The Ticks of Oregon

W. J. Chamberlin

Oregon State System of Higher Education
Agricultural Experiment Station
Oregon State College
Corvallis
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>3</td>
</tr>
<tr>
<td>Historical</td>
<td>3</td>
</tr>
<tr>
<td>What Ticks Are</td>
<td>3</td>
</tr>
<tr>
<td>Economic Importance of Ticks</td>
<td>5</td>
</tr>
<tr>
<td>Ticks as Disease Carriers</td>
<td>6</td>
</tr>
<tr>
<td>Rocky Mountain Spotted Fever or Tick Fever</td>
<td>6</td>
</tr>
<tr>
<td>Tularaemia</td>
<td>8</td>
</tr>
<tr>
<td>How to Avoid Tick Infections</td>
<td>9</td>
</tr>
<tr>
<td>Vaccination Against Rocky Mountain Spotted Fever</td>
<td>10</td>
</tr>
<tr>
<td>What to Do if Infection with Rocky Mountain Fever Is Suspected</td>
<td>11</td>
</tr>
<tr>
<td>A List of Ticks Known to Be in Oregon</td>
<td>12</td>
</tr>
<tr>
<td>The Life Cycle of a Tick</td>
<td>17</td>
</tr>
<tr>
<td>Family Argasidae</td>
<td>18</td>
</tr>
<tr>
<td>Family Ixodidae</td>
<td>20</td>
</tr>
<tr>
<td>List of the Known Hosts of the Ticks of Oregon</td>
<td>23</td>
</tr>
<tr>
<td>Bibliography</td>
<td>29</td>
</tr>
<tr>
<td>Bibliography of the More Important Early Writings on The Spotted-Fever Tick</td>
<td>32</td>
</tr>
<tr>
<td>Recent Articles on Tick Fever</td>
<td>34</td>
</tr>
</tbody>
</table>
The Ticks of Oregon

By

W. J. Chamberlin

INTRODUCTION

ALTHOUGH there is considerable information relative to the ticks of Oregon scattered through various bulletins, circulars, and special articles, few people have access to these.

No previous attempt has been made even to list the species of ticks found in Oregon, although various workers have recorded species as having been taken in this state, and certain diseases disseminated by ticks are known to occur here. The economic importance of the tick group has increased very materially in recent years; and this bulletin has been written in order that those interested may have ready access to an account summarizing the more important information on Oregon ticks.

Aside from accounts of a few new hosts and data pertaining to distribution, the information here set forth has been gained very largely from published accounts and from personal conversation with those most intimately connected with tick work. We are particularly indebted to Dr. R. R. Parker and the staff of the Rocky Mountain Spotted Tick laboratory at Hamilton, Montana, for their assistance and cooperation. This bulletin is a direct result of the work done in cooperation with the Federal government on a Purnell project.

HISTORICAL

Although ticks have long been known as pests of man and his domestic animals, they were usually considered simply as a nuisance, to be avoided when possible. But when Smith and Kilbourne, in 1889, made the momentous discovery that Texas fever of cattle was transmitted by ticks and that it could be transmitted in no other way, these creatures suddenly became very important. Up to that time they had received little attention; many species had not even been described; their biology, life cycle, and distribution were almost unknown. This discovery immediately led to considerable work being done with ticks, and as it became known that they transmitted other diseases they assumed a role of increasing importance.

WHAT TICKS ARE

Ticks form a small natural group within the order Acarina. This order forms a part of the class Arachnida which includes, besides the ticks and other mites, such creatures as spiders, scorpions, daddy-long-legs, and a number of other somewhat similar arthropods. They are not insects and may be distinguished from the latter by the fact that, as adults, they have four pairs of legs and lack antennae.

The great majority of Acarina or mites, of which ticks form a part, are minute creatures, and both in numbers of species and numbers of individuals
are extremely abundant. Banks (1915) states that in almost any one area in the temperate zone one may expect to find from 300 to 500 species of mites. He states also that in this country there were some 650 named species of mites, and remarks that there are doubtless in all at least 2,000 species.

Ewing (1929) remarks that although "mites are the smallest of the arthropods" what they lack in size they make up in numbers. They are "so numerous that in some situations millions of them are to be found in an environment of only a few cubic inches."

The ticks belong to the super family Ixodoidea, and are distinguished from other mites by the presence of a pair of stigmal plates, situated laterally behind the last pair of legs, each plate having a distinct spiracle. They differ from most other mites by their large size and this leather-like integument.

The number of known species of ticks is comparatively small, there being only about 400 named forms (Banks 1915, p. 61), some 46 of which are found in North America. Although usually considered as tropical or semitropical creatures, there are some 20 species that are known to occur in Oregon, and several others will undoubtedly be found in the state.

All the known species are parasites and attack four of the five great classes of vertebrates. They are abundant on reptiles and mammals, and less so on amphibians and birds, and two species have been reported on insects.* A few species are of great importance as vectors of disease among the higher animals including man.

The ticks are, generally speaking, the largest of the mites, and are the most familiar forms so far as man is concerned. This familiarity is due in part to their large size, engorged females often being one-half inch long, and in part to the fact that they are often abundant on domestic animals.

