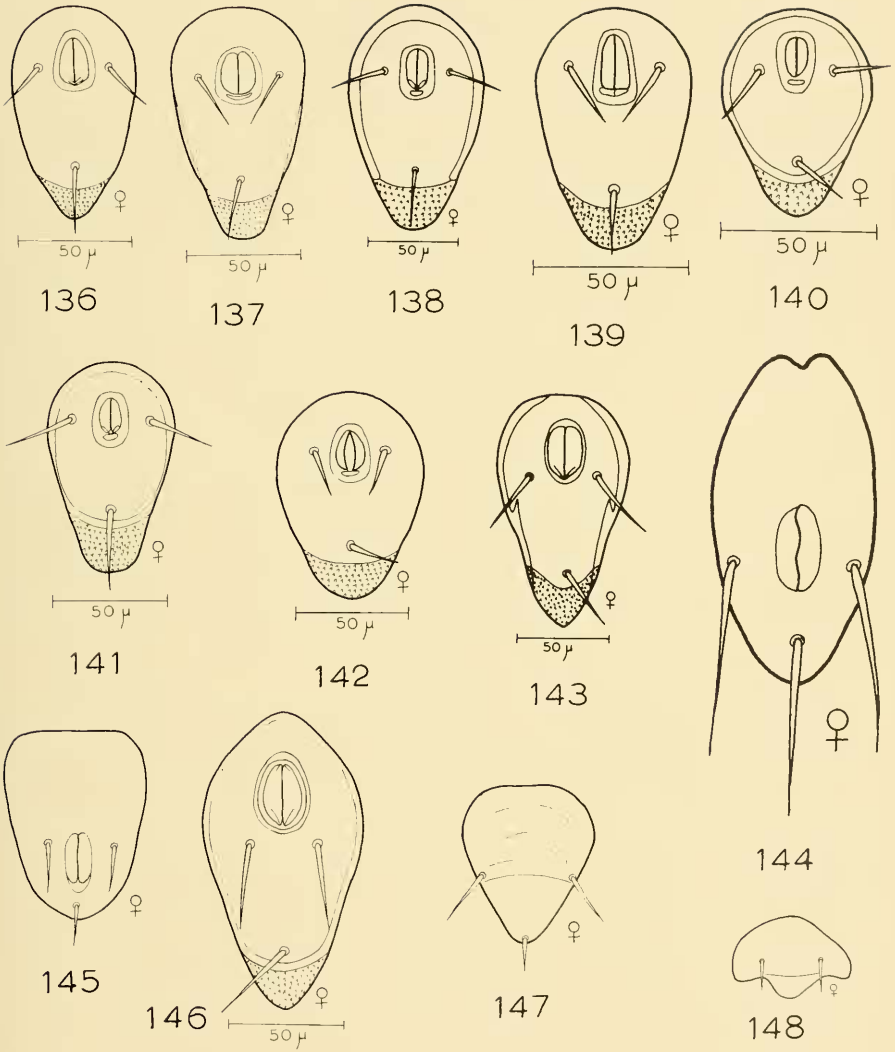
Figs. 93-105. Dorsal plates: 93, *Dermanyssus becki;* 94, *Ornithonyssus aridus;* 95, *O. bacoti;* 96, *Laelaps kochi;* 97, *Eubrachylaelaps circularis;* 98, *Haemolaelaps glasgowi.* 99. *Radfordia bachai* dorsal. Anal plates: 100, *Ischyropoda armatus;* 101, *D. becki;* 102, *Haemogamasus alaskensis;* 103, *Haemolaelaps casalis;* 104, *H. glasgowi;* 105, *E. circularis.*



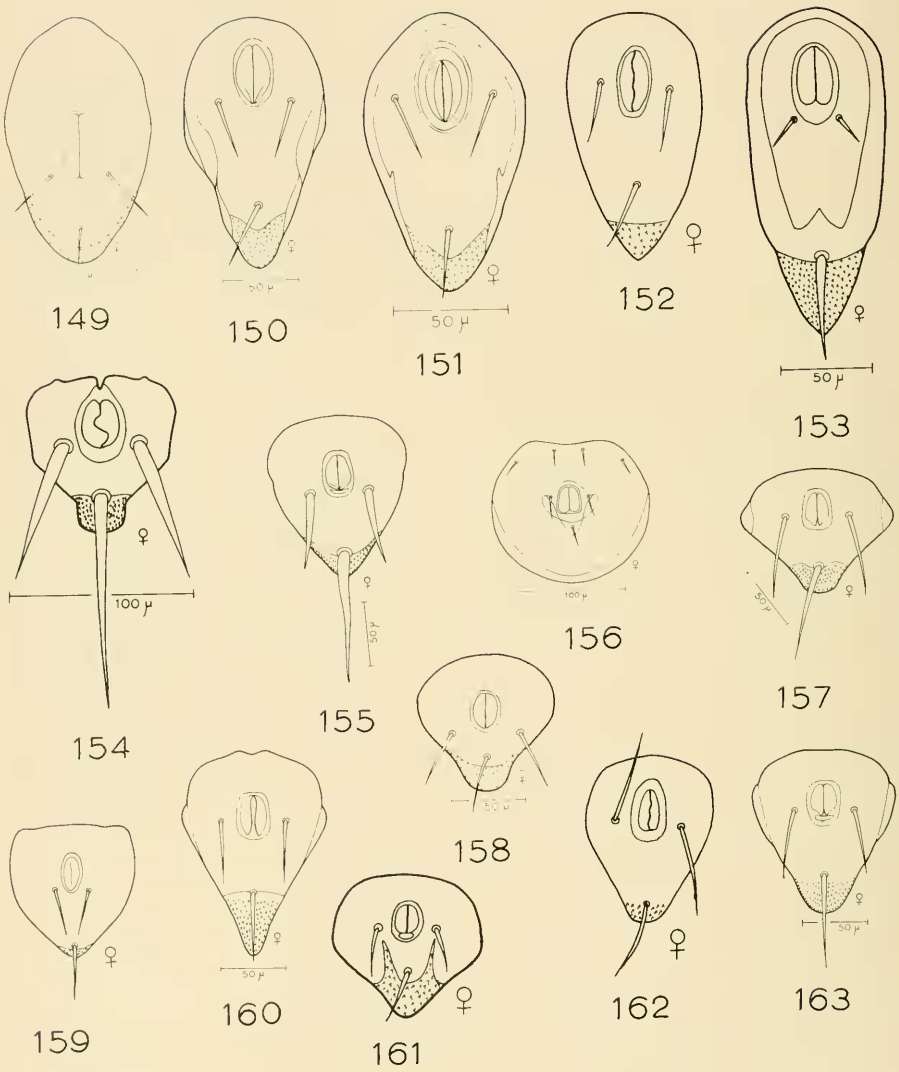
Figs. 106-121. Anal plates. 106, *Ischyropoda armatus;* 107, *Haemogamasus liponyssoides;* 108, *Ischyropoda furmani;* 109, *Brevisterna utahensis;* 110, *H. alaskensis;* 111, *Myonyssus montanus;* 112. *H. ambulans* form B; 113, *Macrocheles* sp.; 114, *H. ambulans* form C; 115, *H. pontiger;* 116. *H. ambulans* form A; 117. *H. ambulans* form D; 118, *B. montanus;* 119, *H. longitarsus;* 120. *Zumptiella bakeri;* 121. *Eulaelaps stabularis.*



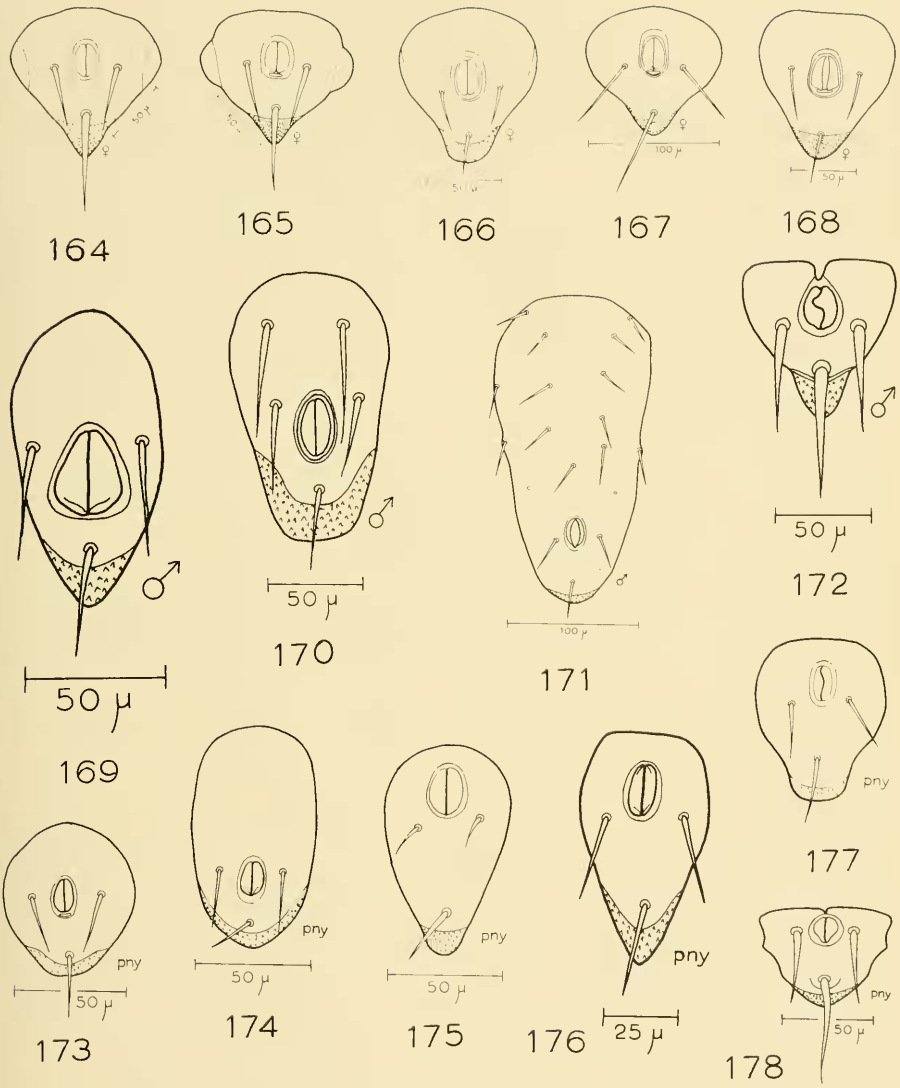
Figs. 122-135. Anal plates of *Hirstionyssus*. 122, *staffordi;* 123, *tarsalis;* 124, *affinis;* 125, *punctatus;* 126, *longichelae;* 127, *invaginatus* variant; 128, *eutamiae;* 129, *utahensis;* 130, *invaginatus,* 131, *palustris;* 132, *angustus;* 133, *thomomys;* 134, *torus;* 135, *femuralis.*



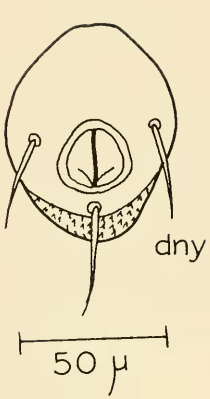
Figs. 136-148. Anal plates. 136. *Hirstionyssus neotomae;* 137. *H. hisetosus;* 138, *H. isabellinus;* 139, *H. hilli;* 140. *H. hilli* variant; 141. *H. triacanthus;* 142, *H. incomptus;* 143, *Ichoronyssus robustipes;* 144, *Dermanyssus sanguineus;* 145. *D. gallinae;* 146, *Ornithonyssus bacoti;* 147, *Spinturnix orri;* 148, *Paraspinturnix globosus.*



Figs. 149-163. Anal plates. 149, *Dermanyssus hecki;* 150. *Steatonyssus antrozoi;* 151, *Ornithonyssus sylviarum;* 152, *O. aridus;* 153, *Laelaps multispinosus;* 154, *L. kochi;* 155, *L. incilis;* 156. *Kleemania* sp.; 157. *Eubrachylaelaps crowei;* 158, *Androlaelaps leviculus;* 159, *L. nuttalli;* 160. *E. hollisteri;* 161, *Hypoaspis gurabensis;* 162. *Haemolaelaps geomys;* 163, *E. debilis.*



Figs. 164-178. Anal plates. 164, 165, *Eubrachylaelaps circularis;* 166, *Hypoaspis lubrica;* 167, *Haemolaelaps glasgowi;* 168, *H. casalis;* 169, *Ischyropoda furmani;* 170, *I. armatus;* 171, *Ichoronyssus robustipes;* 172, *Laelaps kochi;* 173, *H. glasgowi;* 174, *Dermanyssus hecki;* 175, *L. multispinosus;* 176, *Ornithonyssus bacoti;* 177, *E. circularis;* 178, *L. kochi.*



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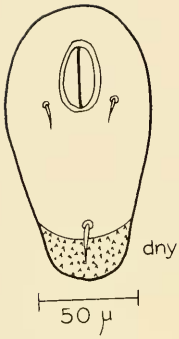

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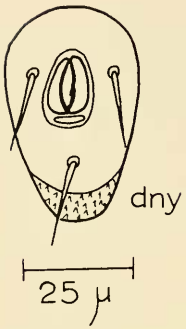

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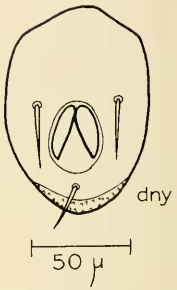

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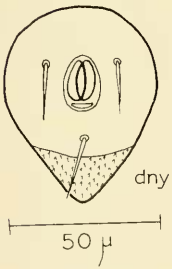

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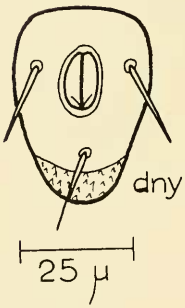

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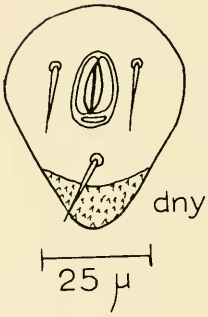

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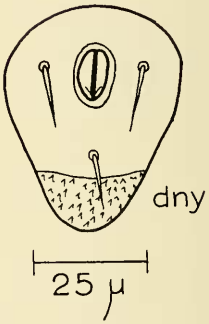

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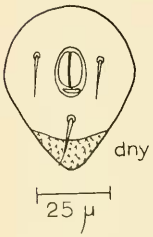

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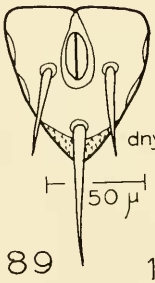

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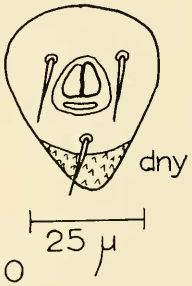

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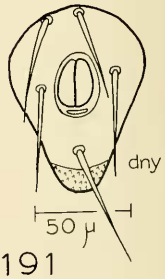

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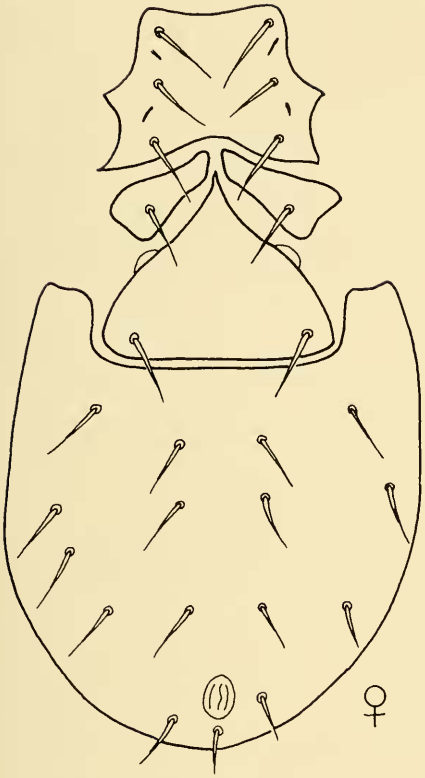
Figs. 179-191. Anal plates. 179, *Ischyropoda furmani;* 180, *Laelaps multispinosus;* 181. *Hirstionyssus neotomae;* 182, *Brevisterna utahensis;* 183. *H. isabellinus;* 184, *H. bisetosus;* 185, *H. torus;* 186, *H. incomptus;* 187. *H. utahensis;* 188, *H. thomomys;* 189, *L. kochi;* 190, *H. femuralis;* 191, *Haemogamasus ambulans* form B.



