

AN ABSTRACT OF THE THESIS OF

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The beetle mites composing the superfamily Oribatoidea have been among the most neglected of the Acarina. However, with the announcement by Dr. H. W. Stunkard in 1937 that certain of these mites had been incriminated as intermediate hosts of the sheep tapeworm, Moniezia expansa, an interest in these mites was aroused. Stoll and Krull later announced that Galumna nigra and emarginata Ewing were the species incriminated. The sheep tapeworm is abundantly present in western Oregon and an attempt was made to determine whether or not the same species of mites responsible for the transmission of the parasite in eastern states are present in western Oregon.

Methods of collecting and rearing, and laboratory technique, particularly for the oribatid mites, are discussed. An historical account of acarology in Europe, America, and Oregon is given. The general characteristics of mites, and especially those found in the Oribatoidea and of taxonomic

importance, is discussed.

Numerous collections of mites were taken from sheep pastures, duff, grass, moss, etc. in the vicinity of Corvallis, Oregon. Mites of three of the families of Oribatoidea were taken, namely, Galumnidae, Nothridae, and Pelopidae. The galumnid mites taken were identified by Dr. H. E. Ewing, Senior Entomologist, Division of Insect Identification, Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, simply to genus or family. The following genera of this family were taken: Galumna, Scheloribates, and Mycobates. Thus without specific identification of the Galumna species taken it cannot now be stated that the same species acting as intermediate hosts of the sheep tapeworm in eastern states are present in Oregon. The galumnid mites taken may be among those responsible for transmission of the parasite in western Oregon but further extended experiments will be necessary to obtain such proof.

In addition to the Oribatoidea, other mites collected with the beetle mites or otherwise available were studied as well as all available information and literature concerning Oregon mites. All the species definitely known to occur in Oregon (73 to date) are discussed briefly under their respective superfamilies and families, and a systematic list of the species is also included in the appendix. Two figures illustrating the characteristics of the galumnid mites, and a list of the terms frequently used in acarology are also included.

OBSERVATIONS ON SOME WESTERN OREGON  
MITES, WITH SPECIAL REFERENCE  
TO THE ORIBATOIDEA

by

ELY MARTIN SWISHER

A THESIS

submitted to the

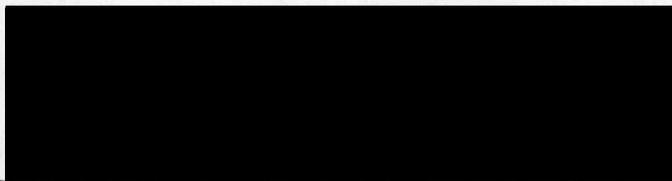
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OBSERVATIONS ON SOME WESTERN OREGON  
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INTRODUCTION

Although the Acarina, or mites, are not insects, this group of arthropods is so closely related ecologically and economically to the insects, that the science of acarology has become very closely allied to entomology. As a whole, the mites comprise a little known order. Most persons are scarcely aware of the existence of these minute creatures, and often entomologists have only a vague knowledge of this interesting group which surpasses many of the orders of Insecta in economic importance.

The "beetle mites" or "moss mites" composing the superfamily Oribatoidea have been among the most neglected, particularly in America. Dr. H. W. Stunkard's announcement in 1937 (60) that certain of these "beetle mites" had been incriminated as intermediate hosts of the sheep tapeworm, Moniezia expansa, has turned the attention of some economic students to the group.

Moniezia expansa is abundantly present in certain parts of Oregon, and an attempt has been made in this work to determine whether or not species of mites incriminated as intermediate hosts in eastern states are present in western Oregon. Various methods of collecting, and laboratory techniques have been tested and evaluated. In all cases possible, notes on habits, habitats, and inter-

relationships were taken, and morphological structures of taxonomic importance were studied.

In conjunction with this work, mites of other families collected with the "beetle mites," or available elsewhere, have been studied as time permitted. A preliminary list of the Acarina of Oregon (exclusive of the Ixodoidea) has been compiled from a study of available literature, collections, and correspondence. General considerations of the order and families, and descriptions of the species listed are, for the most part, taken from published literature included in the bibliography.

It is hoped this small contribution will stimulate further study of Oregon mites, and that the collection and list of species will be increased to serve as an aid to students interested in a broad general knowledge of our mite fauna.

## COLLECTION AND REARING

Mites may be found in almost any situation capable of supporting animal life, and methods of collection must necessarily differ for the various groups. Collectors, too, differ in their methods. All recommended methods of collecting, applicable to the oribatids, were tried and tested.

When collecting oribatids and other mites associated with them, it was necessary to closely examine the bark crevices on trees, the areas beneath fallen debris of all kinds, particularly old wood and fallen leaves, the areas beneath old bark, rotten stumps, grass, moss, and duff. Special emphasis was placed on areas used as sheep pastures. Larger mites may be collected individually from this material with a camel's hair brush or insect pin having its point bent at right angles, but many species are so minute or blend with their environment so completely that this process is very tedious. Again in the case of larger species, the material containing mites can be sifted over a piece of white cloth and the specimens collected with camel's hair brush. Except for a few of the larger, slow moving mites, this method was found to be impractical.

It was preferred to place all material containing mites from one situation in any handy container that could be

carried in the field. In the laboratory a modification of the "Berlese method" was used to drive and shake the mites from this debris. All material collected was placed in a large seive within a funnel and heated by an electric bulb placed closely over the seive. The mites, driven out by the heat and by shaking the seive, fell into the funnel and were collected below. Observed and assorted under the binocular, specimens could be collected alive or quickly preserved for later observation or mounting.

For collecting oribatid mites from grasses, Krull (48) recommends the following procedure.

"Grass from which oribatid mites were to be collected was cut with ordinary shears and transferred in buckets to the laboratory. The grass was then washed immediately by transferring it, not over one pound at a time, to a parallel-sided glass jar, having a capacity of about 14 liters. The jar was filled to within several inches of the top with tap water having a temperature of not more than 60°F. The grass was plunged up and down several times in the water, then removed, a small amount at a time, after it had been agitated to remove any mites that might have remained attached. When all the grass had been removed, the washings were poured into a similar container through a screen having 34 meshes to the linear inch... While the contents of the jar settled, the surface was examined for mites... After 2 or 3 minutes the water, except for 1 to 2 liters, was very carefully and quickly decanted. The remaining portion with the sediment was agitated and transferred to a 4-liter battery jar. The larger jar was rinsed with enough cold water to fill completely the smaller jar to within an inch of the top... As soon as the solid contents had settled the water was carefully and quickly decanted, leaving in the jar about 150 cc, which, after being agitated, was transferred to a 250 cc cone-shaped graduate, filling it to near the top.

After the contents had settled and any mites coming to the surface had been removed, about 200 cc of the water was very carefully decanted and replaced by water having a temperature of 113°F. The addition of warm water changed the density of the medium and forced the mites to the surface and through the film formed by the surface tension so that they could be removed."

This somewhat elaborate and detailed procedure was found to be time consuming and somewhat unwieldy. However, by carefully following the above procedure good results can be obtained. The writer recommends it only in collecting mites from such materials that are found to be incompatible with the above described seive-funnel method.

Following the suggestions of Jacot (44) cells were made in which to keep live mites for observation and rearing. These cells were made by fastening a small glass ring on a microscope slide with balsam. A large cover-glass held in place with vaseline made a good moisture-proof and transparent cover. It was necessary to examine the cells at least every two days to keep the moisture conditions correct, check the food supply, and retard the growth of molds and fungi. A small piece of blotter paper placed in the bottom of the cell aided in holding the moisture. Mites kept in cells of this type could be examined easily under the binocular with very little disturbance.

## LABORATORY TECHNIQUE

The technique involved in the preservation and preparation of the Acarina for study varies with the different types of mites, and is still far from perfect for all groups. For the larger and heavily sclerotized forms, such as many oribatids and parasitids, high grade filtered Canada balsam is the best medium. Specimens to be mounted in balsam should be killed by submersion in hot water or hot alcohol which causes the appendages to become extended. The specimens may then be placed in 50-70% alcohol for two or three hours and then transferred to 95% alcohol for a similar period of time. Beechwood creosote is preferable to xylol as a clearing agent, and when used it is not necessary to place the specimens in 100% alcohol. This clearing agent also leaves the specimen flexible and reduces bubbles in the final mount. Mites should be allowed to remain in the clearing agent from two to six hours and then transferred directly to the balsam on a microscope slide, and the cover glass lowered. Canada balsam is not entirely satisfactory as it is slow to dry, will sometimes cause a slight shrinkage and distortion, and darkens with age. Soft bodied mites cannot be mounted in balsam as they soon become so transparent that smaller structures become invisible.

For most mites, including less sclerotized oribatids, a modification of Berlese's formula recommended by Ewing (32) is preferred. This solution is a clearing-mounting medium and made according to the following formula:

water -----	35 cc
chloral hydrate -----	30 grams
glycerine -----	12 cc
powdered gum arabic -----	12 cc
glucose gum arabic -----	3 cc

This fluid will kill and fix some specimens in an extended position, but it is usually more satisfactory to kill them first by immersion in hot water or hot 10% acetic acid. After the cover glass has been placed, the slide may be gently warmed over a flame or oven baked for an hour or two, at a temperature not exceeding 33°C, to hasten drying, but this is not a necessary procedure. In a few days the slide can be easily cleaned with a damp cloth and examined. This medium has the advantage of being quick drying, shrinks very little, and is soluble in water. Due to the fact that it is also a clearing medium and specimens need not be dehydrated much time is saved in its use. It has the disadvantage of sometimes drying too quickly and forming bubbles, and at times may crystalize. In a recent letter, J. F. Lamiman recommended this general formula for many mites but stated that if desired the chloral hydrate may be increased three or four times, or in other cases, a small

quantity of water may be substituted for some of the chloral hydrate to prevent crystalization, however, this causes increased shrinking. Also the amount of glycerine may be reduced, or the glucose may be increased to meet the needs of the individual problem. The formula as given by Ewing (32) was used with very little variation in the ingredients and gave satisfactory results in most cases. It is not satisfactory for mounting tyroglyphids. Ewing recommends it especially for tarsonemids, and states it is unsatisfactory for the "cheese mites."

In a few cases it may be found helpful to stain some light colored specimens before mounting. For this purpose a modification of Elteringham's procedure proved satisfactory. Specimens are placed in glacial acetic acid for about ten minutes, then transferred to an equal solution of acetic acid and clove oil. Into this solution a drop of acid fuchsin stain is added and the specimen left until properly stained. This time varies considerably for different species. When sufficiently stained, the specimens should be rinsed in 10% acetic acid and immediately mounted in Ewing's solution. It is preferable to mount stained and unstained specimens on the same slide to show the species in its natural as well as stained condition. Some mites may be cleared in warm KOH and then stained as is the

practice with the Coccidae. However, results obtained using this method were not as satisfactory as the modified Elteringham method.

In heavily sclerotized species, particularly the large oribatids, some structures may be brought out more clearly if the specimens are somewhat decolorized. This may be done by placing the mite in hot KOH solution, but the method recommended by Imms (38) is preferred. A few drops of concentrated HCL is placed in the bottom of a small vial with an equal amount of water and a few crystals of potassium chlorate. Chlorine gas is evolved which decolorizes heavily colored mites placed in this solution for 5 to 30 minutes. A decolorized specimen should be mounted on the same slide with a natural specimen.

When possible, two or more specimens of each species, depending on the size, were mounted on the same slide. By following this practice, male and female specimens can be shown together, as well as nymphs and adults. Specimens can be arranged to show dorsal and ventral surfaces, and stained or decolorized specimens and natural specimens can be more easily compared.