Ticks before becoming engorged (Figure 1) are flat and somewhat triangular in outline. There is no distinct head. The exoskeleton is leathery and after the first molt there are eight legs. In most species there is a prominent shield on the dorsal surface, known as the scutum, which in the female is comparatively small but in the male often covers most of the dorsal surface. At the anterior margin of the scutum is a small subtriangular piece called the capitulum, or head. It bears the mouth parts: mandibles, palpi, mandibular sheaths, and the hypostome. By inserting the hypostome and mandibles into the host, the tick feeds by sucking out the blood. It is enabled to maintain its firm hold on the host by means of the many recurved teeth on the hypostome.

Ticks are parasitic during most of their active life. The majority, however, leave the host to molt, and all of them leave to deposit their eggs.

The hosts are largely mammals, but, as previously stated, reptiles, birds, and an occasional amphibian may serve as host.

Most species, although showing a decided preference for certain species of animals as hosts, will infest various species. More than one species of tick may be found on a single host, but when this occurs, the ticks usually belong to different genera.

Figure 2. A Mule-deer Fawn, March 8, 1937, Grant County, Oregon. The winter loss due to parasites is heavy some seasons. Note the rubbed neck where the fawn has rubbed to dislodge the parasites. About 300 ticks were taken from this animal. (Photograph by H. Meyers.)

ECONOMIC IMPORTANCE OF TICKS

All ticks are parasites, and although many species are not known to transmit disease they all suck the blood of their hosts. This blood sucking may, and often does, result in severely weakening the animal host, when the parasites are abundant. This applies to both domestic and wild animals. Southern cattle are sometimes so drained of their vitality that they fall down and are unable to rise. Chickens are killed by the chicken tick, and Banks (1915) reports that quail and meadowlarks are killed by the rabbit tick (Haemaphysalis leporispalustris). The Spinose ear tick is a serious pest of domestic animals in many parts of the country. A single tick deep in the animal's ear causes intense pain and much irritation. When numerous the ticks cause the ears to droop and the animal has a general unhealthy appearance. The winter tick is an important pest of deer (Figure 2), elk, moose, and occasionally of domestic stock. Animals may be so weakened as to fall easy prey to their natural enemies or to unfavorable weather conditions.

The monetary loss from ticks is difficult to estimate, but figures taken from the best available source are indicative of the importance of this small group. The annual loss to the cattle industry in the United States from the cattle tick is reported to be $100,000,000. The Spinose ear tick, the fowl tick and the spot-
ted-fever tick inflict a loss of not less than $75,000,000 per year, making a total of $175,000,000 for the four most destructive species.

In addition to the fact that many species of ticks suck the blood and irritate and annoy animals, there are even more important phases to consider as many species are the vectors of diseases deadly to man and beast.

**TICKS AS DISEASE CARRIERS**

Four different types of disease organisms are known to be carried by ticks; these are spirochaetes, piroplasms, rickettsias, and bacteria. Ticks also carry certain parasitic worms and some virus diseases.* The protozoa of the family Babesiidae are ordinarily transmitted solely by ticks. Diseases due to these organisms attack many mammals, but do not affect man.

Ticks are apparently of very little importance in the transmission of bacterial diseases, although they play an important part in the dissemination of tularemia.

Among the rickettsia diseases, Rocky Mountain spotted fever of man is so far as known carried exclusively by ticks, and the same is true of *R. ruminantium*, which attacks cattle in South Africa.

A number of spirochaetoses of fowls, mammals, and man are tick borne. Aside from carrying disease, ticks, through the piercing of the skin, may also provide a point of ingress for secondary infection.

Table 1 shows the various diseases carried by ticks, the causative organisms, and the species of tick involved.

**ROCKY MOUNTAIN SPOTTED FEVER OR TICK FEVER**

While there is no doubt that spotted fever was present in the Northern Rocky Mountain region long before the white man came, the earliest known case in Oregon was in 1887, and it was not until the late 90's that it was recognized as a distinct disease.

The early records of its occurrence and prevalence are incomplete, but the Rocky Mountain laboratory under the direction of Dr. R. R. Parker has gathered enough data to give a fair idea of what has taken place.† Since 1913 the record is reasonably reliable.

From 1913 through 1933 the number of cases reported in Oregon was 795. Prior to 1913 the known cases are 351, or a total of 1,146 cases for the state. The average number of cases per year from 1913 to 1933 has been approximately 40.

Oregon ranks third among the states for the number of known cases. Idaho is in the lead with 9,833 known cases; Wyoming is slightly ahead of Oregon with 1,350 cases; while Montana occupies fourth place with 1,065 known cases.

A study of the case data in the various states shows that the disease runs in quite definite cycles and that 1915, 1922, 1929, and 1932 were years of high prevalence. The cause for these peaks is not understood.