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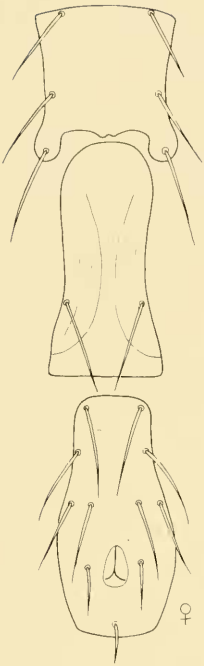

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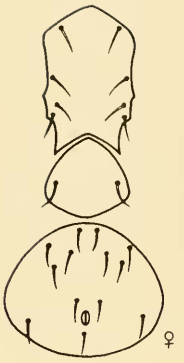

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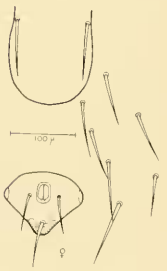

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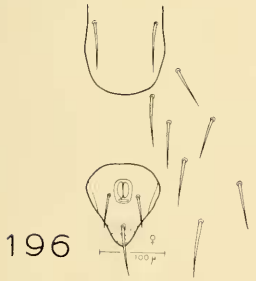

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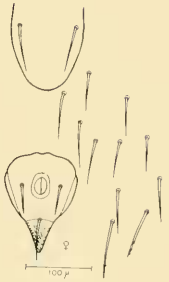

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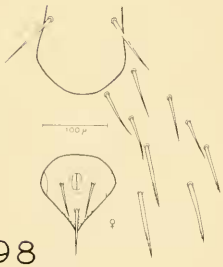

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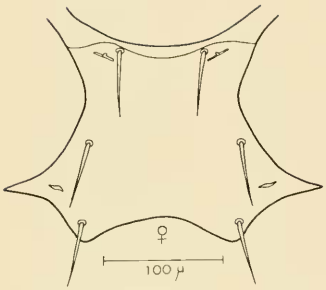
Figs. 192-198. Ventral plates: 192, Parasitidae; 193, Phytoseiidae; 194, Gamasolaelaptidae. Ventral setae arrangement: 195, *Eubrachylaelaps crowei*; 196, *E. debilis*; 197, *E. hollisteri*; 198, *E. circularis*.



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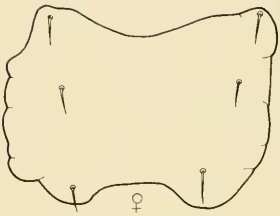

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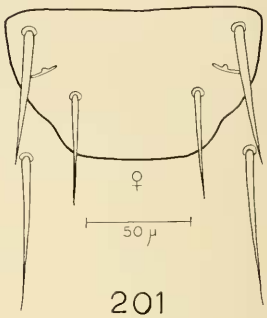

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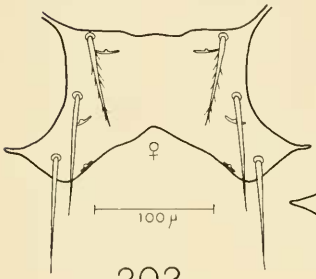

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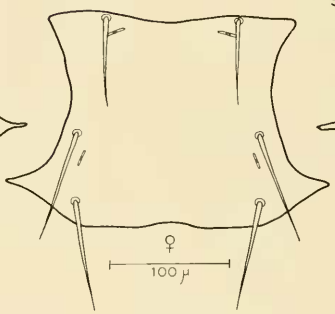

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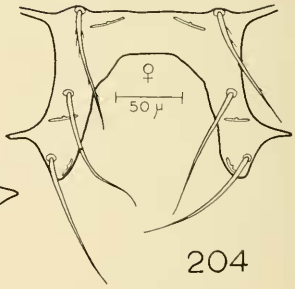

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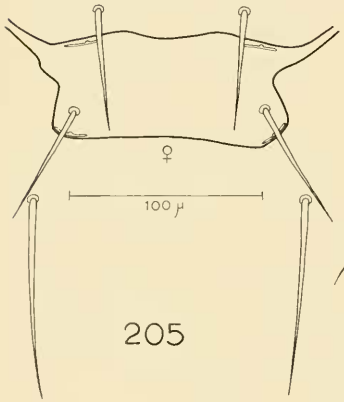

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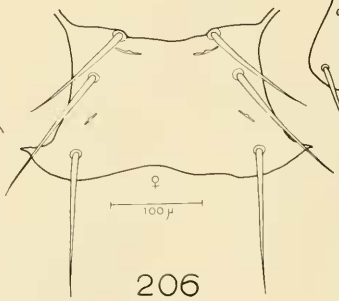

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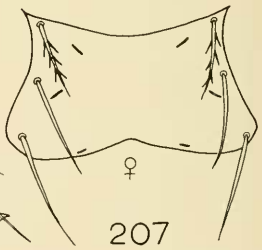

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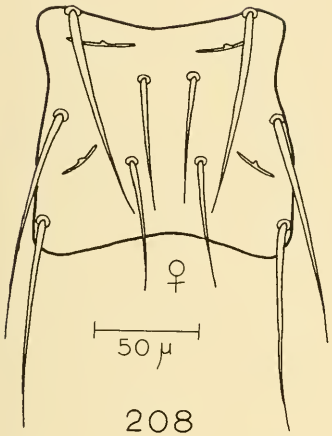
Figs. 199-207. Sternal plates. 199, *Macrocheles* sp.; 200. *Zumptiella bakeri;* 201, *Brevisterna montanus;* 202, *Haemogamasus ambulans* form A; 203, *Eulaelaps stabularis;* 204, *H. pontiger;* 205. *B. utahensis;* 206, *H. liponyssoides;* 207, *H. longitarsus.*



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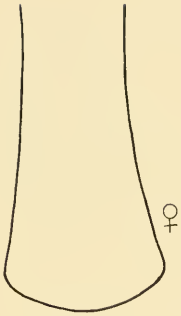

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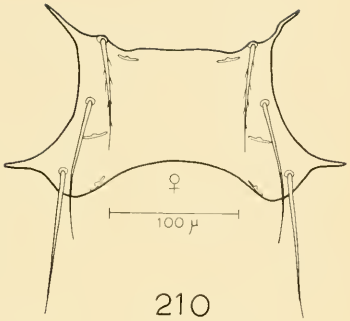

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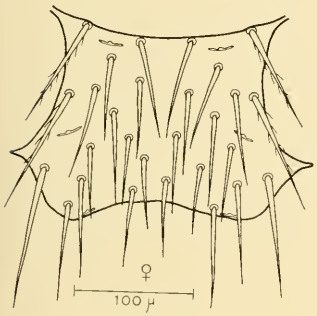

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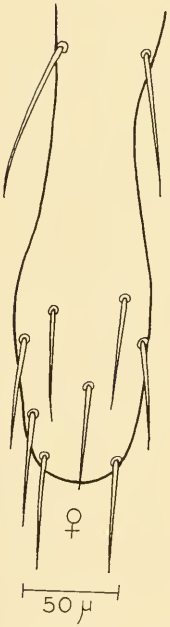

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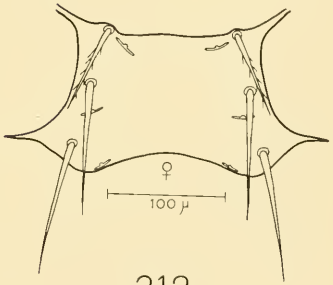

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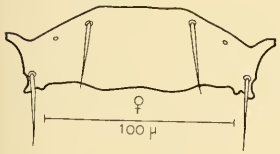

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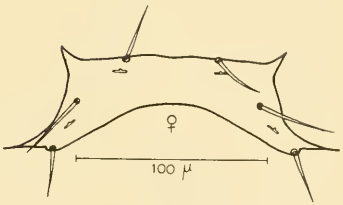

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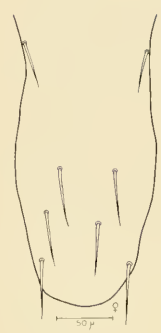
Figs. 208-215. Sternal plates: 208, *Ischyropoda furmani*; 210, *Haemogamasus ambulans* form C; 211, *H. alaskensis*; 212. *H. ambulans* form B; 213, *Hirstionyssus staffordi*; 215, *H. tarsalis*. Genitoventral plates: 209, *Zumptiella bakeri*; 214. *I. furmani*.



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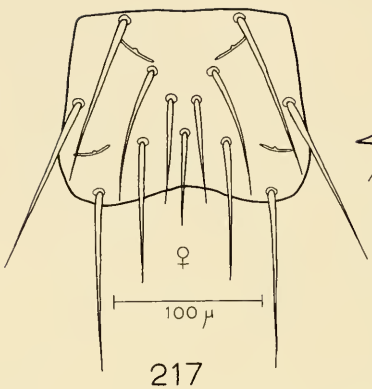

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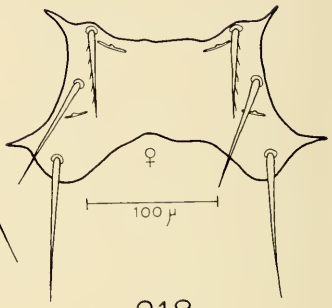

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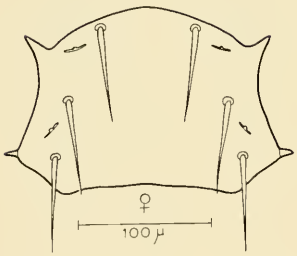

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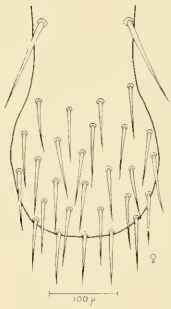

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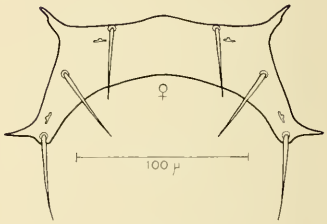

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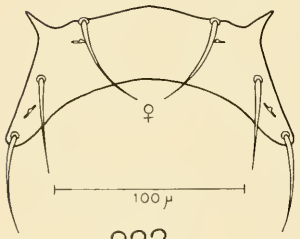

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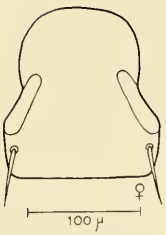

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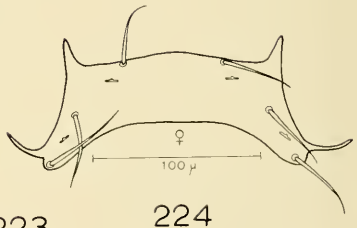

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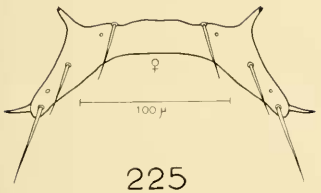
Figs. 216-224. Sternal plates: 217, *Ischyropoda armatus;* 218. *Haemogamasus ambulans* form D; 219, *Myonyssus montanus;* 221, *Hirstionyssus affinis;* 222, *H. palustris;* 224, *H. punctatus.* Genitoventral plates: 216. *Brevisterna utahensis;* 220. *Haemogamasus liponyssoides,* 223. *Macrocheles* sp.



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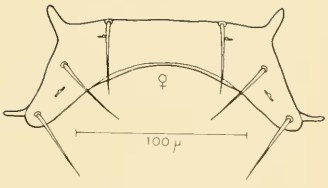

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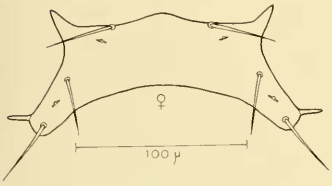

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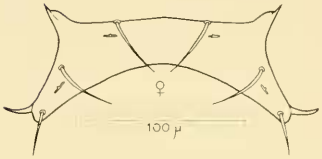

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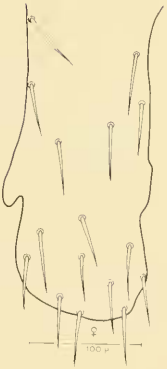

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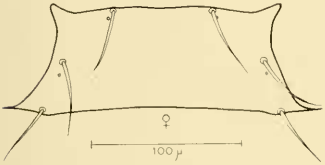

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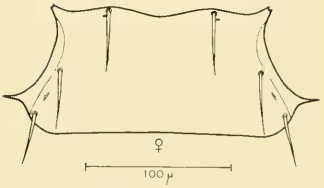

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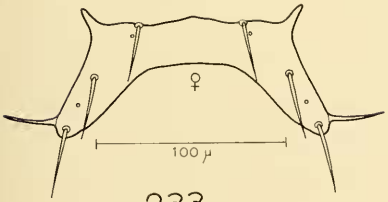

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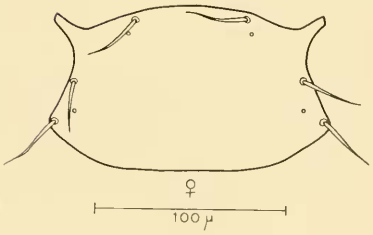
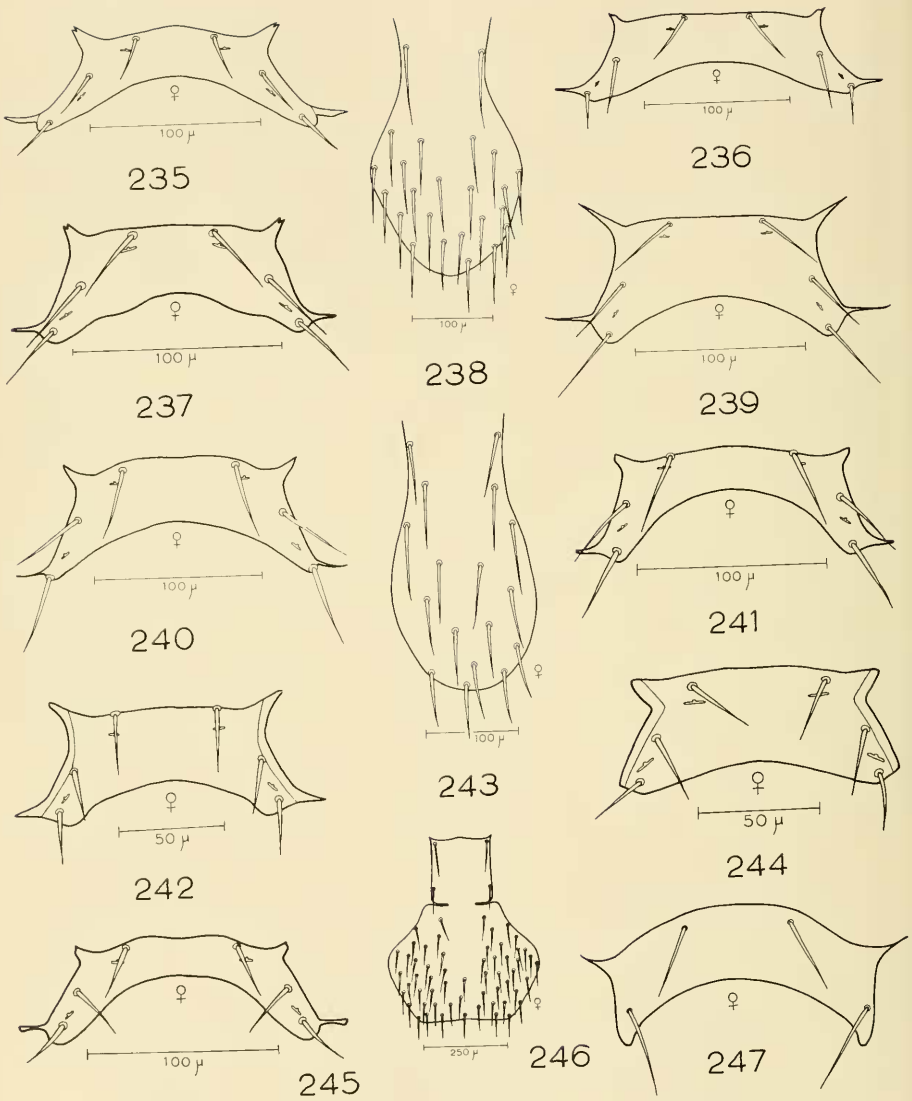
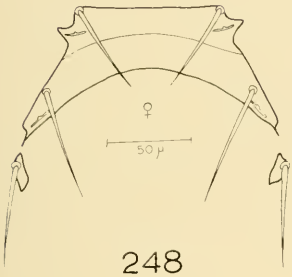


234

Figs. 225-234. Sternal plates: 225, *Hirstionyssus invaginatus;* 227, *H. invaginatus* variant; 228, *H. eutamiae;* 229, *H. utahensis;* 230, *H. thomomys;* 232, *H. femuralis;* 233, *H. angustus;* 234, *H. longichelae.* Genitoventral plates: 226, *Haemogamasus alaskensis;* 231, *Brevisterna montanus.*



Figs. 235-247. Sternal plates: 235, *Hirstionyssus torus;* 236, *H. neotomae;* 237, *H. neotomae* variant A; 239, *H. bisetosus;* 240, *H. isabellinus;* 241, *H. triacanthus;* 242, *H. hilli;* 244, *H. hilli* variant; 245, *H. incomptus;* 247, *Dermanyssus gallinae.* Genitoventral plates: 238, *Ischyropoda armatus;* 243, *Haemogamasus pontiger;* 246, *Eulaelaps stabularis.*



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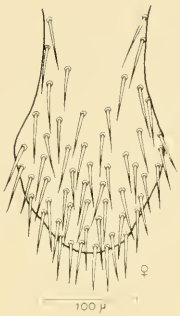

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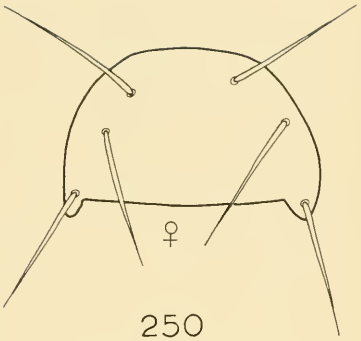

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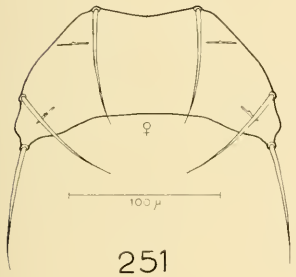

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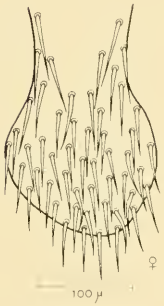

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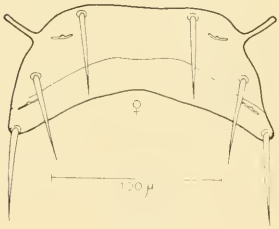