Mites collected in large numbers cannot always be mounted immediately and should be preserved in vials. When possible, duplicate material should also be preserved. 75%

or 85% alcohol is often used, but specimens to be mounted in a chloral hydrate medium should not be preserved in alcohol. Alcoholic material hardens in time and becomes faded. Miller (51) recommends an equal mixture of glacial acetic acid, glycerine, and water as a preserving fluid, and this was found to be very satisfactory. It is preferable to alcohol in several respects: the specimens may be mounted directly from this into a chloral hydrate medium; they remain soft and pliable; evaporation is slower; and the specimens retain their natural color for a considerably longer time than those in alcohol.

## BRIEF HISTORICAL ACCOUNT OF THE ACARINA

Mites are believed to date from the Oligocene. A. C. Oudemans (56) cites articles dating as far back as 850 B. C. in which mites are mentioned, but very little study of the Acarina was attempted until the 18th century. Linnaeus, in his "Systema Natura," 1758, lists a few species with brief descriptions, including the "common red spider mite." He placed all the mites known to him in the genus Acarus.

The first attempt at a classification of the Acarina began with De Geer, who, in 1778, arranged the group into seven divisions based on their general habits. In 1834 Duges devised the first real classification and divided the Acarina into seven families somewhat similar to the present groups (4). Since that time an extensive study of the European fauna has been made and numerous and valuable contributions by such outstanding investigators as Latreille, Megnin, Canestrini, Berlese, C. L. Koch, Nalepa, Michael, and Oudemans have formed the foundations of acarology.

In the United States very little was published in this field until late in the 19th century. For over twenty-five years the only work generally available to the American students was Murray's "Economic Entomology; Aptera," an English publication of 1877. "A treatise on the Acarina, or mites" by Nathan Banks, 1904 (4) was the first outstanding

American publication treating only the Acarina. In 1915 this work was revised and enlarged by Banks, and although much of it is now out of date, it is still the best general American reference to the Acarina. There is a real need for an up to date general work treating this group. Dr. H. E. Ewing of the U. S. Bureau of Entomology is today the most outstanding American acarologist. Dr. Robert Wolcott, A. P. Jacot, E. A. McGregor, R. A. Cooley, and others have also made valuable contributions to this study.

Scientific investigation of our Oregon fauna was begun about 1910 by H. E. Ewing who was with the Oregon State College Department of Entomology at that time. He collected, determined, and described many Oregon species. Ewing's Oregon Experiment Station Bulletin "The common red spider or spider mite" 1914, (22) is still unparalleled. Outstanding also is the study of the cyclamen mite by G. F. Moznette, 1917, (52) then with the Oregon Experiment Station. E. A. McGregor, U. S. D. A., has described several species of "spider mites" collected from the Willamette and Hood River valleys. "The ticks of Oregon" by Dr. W. J. Chamberlin (11) and "The blackberry mite in Oregon" by W. D. Edwards, et al are recent Oregon publications of note.

## GENERAL CONSIDERATIONS OF THE ACARINA

Mites constitute the order Acarina in the arthropod class Arachnida. They are easily recognized at sight, but it is difficult to give definite characters to distinguish a mite from other arachnids. Ewing (18) characterizes the Acarina as

"Arachnida in which the body is unsegmented, or is divided into two parts (cephalothorax and abdomen), which are broadly united; mouth parts frequently united so as to form a beak; palpi well developed and often provided with a prehensile organ; legs various in shape, size, and function in the different groups and often in the two sexes; integument either soft or coriaceous. The larva, or first stage of the young, has but six legs. The nymph, or second stage, is eight-legged and resembles the adult more or less."

Some early writers have claimed that the mites constituted a separate class, but it is now generally agreed that they are true arachnids, and more closely related to the solpugids and phalangids than any other group (4).

The cephalothorax is the anterior of the two body regions. In a few families and many genera, the demarcation between the cephalothorax and abdomen cannot be distinguished, but in a majority of cases this division is easily noted. The cephalothorax extends usually to between the 2nd and 3rd pairs of legs. It is largest in the Bdellidae and Tetranychidae where it may equal the abdomen in size. The cephalothorax is often divided into an anterior rostrum, or

beak, and a posterior part called the dorso-vertex. The oral cavity containing the mouth parts is situated approximately ventrally on the cephalothorax. Chitinous projections arising from the cephalothorax, the epistoma above and the hypostoma below, frequently protect the oral cavity. The epistoma is well developed in the Parasitidae and of taxonomic importance. The hypostoma is best developed in the Bdellidae where it forms a support for the mandibles. One or more pair of eyes may be present near the lateral margins of the cephalothorax. Long tactile hairs may be present on the dorsal surface of the cephalothorax and often are of taxonomic importance. The anterior pairs of legs are borne on the cephalothorax. Chitinous expansions, or tectopodia, above the coxae of the 1st and 2nd pairs of legs, and similar blade-like expansions, or lamellae, are present in some families, as the Oribatidae, and are of taxonomic importance.

The mouthparts consist of the mandibles and palpi and usually one or more parts such as the maxillae, or hypopharynx. The mouth parts are greatly modified among the families, depending upon the habits of the group. In the Bdellidae and Parasitidae the mandibles are very large and chelate and may be nearly one half as long as the rest of the body. The parasitids and some other mites are able to

draw the mandibles within the mouth opening, or camero-  
stome, so that they are invisible from above. In the Ori-  
batidae and Tarsonemidae, for example, the mandibles are  
very minute. The palpi consist of 3 to 5 joints and are  
often of taxonomic importance. They may vary in size from  
nearly rudimentary to large, long appendages equal to the  
entire length of the body. In some cases the palpi are  
modified for grasping and holding prey. Tactile hairs may  
be situated on the palpi, especially at the tip of the last  
segment. The basal joints of the palpi are in some cases  
modified to form maxillae. In the Ixodidae, Parasitidae,  
and some other families, there is a distinct tongue, or  
hypostome, arising from the inner base of the beak. It may  
be simple or divided. In all cases, except in the Ixodidae,  
it is visible only after dissection.

The abdomen is the posterior of the two body regions  
and varies greatly in size and shape. It may bear few or  
many setae or none. The posterior pairs of legs, when pres-  
ent, are usually borne on the abdomen. These openings  
are sometimes contained in chitinous plates known respectiv-  
ely as the anal and genital plates. The female aperature,  
or epigynum, and the male aperature, or epiandrum, are of  
various shapes and position and are often of taxonomic im-

portance.

The legs, usually four pair, are composed of from five to seven segments. The length and character of the joints differ very greatly in the different families, but usually a coxa, trochanter, femur, patella, tibia, and tarsus are distinguishable. The tarsus often bears from one to four claws, or ungues. In many cases there is a median cup-shaped sucker, or pulvillus, between the claws. In a few cases the legs of the male and female of a species differ considerably.

The internal anatomy of mites has been studied considerably by several European workers. The internal parts are greatly centralized and crowded. The alimentary canal, when fully developed, consists of a pharynx, oesophagus, ventriculus, and coeca, hind gut, and malpighian tubules which, when present, are two in number. The nerve ganglia are united into a mass, or brain, lying within the cephalothorax. One unpaired or median nerve serving the pharynx, and nine or more paired nerves serving the other organs, arise from this brain.

The reproductive system of the mites is highly developed and often occupies most of the body cavity. The male possesses a pair of lobate testes opening into two vasa deferentia which unite to form the ductus ejaculatorius. An extensile penis is present in some cases and may be of

taxonomic importance. Female organs differ considerably, but in general they are composed of a pair of ovaries situated in the abdomen and opening into two oviducts which unite to form the vulva, or epigynum. In some mites the vulva may have a spermatheca and may open through an extensible ovipositor.

Many mites have an elaborate tracheal system. The tracheae open through stigmata in various parts of the body, usually near the mandibles. In the Ixodidae and Parasitidae the openings are near the hind legs. The presence or absence and position of the stigmata is often of considerable taxonomic importance. Most of the soft bodied mites have no respiratory system and absorb oxygen through the body wall.

The life histories of mites vary with each species. There are typically four stages of development: egg, nymph, larva, and adult or prosopon. Some mites have additional phases, usually during the nymphal stage. Nearly all mites are oviparous, but a few are ovoviviparous. Aparity is not uncommon.

Several systems of arranging the order Acarina into suborders, superfamilies, and families have been offered, mostly by European workers. The classifications set forth by Ewing (18) and Banks (4) have been most commonly accepted

in this country. In this work the superfamilies and families of Banks have been accepted, and on the following pages the various species of mites definitely recorded from Oregon will be discussed under the families to which they belong. Because of the special reference placed here on the Oribatoidea, that superfamily will be treated first, followed by the other superfamilies in their usually accepted arrangement. In order that the list may be useful, interesting, and illuminating to the reader, the species are listed under their respective superfamilies and families following a brief consideration of these groups. Brief descriptions of the species are given together with notes on hosts, distribution, and other interesting facts. The Ixodoidea, or ticks, are not included in this work, and for a discussion of our Oregon species the reader is referred to Chamberlin (11) and Cooley (12).

## SUPERFAMILY ORIBATOIDEA

The superfamily Oribatoidea is composed of mites commonly known as the "beetle mites;" this common name is derived from their beetle-like appearance. The body is usually coriaceous, short, broad, and high. The division between the cephalothorax and abdomen may be plain or indistinct. They possess few body hairs, no eyes, and very minute, usually chelate, mouthparts. The ventral openings of the abdomen are large and borne on chitinous plates. Most characteristic are the pseudostigmatic organs possessed by all members of this superfamily. The pseudostigmatic organs are a bristle or seta arising from a small pore near each posterior corner of the cephalothorax. Although pseudostigmatic organs occur in some other acarina, they are possessed by all the Oribatoidea and are more highly developed here than in any other group. These organs vary greatly in size and shape in the various species. Jacot (45) states "there are no phylogenic trends in the development of these organs. They seem to be shaped chiefly by the environment and are therefore of ecologic significance."

Some members of this superfamily possess chitinous expansions termed pteromorphae or wings located on each side at the base of the abdomen. The pteromorphae may be movably or immovably attached, and their size and shape are of tax-

onomic importance. Mites possessing such chitinous expansions are often termed winged mites. On the dorsum of the cephalothorax there are often narrow ridges, or lamellae, which are characteristically developed in the various species. Sometimes there are other plate-like expansions known as tectopodia which are at the base of the coxae. Often there are two pair of bristles of taxonomic importance arising on the cephalothorax. Tracheae may be present or absent. When present they vary greatly in size and shape among the species but open at the acetabula of the legs.

The Oribatoidea are mostly oviparous. Viviparity is known in one genus, and aparity is not uncommon according to Jacot (45). The larvae are six legged and after molting become eight legged nymphs. In many cases the nymphs are brightly colored and resemble the drab adults only slightly.

The complex structure of this group has resulted in a considerable difference of opinion on the taxonomic organization. The British acarologist, Michael, considered the entire group to be a family, the Oribatidae, which he divided into seven subfamilies (23). Oudemans (55) treats this group as one of twelve subdivisions of the entire order and terms it the Octostigmata. Banks (8) considers the group to be a superfamily, the Oribatoidea, which he divides into three families-- the Oribatidae, Hoplodermidae, and Labidostommatidae. In 1917 Ewing (23) revised the group

to include four families-- the Oribatidae, Nothridae, Hypochthonidae, and Hoplodermidae. He eliminated the Labidostommatidae from this group because of the absence of pseudostigmatic organs in that family. Since 1917 there have been further revisions, and as a result much of the literature and references on this group is confusing and contradictory.