---

* Heart water in sheep, cattle, and goats; Nairobi sheep disease, paralysis, and other unknown causative organisms.
† See article by Dr. R. R. Parker in *Northwest Medicine* 34: 11-121.
<table>
<thead>
<tr>
<th>Disease</th>
<th>Causative organism</th>
<th>Carrier ticks *</th>
<th>Found in Oregon</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Splenetic fever</td>
<td>Pioroplasma bigeminum</td>
<td>Boophilus annulatus</td>
<td>No</td>
<td>Texas fever of cattle</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Several species of ticks and also other Arthropods</td>
<td></td>
<td>Ticks not necessary for its transmission.</td>
</tr>
<tr>
<td>Anaplasmosis</td>
<td>Unknown</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tularaemia</td>
<td>Pasteurella tularensen</td>
<td>D. andersoni</td>
<td>Yes</td>
<td>Attacks man and domestic animals, rabbits, and game birds. Ticks are not absolutely necessary in its transmission.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D. variabilis</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>I. ricinus californicus</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>H. leporis-palustris</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>D. occidentalis</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Probably other species</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tick paralysis</td>
<td>Unknown</td>
<td>D. andersoni females only</td>
<td>Yes</td>
<td>Occurs in children and a similar if not identical disease is found in sheep and dogs. Carried only by ticks.</td>
</tr>
<tr>
<td>Rocky Mountain spotted fever</td>
<td><em>Dermacentorxenus rickettisia</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>D. andersoni</td>
<td></td>
<td>Transmitted only by ticks.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D. variabilis</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>H. leporis-palustris</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Possibly others</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relapsing fever</td>
<td>Spirochaeta sp.</td>
<td>O. turicata</td>
<td></td>
<td>It is quite probable that this disease occurs in Oregon since it has been found in bordering states.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>O. hermsi</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Another strange phenomenon of the disease is that it may be quite prevalent in a given locality for a number of years and then be entirely absent for a long period. It should also be noted that the mere presence of ticks, even though numerous, does not necessarily indicate that the particular area is dangerous from the disease standpoint. Certain areas having an abundance of ticks have never reported a single case of spotted fever.

Spotted fever is the most important of the tick-borne diseases in Oregon because of its frequency, its severity, the usual prolonged period of convalescence, and its high death rate.

Excepting single cases reported from Clackamas, Washington, Benton, and Lane counties, the known cases in Oregon have occurred in various parts of the state east of the Cascade Range. Evidence indicates that all these cases came from Eastern Oregon infections.

Dr. Parker describes the symptoms of spotted fever as follows:

"The period between tick bite and the first symptoms of infection (that is, the incubation period) varies from 2 to 14 days. In those areas where the disease is severe it is usually 3 to 5 days, but where the less fatal infections predominate it is commonly 5 days or longer. The onset may be gradual or it may be sudden. If gradual, as is usually the case, the appearance of fever is preceded by a period that is mainly characterized by increasing weakness but there may also be chilly sensations. A definite chill frequently follows. With the appearance of the fever some of the following symptoms are present: Headache in the front or back of the head or both; eyes more or less bloodshot and often sensitive to light; eye balls sensitive to pressure; the tongue coated white with red edges; face with deep, dusky flush; pains in muscles, bones and joints; backache, particularly in the lower portion; nose bleed; bronchial cough; vomiting; constipation; and marked weakness. In the case of the highly fatal type the rise in temperature may also be accompanied by a considerable increase in the pulse rate, but in areas where the milder type prevails, the pulse rate frequently does not reach 100. The characteristic eruption, from which the common name of the disease is derived, commonly appears between the third and fifth days of fever and is usually seen first on the hands or forearms, or on the ankles and legs—less often on the back. This eruption is due to lesions in the walls of the small blood vessels in the skin."

**TULARAEMIA**

Tularaemia is described by Dr. Parker as follows:

"Tularaemia, which is also known as rabbit fever and deer fly fever, is not so frequently fatal as is spotted fever, but is nevertheless, a very serious disease, and convalescence may extend over a period of many weeks. It is primarily an infection of small wild animals and is presumably resident in the native fauna throughout the entire state.

"Most of the cases in man in this state, however, have been reported from the eastern section. The virus was obtained from ticks in the southwestern part of the state in 1936.

"Tularaemia infection in man is accidental and occurs as the result of a direct or an indirect contact with the disease in nature. Infection may take place through the unabraded skin, but most frequently results from the contamination of an abrasion or a skin puncture made by an insect or other agency."**

---

* Rocky Mountain spotted fever and other diseases—A mimeograph circular by Dr. R. R. Parker.
Again quoting Dr. Parker:

"Rabbits are the most frequent source of infection, particularly jack rabbits and cottontails. Infection follows the contamination of some parts of the body, usually the hands or eyes, with infected tissues while skinning, dressing, or otherwise manipulating the animal. Tularaemia is perhaps the disease most frequently concerned when rabbits are dying in large numbers. Rabbits found dead should always be viewed with suspicion.

"Ticks are next in importance to rabbits as a source of infection, and the spotted fever tick is the one commonly concerned. Not only is its bite infectious, but also its excrement. The hands may be easily contaminated with the excrement or tissues of ticks when picking ticks from horses or other animals, and should be immediately cleansed.

"Other less frequent sources of infection are the manipulation of the carcases of rodents other than rabbits and of small carnivores, the bites of deer flies, and the bites of animals. Some cases have occurred in which the obvious site of infection was a scratch or puncture of the skin due to burrs removed from the wool of sheep, sagebrush, rose briars, barbed wire, or other agency. The source from which these wounds became contaminated, however, has not been apparent.