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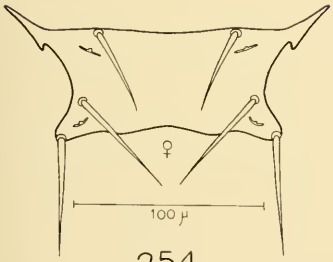

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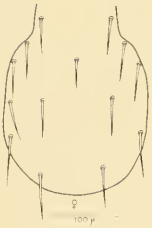

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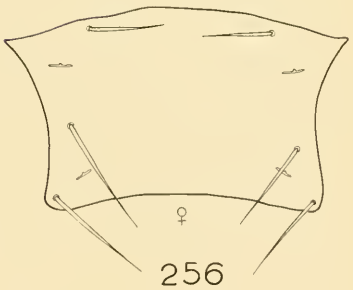
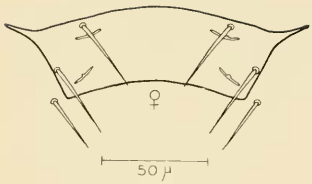


256

Figs. 248-256. Sternal plates: 248. *Ichoronyssus robustipes;* 250, *Dermanyssus sanguineus;* 251, *D. hecki;* 253, *Steatonyssus antrozoi;* 254, *Ornithonyssus bacoti;* 256. *O. aridus.* Genitoventral plates: 249. *Haemogamasus ambulans* form A; 252, *H. ambulans* form B; 255. *Myonyssus montanus.*



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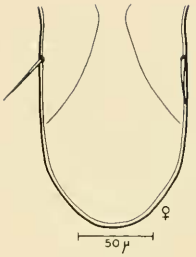

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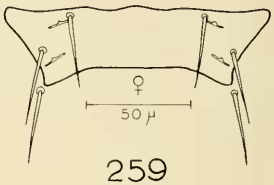

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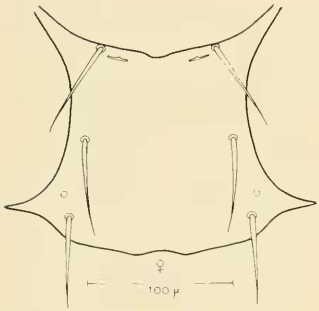

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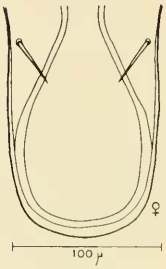

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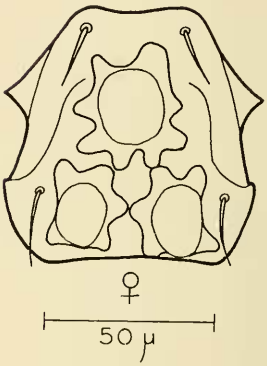

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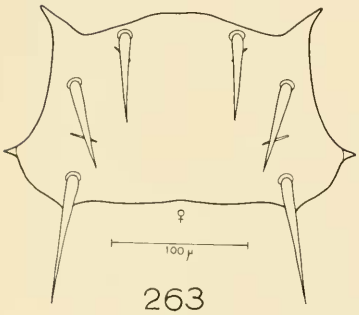

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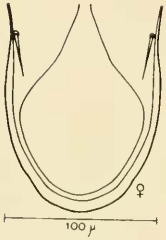

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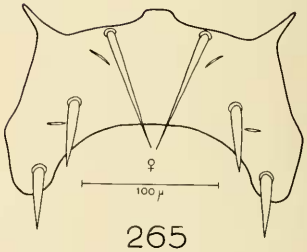
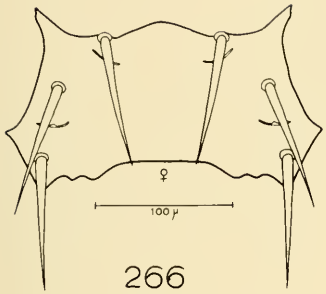


265

Figs. 257-265. Sternal plates: 257, *Ornithonyssus sylviarum;* 259, *O. sylviarum* variant; 260, *Androlaelaps leviculus;* 262, *Kleemania* sp.; 263, *Laelaps multispinosus;* 265, *L. kochi.* Genitoventral plates: 258. *Hirstionyssus punctatus;* 261, *H. palustris;* 264, *H. utahensis.*



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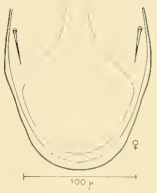

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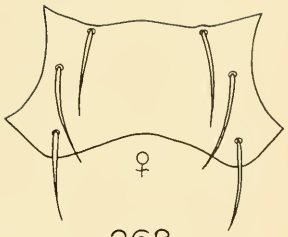

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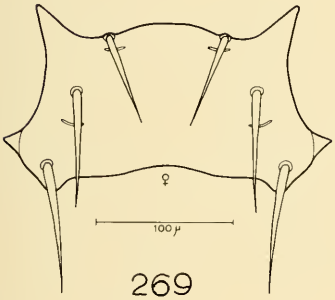

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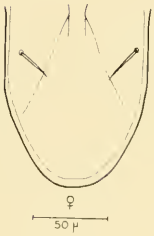

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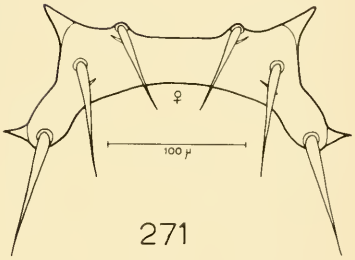

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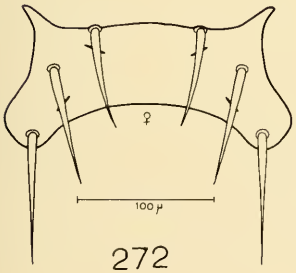

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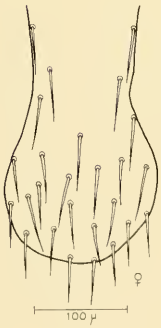

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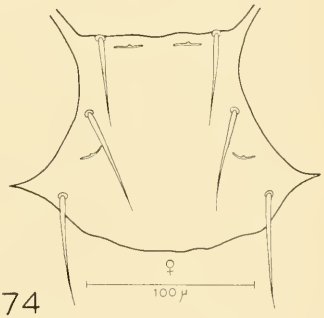

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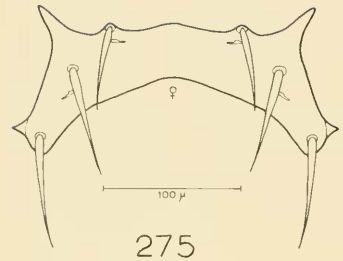
Figs. 266-274. Sternal plates: 266, *Laelaps incilis;* 268, *L. nuttallii;* 269, *Eubrachylaelaps crowei;* 271, *E. hollisteri;* 272, *E. circularis;* 274, *Hypoaspis lubrica.* Genitoventral plates: 267, *Hirstionyssus invaginatus* variant; 270, *H. tarsalis;* 273, *Haemogamasus ambulans* form C.



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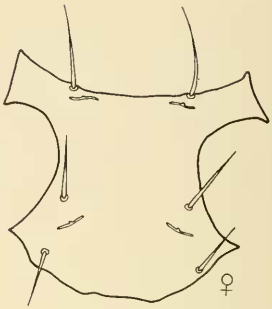

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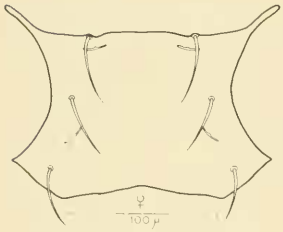

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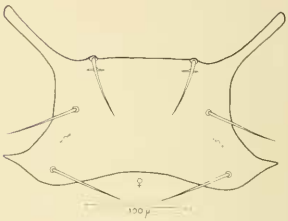

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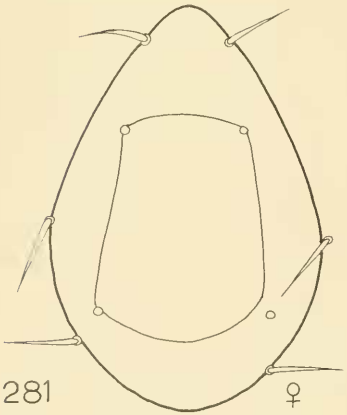

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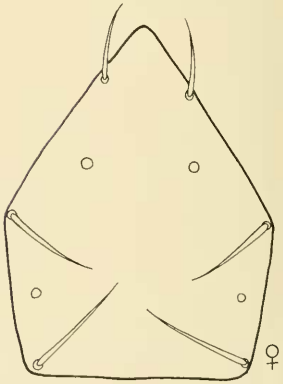

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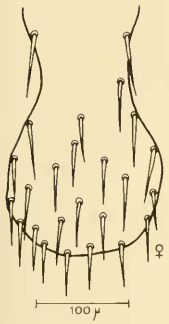
Figs. 275-283. Sternal plates: 275, *Eubrachylaelaps debilis;* 277, *Hypoaspis gurabensis;* 278, *Haemolaelaps casalis;* 280, *H. glasgowi;* 281, *Paraspinturnix globosus;* 283. *Spinturnix orri.* Genitoventral plates: 276, *Hirstionyssus invaginatus;* 279, *H. eutamiae;* 282, *H. staffordi.*



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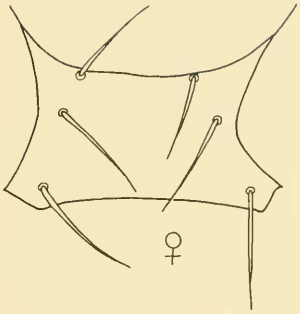

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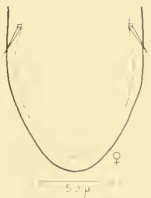

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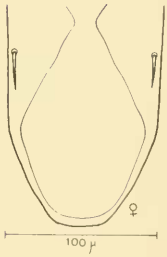

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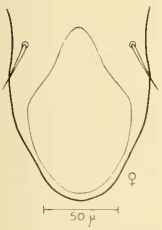

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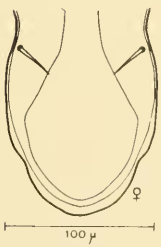

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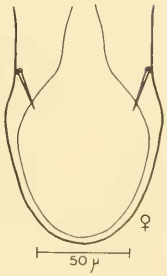

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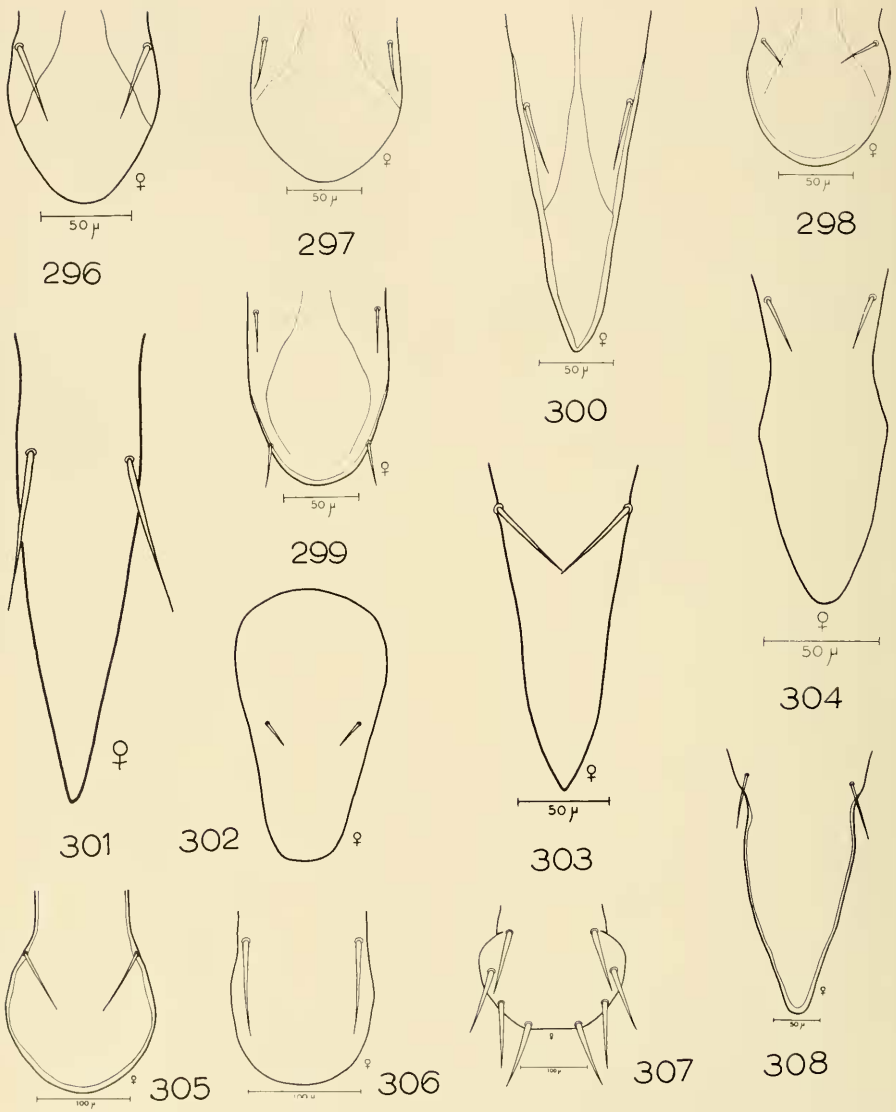
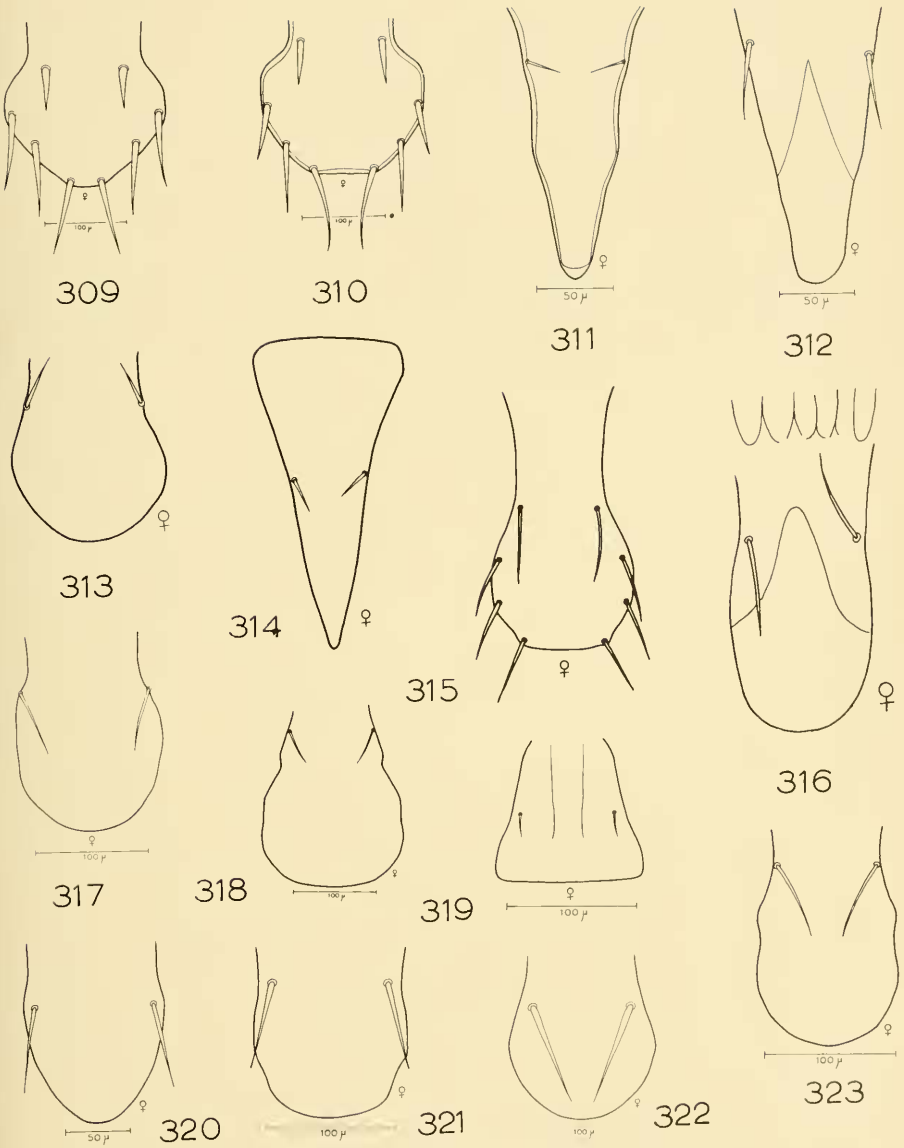
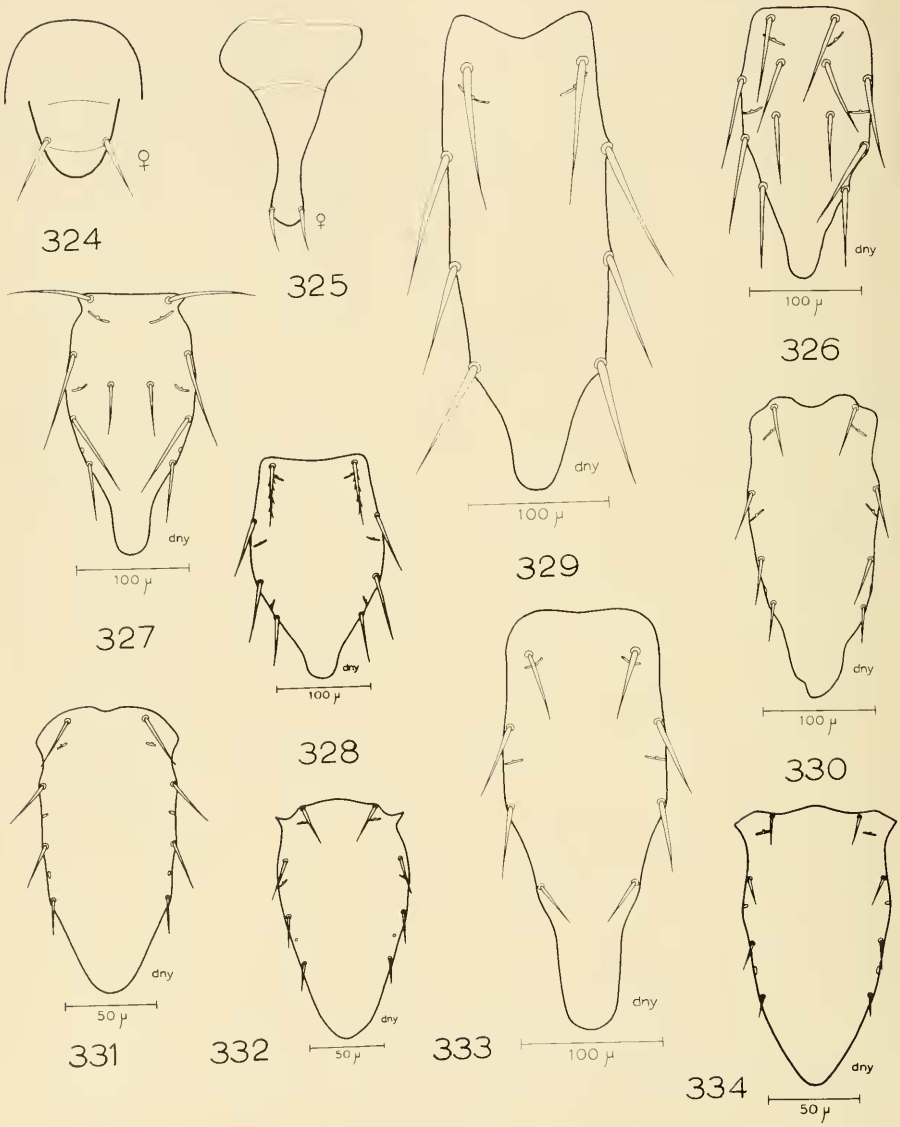
Figs. 284-295. Genitoventral plates: 284. *Haemogamasus ambulans* form D; 286, *Hirstionyssus affinis*; 287. *Haemogamasus longitarsus*; 288, *Hirstionyssus femuralis*; 289, *H. thomomys*; 290, *H. longichelae*; 291, *H. torus*; 292, *H. neotomae*; 293, *H. incomptus*; 294, *H. angustus*; 295, *H. isabellinus*. 285, sternal plate of *Haemolaelaps geomys*.