Most important of the recent revisions is the division of the family Oribatidae into several families. Of these the Galumnidae, Oribatidae, and Pelopidae are the most important. Ewing now considers the Oribatidae to contain only wingless species and the Galumnidae to be those mites with movable abdominal wings. In addition, some authors include in the Galumnidae many of those species that have fixed abdominal wings. On the other hand, Arthur P. Jacot, who was one of the most exacting workers in this group, does not recognize the family Galumnidae but considers it essentially to be the subfamily Galumninae of the family Oribatidae. In this work the author is more concerned with the Galumnidae than any other group of the superfamily Oribatoidea, and following is a detailed discussion of this family.

#### Family Galumnidae

The Galumnidae are Oribatoidea having the pteromorphae

very large, hinged along the dorsal edge, and extending downward to the cover part of the ventral plate and covering over a shallow in the sides of the abdomen which receives the legs. The lamellae are reduced to flattened bands or, at the most, low blades.

This family is considered by Jacot and other recent workers to be a subfamily of Oribatidae, but Heinrich of the Division of Insect Identification, Bureau of Entomology and Plant Quarantine states in a recent letter to the author that Ewing considers them "to be distinct families." Now included in this family are the genera Galumna, Oribates, Oribata, in part, and others. Much of the literature on the genus Oribata is very confusing. Authors have placed both winged and wingless mites in this genus, but Ewing (23) states that this is a mistake and that the genus Oribata as Latreille described it applies to certain wingless mites and is now placed in the family Oribatidae. The genus Oribata of authors other than Latreille applies to winged mites and is now equivalent to the genus Galumna in the family Galumnidae. Recently the genera Galumna, Oribata, and Oribates have been further revised and broken down into several genera which include Zetes, Neorizetes, Holozetes, Ceratozetes, Neoribates, Centroribates, Scheloribates, and Mycobates. Jacot (39) has further divided the genus Neoribates to also include the genera Protokalumna and Parakalumna.

The genus Galumna to date has been found to be the most economically important of the group, and includes those species in which the writer is most interested.

#### IMPORTANCE OF GALUMNID MITES

Until recently the mites of the genus Galumna as well as other Oribatoidea were considered to be of very little if any real economic importance. In 1937 Dr. H. W. Stunkard (60) reported recovering cysticercoids of the common sheep tapeworm, Moniezia expansa, from experimentally infected mites of the genus Galumna. He did not definitely identify the species but later stated that "all the mites used fall within the generic concept of Galumna." Stoll (59) in 1938 reported infecting Galumna sp. and Galumna nigra (Ewing) by feeding these mites tapeworm eggs, and Krull (48) reports recovering infective cysticercoids of this tapeworm from Galumna emarginata (Banks). These writers have shown that sheep become infected with the tapeworm only by ingesting these mites which have previously fed on tapeworm eggs. Stoll (59) states "no infection of susceptible sheep was secured by feeding apparently mature cysticercoids freed from mites six weeks after exposure to the eggs, or by feeding live mites--" to the sheep. Thus the mites become infected after the feeding on the contents of the tapeworm eggs; the cysticercoids develop within the body of the mite; the mite

dies, and the sheep become infected by ingesting these mites with grass. Stoll states that from nine to eleven weeks were required for this process in his experiments.

#### OCCURRENCE OF GALUMNID MITES IN THE WILLAMETTE VALLEY

The tapeworm, Moniezia expansa, is a common parasite in the Willamette valley and if the work of the eastern investigators is to be accepted as conclusive it might be assumed that one or more species of Galumnidae is responsible for transmitting the sheep parasite in this area. However, the definitely incriminated species, Galumna nigra and emarginata, or any other species of this family, have never been recorded from Oregon. An attempt was made by the writer to collect and study oribatid mites inhabiting areas used as sheep pastures for the purpose of determining whether these or closely related species are present in this area. Unfortunately, all specimens sent to Washington, D. C. were identified by H. E. Ewing only to family, subfamily, or genus. The following were collected in the Willamette valley.

#### Genus Galumna

The genus Galumna as it now stands includes those Galumnidae which possess lamellae closely oppressed to the cephalothorax, movable pteromorphae with the ventral edge

distinctly emarginated, with the abdomino-cephalothoracic suture lacking or partially lacking or indistinct, and with the ventral openings distant.

Mites identified in this genus were taken by the writer just south of Corvallis in the fall of 1939. They were found to be extremely abundant in old grass and fir duff in an area frequently used to pasture sheep. Several hundred specimens were taken. The mite is a rich, dark, chocolate brown in color, approximately .9 mm. in length and .7mm. wide. The pseudostigmatic organs are long and clavate; the legs two clawed. A number of these mites were kept alive for two months in glass cells. They were fed moss and decayed wood and grass particles. Approximately twenty-five were examined for cystercercoids but none of these were found. It may be that this mite is responsible, at least in part, for the transmission of the tapeworm to its sheep host in this area, but extended experiments will be necessary to obtain such proof. Without this proof and without specific determination of this mite it can now only be stated that the mite may be one of those species responsible for transmitting the sheep parasite in western Oregon. The material in which these mites were always taken was found to be nearly devoid of any other species of mites or insects. They were found under conditions which were quite damp but not soggy. These mites seem to have a very delicate

adjustment to moisture and soon die under room conditions if they are not protected from evaporation.

#### Genus Scheloribates

Mites of this genus taken by the author are greenish brown to brown in color with the abdomen well rounded posteriorly and the cephalothorax sharply triangular. The mite measures about .7 mm. in length. Lamellae are not well developed but are present. The abdomino-cephalothoracic suture is indistinct. The pseudostigmatic organs are slightly clavate. The ventral plates are widely separated, the anal plate being approximately twice the size of the genital plate and situated at the extreme posterior region of the abdomen. The pteromorphae are sharply terminated anteriorly and gradually posteriorly. These mites were found to be common under the bark of old, damp, moss covered stumps around Corvallis. Many other species of mites and some insects, mostly Collembola, were taken with these mites, but they were frequently the most abundant species.

#### Genus Mycobates

Mites taken and identified in this genus are very similar to the above in size, shape and appearance. The lamellae are well developed; lamellae hairs and inter-

lamellae hairs are present. The pseudostigmatic organs are short, rough, and very clavate. These mites were taken from oak duff and grass pasture around Corvallis in October 1939.

#### OTHER OREGON ORIBATOIDEA

##### Family Nothridae

This family includes Oribatoidea which possess no pteromorphae, with the body often rugose or sculptured, chitinous integument, and with lamellae present. The cephalothorax is immovably united to the abdomen. Tracheae are present.

##### Damaeus clavipes Hermann

This is a dark brown convex mite with the integument of the dorsum smooth and slender legs with monodactyle tarsi. Ewing took this species at Corvallis in 1923, but no other reference to it has been found by the writer.

##### Hermanniella punctulata Banks variety parva Ewing

This is a new variety of the species described by Banks and was taken by Ewing from under an old log in the coastal range in Benton County, Oregon, in 1912. One specimen is in the Oregon State College collection. No

other references have been found. Members of this genus possess a convex or arched abdomen with a pair of lateral excretory tubes projecting some distance from the surface of the body wall (23).

#### Genus Nothrus

Mites of this genus possess a flat rectangular abdomen bearing prominent marginal seta-bearing tubercles. A single light brown, rectangular mite with a very granular integument, tridactyle tarsi, and four prominent tubercles on the abdomen was taken by the author from debris and leaves in the Oregon State College sheep yard in October 1939.

Another mite identified by Ewing as "Nothridae" was found by the author to be quite common in oak duff at Corvallis. The mite is oval in shape, light brown in color, with the genital and anal pores distinctly separated but close together. The chitinous dorsal plate cleat V-shaped on the venter. The mite was usually taken with numerous other mites and Collembola.

#### Family Pelopidae

This family was formerly considered to be a subfamily of the family Oribatidae. These mites possess chitinous pteromorphae, styliform chelicerae swollen at the base and

ending in minute chelae. Several mites identified by Ewing as "Eupelops" were taken by the author from fir duff at Corvallis. This genus is characterized by possessing lamellae and frequently translamellae (22). The mites taken by the author are very dark in color, the abdomen convex and semi-circular in shape with a rough integument, and the genital and anal plates well separated.

## SUPERFAMILY EUPODOIDEA

Members of this superfamily possess conspicuous but simple palpi of four or five segments. The body is soft, distinctly separated into a cephalothorax and abdomen, and possesses few body hairs.

Family Eupodidae

These are small, soft bodied, rapidly running mites quite commonly found in damp situations under old bark and fallen leaves, but very difficult to capture. The palpi are short and four segmented. The legs are moderately long and usually terminate in two claws. One pair of eyes is usually present. These mites are mainly predaceous on other mites and small insects. There is no sexual dimorphism.

Two mites taken from old oak leaves near Corvallis were identified as members of this family. One species has been determined.

Rhagidia pallida Banks

Trans. Amer. Ent. Soc. XXI, 1894, p. 222

This is a delicate, milky white mite with moderately long legs and a long abdomen somewhat narrowed posteriorly. Banks (1,8) states that members of this genus are probably

"the most primitive of living mites and are in many ways closely linked to the Solpugida." This species seems to be common throughout the nation, particularly in the north, and is probably well distributed over western Oregon. Several specimens were taken October 21 from old oak leaves and duff near Corvallis.

Michaelia pallida Ewing

Ewing described this species from specimens taken in moss at Corvallis, 1912. The abdomen of this species appears to be distinctly segmented. The mandibles are long and slender. No eyes are present. This is the genus Bimichaelia of some writers, and Banks (8) states that this genus has been taken in Oregon.

Several mites, yellowish green and black in color, oval in shape, and appearing somewhat like small leaf bugs, taken from fir duff in October, were identified by Ewing simply as "Eupodidae sp."

Family Bdellidae

The "snout mites" can be easily identified by their unusually long beak and long, three to five segmented, often distinctly elbowed, palpi. The palpi frequently terminate in long tactile spines. These mites are usually

bright red in color. The cephalothorax is large and sub-triangular, and has one or two pair of eyes on each side, usually near the posterior corners. The abdomen is large and often tapers from the shoulders posteriorly. These mites usually walk slowly over the bark or leaves, but if disturbed they can run rapidly in either direction with nearly equal speed. The species known are all predaceous and are very common on and under the bark of trees, old stumps, fence posts, etc.

The following species have been recorded from Oregon.

Bdella magna Ewing

This is a large dark red species with two pair of eyes on the cephalothorax. The palpi are long and very prominent, elbowed, and terminate in a pair of long tactile hairs. Ewing reports taking this species from the mines of Dendrocotonus pseudotsugae, Douglas fir and fence posts in 1913. Chamberlin (10) also reports it from the galleries of the bark beetle in drier bark.

Two other species taken by the author were identified as Bdella. These mites were taken frequently from oak bark, fallen leaves, and on fence posts. They were very abundant in September and October, and were also taken in January and March. Their red color and large size make them one of

the easiest to see in the field. These mites were found most abundantly in situations in which species of Collembola were dominant, and it is likely that these insects form their main diet. On one occasion the writer observed a bdellid, crawling over duff, come suddenly upon one of the larger Collembola. With a quick jab the mite inserted its beak into the insect and proceeded to suck out the body juices. After less than a minute, the beak was withdrawn and re-inserted in the thorax. The beak was again withdrawn in about half a minute, and the mite, increased in size by approximately one-eighth, wandered away. Other Collembola encountered by the mite soon after this feed were not attacked.