"There are several types of tularaemia. The most common type, however, is that in which the site of infection is marked by an ulcer. There is an accompanying enlargement of the lymph glands that drain the site of infection. Occasionally, infection is acquired by way of mouth, as for instance, by the eating of insufficiently cooked meat of an infected rabbit. In such cases there is no local ulceration or any enlargement of the regional nodes.

"The appearance of symptoms is frequently sudden and is generally accompanied by alternate periods of chilly sensations and fever. There is commonly a frontal headache and the eyes may be sensitive to pressure, but are seldom infected as in the case of Rocky Mountain spotted fever. Sweating may be profuse. There is usually a backache and shifting pains in the muscles. Weakness is very marked.

"There is no specific treatment for this disease. Physicians, however, can relieve the symptoms in some measure. Complete rest in bed is of the greatest importance. Relapses are not uncommon and may even occur six months or longer after the original illness."*

HOW TO AVOID TICK INFECTIONS†

For the prevention of tick-caused diseases, it is important (1) to avoid tick bites, and (2) to remove early any ticks that may have become attached to the body. For prevention of spotted fever, vaccination is recommended as an additional precaution.

One of the best means of avoiding tick bites is to wear clothing that tends to prevent ticks from getting inside the trousers from the bottom. This may be accomplished by high boots, leggings, puttees, or socks that are worn outside the trouser legs.

In the spring when the adult wood ticks emerge from hibernation, they crawl up on grass, bushes and other low vegetation to await the passing of suitable hosts—animals or man. They are most frequently found at a height of not greater than 18 inches from the ground but are sometimes higher.

If ticks are carefully watched for on the legs, most of them can be picked off soon after they catch hold. Some, however, will reach the body in spite of

* Rocky Mountain spotted fever and other diseases—A mimeograph circular by Dr. R. R. Parker.
† Montana Department of Health, Special Bulletin 47.
all precautions. It is necessary, therefore, that the foregoing measures be supplemented by the examination of the body and of the inside of the clothing. Ticks seldom attach immediately unless late in the season, and as they can but rarely transmit infection until after having fed for several hours, such examinations made twice a day—perhaps at noon and upon retiring—are ordinarily sufficient. In areas that are heavily tick-infested, however, or in those known to be particularly dangerous, more frequent examinations should be made.

Persons whose exposure is only for a few hours or for part of a day would do well to make a complete change of clothing on reaching home. The clothes that have been worn into tick country should be so cared for that any unobserved ticks will not be a danger to other members of the household.

Articles of clothing left on the ground attract ticks from some distance (ten feet or even more) and should be carefully examined before again being put on. Ticks will also crawl to persons who remain in a small circumscribed area for shorter or longer intervals, as for example persons eating lunch or sleeping on the ground. For these reasons persons sleeping out-of-doors should use care in the placing of the bed or tent. In this connection, it should be borne in mind, also, that ticks are usually more numerous where rodents (such as ground squirrels, rabbits, woodchucks, and mice) are more abundant. Such places should be avoided. One of the safest camping situations is in standing timber, especially where low vegetation is scant. Proximity to trails and old roads should be especially avoided. In sagebrush sections avoid the sagebrush.

Particular care should be observed by persons following trails, as ticks tend to congregate on the vegetation along either side. This is particularly true at the foot of slopes or the up-hill side of a trail that crosses a slope. Grassy strips in the middle of little-used roads and vegetation along roadsides also are frequently heavily infested with ticks.

If a tick is found attached to the body, it is best to remove it immediately. Every added minute of attachment increases the danger of the transmission of spotted fever or other tick-borne disease. Many practices are resorted to for removal. Some persons apply such substances as turpentine or kerosene. Others touch the tick with a hot wire, hold a lighted match near it, or coat it with plain or carbolized vaseline. There is no assurance, however, that any of these practices will be effective. Ordinarily, the desired result is easily and safely accomplished by gently pulling with the fingers. If available, iodine or other disinfecting agent should be applied to the site of the bite. A silver-nitrate pencil, which can be bought at any drug store for ten cents, may be used for this purpose and is convenient to carry in the pocket. The tip of the pencil should be moistened and then applied to the wound until the flesh is slightly burned. Such procedures are probably of more value for the prevention of possible secondary infection of the wound than for the prevention of tick-transmitted disease.

There is no satisfactory material that is practical which can be placed on either the clothing or the body to prevent the attachment of ticks.

VACCINATION AGAINST ROCKY MOUNTAIN SPOTTED FEVER

A vaccine developed by the United States Public Health Service and known as the Spencer-Parker vaccine has now been in use for fourteen years for the prevention of Rocky Mountain spotted fever.
The records of the use of this vaccine indicate that it fully protects the average person against the less severe type of Rocky Mountain spotted fever. Against the highly fatal type, however, the average individual acquires only partial protection, but this is generally sufficient very markedly to lessen the severity of the disease and insure recovery. According to Dr. Parker the duration of immunity varies. Most persons are protected for only part of a year. It is necessary, therefore, that one be vaccinated each spring. This should preferably be done at least ten days before any expected exposure to possible tick bites.