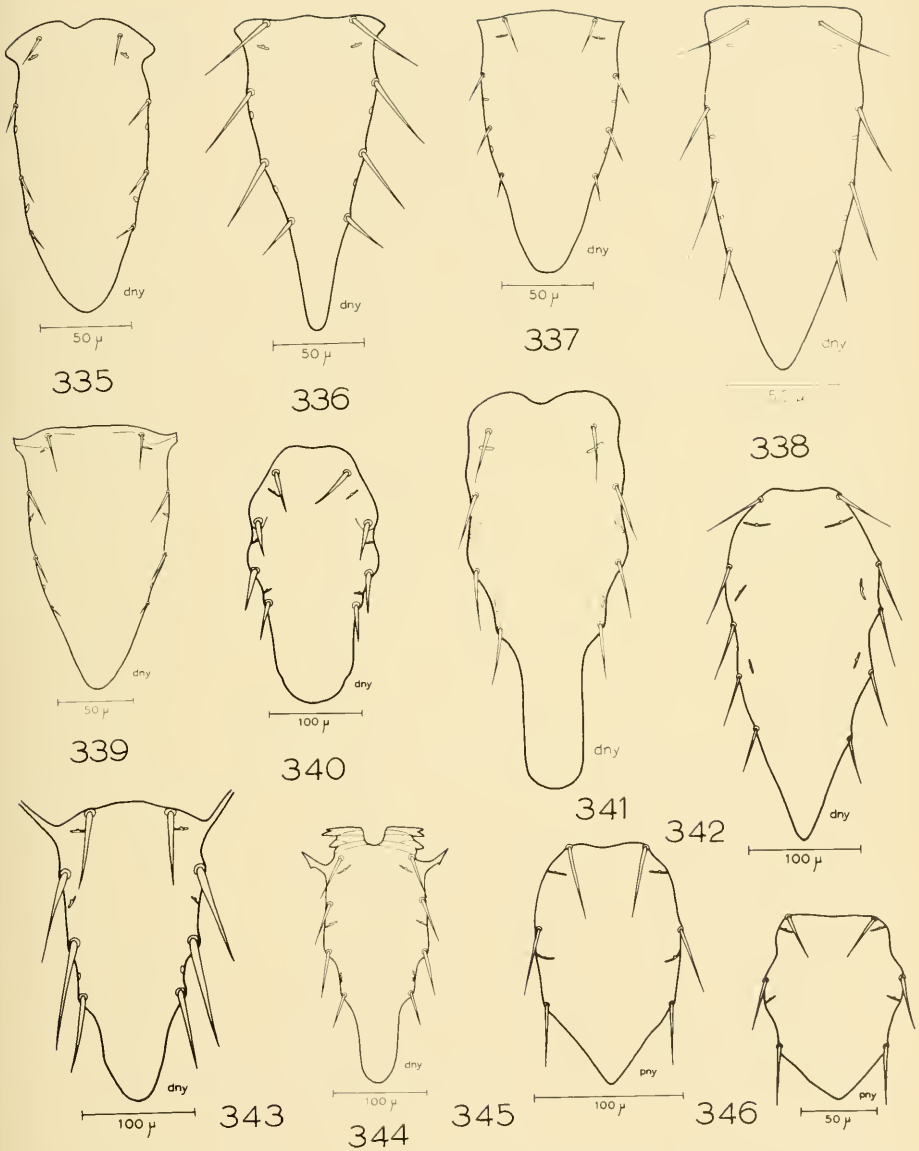
Figs. 296-308. Genitoventral plates. 296, *Hirstionyssus triacanthus;* 297, *H. hilli;* 298, *H. hilli* variant; 299, *H. bisetosus;* 300, *Ichoronyssus robustipes;* 301, *Dermanyssus sanguincus;* 302, *D. gallinae;* 303, *Ornithonyssus bacoti;* 304, *O. sylviarum;* 305, *Androlaelaps leviculus;* 306, *Eubrachylaelaps crowei;* 307, *Laelaps incilis;* 308, *D. becki.*



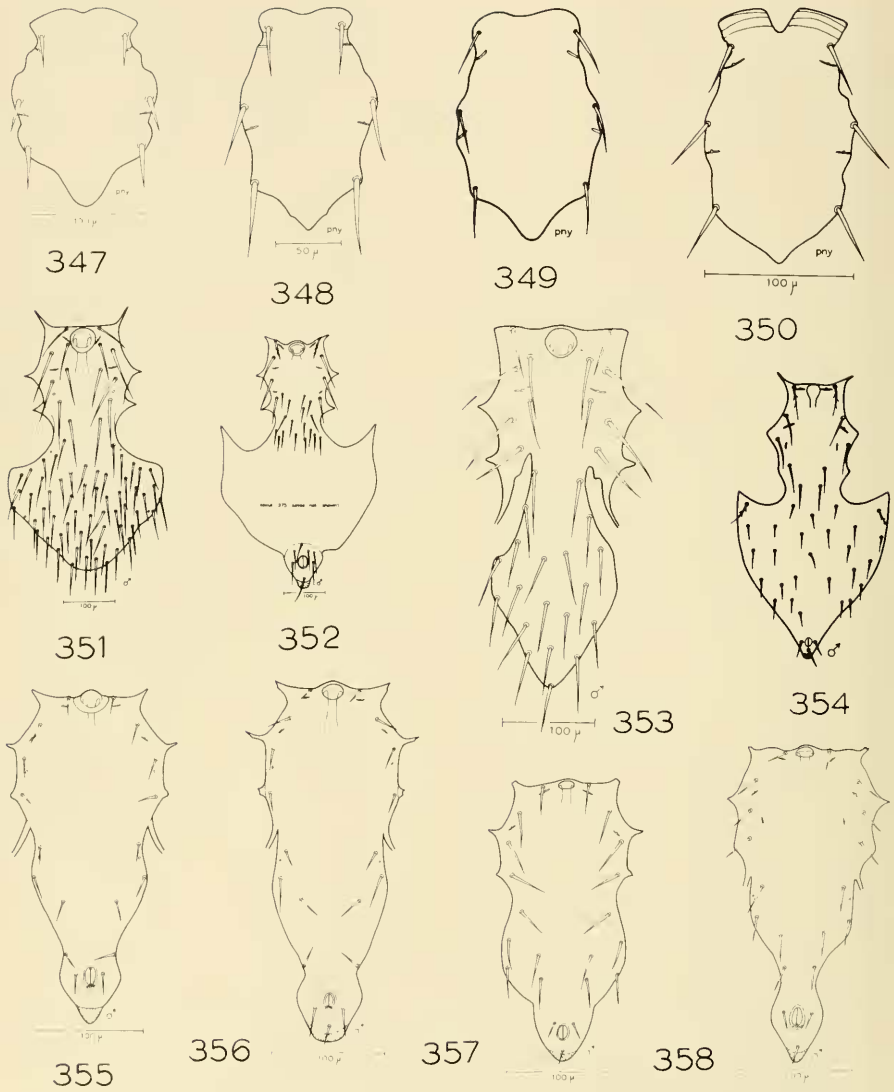
Figs. 309-323. Genitoventral plates. 309, *Laelaps kochi;* 310, *L. multispinosus;* 311, *Ornithonyssus sylviarum;* 312, *Steatonyssus antrozoi;* 313, *Hypoaspis gurabensis;* 314, *O. aridus;* 315, *L. nuttalli;* 316, *Haemolaelaps geomys;* 317, *Hypoaspis lubrica;* 318, *Haemolaelaps casalis;* 319, *Kleemania* sp.; 320, *Eubrachylaelaps hollisteri;* 321, *E. debilis;* 322, *E. circularis;* 323, *Haemolaelaps glasgowi.*



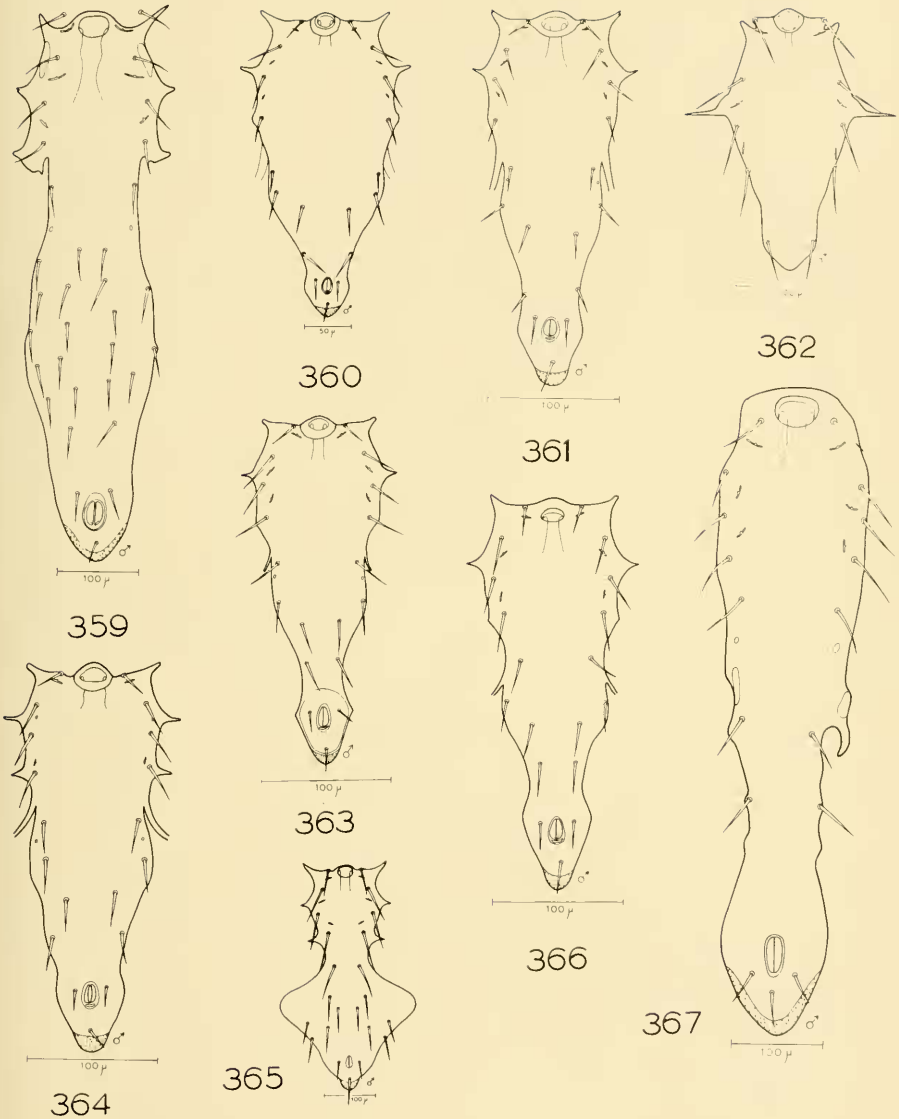
Figs. 324-334. Genitoventral plates: 324, *Spinturnix orri;* 325, *Paraspinturnix globosus.* Sternogenital plates: 326, *Ischyropoda armatus;* 327, *I. furmani;* 328, *Haemogamasus ambulans* form B; 329, *H. alaskensis;* 330, *Brevisterna utahensis;* 331, *Hirstionyssus neotomae;* 332, *H. femuralis;* 333, *Haemolaelaps casalis;* 334, *Hirstionyssus utahensis.*



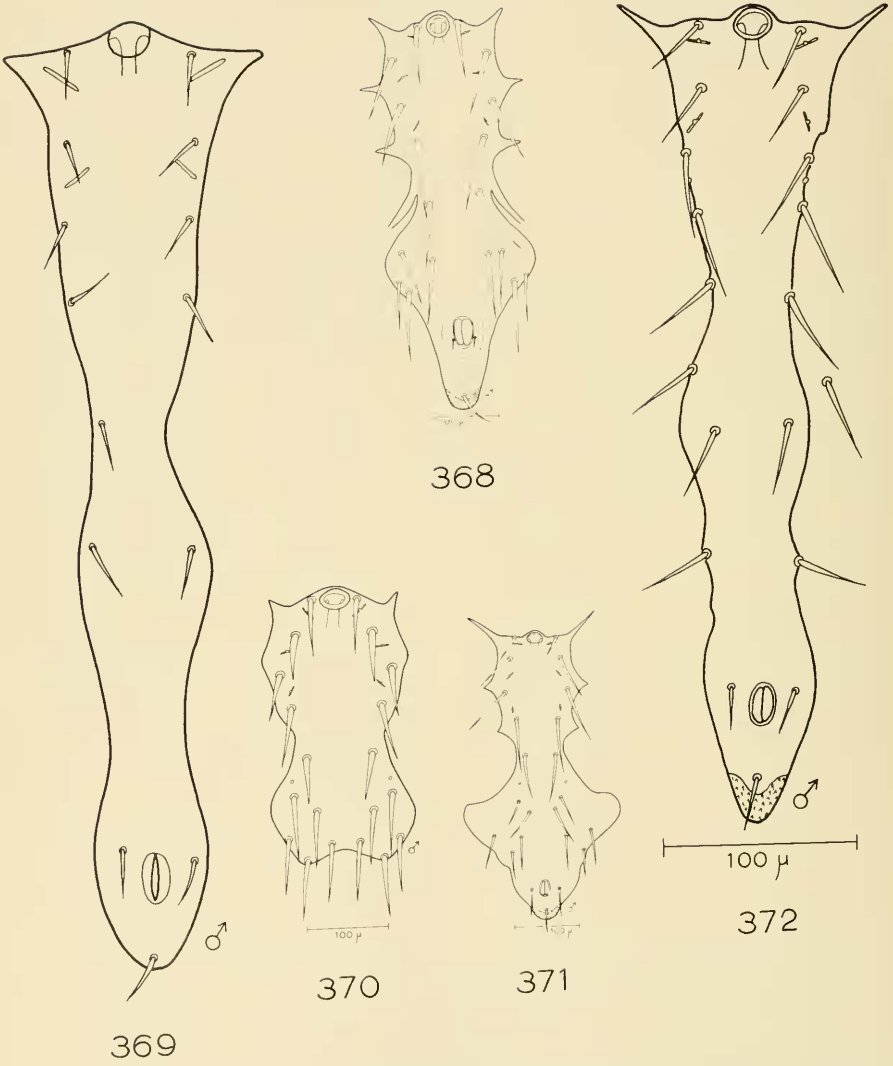
Figs. 335-346. Sternogenital plates. 335, *Hirstionyssus torus;* 336, *H. thomomys;* 337, *H. incomptus;* 338, *H. bisetosus;* 339, *H. isabellinus;* 340, *Laelaps kochi;* 341, *Eubrachylaelaps circularis;* 342, *Dermanyssus hecki;* 343, *L. multispinosus:* 344, *Haemolaelaps glasgowi;* 345, *D. hecki;* 346, *Ornithonyssus bacoti.*



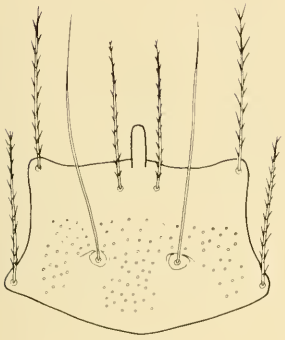
Figs. 347-358. Sternogenital plates: 347, *Laelaps kochi;* 348, *L. multispinosus;* 349, *Eubrachylaelaps circularis;* 350, *Haemolaelaps glasgowi.* Sterno-genitoventral plates: 351, *Ischyropoda armatus;* 353, *I. furmani.* Holoventral plates: 352, *Haemogamasus ambulans* form B; 354, *H. pontiger;* 355, *Hirstionyssus utahensis;* 356, *H. torus;* 357, *H. femuralis;* 358, *H. neotomae* variant B.