## SUPERFAMILY TROMBIDOIDEA

This group includes mites similar in many ways to the Eupodoidea, but they can be distinguished by the palpi, the last segment of which forms a thumb to the preceding segment which ends in a claw. The body is soft and often possesses many hairs.

Family Cheyletidae

The Cheyletids are very small mites differing considerably in both habits and structure. Typically, they possess very large, three to five segmented palpi attached to a distinct beak. The beak is separated from the body by a deep constriction. The body of these mites is oval and the cephalothorax is large, often equalling the abdomen in size. The legs are moderately short and usually end in two claws. One species has been recorded from Oregon.

Cheyletus seminivorus Packard

Guide Study Insects, 1869, p. 665

These are small, pale yellow to pinkish mites with the palpi and beak darker than the body and legs. It is widely distributed in the United States and is often taken from cereals, Essig (16) states it is predaceous on Tyroglyphus species. It has been recorded from Portland where it was

found in rice infested with Tygroglyphus species.

Family Erythracaridae

This is the family Anystidae of some writers. These mites can be separated from other members of the superfamily in that the coxae are close together and arranged in a radiate manner. The palpi are slender but prominent. The body shows no complete division between the cephalothorax and abdomen and is often covered with many hairs. The mandibles are large and taper to a point terminated by a curved claw. Most species recorded are predaceous on small insects, but two genera have been recorded as parasitic on lizards. One species has been definitely recorded from Oregon.

Anystis agilis Banks

Trans. Amer. Ent. Soc. XXI, 1894, p. 211

This is a large bright red mite measuring nearly 1 mm. in length. The body widens sharply from the apex of the cephalothorax, posteriorly, producing an egg-oval shape. The legs are long and hairy, and the mite is very agile. It is reported as predaceous on aphids, scales, and other small insects and their eggs. Essig (16) states that it has been recorded in Oregon preying on the larvae of the bud moth

(Spilonata ocellana). Ewing (22) states that he has found considerable numbers of this mite on violets and hops at Corvallis and McMinnville and that it is known to feed on the hop aphid (Phorodon humuli) and is probably a predator of the red spider mite (T. telarius).

Anystis sp. nymphs have been recorded from flea beetle eggs at St. Helens, Oregon in 1937.

#### Family Tetranychidae

This family includes the spider mites, the clover mites, and other plant feeding species of economic importance. As other Trombidoidea, these mites possess the claw and thumb arrangement of the palpi, but this characteristic is difficult to note. The basal segments of the mandibles unite to form a plate. The terminal segment of the mandibles is a needle-like stylet which is inserted into the plant tissue during feeding. The body is oval or elliptical and provided with few hairs arranged in four rows. The cephalothorax is large and distinctly separated from the abdomen. The legs are moderately long, the first pair longer than the others, possess a few long hairs, and end in one or two claws. The species are often hard to distinguish and some are separated on the structure of the male genitalia. The following species have been recorded from Oregon.

Bryobia praetiosa Koch

Ubersicht der Arachniden system, 1837

This species, known as the brown, or clover mite, is also referred to as B. pratensis Garman, and B. praetiosa Koch was thought to be a European species. They are now believed to be the same species (51). This mite is easily distinguished by its large size (adults average about .75 mm.), The extremely long front legs, the somewhat flattened dorsum, and the four prominent tubercles projecting from the anterior margin of the cephalothorax. The mouth parts are small and invisible from above. The cephalothorax is nearly one half as long as the abdomen and is anteriorly ovate. The color of the adults varies from rust brown to olive green or reddish. The larvae do not have the front legs as noticeably elongated, and both the larvae and the nymphs are usually more greenish than the adults. The winter is usually passed in the egg stage, but the mites may migrate into houses and pass the winter as either adults or nymphs. One such infestation was reported from Pilot Rock, Oregon in February, 1938. The writer also took a gravid female from under the bark of an old stump in January, 1939. This species is widely distributed through out the state.

Tenuipalpus erythreus Ewing

Proc. Ent. Soc. Wash. 14: 96, 1912

This mite, often called the cedar mite, is a bright red, small, but robust species about .35 mm. long. The palpi are very short and do not show the thumb arrangement distinctly. No tubercles extend from the cephalothorax. The legs are all approximately equal in length. Ewing has reported this mite from Hood River, Oregon where it was taken on branches of Thuja plicata in 1911.

Paratetranychus pilosus Canestrini and Fanzaggio

Intorno agli Acari Italiani, Atti Ist. Venet. ser 5 IV  
1877-78, pp. 69-208

This species, commonly known as the European red mite, is a deep cardinal red mite (averaging about .5 mm. in length) with four rows of long curved spines on the dorsal surface. The appendiculate claw is six cleft. The mite is a light web spinner compared to some of the other spider mites. It overwinters in a dull red, onion-shaped egg.

The European red mite was first observed in this country by Ewing in Oregon in 1911. At that time he reported it as Tetranychus mytilaspides Riley, the citrus mite, also later known as Paratetranychus citri McGregor.

Essig (16) treats P. citri and pilosus as synonymous species, but they have now been shown to be distinct. P. citri is a pest of citrus fruits and P. pilosus attacks deciduous fruits.

Paratetranychus ununguis (Jacobi)

This species, sometimes called the spruce mite, is a very small, somewhat oval mite. The adults vary in color from dark green to nearly black; the larvae and nymphs are light green in color. The females may be distinguished by a narrow pale streak on the back and collar. The winter is passed in the egg stage. This species has been reported frequently from the East where it is quite destructive to spruce. Injury is caused by the mite sucking chlorophyll from the needles. Doane et al. (13) report that "it has been observed on Sitka spruce occasionally but was noted in July, 1930, at Miller lake, Deschutes National Forest, in tremendous numbers killing quantities of lodgepole pine at about 6,000 ft. elevation."

Tetranychus telarius (Linn.)

Fauna Suecica, 1761, 1974, p. 431

This species, known as the common red spider mite, was first described as Acarus telarius by Linnaeus from specimens taken on Linden in 1761 (51). The genus

Tetranychus was described by Dufour in 1832 (7). Due mainly to color variations, this species has been described in four genera and at least twenty-eight species. The sexes differ slightly. The adult female averages about .42 mm. in length and varies markedly in color. It may be red, yellow, green or orange. Black markings are usually on the abdomen. The cephalothorax is about twice as broad as long and bears five pair of bristles. Two pair of eyes are present near the lateral margins of the cephalothorax. The palpi are prominent and extend to the tips of the femora of the first pair of legs. The abdomen is about two thirds as broad as long and is provided with sixteen simple spines arranged in four rows of four each (22). The legs are moderately slender and nearly equal in length, although the first pair is just slightly longer than the others. The tarsus of each leg bears four tenent hairs of slightly different lengths. The male is much smaller than the female, averaging about .32 mm. in length, and the abdomen is more slender and pointed. The sexes differ in color only in that the two anterior legs of the male are somewhat reddish.

The immature stages of this mite are a minute oval, three-legged larva, a somewhat larger, four-legged oval protonymph, and a deutonymph very similar to the adult but about  $\frac{2}{3}$  the size. The eggs are minute spheres which are

almost colorless when first laid, but later develop a reddish hue. The eggs are attached to the underside of the leaves of the host plant.

The winter is passed mainly in the adult stage and the mites hibernate in the soil or in cracks and crevices. There are several generations a year. In the summer the adults live from one to two weeks, but hibernating adults live all winter.

The red spider mite is a web spinner and uses this web mainly as a means of facilitating locomotion, but it also serves as a protection from natural enemies, rain, insecticides, and as a method of escape.

This species is widely distributed in both Europe and America and has been recorded from a large number of host plants. In Oregon it has been recorded from apple, hops, blackberry, pear, peach, cherry, strawberry, English walnut, black walnut, gooseberry, cucumber, beans, lettuce, tomato, red clover, white clover, sage, snowball, cottonwood, willow, rose, chrysanthemum, violets, and other hosts from all sections of Oregon (22). It is particularly important in Oregon as a pest of apples and hops.

The writer has taken specimens from hops and violets in Corvallis. Leaves infested by the red spider mite have pale blotches showing through the leaf. In heavy infest-

ations the entire leaf becomes light in color, dries up, and may turn reddish brown around the edges. Infested leaves will show many silken threads spun on the under surface, and in extreme infestations of smaller plants the entire plant may be covered with the webbing. For a thorough discussion of this species the reader is referred to Ewing (22).

Tetranychus bimaculatus Harvey

Ann. Rept. Maine Agric. Exp. Sta., 1892, p. 133

The two spotted mite, as this species is commonly known, is pale in color with two large indefinite black spots covering a large part of both sides of the body. It may vary in color from whitish to yellow, reddish, or pale green. It is a web spinning species and is often associated with the common red spider mite. Ewing (22) considers this species to be synonymous with T. telarius. He states, "T. bimaculatus, according to Harvey's own statement, was not established because of any demonstrated structural differences between his forms and Tetranychus telarius Linn., but on account of supposed differences in habits." McGregor (50) considers it to be a distinct species. As such, it has been frequently recorded from Oregon and attacks most of the hosts listed under T. telarius.

Tetranychus borealis Ewing

Ann. Ent. Soc. Am. 6, 1913, p. 457

This species, sometimes called the boreal mite, is very similar to T. telarius, but is smaller and never orange or red in color. Ewing described the species from specimens taken from spirea in Benton County, Oregon.

Tetranychus flavus Ewing

Ann. Ent. Soc. Am. 6, 1913, p. 458

The yellow mite is the common name given this species. It is a small, pale green or yellow mite occurring chiefly at altitudes above 1000 feet. It may at times be a pest in apples in some parts of Oregon (14). The hibernating forms are yellow and pass the winter in the ground at the base of the host tree. It was described by Ewing from specimens taken on tumbleberry at Corvallis in 1911.

Tetranychus monticolus McGregor

Proc. U. S. Nat. Mus., 51. 1917, p. 584

This species, known as the mountain mite, was described from specimens taken from the leaves of the large-berried huckleberry on Mt. Hood, Oregon (49). It is pale uniform amber in color.

Tetranychus oregonensis McGregor

Proc. U. S. Nat. Mus., 51, 1917, p. 585

This species is known as the Oregon mite and was described by McGregor from specimens taken on wild cherry in Portland, Oregon (49). It is a pale yellow or amber in color, and with or without lateral spots.

Tetranychus pacificus McGregor

Proc. U. S. Nat. Mus., 51, 1917, p. 657

The Pacific mite is the common name often given this species. It is yellow amber in color with large lateral spots and is very similar to T. bimaculatus Harvey. It has been taken in Oregon on mock orange, vetch, and wild currant (16) and on apple at Wenatchee, Washington where it is at times quite a serious pest.

Tetranychus willamettei McGregor

Proc. U. S. Nat. Mus., 51, 1917, p. 586

This species has been called the Willamette mite and was described from specimens taken on white oak leaves at Oregon City, Oregon (49). It was reported causing a russeting of the oak leaves. The mite is a pale lemon yellow in color. It has been reported on pear in the Medford, Oregon, district.

The above species of Tetranychus are very similar in external characters, and are separated by McGregor (50) on structural variations of the penis in the male.

Caligonus mali Ewing

Jour. Econ. Ent., 10, 1917, p. 499

This species, known as the apple mite, is a yellowish or reddish mite about .30 mm. long and sparsely covered with simple hairs. It differs structurely from species of Tetranychus principally in the shape of the mandibles, and the thumb of the palpi extends well beyond the claw. It has been recorded as seriously injuring apple in Oregon and produces a silvering of the leaves (16). The genus Caligonus is the genus Eupalopsis of some writers.