In certain persons vaccination in successive years appears to result in an increasing degree of immunity. As a result, the erroneous idea has become widespread that vaccination each year for three years insures permanent immunity. There is no evidence to justify this idea, and it is likely that no lasting immunity is ever acquired except as the result of an actual spotted-fever infection.

The Public Health Service furnishes this vaccine to physicians without charge. It is manufactured only at the Service laboratory at Hamilton, Montana.

The vaccine does not afford protection against other tick-borne diseases than Rocky Mountain spotted fever, and is not of value for the treatment of spotted fever.

WHAT TO DO IF INFECTION WITH ROCKY MOUNTAIN FEVER IS SUSPECTED

If a person has reason to believe himself infected with spotted fever, three points should be borne in mind: (1) to conserve one's strength, (2) not to use drugs, and (3) to reach a physician and obtain hospitalization as soon as possible. These points are particularly important in cases of infection with the highly fatal type. In these very severe cases, the chance of recovery depends in large measure on the amount of resistance that the body can offer, and conservation of strength during the initial stages of the disease is extremely important. Any unnecessary expenditure of energy lowers the resistance and decreases the chances of recovery. This is even true of vaccinated cases that become infected with this type. The usual vaccinated case differs from the unvaccinated case mainly in that an additional degree of resistance has been acquired. This extra margin of safety varies in different individuals and in some may be easily expended. A person believing himself infected, therefore, should save himself in every way possible, whether vaccinated or not. These points should be borne in mind by persons living in the mountains or at a distance from others. Under such circumstances, assistance should be summoned rather than sought, if at all possible to do so, and the patient should remain quiet pending the arrival of help. Any necessary journey should be made with as little expenditure of energy as possible. Drugs should not be taken until prescribed by a physician. Certain drugs, such as aspirin, which uninformed people are likely to use, are deleterious in their effects and should be avoided.
A LIST OF TICKS KNOWN TO BE IN OREGON

Class Arachnida
Order Acarina
Superfamily Ixodoidea

I. Family Argasidae. There are two genera found in the United States.
   A. Genus Argas. Of the two species that occur in the United States, one is found in Oregon.
      1. The Fowl Tick, *Argas miniatus* Koch. Rare in Oregon, and probably will not persist here.
   B. Genus Ornithodoros. Six species occur in the United States. One is found in this state while two more probably will be found here.
      2. The Spinose Ear Tick, *O. megnini* (Duges). This species is rare in Oregon. See Figure 3.
   A recently described species, *O. parkeri* Cooley, probably will be found in Oregon, as it has been taken near Yakima, Washington. *O. hermsi* Wheeler has been taken near Moscow, Idaho, and doubtless occurs in Oregon.

II. Family Ixodidae. Eight genera belonging to this family occur in the United States.
   C. Genus Rhipicephalus. The one species known from the United States is not found in Oregon.
   D. Genus Boophilus (Margaropus). The one species in the United States is not found in Oregon.
   E. Genus Haemaphysalis. Of the two species in the United States, one occurs in Oregon.
      3. The Rabbit Tick, *H. leporis-palustris* (Pack). Common in Oregon. See Figure 3.
   Another species of this genus *H. cinnabarina* Koch has been taken in Montana.
   F. Genus Dermacentor. There are ten species of this genus in the United States. Six of them are found in Oregon.
      4. The Rabbit Dermacentor, *D. parumapertus* Neum. There are several records as shown in Figure 4.
   4a. A variety *marginatus* Banks is a rare species found in the extreme southeastern part of the state. According to Dr. Cooley this name should be eliminated as it is based on a color pattern that is extremely variable.
   5. The Rocky Mountain spotted fever tick, *D. andersoni* Stiles. This is a common and extremely important species. See Figure 6.
   6. The Pacific Coast tick, *D. occidentalis* Neum. A fairly common species. See Figure 8.
   7. The American dog tick, *D. variabilis* Say. A common species in some localities, but very rare in Oregon.
   8. *D. albipictus* Pack. Widely distributed in this state, but seldom collected.
9. The Black-lined tick, *D. nigrolineatus* Pack. There are a few records of this tick being collected in Oregon. See Figure 8. According to Professor Cooley, it is doubtfully distinct from *D. albipictus*.

G. Genus *Ixodes*. Of the sixteen species *Ixodes* found in the United States, eleven are known from Oregon.

10. *I. auritulus* Neum. A very few specimens of this tick have been taken here. See Figure 5.

11. The Rotund tick, *I. kingi* Bishopp. This species is very rare in Oregon.

12. *I. sculptus* Neum. There is a single record of this species in this state. See Figure 7.

13. The California *Ixodes*, *I. californicus* Banks.* There are several Oregon records as shown in Figure 5.

14. The Castor bean tick, *I. ricinus* (Linn.) This species is not uncommon in southwestern Oregon. See Figure 4.

15. Brunner's tick, *I. brunneus* Koch. We have several records of this species occurring on birds in this state. See Figure 5.

16. The Narrow tick, *I. angustus* Neum. One record from each of the following localities: Portland, Detroit, Empire, and Washington county.

17. The Hexagonal tick, *I. hexagonus* Leach. There is only one authentic record of this species occurring in Oregon. Some authorities say that the true *hexagonus* is not found in the United States. See Figure 7.