Figs. 359-367. Holoventral plates: 359, *Brevisterna utahensis;* 360, *Hirstionyssus thomomys;* 361, *H. neotomae* variant C; 363, *H. neotomae* variant A; 364, *H. incomptus;* 365, *Eubrachylaelaps circularis;* 366, *H. bisetosus;* 367, *Dermanyssus becki.* 362, sternogenital plate of *Ichoronyssus robustipes.*



Figs. 368-372. Holoventral plates: 368, *Laelaps multispinosus;* 369, *Ornithonyssus aridus;* 371, *Haemolaelaps glasgowi;* 372, *O. bacoti.* 370, sterno-genitoventral plate of *L. kochi.*



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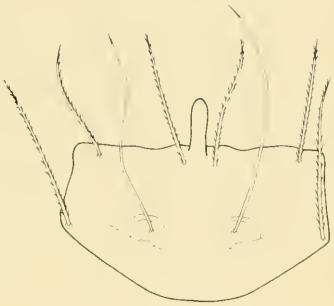

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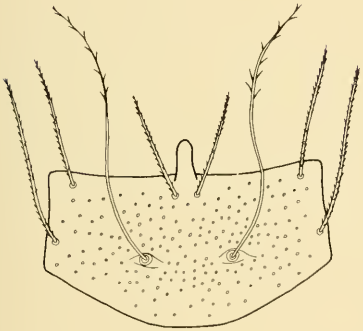

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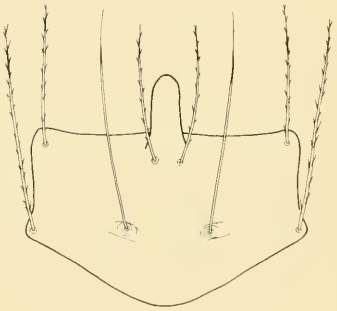

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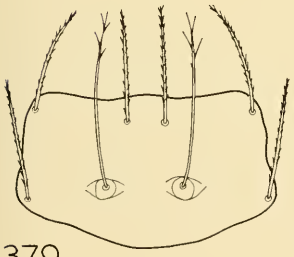

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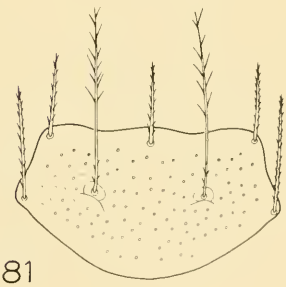

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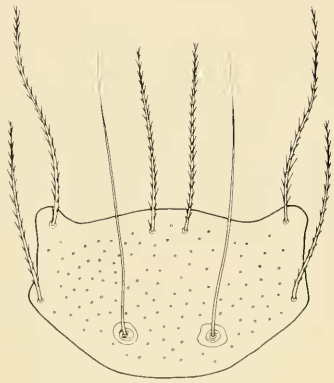
Figs. 373-381. Scuta: 373, *Leeuwenhockia americana;* 375. *Odontacarus micheneri,* 376, *O. linsdalei;* 378, *O. hirsutus;* 379, *Whartonia perplexa;* 381. *Trombicula belkini.* Chelicerae: 374, *Ischyropoda armatus;* 377, *Haemogamasus liponyssoides;* 380, *H. ambulans* form B.



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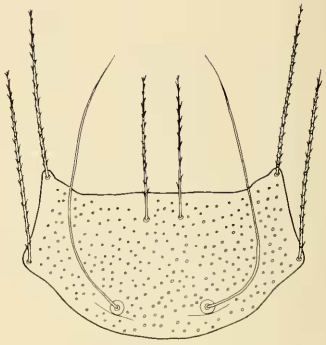

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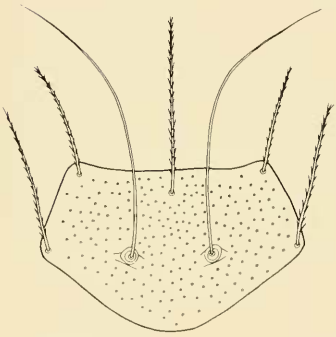

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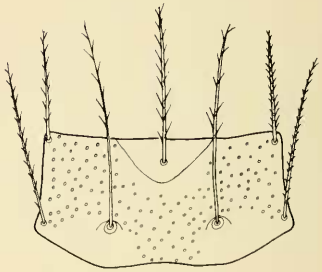

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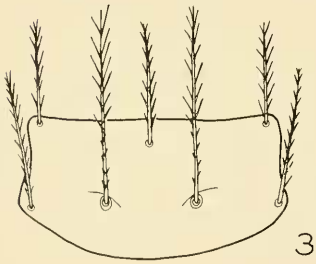

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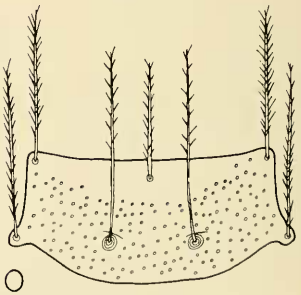

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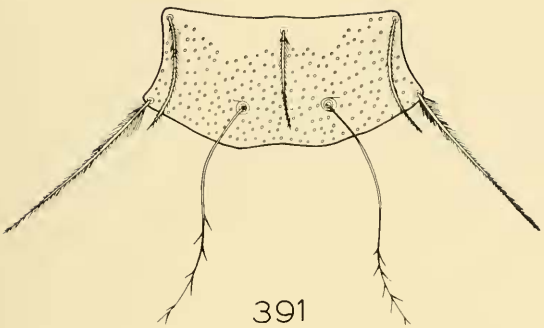
Figs. 382-390. Scuta: 382. *Chatia ochotona*; 384, *C. setosa*; 385, *Trombicula californica*; 387, *T. myotis*; 388, *T. hoplai*; 390. *T. panamensis*. Chelicerae: 383. *Haemogamasus ambulans* form A; 386, *Ornithonyssus sylviarum* variant; 389, *Dermanyssus hecki*.



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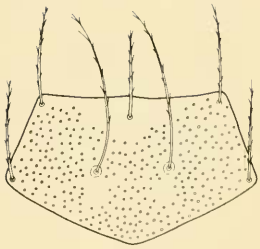

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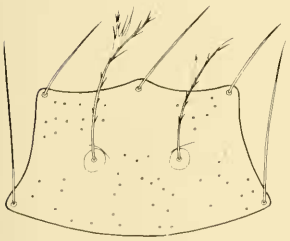

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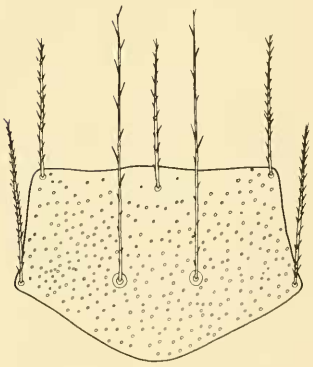

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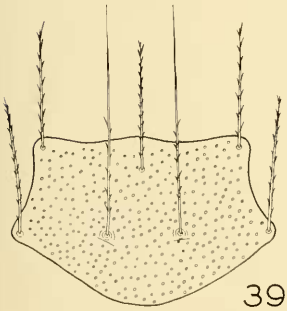

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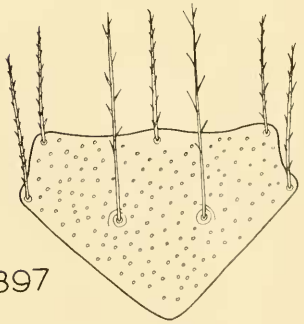

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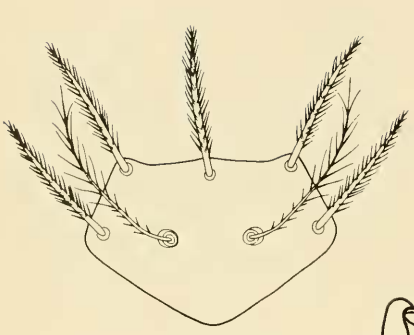
Figs. 391-397. Scuta: 391, *Trombicula potosina;* 392, *T. subsignata;* 393, *T. univari;* 394, *T. harperi;* 395. *T. jewetti;* 397, *T. esoensis.* 396, chelicera of *Haemogamasus ambulans* form D.



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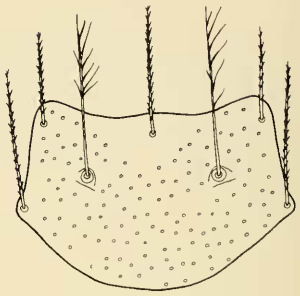

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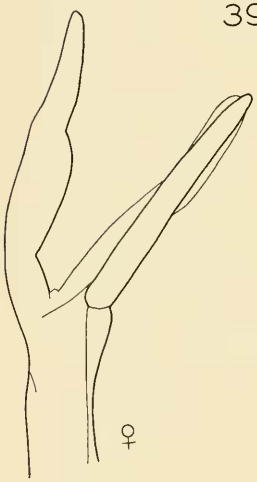

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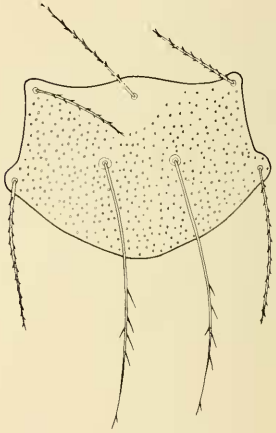

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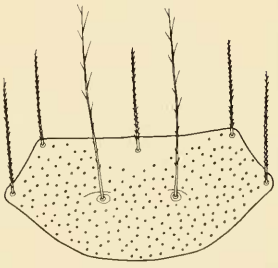

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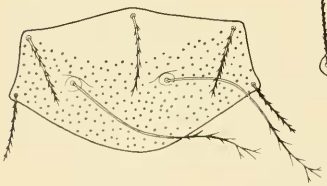

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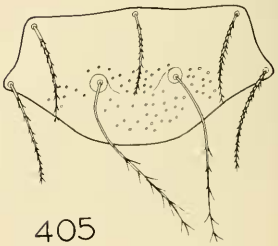

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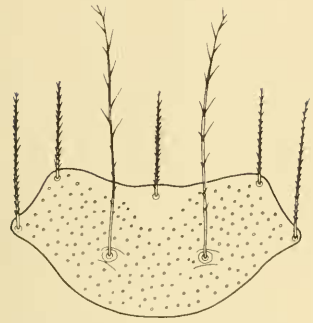
Figs. 398-405. Scuta: 398, *Trombicula sargenti;* 399, *T. bakeri;* 402, *T. montanensis;* 403, *T. kardosi;* 404, *T. doremi;* 405, *T. allredi.* Chelicerae: 400, *Haemogamasus ambulans* form C; 401 *Ornithonyssus aridus.*



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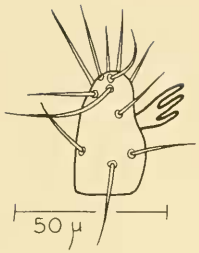

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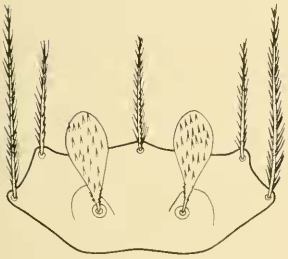

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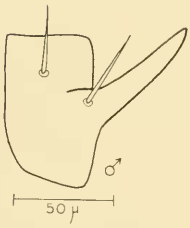

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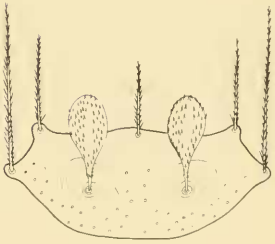

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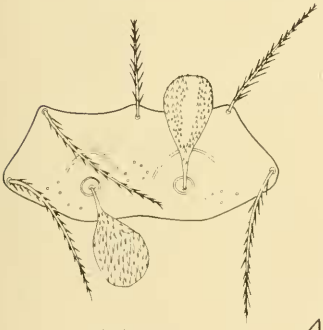

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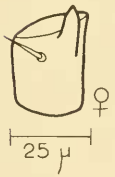

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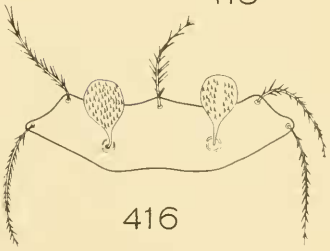

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Figs. 406-416. Scuta: 406, *Trombicula arenicola;* 408, *Euschoengastia radfordi;* 409. *E. criceticola;* 411, *E. rotunda;* 413, *E. obesa;* 414. *E. fasolla;* 416. *E. pomerantzi.* 407, *Macrocheles* sp. specialized seta of palpal tarsus; 410, *Eulaelaps stabularis* metapodal plate; 412, *Ichoronyssus robustipes* femur IV; 415. *Ornithonyssus sylviarum* palpal trochanter.

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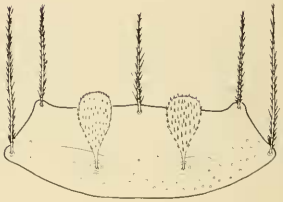

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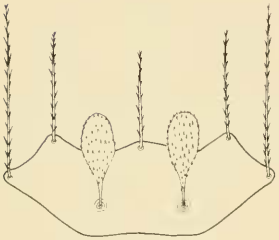

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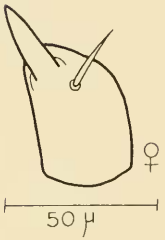

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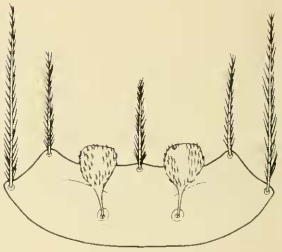

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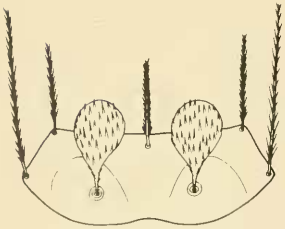

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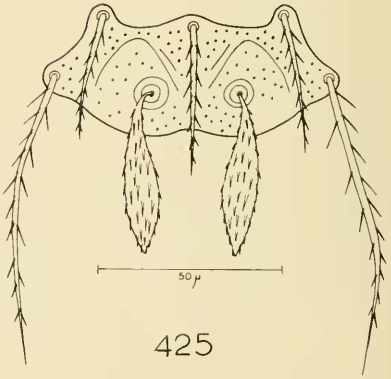

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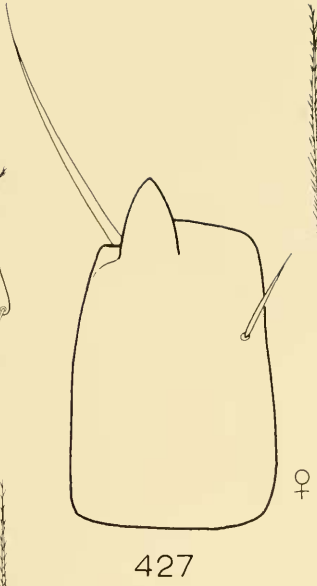
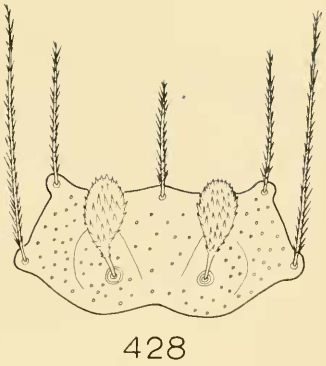
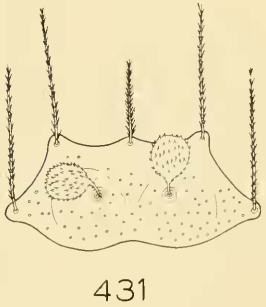
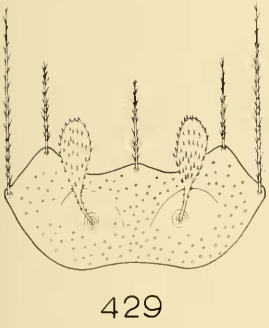
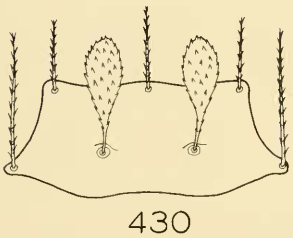
Figs. 417-425. Scuta: 417, *Euschoengastia lanceolata;* 419, *E. lanei;* 420, *E. luteodema;* 422, *E. sciuricola;* 423, *E. cynomyicola;* 425, *E. soricinus.* Palpal trochanters: 418, *Ichoronyssus robustipes;* 421, *Steatonyssus antrozoi.* 424. *Hypoaspis gurabensis* body seta.