Family Erythraeidae

This family is named Rhyncholopidae in many of the older writings. The members of this family resemble the Trombidiidae but are more slender and more rapid in movement. The cephalothorax is large and on the same plane with the abdomen, but it is not always distinctly separated from the abdomen. Along the dorsal side of the cephalothorax there is often a median line known as the crista metopica. The palpi are prominent, five segmented, and

have the claw and thumb well developed. The seven segmented legs are usually long and slender and terminated by two claws. The eggs of these mites are usually deposited in the soil and the larvae are parasitic on insects. The general habits of the adults differ greatly. The following species have been recorded from Oregon.

Erythraeus gracilipes (Banks)

Proc. Calif. Acad. Sci., (3), III, 1904, p. 305

This species is often listed under the old genus Rhyncholophus. It is a bright red mite varying much in size, but averaging about 1 mm. in length. There is no distinct demarcation between the cephalothorax and the abdomen. The legs are very long, and the body and legs are covered with short hairs.

Ewing (22) reports this mite to be common in Corvallis during the summer months on plants heavily infested with the common red spider mite, and states that it is probably predaceous upon this pest. Essig (16) reports it attacking San Jose scale.

The larvae of this mite are parasitic, but the host is not definitely known. The adult overwinters under loose bark and debris. Several mites believed to be this species were taken by the writer from under the bark of oak and elm in October.

Erythraeus sp. are recorded taken from the bark of apple trees by Ewing in 1912.

Family Trombidiidae

Members of this family are commonly known as the harvest mites. They are distinguished from the Erythraeidae in having a small thorax on a different plane than the abdomen and in having a jaw-like appendage at the tip of the chelicerae. The palpi are five segmented with the thumb and claw prominent. The cephalothorax bears a prominent crista and the separation between the cephalothorax and abdomen is distinct. There are two pair of eyes on each side of the cephalothorax, and often they are borne on a distinct pedicel. In some species the body is covered with feather-like hairs. The larvae of the harvest mites are parasitic on insects, but the adults are predaceous. The winter is passed in the adult stage in the soil.

Recorded from Oregon are the following species.

Trombicula oregonensis Ewing

Proc. Ent. Soc. Wash., 31, 1929, p. 11

In this species the crista is present and enlarged at the posterior end, and the body is strongly constricted at the insertion of the posterior two pair of legs. It meas-

sure about .30 mm. in length and possesses 40 dorsal setae. It was described from specimens taken on the mole, Scapanus, at Corvallis, Oregon.

Trombidium pacificum Banks

Trans. Amer. Ent. Soc., 21, 1894, p. 213

This is a dark red species measuring about 2.2 mm. in length and with the crista enlarged at the anterior end. Essig (16) reports it occurring in ant nests and under stones in Oregon. It was first described from Olympia, Washington, and is commonly known as the Pacific red mite.

Eutrombidium trigonum (Hermann)

Mem. Apt., 1804, p. 26

Banks (8) lists this species as Microtrombidium locustarum (Riley). It is known as the common locust mite of the United States and Europe. The adults are a bright red and measure about 3 mm. in length. The larvae can be distinguished from other closely related species by the bifurcate coxal spurs.

The adults feed on grasshopper eggs and are much more common in the "grasshopper belt" than in Oregon. The larva, upon hatching, attaches itself to a grasshopper, beneath the wing pad on the intersegmental commissures, and feeds on the body juices. These larvae are sometimes referred to

as "grasshopper ticks" (33). They sometimes weaken the grasshopper nymph to such an extent that it cannot molt and it soon dies. After feeding for from one to three weeks the larva drops to the soil and transforms into the nymphal stage. The nymph closely resembles the adult and feeds on grasshopper and other arthropod eggs. These habits make this species one of considerable economic importance.

Ewing and Hartzell (33) state this mite was reported from Oregon in 1869. This is the only coast state in which this species has been definitely recorded.

## SUPERFAMILY HYDRACNOIDEA

This group includes the aquatic mites living both in fresh and marine waters. Early workers gave more attention and study to this group than any other, and a rich fauna is known particularly in Europe. Dr. Robert Wolcott and Dr. Ruth Marshall have studied the American fauna more extensively than any other workers.

This superfamily is composed of two families: the Halacaridae, usually inhabiting marine waters, and the Hydrachnidae, mainly in fresh water. Most species are free living, but a few are known to be parasitic on aquatic insects and mollusks.

In Oregon no records are known recording species of water mites, although unidentified specimens have been taken frequently from ponds, streams, and marine waters. If the fauna of other parts of the country can be taken as an indication of the prevalence of water mites, Oregon undoubtedly has a rich fauna of these acarids.

## SUPERFAMILY PARASITOIDEA

This group includes those mites having a small hypostome lacking any recurved teeth, and a tubular peritreme, or chitinous rings surrounding the spiracles, which open on each side of the body slightly in front of the 4th coxa. The integument is partially or entirely chitinized. No eyes are present. The superfamily Parasitoidea, often termed Gamasoidea, is usually separated into three major families: the Parasitidae, Dermanyssidae, and Uropodidae.

Family Parasitidae

This is the family Gamasidae of some writers. These mites have the first pair of legs inserted at one side of the camerostome; the dorsum not projecting beyond this opening. The mandibles are stout, normally chelate and toothed. The body is usually rather flattened and covered with few or many hairs. The demarcation between the cephalothorax and the abdomen may or may not be distinct. The legs are six segmented.

Despite the family name, most species of the Parasitidae, as that family is considered here, are not parasitic. Many species have been taken from insects, but the latter serve as carriers rather than hosts, and the mite probably secures all its food from captures made by the insect.

Other species are predaceous. The eggs are usually laid in any sheltered place and hatch into pale, soft-skinned, six-legged larvae which often are very different from the adults. The nymphal stage is the longest and most active period of their life history.

These mites are very common in moss, duff, under bark, in fields and meadows. There is undoubtedly a large number of species in Oregon, but only the following have been definitely recorded from this state.

Macrocheles muscae Ewing

Ent. News, 24, 1913, p. 452

The fly mite, as this species is known, is a dark yellowish brown mite with the dorsal shield entire. The abdomen is broad and evenly rounded behind. The body is very sparsely clothed with simple bristles. The mite averages about .97 mm. in length. It is parasitic on the house fly, Muscae domestica, and attaches itself to the ventral surface of the host. Ewing (20) described this species from specimens taken on the house fly from Ithaca, New York, and Corvallis, Oregon. Essig (16) states that "this mite is reported only from Oregon and New York, but undoubtedly has a wide distribution." The writer captured two specimens at Corvallis, Oregon from the house fly in October, 1939.

Seius pomi Parrott

N.Y. Agr. Exp. Sta. Bul. 283, 1909

The "predaceous mite" is a pale oval species averaging about .4 mm. in length. The dorsal shield is entire and sparsely covered with short curved hairs. The body is much depressed, widest near the posterior end, and is evenly rounded behind. A very prominent and characteristic pair of bristles is situated on the posterior margin. The eggs are nearly transparent, oval and somewhat flattened. They are laid on the underside of leaves. The larvae and nymphs have the same habits as the adults which are common predators on the eggs, larvae, and adults of the red spider mites, Eriophyids, and other minute arthropods. Ewing (22) states "in Oregon this mite is perhaps the most efficient of any of the natural enemies of the red spiders." It has a wide distribution and is well known in Oregon, both in the field and in the greenhouse. Several specimens were taken by the writer in November from greenhouse hops infested with the common red spider. Edwards et al. (14) state that this species is of "considerable value in the control of the blackberry mite."

Seius safroi Ewing

This is a small pearly white, semi-transparent mite

which Chamberlin (10) has reported finding in numbers in mines, pupal cells, and on pupae and adults of Dendroctonus pseudotsugae Hopkins. Ewing took this species at Corvallis in 1912.

Euhaemogamasus oregonensis Ewing

U. S. Nat. Mus. 82, art. 30, 1933, p. 5

This species is characterized particularly by the produced lateral angles of the sternal plate. It measures just less than 1 mm. in length (female) and is twice as long as broad. It was described from specimens taken on the forest tree mouse, Phenacomys albipes, at Netarts, Oregon, December, 1930 by R. R. Walker.

Euhaemogamasus liponoyssoides Ewing

This species is reported by H. H. Stage taken from the mole, Scapanus townsendii, at Wilsonville, Oregon in May, 1938. He also reports Euhaemogamasus sp. taken from chickens at Astoria in September, 1937.

Atricholaelaps glasgowi Ewing

This species is a light yellowish brown in color; oval in shape. The dorsal shield is not entire and possesses many moderately short bristles. The specimens observed

were taken on the field mouse at Hillsboro, Oregon, June, 1938, by S. E. Crumb, Jr.

Atricholaelaps californicus Ewing

H. H. Stage reports this species taken on the pocket gopher, Thomomys bulbivorus, at Jewell, Oregon in April, 1935, and on the meadow mouse, Microtis, and the rusty song sparrow in Portland, 1931.

Mites taken from fish meal at Puyallup, Washington by S. E. Crumb, Jr. were identified by Ewing as Parasitus sp.

Undetermined species of the subfamily Laelaptinae are reported by H. H. Stage from Townsend's meadow mouse, Microtis townsendii, in Portland, 1931.

Five large yellowish brown parasitid nymphs were taken from the beetle Necrophilus at Port Orford, Oregon in September, 1939. These mites have the dorsal shield divided and clothed with many short hairs.

A yellowish brown species measuring about 1 mm. in length, and with the dorsal shield almost entire was taken from a dog at Corvallis, Oregon.

Several other species identified by H. E. Ewing simply as "Parasitidae sp." were taken in moss, fir, and oak duff, and from under bark.

Family Dermanyssidae

Some writers treat this group as a subfamily of the Parasitidae, but Ewing considers it to be a separate family. These mites are very similar to the parasitids but have very slender mandibles fitted for piercing and are parasitic on vertebrates. The following species have been recorded from Oregon.

Dermanyssus gallinae (De Geer)

Parasit., 1880, p. 115

This species is commonly known as the chicken mite, poultry mite, red mite, or roost mite and is parasitic on the domestic chicken. It is dark reddish brown in color with a few blotches of black. It is oval in shape and averages about .9 mm. in length. The peritreme is long and extends beyond the second coxa. A large undivided dorsal shield is present in both sexes. The chelicerae of the female are needle-like, but in the male are cylindrical and stout. The legs are moderately long, the anterior pair being equal to the body in length (31).

These mites are temporary parasites and drop off the host after becoming engorged with blood. The eggs are laid in cracks between timbers or in dry manure under the roosts in the chicken house. Two or three dozen eggs are laid

over a period of several weeks in the spring. The newly hatched larvae are six-legged, nearly white in color, and quite sluggish. The larva does not feed, and molts within a few days into an active eight-legged nymph which seeks a host and fills up on blood. After engorging, the nymph drops off and hides away in a dark crack for a day or two and again molts. This second nymph again engorges, drops off, molts, and becomes an adult. Mating may take place almost as soon as the adult stage is attained, but oviposition occurs only after another feeding. The complete life cycle may be passed in ten days in the summer but in the winter activity and reproduction are greatly reduced and life is prolonged. Adults may live two or three months without food.

When heavily infested, the fowls become droopy, pale about the head, and cease laying. Setting hens and baby chicks often die from the parasitism. In addition to the chicken, this mite has been reported attacking turkeys, pigeons, canaries, sparrows, wrens, and other birds, and mammals including man (31). This species is very cosmopolitan and is known throughout the world, but is more troublesome in the warmer regions. It is well known in Oregon.