18. *I. cookei* Pack. Hemlock, Tiller, Grants Pass, and Dairy are the localities where this species has been taken in Oregon.

19. *I. diversifossus* Neum. Five records of this species having been taken in Oregon have been found in the files of Dr. Bishopp.

20. *I. texanus* Banks. A single specimen of this tick was taken from a chipmunk in Douglas county.

H. Genus *Ceratixodes*. Two species occur in the United States and should be found in Oregon.

*C. signatus* Briula. Probably occurs in Oregon. Taken on cormorants in California.

*C. pusus* Cambridge. Probably occurs in Oregon.

I. Genus *Aponomma*. One species occurs in the United States, but is not found in Oregon.

J. Genus *Amblyomma*. Five species are known from this country, but none occur in Oregon.

As indicated in the foregoing list, 20 species of ticks have been recorded as occurring in this state.

Several of these are known from records not to exceed a half dozen and are at present of little or no economic importance. On the other hand, a number of the most dangerous disease-carrying species occur in large numbers.

In the following pages will be found a short discussion of the more important forms.

* In a recent letter Professor Cooley informs the author that numbers 13 and 14 probably represent a single species, *I. ricinus californicus*. 
Figure 3. The Distribution of *Argas minimus* (the Fowl tick), *Ornithodoros megnini* (the Spinose ear tick), and *Haemaphysalis leporis-palustris* (the Rabbit tick) in Oregon.

Figure 4. The Distribution of *Ixodes cookei*, *Ixodes ricinus* (the Castor bean tick), *Ixodes kings* (the Rotund tick) and *Ixodes diversifossus* in Oregon.
Figure 5. The Distribution of *Ixodes brunneus* (Brunner's tick), *Ixodes angustus* (the Narrow tick), *Ixodes auritulus* and *Ixodes californicus* in Oregon.

Figure 6. The Distribution of *Dermacentor andersoni* (the Rocky Mountain spotted fever tick) in Oregon.
Figure 7. The Distribution of *Ixodes hexagonus* (the Hexagonal tick), *Ixodes texanus*, *Ixodes sculptus*, and *Dermacentor albipictus* (the Winter tick) in Oregon.

Figure 8. The Distribution of *Dermacentor variabilis* (the American dog tick), *Dermacentor occidentalis* (the Pacific Coast tick), *Dermacentor nigro-lineatus* (the Black-lined tick), and *Dermacentor parumapertus* (the Rabbit Dermacentor) in Oregon.
THE LIFE CYCLE OF A TICK

The life history of the various species of ticks differs, but the following is typical.

The engorged female drops from the host to the ground, where she deposits her mass of eggs, varying from 1,000 to as many as 20,000 in number. The task of egg deposition may require several days. The period required for incubation may be only a few days or a few weeks in case they are deposited early in the summer, but when deposited in the fall, the eggs do not hatch until the following spring.

![Figure 9. The average life cycle of the Spotted-Fever Tick. Top, First year; Bottom, Second year.](image)

The young ticks or larvae are known as “seed ticks” and differ from the later forms in that they have but three pairs of legs. These seed ticks shortly after hatching ascend some nearby grass, bush, or other object and patiently await the passing of some animal that will serve as a host (Figure 9). It is natural that a very large percentage are disappointed and ultimately die of starvation even though they are endowed by nature with the ability to withstand very long periods of fast. Those seed ticks which do find a host feed on the blood for a few days, become engorged, then drop to the ground, and seek a hiding place where they remain for one to several weeks while they undergo a metamorphosis and molt their outer skin. The form which emerges after this first molt is known as the nymph and possesses four pairs of legs. The nymph climbs to some point of vantage and again waits for a suitable host to come close enough so that it may attach itself. Again the percentage of mortality must be very
large, but enough of the parasites reach this second host to assure the survival of the species. Having succeeded in attaching itself to this second host, the tick again inserts its hypostome and feeds on the blood until fully engorged, when it again drops to the ground, hides, and molts. When it emerges from this second molt it is an adult, but again it must find a host and feed for the third time in order to become sexually mature and to mate. The females drop to the ground and deposit their large complement of eggs, and the life cycle is complete, having in the majority of cases required a period of two or more years.

This is the ordinary procedure followed by what are termed the three-host ticks. Some species, such as the Texas cattle tick, the Spinose ear tick, and others, do not drop off to molt and hence are termed one-host ticks. They do, however, leave the host to deposit their masses of eggs. This habit naturally reduces the hazard of not finding a host and admits of a more rapid reproduction. As would be expected, we find that such ticks deposit fewer eggs. Some species have habits which lie between these two extremes in that they pass the first molt on the host but drop to the ground for the second molt.

In addition to the great hazard of not finding suitable hosts at the correct time, ticks have other adverse conditions to overcome in the way of climatic conditions. Although most species prefer dry, warm weather, many species cease activities when hot weather comes on. Temperature and moisture both play an important part in their activities. Among the natural enemies they must overcome are various species of birds, insect predators, and a very small number of insect parasites. All of these taken together apparently destroy only a small percentage of the ticks. It is evident that the important factor in keeping their numbers down is the small chance they have to find suitable hosts at the correct time.