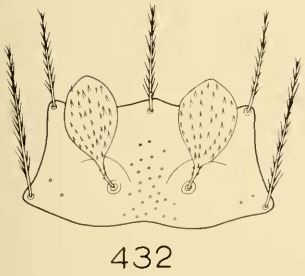


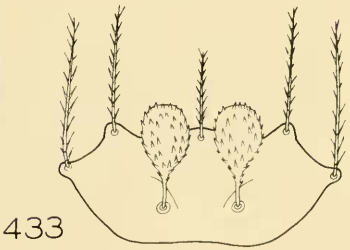


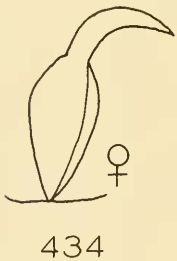




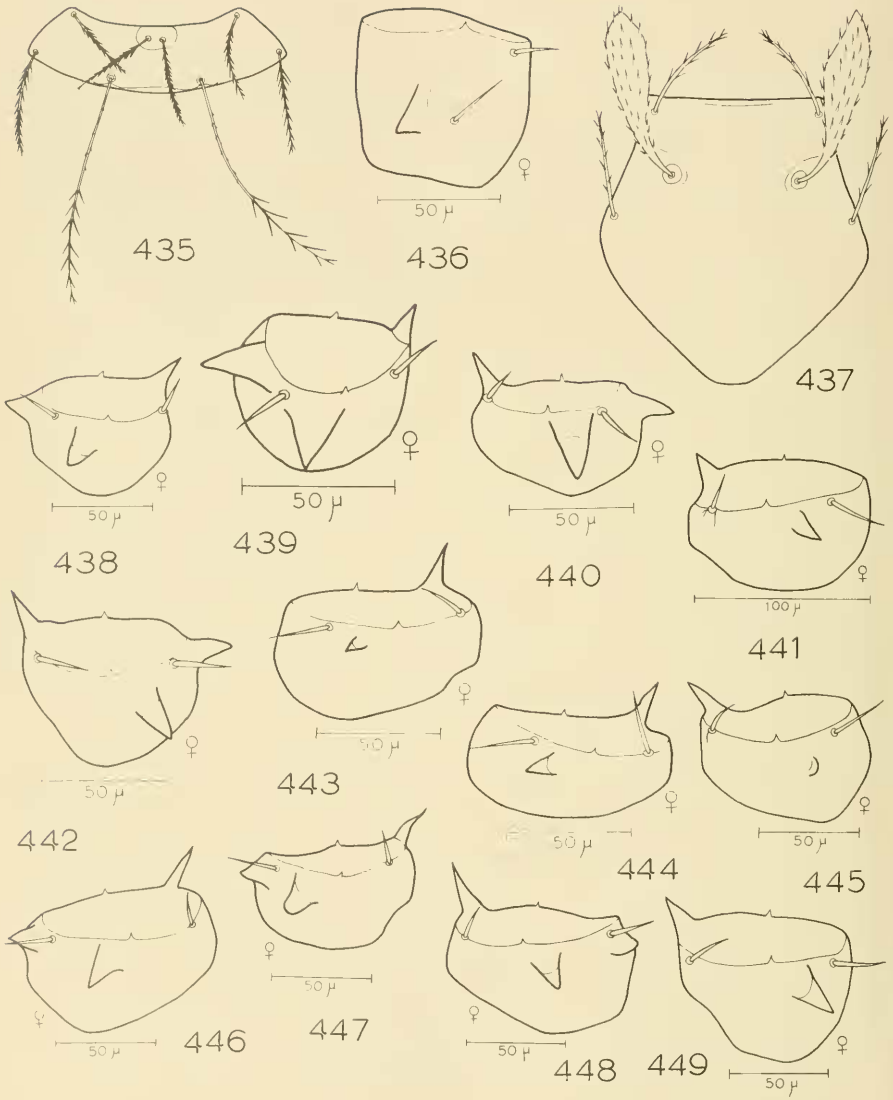




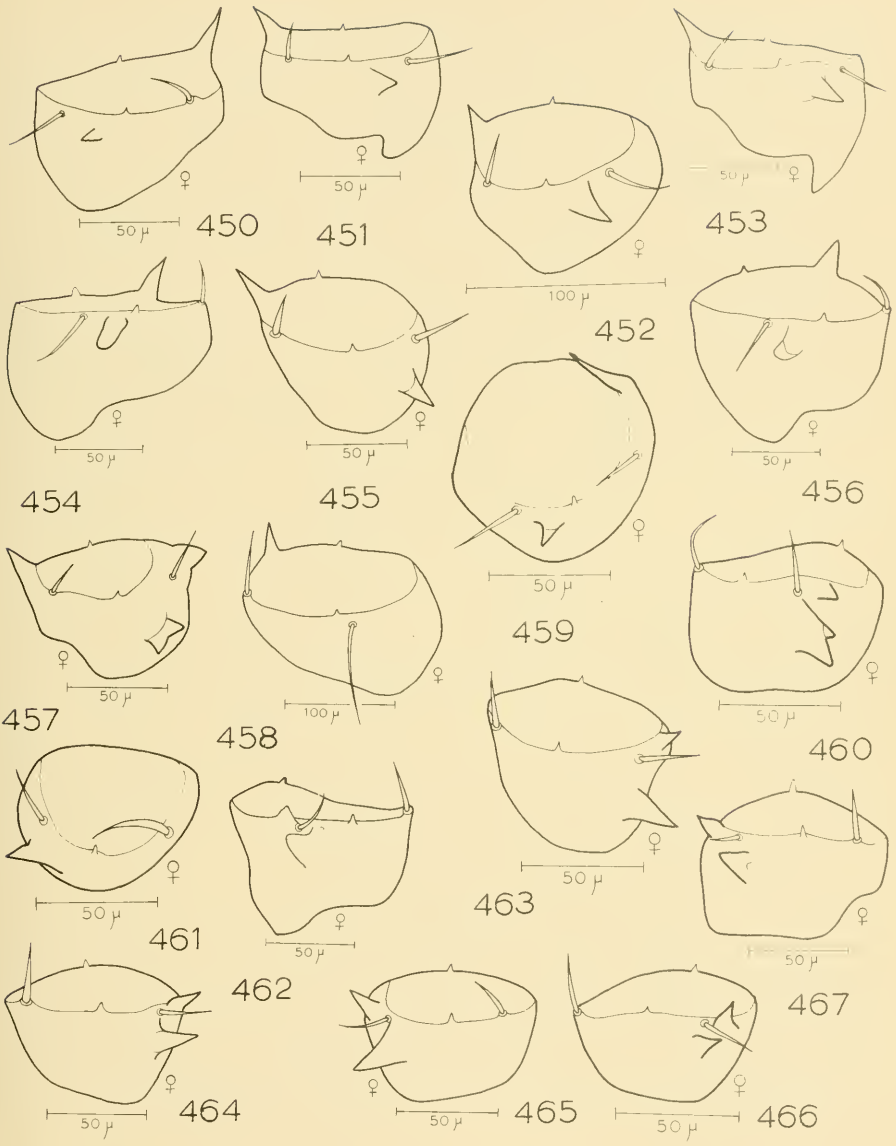




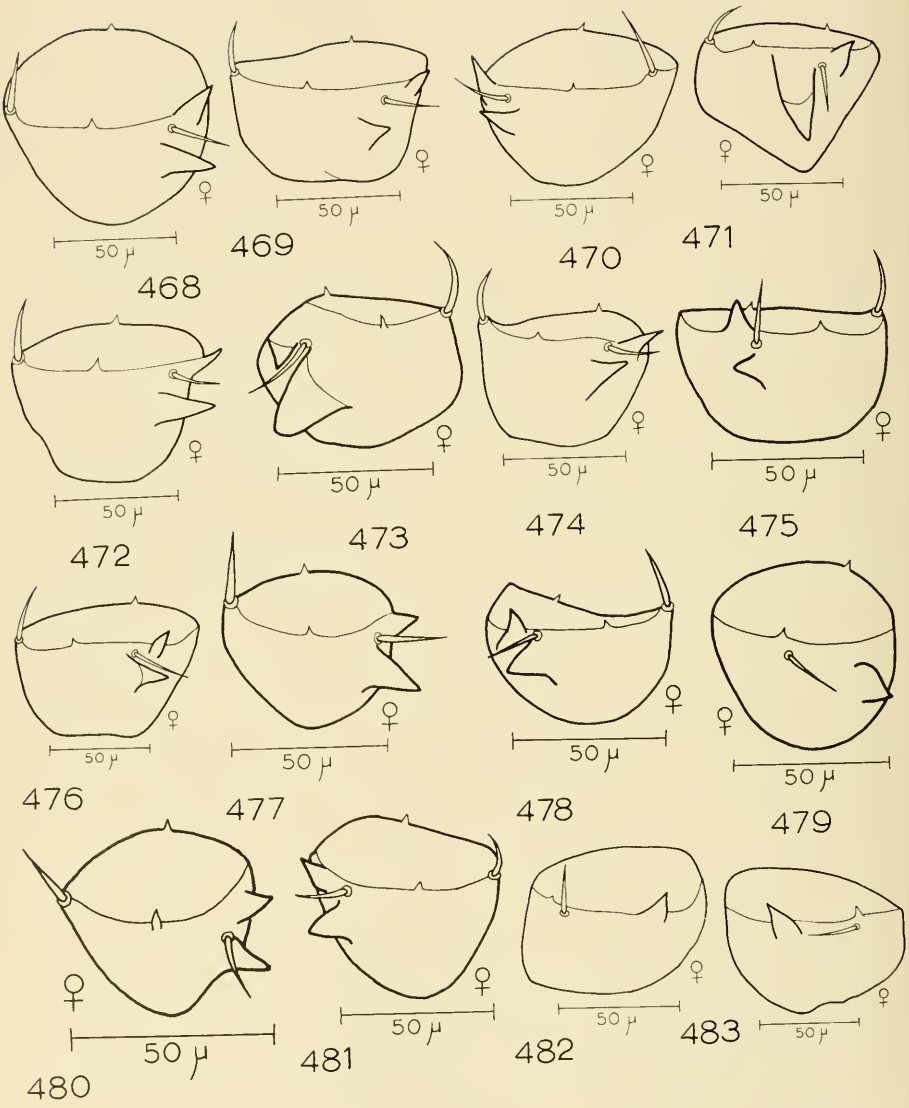
Figs. 426-434. Scuta: 426, *Eusehoengastia utahensis;* 428, *E. oregonensis;* 429, *E. cordiremus;* 430, *E. lacerta;* 431, *E. decipiens;* 432, *E. furmani;* 433, *E. hoffmannae.* 427, *Ornithonyssus aridus* palpal trochanter; 434, *Haemolaelaps glasgowi* specialized seta on cheliceral digit.



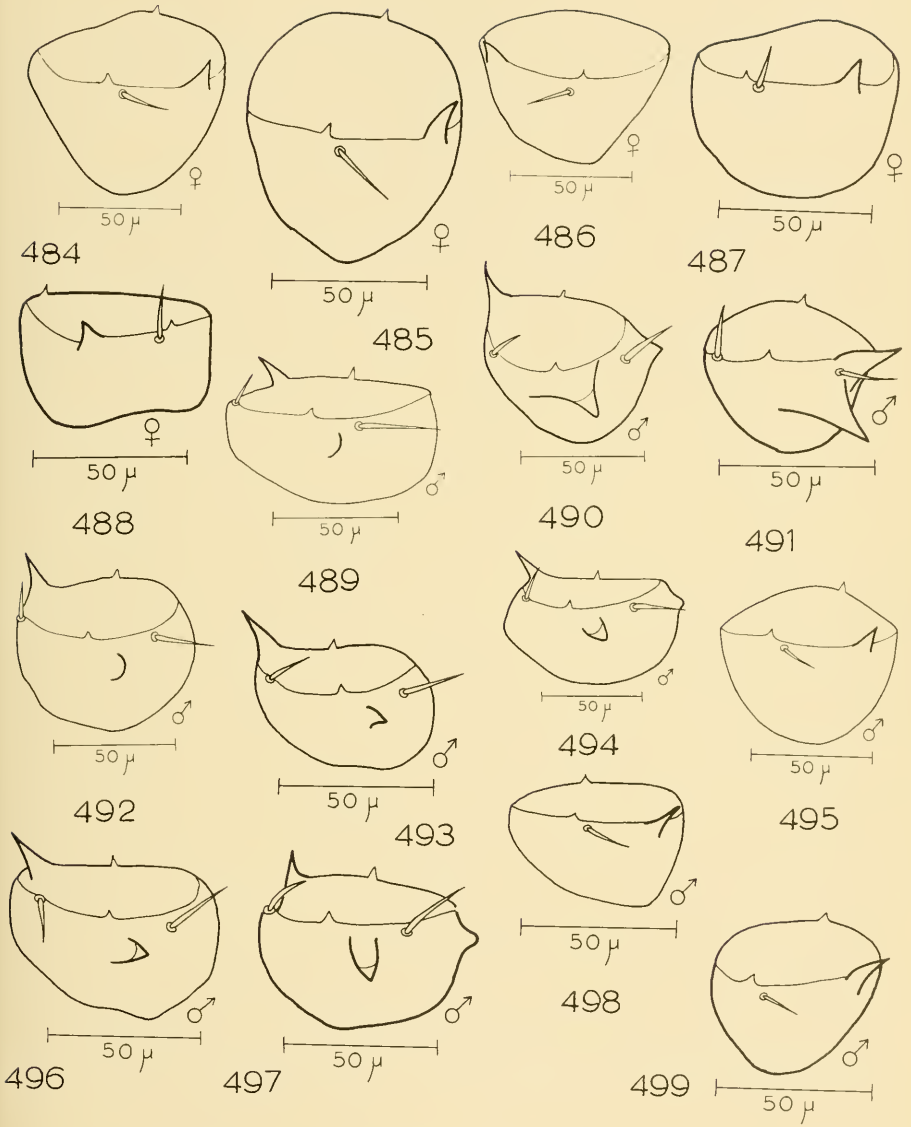
Figs. 435-449. Coxae II of *Hirstionyssus*: 438, *incomptus;* 439, *hilli* variant; 440, *hilli;* 441, *isabellinus;* 442, *triacanthus;* 443, *bisetosus;* 444, *neotomae;* 445, *torus;* 446, *thomomys;* 447, *longichelae;* 448, *femuralis;* 449, *angustus.* Scuta: 435, *Bernia marita;* 437, *Gahrlepia americana.* 436, *H. staffordi* coxa I.



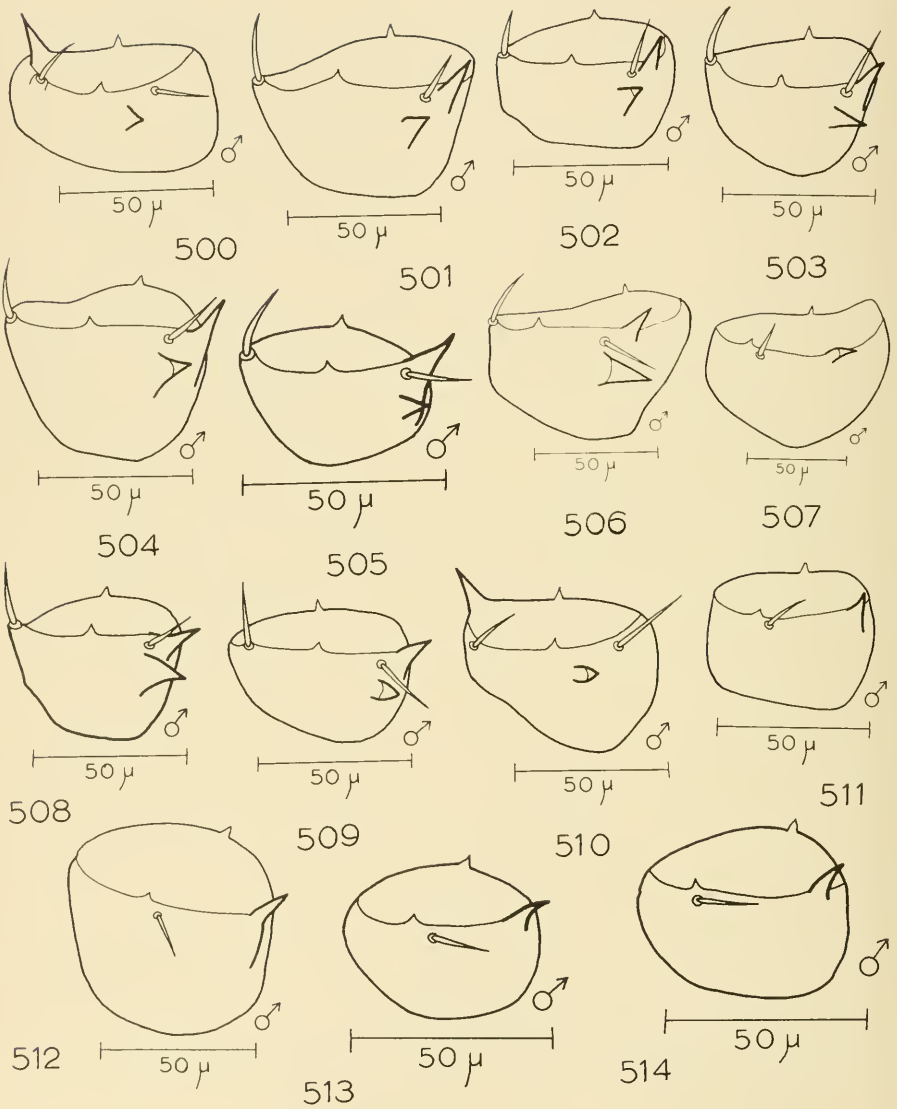
Figs. 450-467. Coxae II of *Hirstionyssus*: 450, *utahensis;* 451, *eutamiae;* 452, *invaginatus* variant; 453, *invaginatus;* 454, *punctatus;* 455, *palustris;* 456, *affinis;* 457, *staffordi;* 459, *tarsalis.* 458, *Ischyropoda armatus* coxa II. Coxae III of *Hirstionyssus:* 460, *staffordi;* 461, *tarsalis;* 462, *affinis;* 463, *palustris;* 464, *invaginatus;* 465, *thomomys;* 466, *bisetosus;* 467, *punctatus.*