Dermanyssus scutatus Ewing

Proc. Ent. Soc. Wash., 38, p. 49, 1936

This is a stout mite with rather short legs, and shoulders slightly developed opposite the insertion of leg II. It measures about .67 mm. in length. This species was described from specimens taken from the Northwestern flicker, Colaptes cafer cafer, at Corvallis, Oregon in 1931 by M. F. Canova (31). It was also taken at Portland from the same host by C. M. Gjullin in 1932.

Dermanyssus brevis Ewing

Proc. Ent. Soc. Wash., 38, p. 54, 1936

This species differs from other North American species of this genus in the shortness of its peritremes. Ewing described it from a single specimen taken from the dusky horned owl, Otocoris alpestris merrilli, at Portland, Oregon by S. G. Jewett, Jr., in January, 1932.

Liponyssus pacificus Ewing

Proc. U. S. Nat. Mus., 62, Art. 13, 1923, p. 19

In this species the dorsal shield is not entire and but partially covers the body. It nearly extends across the cephalothorax at the shoulders. The mite averages about .57 mm. in length and possesses moderately long legs.

The body of the female is without constrictions (25).

This mite was present in great numbers on poultry at the Hanson Poultry Farm at Corvallis, Oregon in October, 1932, heavily infesting chickens on range. F. C. Bishopp, in a letter of January, 1933, states "it would not surprise me if it (this mite) may have come from blackbirds. Mites of this species, or the closely related sylviarum, have been taken on a number of wild birds." It was described from specimens taken from the nest of Brewer's blackbird. It can be controlled by painting the roost with nicotine sulphate.

#### Liponyssus sylviarum Canestrini and Fanzaggio

This species is known as the feather mite or northern fowl mite and is very similar to L. pacificus. H. H. Stage reports it taken on the Rusty song sparrow, Melospiza melodia morphia, at Portland, Oregon, December, 1931, and in robin's and sparrow's nests in 1936.

#### Liponyssus bacoti Hirst

This species is known as the rat mite and is parasitic on the brown rat, Rattus norvegicus. It is an introduced species and was described from Egypt. It usually remains hidden in a rat nest but if hungry will crawl about freely during the day or night in search of food. Both nymphs

and adults attack man freely, causing an itch. It is thought to be a possible vector of endemic typhus (27). This mite was reported from Bend, Oregon in 1938 where specimens were taken from the edge of a bath tub. H. H. Stage reports it from rats in Portland.

H. H. Stage also reports specifically undetermined mites of the genus Liponyssus on the Pacific mountain beaver, Aplodontia rufa pacifica, from Otis Junction, Oregon, March, 1936.

Ceratomyssus occidentalis Ewing

Proc. U. S. Nat. Mus., 82, Art. 30

Ewing described this new genus and species from specimens taken at Adel, Oregon. No other records are known.

Ichoronyssus carnifex Koch

This is a European species, and Ewing in 1923 (25) reporting it taken from the house mouse, Corvallis, Oregon in 1912, states his reference to be the only U. S. reference on this mite at that time.

Family Uropodidae

Members of this family resemble the Parasitidae very

closely in that the body is usually coriaceous and depressed. However, the first pair of legs is inserted in the same opening with the mouth parts, and the dorsum of the body extends forward over the camerostome.

No records have been found of species of this family definitely recorded from Oregon. Undoubtedly there are many species. Mites collected from hay in Tillamook County, and from Regal lillies at Roseburg in 1938 were identified by Ewing as "Uropoda nymphs (?)."

## SUPERFAMILY SARCOPTOIDEA

This group includes soft bodied mites in which the palpi are small and three segmented, no eyes present, tarsi often ending in suckers, ventral suckers usually present, and with rodlike epimera supporting the legs visible beneath the skin on the venter. Tracheae are not present in most forms. They are frequently parasitic, but many are plant feeders and of considerable economic importance.

Family Tarsonemidae

Members of this family are very small mites having tracheae which open on the ventral surface near the rostrum. The mouth parts are very small and needle-like. The sexes are clearly differentiated, the hind legs of the female ending in long hairs. This sex also possesses a clavate hair of uncertain function between legs I and II. This character alone separates them from all other mites.

Tarsonemus pallidus Banks

Proc. Ent. Soc. Wash., IV, 1899, p. 295

This species is commonly known as the cyclamen or strawberry mite. It is a very pale brownish mite with the general characters of the family Tarsonemidae. The females are about .22 mm. long and half as wide, and the males are

about one-fourth smaller. On the fourth pair of legs in the female only three segments are distinguishable, the segments being grown together more or less. This pair of legs terminates in two appendages, one of which is a needle-like spine, the other a long curved hair. In the male the fourth pair of legs are very stout, at least twice as broad as the other legs, and are curved inward beyond the abdomen. The third segment bears a small inwardly pointing spine and a long tactile bristle. The leg terminates in a single stout, pointed claw.

The females are oviparous and lay but one large egg at a time. The egg hatches in 7 to 10 days into a pale white six-legged larva. There is no nymphal stage, and instead, the larva transforms into a quiescent stage which after a few days gives rise to the eight-legged adult (52).

Several cyclamen plants infested with this mite were available for study. Eggs, larvae (both active and quiescent), and adults were found on the petals and sepals of the flowers. In October the larvae were much more numerous than the adults, and the females outnumbered the males at least three to one. Observations on another infested plant in January revealed about the same condition, but males were more numerous than in the fall.

These mites were found to be negatively phototropic and were most abundant in the deeper parts of the flower.

Mites on petals exposed to ordinary light moved as rapidly as possible to less exposed areas.

Infested blossoms at first showed only a slight blotching. Later the petals became distorted, curled, and stunted. Infested buds failed to bloom properly. Infested leaves became curled and browned at the edges.

This mite is well known in Oregon and other west coast states as a greenhouse pest, and it often causes considerable loss. The strawberry tarsonemid mite, Tarsonemus fragariae, frequently a serious pest of strawberries, has been found by Ewing (32) to be synonymous with T. pallidus. It has also been reported on snapdragons, geraniums, and in citrus orchards. The writer has taken it from azalia.

Hemitarsonemus latus (Banks)

This species, first described in the genus Tarsonemus, is known as the broad mite. Banks (8) states that he found it causing galls on the main shoots of mango plants. It also attacks a number of other hosts similar to those attacked by T. pallidus. No definite records of this mite occurring in Oregon have been found, but mites taken from azalia, which was also infested with T. pallidus, were believed to be this species. A recent taxonomic description of this species was published by Ewing (32).

Family Pediculoididae

Most of the older writers consider this group as a subfamily of Tarsonemidae, and the species differ mainly from the above group in that the hind legs of the female end in claws and suckers. In the male, the 4th pair of legs are shorter than the 3rd pair. The females are very prolific and often become 20 to 100 times their normal size when pregnant. Some species are parasitic; others are predaceous on mites and small insects; and a few are plant feeders. There is some evidence that these latter may transmit plant diseases.

Only one species has been definitely recorded from Oregon.

Pediculoides ventricosus (Newport)

Trans. Linn. Soc., London, XXI, 1853, p. 95

The "ventricose mite" is a pale yellow species normally less than 1 mm. in length. The mouth parts are terminal and distinct. Sexual dimorphism is very evident. The male has a relatively small abdomen, and the body is very short and angulate behind. The female has a large abdomen which swells enormously when pregnant. The eggs are not deposited, but carried within the abdomen of the female where they hatch. Development through several metamorphoses to matur-

ity occur before the mites emerge from the abdomen, and they may not emerge until after the death of the mother (57).

Normally these mites feed upon a great variety of insects, and are often taken in stored grain where they attack the larvae of the Angoumois grain moth and granary weevils. They frequently become parasitic on man and cause a severe itching by producing lesions on the skin. Men working in grain fields or handling stored grains are often seriously attacked.

In Oregon this mite has been taken frequently. Chamberlin reports it attacking flat headed borers which were seriously damaging fruit trees at Dundee, Oregon. It has also been taken from the burrows of Dendroctonus pseudotsugae and Chrysobothris sylvania.

#### Family Tyroglyphidae

These are pale colored, soft bodied mites with the integument usually quite smooth. The palpi are small; tracheae are absent; the mandibles are usually prominent and chelate; the legs are moderately long and ending in one claw, and often a sucker. The demarcation between the cephalothorax and abdomen is usually distinct. The body is about twice as long as broad, and broadest behind the middle. No eyes are present. Genital suckers are often

present on the venter between the hind coxae. There is little difference between the sexes.

The life cycle of these mites is peculiar. The eggs are laid haphazardly. Upon hatching, a six-legged larva emerges and soon molts into an eight-legged nymph. Development from the nymphal stage to the adult may then be direct, but often the nymph passes through a stage called a "hypopus." This stage is very different. The body is hard and chitinous, the mouth parts are not distinct, and the legs rudimentary. On the ventral surface are several sucking disks. By means of these disks the mite attaches itself to an insect or other available animal and is thus carried to a new locality. When a suitable place has been found, the hypopus drops off and molts into an eight-legged nymph. After a short period of feeding it molts again and becomes adult (8).

These mites feed on a great variety of materials such as cheese, flour, cereals, dried fruits, dried meats, hairs in stuffed furniture, many kinds of bulbs, roots, mushrooms, hay, scale insects, dead insects, and other animals. Some writers using a different classification do not include this family in the Sarcoptoidea.

The following species are known from Oregon.

Rhizoglyphus hyacinthi Boisduval

Ent. Hort., 1867, p. 8

This mite is frequently referred to as the bulb mite. It is a nearly pure white species of moderate size, the female averaging from .5 to .75 mm. in length, and the male about .35 mm. Frequently there are two large greenish or brownish spots on the abdomen. It was found that these spots are more evident on specimens killed in hot water. The cephalothorax and abdomen are separated by a distinct suture. The legs are short, the 2nd pair being the largest, and bearing a distinct claw. The mandibles are chelate.

The life cycle is typical of the members of this family having a hypopial stage. The mites are usually found in colonies, and because of their oval shape, white color, and sluggish movements may, at first glance, be taken for a mass of eggs. This species commonly attacks the bulbs of hyacinth, lilies, tulips, narcissus, and onions, and also the woody stems under ground of asparagus, peony, etc. In addition to direct damage, these mites are known to carry fungus and bacterial diseases (16).

A large number of these mites were taken by the writer in November from narcissus bulbs. The cores of the infested bulbs had been almost entirely eaten out, and the hollow was filled with myriads of these mites in all stages. The

adults were far less numerous than the larvae. In some cases, bulbs that became very rotten were abandoned for more healthy ones.

This mite is widely distributed over the United States and is frequently encountered in Oregon, both in the greenhouse, and in fields and gardens.

Mites taken in great numbers from oat hay at Waldport, Oregon in November, 1936, and from Clarke seedling strawberries at Hood River, Oregon in July, 1934 were identified by Ewing simply as Rhizoglyphus sp. Whether or not any damage was apparent was not reported in either of the above cases.

Tyroglyphus siro (Linnaeus)

Syst. Nat., 1758, I, p. 616

Mites of the genus Tyroglyphus differ from Rhizoglyphus in possessing four long distinct bristles arranged in a row on the cephalothorax; tarsi I and II are approximately twice as long as the preceding joint. This species, known commonly as the "cheese mite," is a dirty white mite averaging about .6 mm. in length. None of the body hairs are as long as the body and none of the longest hairs are pectinated. This mite is cosmopolitan, and infests cheese principally. It is also frequently found attacking flour and cereal products, dried meats and other dried foodstuffs,

and overstuffed furniture. It is frequently reported attacking the hands and arms of grocers, and produces a dermatitis known as "grocers' itch."