All ticks are easily assigned to one of two families:

I. *Argasidae*. No scutum; no ventral shield. Mouth parts of the adults not prominent from above; stigmal plate between coxae III and IV.

II. *Ixodidae*. Scutum present; ventral shield usually present; mouth parts of the adult prominent from above; stigmal plates behind coxae.

**FAMILY ARGASIDAE**

There are two genera in this family. They are very closely related but can be distinguished as follows:

Margin of body thin and acute—Genus *Argas*.

Margin of body rounded—Genus *Ornithodoros*.

A technical description of the various species of ticks is omitted, because the identification of the different species is difficult and the specimens should be submitted to an authority on the groups.

**Genus *Argas***

No species of *Argas* occur regularly in Oregon, but the fowl tick or blue bug (*A. minuta* Koch.) is reported to be firmly established* in Shasta County, California, and specimens have been seen in Oregon (Figure 3), probably from introduced poultry. It is not likely that the species will become established

---

*1927, United States Department of Agriculture, Farmers Bulletin No. 1070, p. 1.*
here since its range indicates a very decided preference for those areas where the rainfall is very light.

As this species is only an accidental visitor in this state an extended account is not necessary here. Any reader interested will find a full account in Farmers Bulletin No. 1070.

**Hosts:** Aside from chickens, the fowl tick attacks turkeys, geese, ducks, pigeons, guineas and the ostrich. A few cases of the species infesting wild birds such as quail, vultures and wild turkeys are known. The females of this and some other species of *Argas* may engorge several times as adults.

**Genus Ornithodoros**

Although the species of *Ornithodoros* are essentially tropical ticks, six species are reported from the United States and one has been found in Oregon.

Species of the genus *Ornithodoros* attack cattle while the "maubata bug" *O. maubata* transmits a blood parasite *Spirochaeta duttoni* which causes the fatal relapsing fever or tick fever in Africa. The Spinose ear tick (*O. megginii* Duges) is also a member of this genus. This tick differs in a number of ways from most of our other species as indicated below.

**The Spinose ear tick:** The common name indicates that this species is found most prevalent in the ears of its host; the body of the nymph is somewhat spiny.

The hosts are almost any of the larger mammals, especially horses, and cattle. For a complete list of the known hosts see page 24.

This species is widely distributed in the western United States and is occasionally taken in Oregon.

The life cycle differs from some of the other ticks. The larval ticks having succeeded in getting on a host, they at once seek the ears, where they settle down inside, below the hair line, and are then protected from their enemies. They engorge, become whitish or pinkish in color. They then molt and emerge in the nymphal stage with eight legs and a body covered with numerous small spines. At this time the ticks are about ½ inch long and again attach themselves to the lining of the ear and engorge. They remain in the ear for a period varying from one to seven months, when they are completely engorged and fully grown. They are now from ½ to ⅜ inches long and drop to the ground, hide themselves in some protected place, shed their skins, and emerge as adult, sexually mature ticks. All this occurs in a few days after leaving the host. The mature tick lacks the spines of the immature stage and does not feed. Mating takes place very soon after dropping to the ground, and the female climbs to some point of vantage and deposits her eggs. The number of eggs deposited is far less than in the case of many other species. Ordinarily from 350 to 1,500 eggs are deposited in small batches at intervals. The whole egg-laying process extends over a period of as much as six months. The female dies when oviposition is complete. The eggs hatch in ten days under favorable conditions, and the young ticks are ready to attach themselves to a host. They may live as long as three months awaiting a host. If not successful in that time, they starve.

For a description of this tick as well as for methods of control see Farmers Bulletin No. 980, United States Department of Agriculture.
FAMILY IXODIDAE

The family *Ixodidae* is represented in the United States by eight genera and some thirty-eight species. Hooker (1912) divides the family into three groups based upon habits.

1. The one-host ticks, which pass both molts upon the host.
2. The two-host ticks, which pass the first molt on the host but drop to the ground for the second molt.
3. The three-host species, which drop to the ground for both molts.

These habits are not confined to any single genus; for instance, *Dermacentor albipictus* comes under the first class, while *D. andersoni* falls in class three.

The females of *Ixodidae* engorge but once as adults. The period of engorgement for the different species varies and is apparently influenced largely by temperature. Bishop's study of some eighteen species shows that the engorgement period for larvae and for the nymphal stages are nearly the same and vary from three to twelve days, occasionally a little longer, while the average feeding period for adults is longer, ranging from seven to twenty-five days. The period required for engorgement when the host is a cold-blooded animal is considerably longer than in the case of a warm-blooded host.

Among the better-known species in the United States is the Texas fever tick, *Boophilus (Margaropus) annulatus* Say, which carries *Piroplasma bigeminum*, the protozoan parasite so often fatal to northern cattle. This species does not occur in the Northwest. A complete account of its various stages, its activities and the various methods for its control will be found in Farmers Bulletin No. 1057, United States Department of Agriculture.

Species of the Genus *Dermacentor* also belong to this family. They usually have the scutum more or less variegated with white and brown. There are some ten species in the United States, including such well-known forms as the dog tick (*D. variabilis*), the Rocky Mountain spotted-fever tick (*D. andersoni*), the western dog tick (*D. occidentalis*), and the elk tick or winter tick (*D. albipictus*).