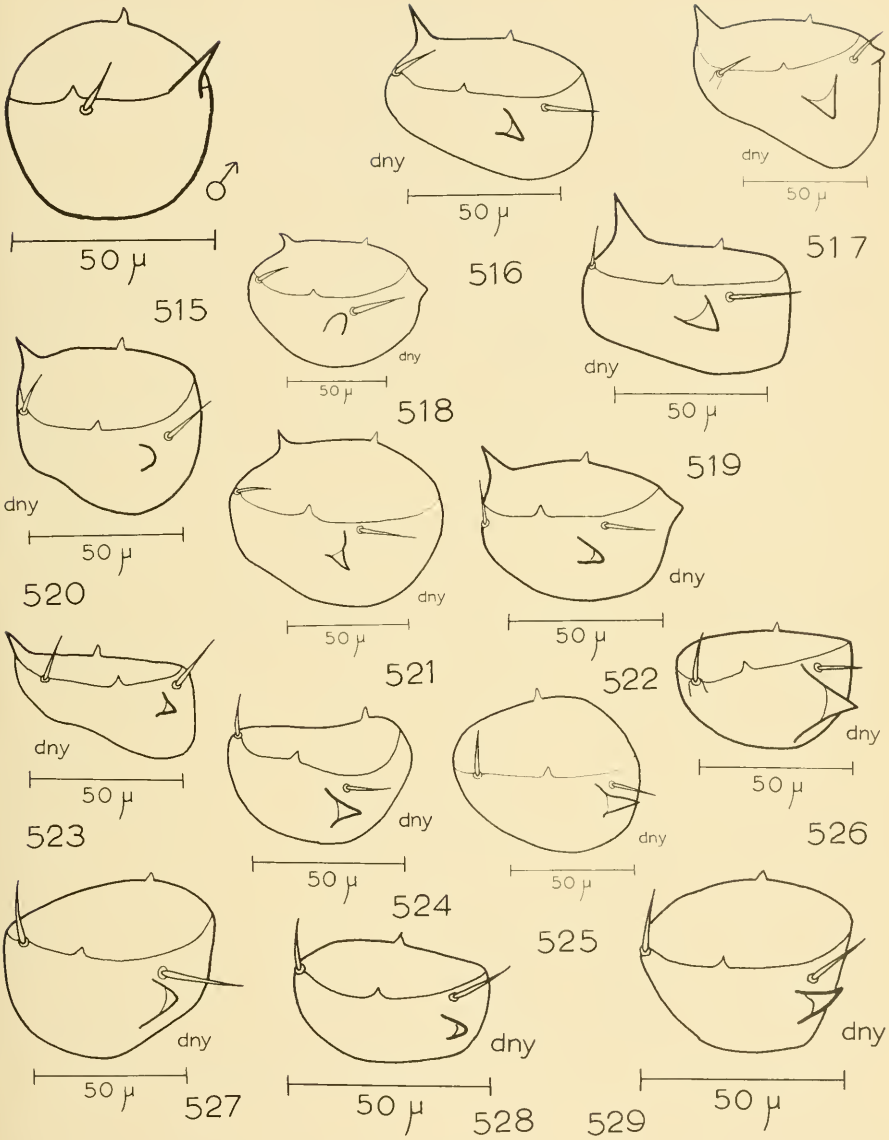
Figs. 468-483. *Hirstionyssus.* Coxae III: 468, *invaginatus* variant; 469, *eutamiae;* 470, *utahensis;* 471, *femuralis;* 472, *angustus;* 473, *longichelae;* 474, *torus;* 475, *neotomae;* 476, *isabellinus;* 477, *triacanthus;* 478, *hilli;* 480, *hilli* variant; 481, *incomptus.* Coxae IV: 479, *staffordi;* 482, *eutamiae;* 483, *punctatus.*



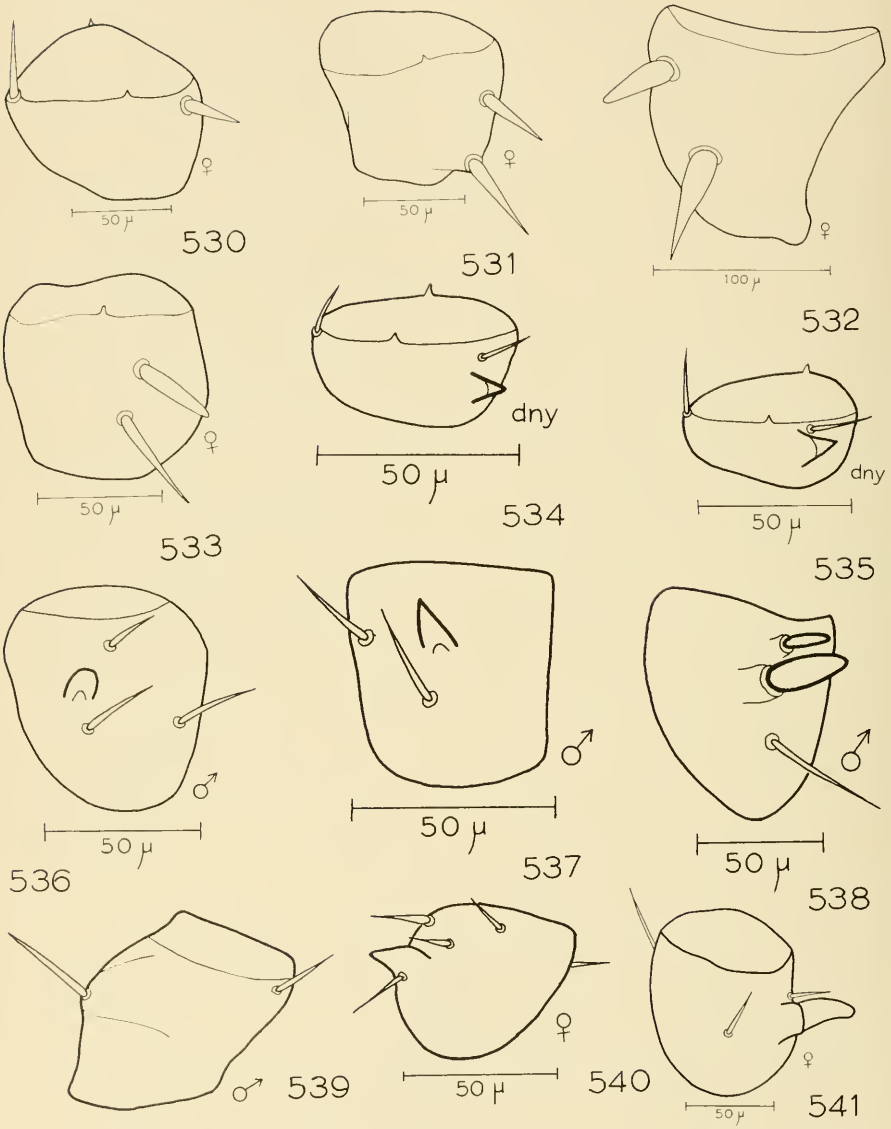
Figs. 484-499. *Hirstionyssus.* Coxae II: 489, *utahensis;* 490, *femuralis;* 492, *torus;* 493, *neotomae* variant A; 494, *thomomys;* 496, *bisetosus;* 497, *incomptus.* Coxa III: 491, *femuralis.* Coxae IV: 484, *invaginatus;* 485, *invaginatus* variant; 486, *utahensis;* 487, *torus;* 488, *neotomae;* 495, *utahensis;* 498, *neotomae* variant B; 499, *femuralis.*



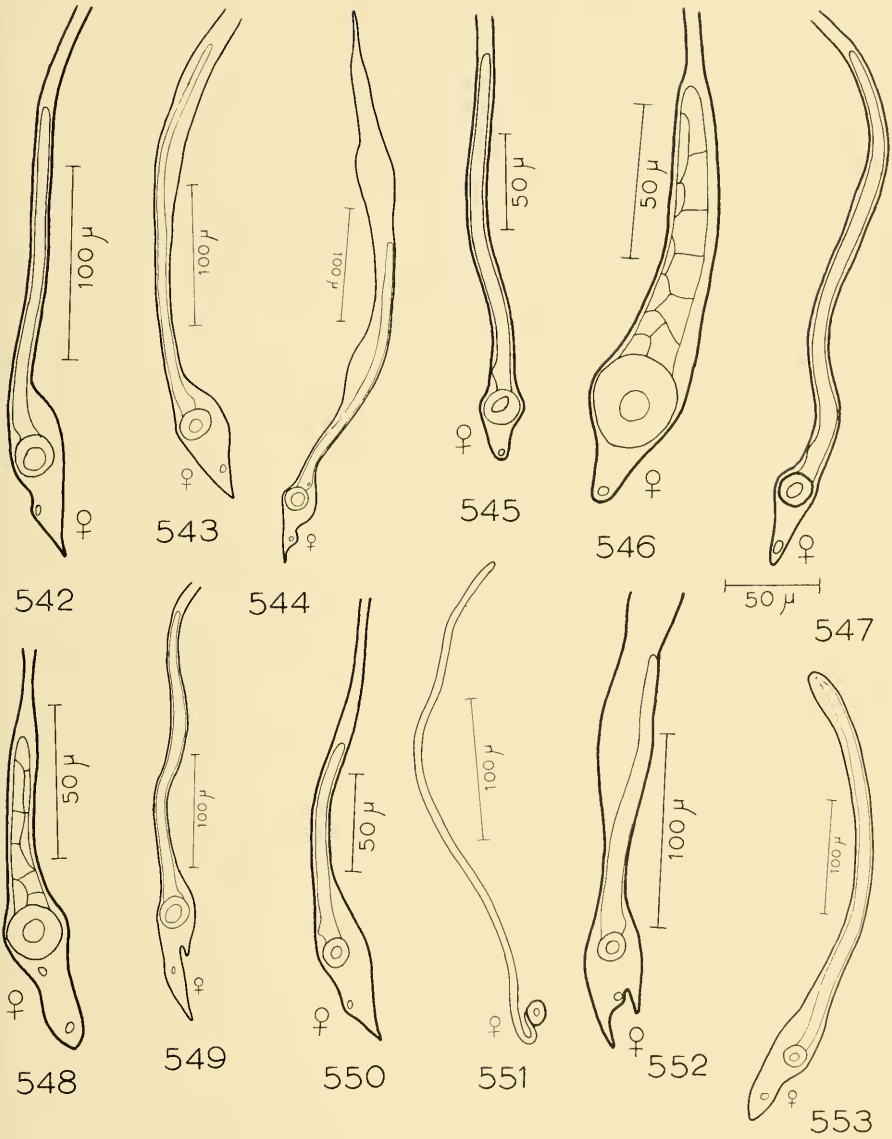
Figs. 500-514. *Hirstionyssus*. Coxae II: 500, *neotomae* variant B; 510, *neotomae* variant C. Coxae III: 501, *utahensis*; 502, *neotomae* variant B; 503, *neotomae* variant C; 504, *torus;* 505, *neotomae* variant A; 506, *thomomys;* 508, *incomptus;* 509, *bisetosus*. Coxae IV: 507, *thomomys;* 511, *bisetosus;* 512, *torus;* 513, *neotomae* variant A; 514, *neotomae* variant C.



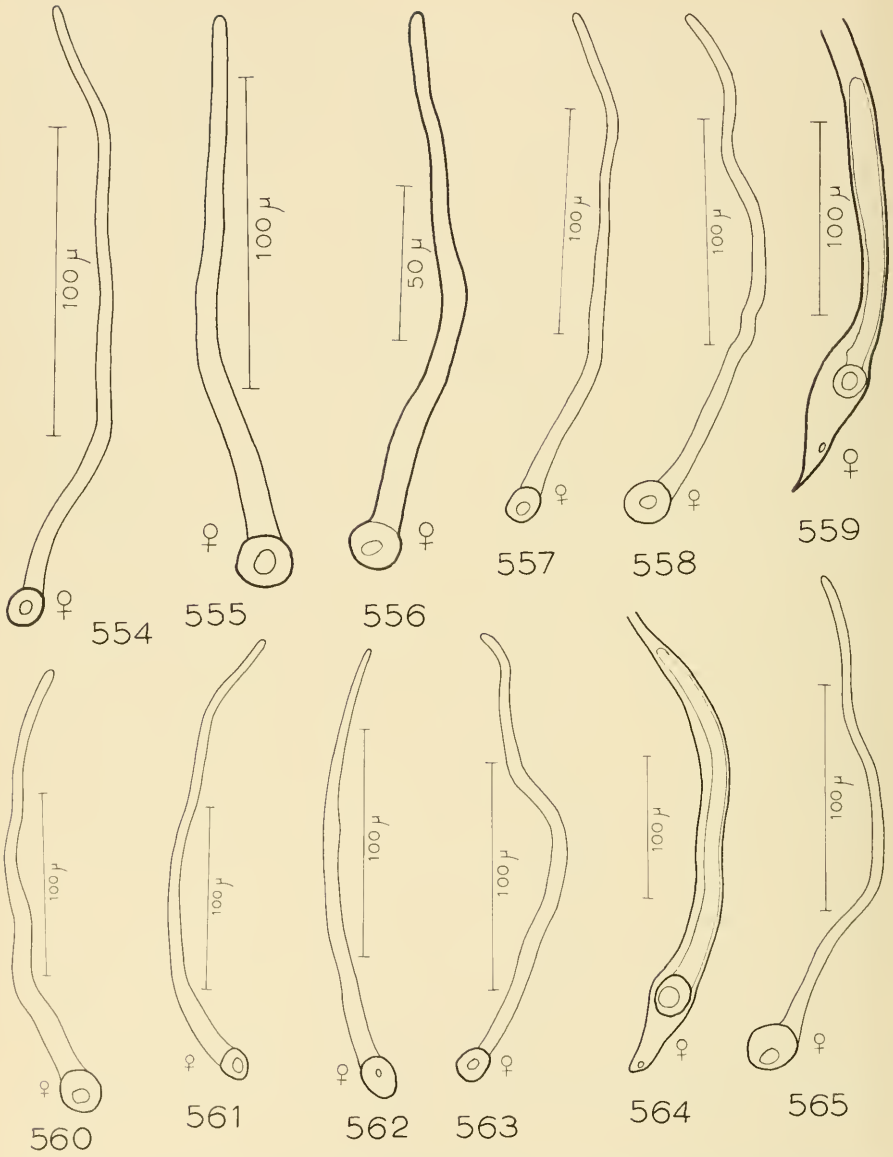
Figs. 515-529. *Hirstionyssus*. Coxae II: 516, *utahensis;* 517, *femuralis;* 518, *thomomys;* 519, *bisetosus;* 520, *torus;* 521, *isabellinus;* 522, *incomptus;* 523, *neotomae*. Coxae III: 524, *utahensis;* 525, *isabellinus;* 526, *femuralis;* 527, *thomomys;* 528, *neotomae;* 529, *torus*. Coxa IV: 515, *incomptus*.