These mites occur in colonies and their life history is very similar to the bulb mite. The writer took many specimens of both nymphs and adults in January from cheese.

Tyroglyphus lintneri Osborn

Science, 1893, p. 360

The "mushroom mite" is very similar to the above species but is somewhat smaller, averaging about .35 mm. in length. The terminal abdominal bristles are very long, and the body bristles are pectinate. It frequently does great damage to mushroom beds, but also feeds on dead organic matter. Specimens taken from hay in Tillamook county, Oregon in September, 1938 were identified by Ewing as this species.

Tyroglyphus breviceps Banks

Tech. Bull. 13, Bur. Ent. U. S. D. A., 1906

This species is quite similar to the above but the cephalothorax is very short. It was described from specimens taken from dead larvae of the cotton boll weevil (5). Mites found associated with earwigs in the Portland Earwig Laboratory, March, 1931 were determined by Ewing as

this species.

Mites taken from a package of rice at Portland, July, 1938 were identified by Ewing simply as "Tyroglyphus sp."

Aleurobius farinae (De Geer)

Mem. Hist. Inst., VII, 1778, p. 97

This species, sometimes called the flour mite was described originally in the genus Tyroglyphus, but has since been separated because of the enlarged front legs of the male. Not all writers accept this change and it is often referred to under the old name. As Tyroglyphus species, this mite possesses four long subequal bristles on the cephalothorax. The legs are quite short with the front pair thickened, particularly in the males. The species measures .45 mm. to .6 mm. in length. It is a cosmopolitan species and commonly infests flour, cereals, and cereal products, cheese, seeds, mustard, peas, etc., and may attack man, producing a dermatitis (16). It is known in Oregon and mites taken from chick-egg mash at Myrtle Point, Oregon in 1934 were identified as this species.

Monieziella bipunctata Ewing

This is a small pale yellow mite with brown markings and measuring about .22 mm. in length. A pair of long

bristles are situated on the abdomen. This species, as well as others of this genus, are predaceous on mites and small insects. Essig (16) reports it occurring in Oregon.

#### Family Canestriniidae

Mites of this small family are very minute species with short legs ending in a sucker. The demarcation between the cephalothorax and abdomen is not visible. Tracheae are absent. Most of the species live on insects, and are known commonly as the "insect mites."

No species have been definitely recorded from Oregon, but Chamberlin states that the coccid eating mite Hemisarcoptes coccisugus (Lignieres) is very possibly in Oregon. This species was originally described in 1868 from Ohio as Acarus malus Shimer where it was found to be predaceous on the eggs of the oyster shell scale, Lepidosaphes ulmi Linn. It was introduced recently into British Columbia to prey on the oyster shell and San Jose scales.

#### Family Sarcoptidae

These are very small white mites, semiglobular in shape. The cephalothorax and abdomen are separated and the body has only a few stout, sharp bristles. The vulva on the venter of the female is transverse. The mouth parts

are small and the mandibles are chelate. The legs are very short and often terminate in a claw and sucker.

These mites are often termed itch mites or scab mites as they live in or on the skin of man and other mammals and a few birds. Many of the species are cosmopolitan with their hosts.

Sarcoptes scabiei hominis Hering

N. Acta Acad. Leop., XVIII, 1838, p. 584

In these mites only the first two pair of legs bear suckers. This species is the one commonly infesting man although the parasite is not limited to one host and will attack domestic animals. People living under reasonably sanitary conditions are seldom attacked. Children are more commonly infested than adults. Cases are occasionally reported in Oregon.

The female burrows into the skin of the host, depositing eggs along the way. The female dies at the end of the burrow when she has deposited all her eggs. The young soon hatch and start burrows of their own. Burrows near the skin cause a loosening of the epidermis and produce a scaly appearance which is called the "mange" or "scabies" (57).

Sarcoptes scabiei suis Gerlach

Kratze, t. 3, 1857, p. 137

This mite causes the common mange of hogs. It usually attacks the host around the eyes, ears, and nose, but may cover all the body or any part of it (16). It is communicable to both man and dog but will live only a short time on these hosts. It is the largest of the Sarcoptes, measuring about .5 mm. in length.

Sarcoptes scabiei equi Gerlach

Kratze, t. 2, 1857, p. 72

This mite attacks the horse and its near relatives, and may at times attack man. It causes a dry mange which usually starts at the withers and spreads to the back, shoulders, and neck (16).

Sarcoptes scabiei canis Gerlach

Kratze, t. 2, 1857, p. 141

This mite attacks dogs, particularly the long haired varieties, and is likely to occur on dogs anywhere. It may occasionally be communicated to man.

Sarcoptes scabiei ovis Megnin

Parasit., 1880, p. 168

This is the sheep sarcoptic mite and its attack causes a face mange. It will also attack other parts of the sheep that are free from heavy wool. It is much less serious than

the sheep scab mite (16).

Psoroptes communis ovis Hering

N. Acta. Acad. Leop., XVIII, Ser. II, 1838, p. 594

This mite is often a serious parasite of sheep, causing a disease known as sheep scab. It differs mainly from the Sarcoptes in that it possesses styliform mandibles, and the tarsal pedicels are segmented.

The mite spends its entire life cycle on the host. Eggs are laid on the skin of the sheep. These hatch in two to ten days into six-legged larvae which grow rapidly and mature in from nine days to two weeks. A female may live one month or more and deposit up to 100 eggs. In wet cold weather, generations succeed each other rapidly and spread from sheep to sheep soon infesting the entire flock. The mites pierce the skin with their sharp mandibles and the blood forms a scab. The wool soon becomes sticky, matted, and eventually drops out. This parasite is practically cosmopolitan with sheep and goats, but in many areas it has been almost eradicated by quarantine and dipping campaigns.

Cnemidocoptes mutans Robin

Bull. Soc. Moscow, XXXIII, 1869, p. 184

This species (and the following one) differs from

Sarcoptes in possessing suckers on all the legs. This species, known as the "scaly leg mite," is a whitish mite almost round and somewhat flattened. It is very minute, measuring only .25 mm. to .5 mm. and scarcely visible to the naked eye. It works under the epidermal scales of the legs of domestic and small wild fowl, causing a deformation of the scales and eventually crippling the bird (16). It may also attack the comb. It is cosmopolitan with its host and is known in Oregon.

Cnemidocoptes laevis gallinae Railliet

Bull. Soc. Zool. France, XII, 1887, p. 132

This species is quite similar to the above but is even smaller. It burrows at the base of the feathers of domestic and other fowl and causes a loss of feathers. Hence the common name, "depluming mite" or "chicken body mite."

## SUPERFAMILY DEMODICOIDEA

Members of this superfamily are microscopic mites distinguished by the prolonged, annulated abdomen. Most species possess only two pair of legs. There are no spiracles.

Two families, including species quite different in habitat, compose this group.

Family Demodicidae

These are very minute mites inhabiting the sebaceous glands and hair follicles of man and various other mammals. The body is much elongated and cylindrical in shape. The abdomen is tapering and striated transversely giving the appearance of segmentation. Eight very short, three segmented legs are present in the adults.

Demodex folliculorum Simon

Arch. Anat. Physiol. Med., 1842, p. 218

This mite inhabits the sebaceous glands of man and is a cosmopolitan species. However, it is rarely reported and is uncommon except under very unsanitary conditions.

Varieties or subspecies of this species attack domestic animals. D. folliculorum bovis Stiles occasionally attacks cattle, producing an abscess about the size of a

pea. These may spread over the entire body, and are not only very irritating to the host but ruin the hide for leather.

#### Family Eriophyidae

These mites are commonly known as the blister mites or gall mites. They are very minute, varying in length from about 150 to 250 microns in length, and cylindrical in shape. Only two pair of legs, situated at the anterior end of the cephalothorax, are present. The demarcation between the abdomen and cephalothorax is distinct dorsally but indistinct ventrally. The family is divided into two subfamilies principally on the basis of whether or not the abdominal striations are uniform dorsally and ventrally. Striations differ with the species. The number and position of the few body hairs is also of taxonomic importance.

The blister mites are among the most important of the mites economically. They attack a great variety of plants hosts and the injury caused is extremely variable. All parts of the host plant except the root are subject to attack by these mites. Galls and blisters, often produced on the twigs and leaves of the host plant by Eriophyids, were believed to be fungus diseases until about the middle of the last century.

H. H. Keifer (47) has recently made a thorough tax-

onomic study of many California species and undoubtedly many of those occur also in Oregon. The following species are definitely known to occur in this state.

Eriophyes tristriatus erineus (Nalepa)

Anz. Akad. Wien, V, 28, 1861, p. 162

This species, known as the walnut erinose or blister mite, is a minute wormlike mite slightly curved in shape. The female measures up to 240 microns in length. The legs are short and stout. This species is distinguished from others by its body form, smooth shield, and the shape of the female genitalia.

The life cycle of this species, as described by Hassan (36), is typical of the group. The eggs are ovoid in shape and heavily laden with yolk. Due to the presence of this large yolk material, the larvae hatch out in a well advanced stage of development. Their form does not differ greatly from that of the adults, and they are capable of moving about and feeding. After approximately one week the larva molts and becomes a quiescent nymph, and later transforms into the adult stage. The winter is passed as an adult in hibernation, usually around or within the bud scales. Reappearing about April, the adults attack the lower surface of the leaves of the English walnut, causing a large dense yellow or brownish erineum. Eggs are then

laid and reproduction continues throughout the summer. Males are extremely rare and parthenogenesis is common. The mites migrate to a limited extent, but man, wind, and insects are chiefly responsible for their distribution. This mite is common in Oregon but is not of much economic importance (16).

Eriophyes pyri (Pagenstecher)

Vehr. Ver. Heidelberg, V, 1, 1857, p. 48

This species, introduced from Europe about 1870, is very similar in both size and color to the above species and is distinguished by the number of body rings, the shield design, and the size and shape of the body. It is commonly known as the pear leaf blister mite and attacks pears and apples. Brown blisters appear on the underside of infested leaves, on fruit and young shoots. Fruit may be so deformed as to be a total loss. This mite is common in Oregon, especially in the Willamette valley.

Eriophyes essigi Hassan

Univ. of Calif. Pub. in Ent. 4, 1928, p. 341

This mite is known as the blackberry mite. It was formerly thought to be E. gracilis Nalepa, and is sometimes referred to under that name. It is yellowish or translucent white in color and measures about 150 microns in

length. The mite attacks Evergreen and Himalaya varieties of blackberries, and causes all or part of the druplets to turn a brilliant red, thus ruining the berry for market. This condition is termed "redberry." This mite has also been reported attacking loganberry, raspberry, thimbleberry, but Edwards et al. (14) state that these attacks were probably E. gracilis or E. vitis. This mite has caused considerable damage to blackberries in western Oregon since about 1929. A large number of infested blackberries were taken by the writer at Corvallis, in October, 1939. Mites on this fruit were found mainly along the base of the druplets. When disturbed they moved very slowly by first elevating themselves on the base of the abdomen and moving the body ahead much as do the Geometrids but with less arching of the back.

Eriophyes gracilis (Nalepa)

As mentioned above, this species was formerly thought to be responsible for the "redberry" condition of infested blackberries. However, it is now believed to be the species responsible for injury to raspberries, loganberries, and thimbleberries, and is sometimes referred to as the "raspberry mite." It is common in Oregon.

Eriophyes avellanae (Nalepa)

This species, known as the filbert bud mite, works in the developing buds of filberts and hazelnuts. It causes an enlargement of the buds known as "big bud" which often ruins them completely. Heavily infested trees may not only be without nuts, but have very few leaves. This species is known only from the filbert growing sections of western Oregon (16).

Eriophyes viti (Landois)

Zeitach. wiss. Zool., XIV, 1864, p. 353

This is the grape erinose mite which works on the underside of the leaves of European varieties of grapes. Its attacks produce an erineum which yellows at first, later becoming brown. It is well known in Oregon but seldom is of real economic importance (16).

Eriophyes ceanothi Keifer

Bul. Calif. Dept. Agric., XXVIII, 5, 1939 p. 330

This mite is very closely allied to E. essigi but is somewhat smaller. Keifer (47) recently described it from specimens collected on the tobacco bush, Ceanothus valutinus Dougl., at Crater Lake, Oregon. The author observed specimens collected by F. C. Bailey in Lincoln County, Ore-

gon. Keifer states "these mites form small lower surface bead galls on the leaves. These small galls are not embedded in the leaf tissue but project below...Most of the galls contain no mites."

Phyllocoptes schlectendali Nalepa

Sitz. Akad. Wiss. Wien, Math-natur. Cl., XCIX, 1890, p. 62

Parrott, Bull. 283, N.Y. Exp. Sta. 1907, p. 314

This mite differs from the Eriophyids in possessing the abdominal striations unequal dorsally and ventrally. It is commonly known as the rusty leaf mite, and works on the leaves, fruit, and new bark, causing a russeting of the leaves, and cracking of the fruit and bark. Apple and pear are the preferred hosts but other trees, especially nursery stock, may be seriously affected. It is less common in Oregon than further south (16).

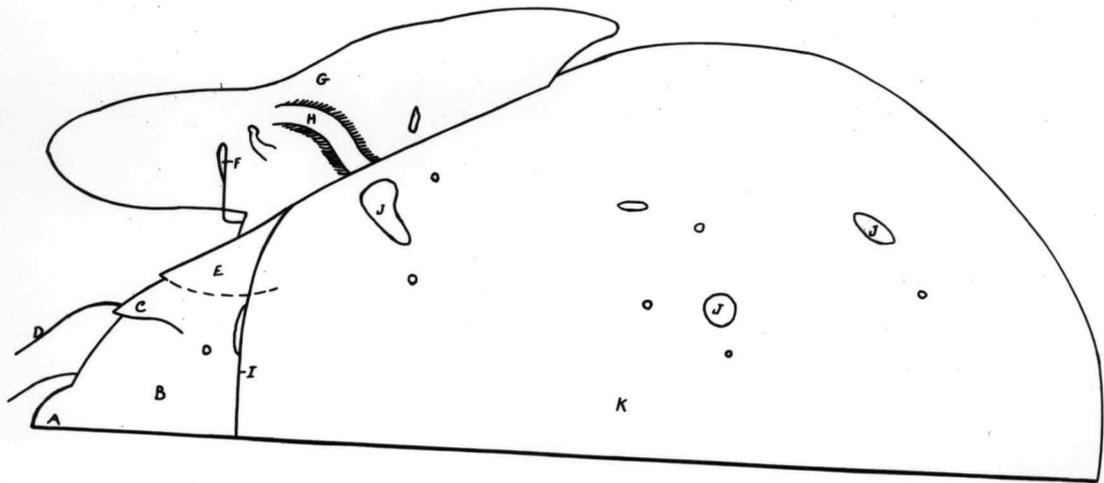
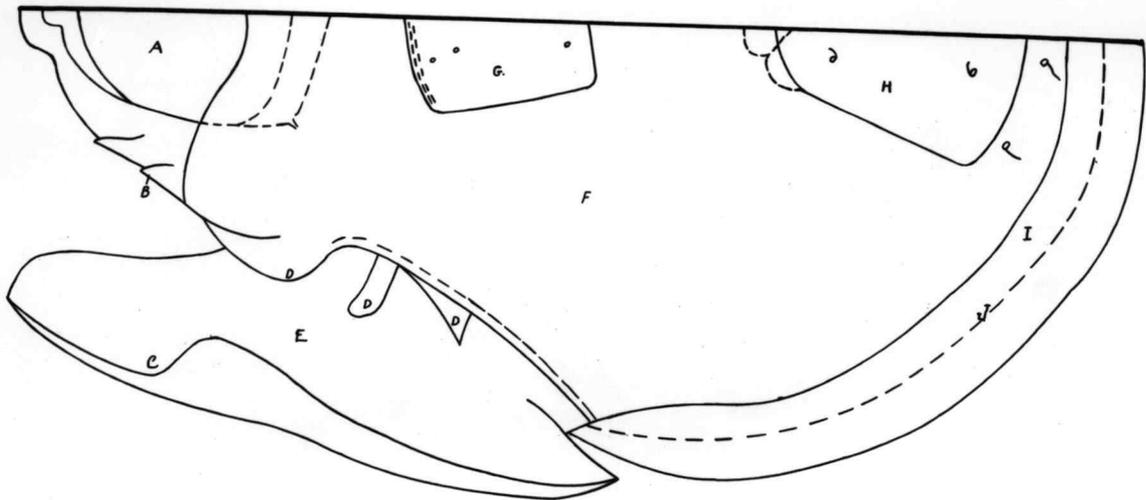


FIG. I

FIG. II



## ILLUSTRATIONS

Figure I----A Galumnid Mite (dorsal aspect)

A--Rostrum	G--Pteromorpha
B--Cephalothorax	H--Pteromorphal groove
C--Lamella	I--Abdominocephalo-
D--Lamellar bristle	thoracic suture
E--Tectopedium	J--Porose areas
F--Pseudostigmatic organ	K--Notogaster

Figure II----A Galumnid Mite (ventral aspect)

A--Labium	G--Genital cover
B--Tectopedium	H--Anal cover
C--Notch in pteromorpha	I--Ventral edge of
D--Tectopedia	notogaster
E--Pteromorpha	J--Edge of ventral plate
F--Ventral Plate	(after Jacot, 45)

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## SYSTEMATIC LIST OF OREGON MITES

## Superfamily Eupodoidea

Family Eupodidae

Rhagidia pallida Banks

Michaelia pallida Ewing

Family Bdellidae

Bdella magna Ewing

## Superfamily Trombidoidea

Family Cheyletidae

Cheyletus seminivorus Packard

Family Erythracaridae

Anystis agilis Banks

Family Tetranychidae

Bryobia praetiosa Koch

Tenuipalpus erythreus Ewing

Paratetranychus pilosus Canestrini and

Fanzaggio

Paratetranychus ununguis (Jacobi)

Tetranychus telarius (Linnaeus)

Tetranychus bimaculatus Harvey

Tetranychus borealis Ewing

Tetranychus flavus Ewing

Tetranychus monticolus McGregor

Tetranychus oregonensis McGregor

Tetranychus pacificus McGregor

Tetranychus willamettei McGregor

Caligonus mali Ewing

Family Erythraeidae

Erythraeus gracilipes (Banks)

Family Trombidiidae

Trombicula oregonensis Ewing

Trombidium pacificum Banks

Eutrombidium trigonum (Hermann)

Superfamily Parasitoidea

Family Parasitidae

Macrocheles muscae Ewing

Seius pomi Parrott

Seius safroi Ewing

Euhaemogamasus oregonensis Ewing

Euhaemogamasus liponoyssoides Ewing

Atricholaelaps glasgowi Ewing

Atricholaelaps californicus Ewing

Parasitus

Laelaptinae

Family Dermanyssidae

Dermanyssus gallinae (De Geer)

Dermanyssus scutatus Ewing

Dermanyssus brevis Ewing

Liponyssus pacificus Ewing

Liponyssus sylviarum Canestrini and  
Fanzaggio

Liponyssus bacoti Hirst

Ceratomyssus occidentalis Ewing

Ichoronyssus carnifex Koch

Family Uropodidae

Uropoda

Superfamily Oribatoidea

Family Galumnidae

Galumna

Scheloribates

Mycobates

Family Nothridae

Damaeus clavipes Hermann

Hermanniella punctulata Banks

variety parva Ewing

Nothrus

Family Pelopidae

Eupelops

Superfamily Sarcoptoidea

Family Tarsonemidae

Tarsonemus pallidus Banks

Hemitarsonemus latus (Banks)

Family Pediculoididae

Pediculoides ventricosus (Newport)

Family Tyroglyphidae

Rhizoglyphus hyacynthi Boisduval

Tyroglyphus siro (Linnaeus)

Tyroglyphus lintneri Osborn

Tyroglyphus breviceps Banks

Aleurobius farinae (De Geer)

Monieziella bipunctata Ewing

Family Canestriniidae

Hemisarcoptes coccisugus (Lignieres)

Family Sarcoptidae

Sarcoptes scabiei hominis Hering

Sarcoptes scabiei suis Gerlach

Sarcoptes scabiei equi Gerlach

Sarcoptes scabiei canis Gerlach

Sarcoptes scabiei ovis Megnin

Psarcoptes communis ovis Hering

Cnemidocoptes mutans Robin

Cnemidocoptes laevis gallinae Railliet

Superfamily Demodicoidea

Family Demodicidae

Demodex folliculorum Simon

Family Eriophyidae

Eriophyes tristriatus erineus (Nalepa)

Eriophyes pyri (Pagenstecher)

Eriophyes essigi Hassan

Eriophyes gracilis (Nalepa)

Eriophyes avellanae (Nalepa)

Eriophyes viti (Landois)

Eriophyes ceanothi Keifer

Phyllocoptes schlectendali Nalepa

## TERMS

Basis Capituli (basis) -- The basal portion of the capitulum.

Camerostome -- The opening of the body into which the mouth parts are inserted (and in some cases the 1 st pair of legs).

Chelicerae (mandibles) -- The most anterior paired appendages of the cephalothorax and used for piercing.

Crista metopica (crista) -- A dorsal groove along the median line of the cephalothorax.

Dorso-vertex -- The posterior part of the dorsum of the cephalothorax.

Epigynum -- A chitinous plate which folds down over the opening of the female genital pore.

Epistoma -- Ventral chitinous projections of the cephalothorax protecting the oral cavity.

Hypostoma (lingula) -- A simple or divided tongue arising from the inner base of the beak.

Inferior bristles -- A pair of bristles situated at the side of the rostrum in some beetle mites.

Lamellae -- Paired, blade-like expansions of chitinous integument of the dorsal wall of the cephalothorax.

Palpi -- The segmented appendages of the maxillae.

Patella (genua) -- The smallest segment of the leg and the one at which the bend of the leg is greatest.

It is the next segment distad to the femur.

Prosoma -- The anterior part of the body or cephalothorax.

Prosopon -- The adult mite.

Pseudostigma (e) -- A pair of large dorsal pores on the dorso-vertex in the Oribatoidea.

Pseudostigmatic organs -- Specialized bristles arising one from each pseudostigma.

Pteromorphae -- Chitinous wing-like expansions of the abdomen in some Oribatoidea.

Rostrum (capitulum) -- The anterior portion which bears the mouthparts, and sometimes referred to as the "false head" or "head".

Superior bristles -- A pair of bristles between the pseudostigmatic organs of some beetle mites.

Tectopedium -- Curved chitinous projections arising near the coxa of a leg and extending more or less around the coxa.

Translamella -- A chitinous blade joining the lamellae at their anterior ends.

Vomer -- A groove on the dorsal side of the hypostome.

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