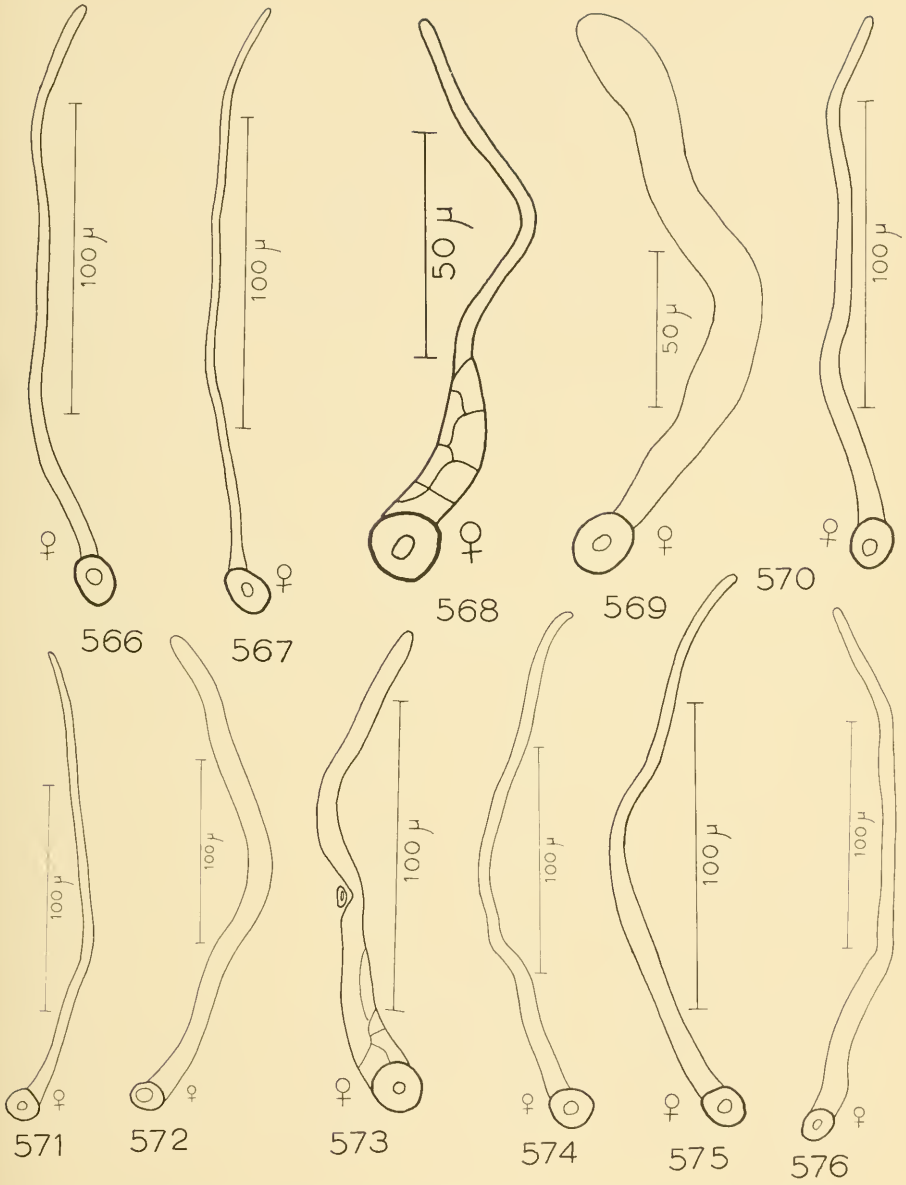
Figs. 530-541. Coxae I: 531, *Laelaps kochi;* 532, *L. multispinosus;* 533, *L. incilis.* Coxae III: 530, *Eubrachylaelaps circularis;* 534, *Hirstionyssus incomptus;* 535, *H. bisetosus.* Femora II: 536, *Ichoronyssus robustipes;* 538, *Ischyropoda armatus;* 540, *H. femuralis;* 541, *Androlaelaps leviculus.* 537, *Ichoronyssus robustipes* femur III. 539, *Ornithonyssus aridus* palpal femur.



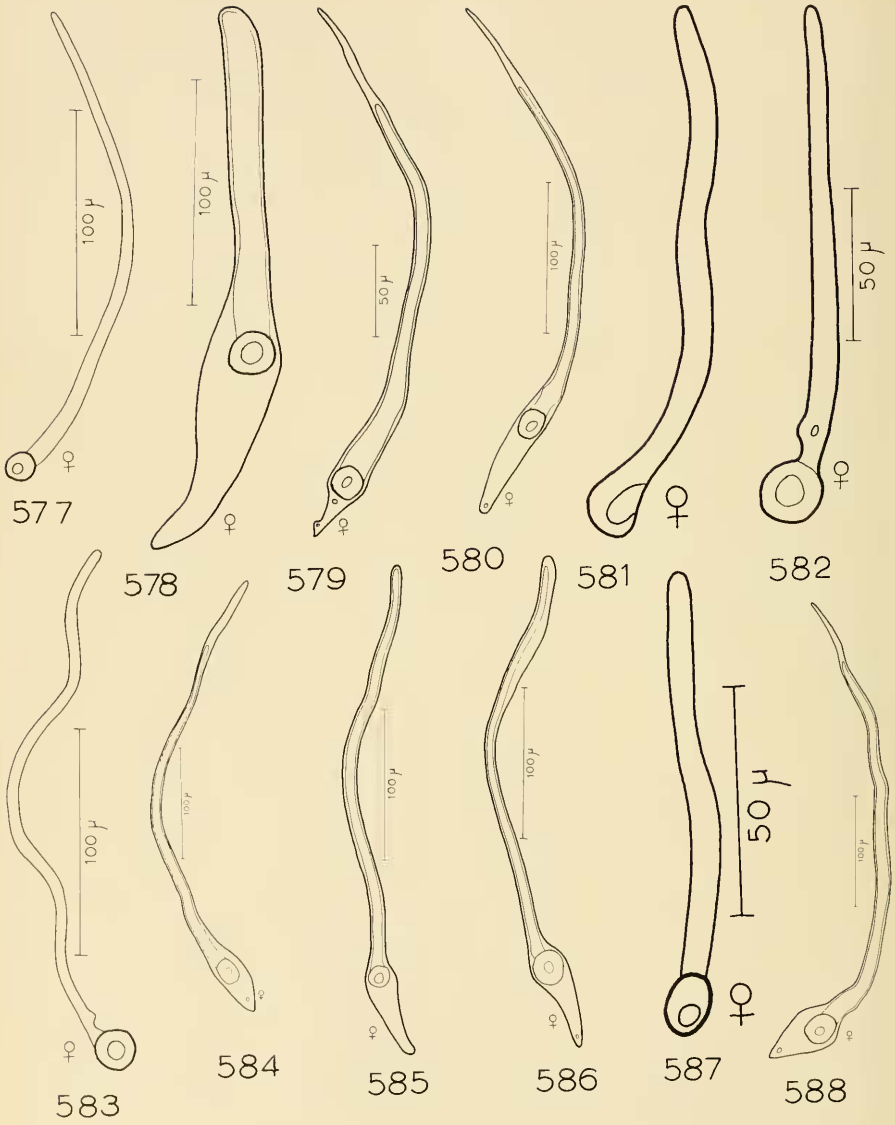
Figs. 542-553. Peritremes. 542, *Haemogamasus ambulans* form C; 543, *H. alaskensis;* 544, *H. ambulans* form A; 545, *Ischyropoda furmani;* 546, *Brevisterna montanus;* 547, *I. armatus;* 548, *B. utahensis;* 549, *H. liponyssoides;* 550, *H. ambulans* form B; 551, *Macrocheles* sp.; 552, *H. pontiger;* 553, *Eulaelaps stabularis.*



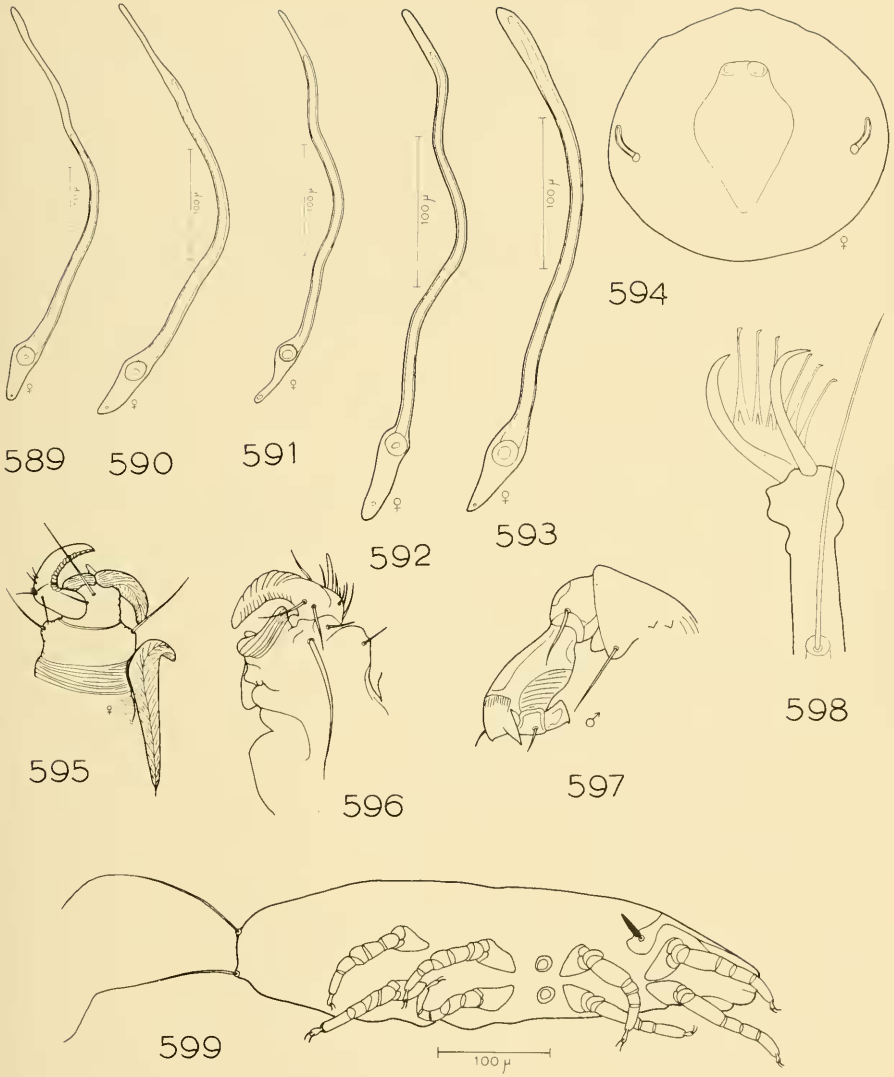
Figs. 554-565. Peritremes. 554, *Hirstionyssus femuralis;* 555, *H. eutamiae;* 556, *H. affinis;* 557, *H. utahensis;* 558, *H. palustris;* 559, *Haemogamasus ambulans* form D; 560, *Hirstionyssus invaginatus;* 561, *H. invaginatus* variant; 562, *H. punctatus;* 563, *H. tarsalis;* 564, *Myonyssus montanus;* 565, *Hirstionyssus angustus.*



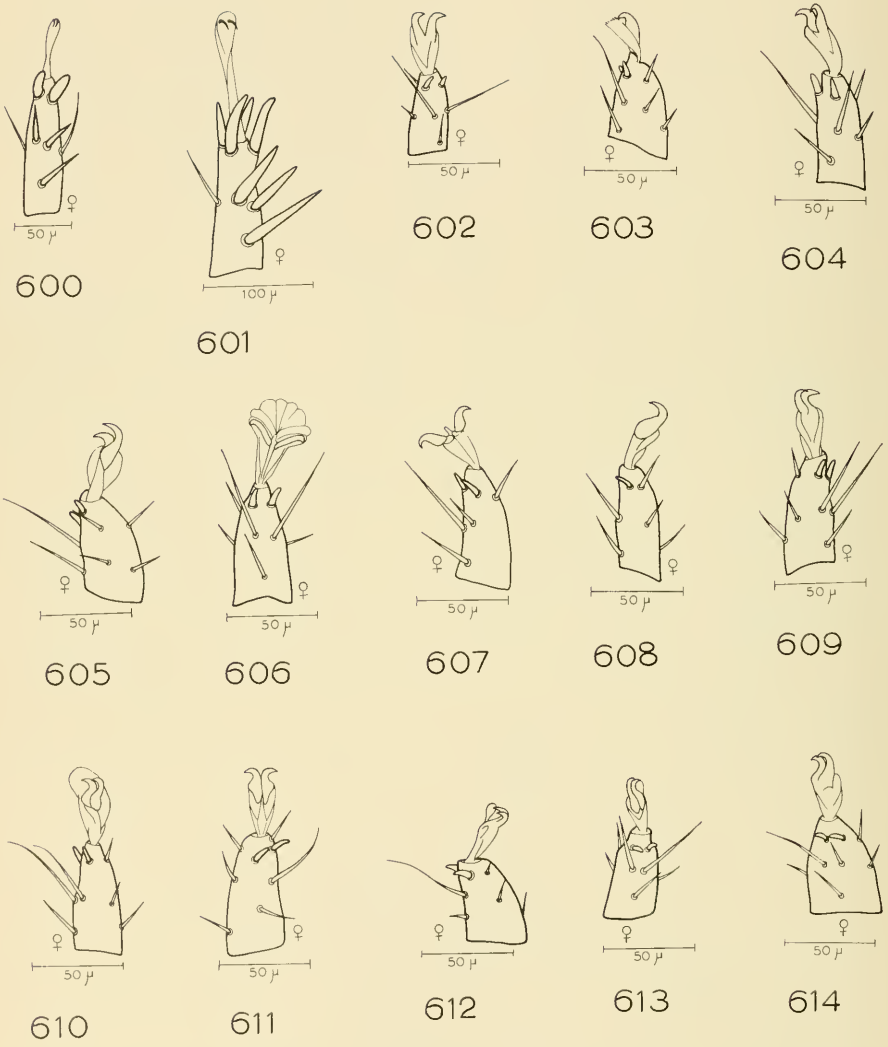
Figs. 566-576. Peritremes. 566, *Hirstionyssus bisetosus;* 567, *H. longichelae;* 568, *H. hilli* variant; 569, *H. triacanthus;* 570, *H. neotomae;* 571, *H. torus;* 572, *Ichoronyssus robustipes;* 573, *H. hilli;* 574, *H. isabellinus;* 575, *H. incomptus;* 576, *H. thomomys.*



Figs. 577-588. Peritremes. 577, *Ornithonyssus sylviarum* variant; 578, *Steatonyssus antrozoi*; 579, *Laelaps incilis*; 580, *L. kochi*; 581, *O. aridus*; 582, *Dermanyssus hecki*; 583, *O. sylviarum*; 584, *Eubrachylaelaps crowei*; 585, *Androlaelaps leviculus*; 586, *E. hollisteri*; 587, *O. bacoti*; 588, *L. multispinosus*.



Figs. 589-599. Peritremes: 589, *Eubrachylaclaps circularis;* 590. *E. debilis;* 591, *Hypoaspis lubrica;* 592, *Haemolaclaps casalis;* 593, *H. glasgowi.* 594, *Paraspinturnix globosus* dorsum; 595, *Radfordia bachai* leg I and specialized seta; 596, *R. lemnina* leg I; 597, *Myocoptes* sp. leg III; 598, claws and empodium typical of Cheyletidae and Tetranychidae; 599, *Listrophorus* sp. ventrolateral view.



Figs. 600-614. Tarsi 11. *Ischyropoda*: 600, *furmani*; 601, *armatus*. *Hirstionyssus*: 602, *staffordi*; 603, *tarsalis*; 604, *affinis*; 605, *palustris*; 606, *punctatus*; 607, *invaginatus*; 608, *invaginatus* variant; 609, *cutamiae*; 610, *utahensis*; 611, *angustus*; 612, *femuralis*; 613, *longichelae*; 614, *thomomys*.

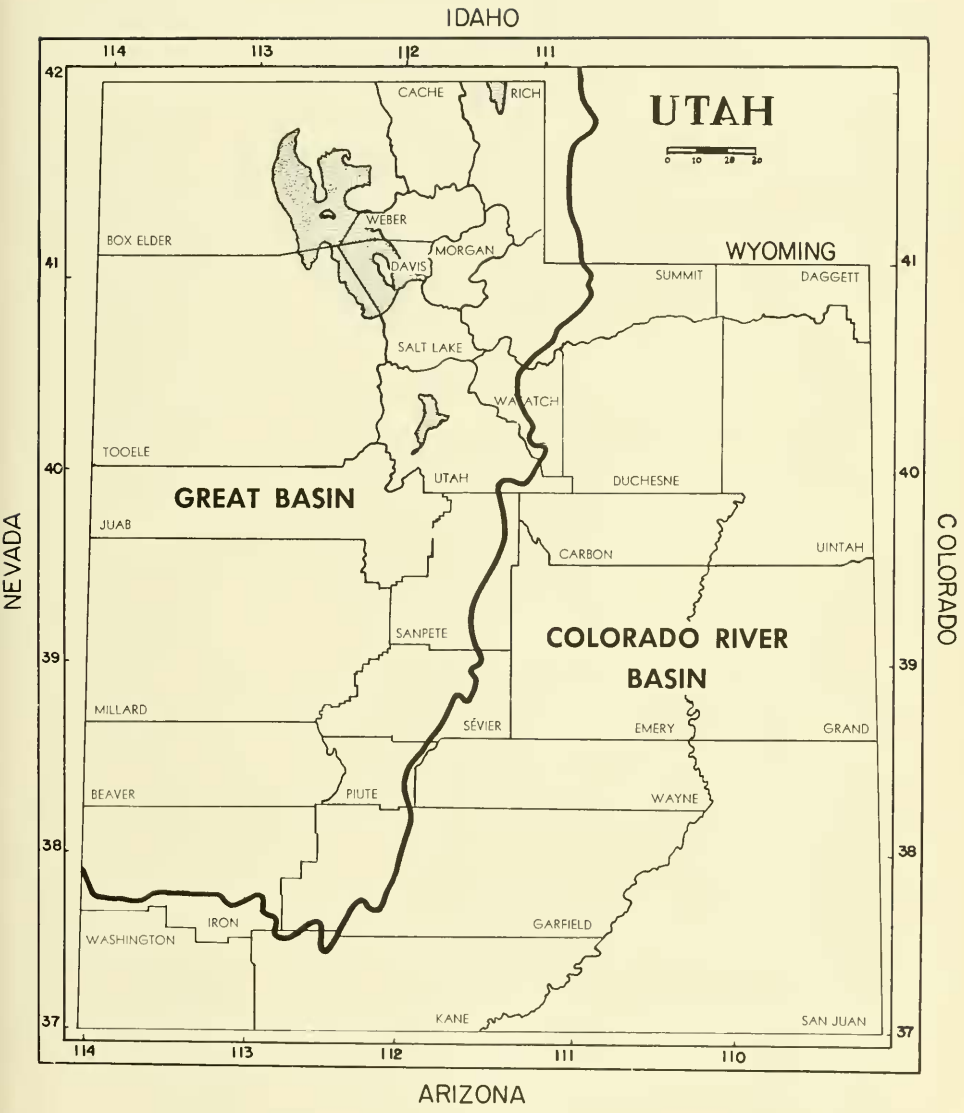


Fig. 615. Map of Utah showing counties and division into Great Basin and Colorado River Basin.