*Amblyomma* is a large genus. Some exotic species occur on snakes and the lone-star tick of Texas (*A. americanum*) is a member of the genus. No members of the genus are found in Oregon.

Genus *Ixodes*

The genus *Ixodes* is the largest in this country. Only one of the species which occur in the United States is known to carry disease, but in Europe several species are connected with disease transmission. Of the sixteen species found in the United States, eleven species occur in Oregon and two others probably will be found here.

*Ixodes auritulus*: This rare species has been taken at four localities, two in Tillamook, and two in Lane County, Oregon. (See Figure 5.) It was described from specimens taken near the southern tip of South America. It is found very largely upon small birds. See host list on page 27.

*Ixodes hexagonus*: A species which is at present called the hexagonal tick is found on woodchucks just across the Oregon line in Idaho, and we have a single record of its being taken in this state at Burns. (Figure 7.) The known hosts are listed on page 28.
Ixodes californicus: The California ixodid is reported from Redwood Creek, Humbolt County, California, on fox and deer. It is rare in this state but has been taken at various points in Western Oregon from Estacada in the North to Kerby in the South (see Figure 5.). The known hosts are listed on page 27.

Ixodes brunneus: This species is confined to small birds and has been taken at Corvallis, Tillamook, and Harrisburg, Oregon.

Ixodes texanus: A single specimen was taken from a chipmunk in Douglas County, Oregon. The other known hosts are listed on page 28.

Ixodes cookei: This tick has been taken at a few widely scattered localities as shown in Figure 5.

Ixodes kingi: A pale gray species found infesting various species of rodents and other small mammals in all parts of the West. The only authentic record we have for Oregon is of specimens taken at Adel, Lake County, on the pocket mouse. Other known hosts are listed on page 27.

Ixodes diversifossus: Five records of this species having been taken in Oregon were found in the files of the Bureau of Entomology.

Ixodes angustus: This species occurs on various rodents from Alaska to California. It has been taken at several localities in Western Oregon. See Figure 5 for distribution in Oregon.

Ixodes sculptus: There is one record of this species taken in Oregon. On April 9, 1932, a specimen was taken at Portland, Oregon, by M. Canova, from the white-footed mouse.

Ixodes ricinus: The Castor-bean tick is a widely distributed species found on many wild and domestic mammals, which are listed on page 28. It is very abundant in Southwestern Oregon, less so in the more northern sections. (See Figure 4.)

Genus Haemaphysalis Koch.

The rabbit tick (Haemaphysalis leporis-palustris) in its various stages attacks rabbits primarily but has been found on the horse and the domestic cat; it is also found on ground birds such as the robin, meadow lark, quail, grouse, etc. It is abundant over the entire state except the Coastal Region and the Willamette Valley. It does not attack man. See Figure 4 for Oregon distribution.

Genus Ceratixodes Neum.

There are but two indigenous species in this genus and these are found on sea birds.

Ceratixodes signatus is a yellowish species, with a large red-brown shield, which occurs on cormorants (and probably other sea birds) from Alaska to California and there is no question but that it occurs on sea fowl along our Oregon Coast, although we do not have records of its actual capture here.

C. putus is a similar species taken from large sea birds in Unalaska, Bering Island, Scotland, and its range may extend down the Pacific Coast of Oregon.
Genus *Dermacentor* Koch.

This genus is well represented in Oregon. Of the ten species found in the United States, six species and one variety are reported from this state.

*D. albipictus* (Figure 10) known as the elk tick, deer tick, moose tick, or winter tick, is found all over the state, where it occurs on deer, elk, horse, Rocky Mountain goat, ox, moose, and has been reported (Banks 1908, p. 45) from the beaver. It is an important enemy of the larger game animals and is partly responsible for the death of many deer. It sucks such quantities of blood from the animals that they are unable to withstand severe winter weather and many succumb. *Albipictus* is a one-host tick.

*D. andersoni*, treated by Banks under the name *D. venustus*, is the species that is primarily responsible in the northwestern states for the transmission of spotted-fever virus. It occurs in all parts of Eastern Oregon. A series of typical examples have been taken in the vicinity of Detroit and Breitenbush on the west side of the Cascades. Single specimens were taken in western Benton County and in Columbia County. A questionable record of its occurrence in Curry County exists.

Cases of spotted fever have occurred in Benton, Lane, Clackamas, and Washington counties, but the tick was undoubtedly picked up in Eastern Oregon.

The hosts of the larval and nymphal forms include practically any of the small mammals, while the adults are found on larger mammals such as deer, cattle, horses, sheep, mountain goats, and occasionally on man. A complete list of the known hosts is given on pages 24-25.

*Dermacentor occidentalis* is quite similar to *D. andersoni*. It is often referred to as the Pacific Coast tick. This species occurs west of the Cascade Mountains from British Columbia to California (see Figure 10) and is quite abundant in the southwestern Oregon counties. The preferred host is deer, but it attacks other large mammals and is frequently found on man.

*D. occidentalis* is a vector of tularemia. The virus of this disease was recovered from ticks taken in the Grants Pass area in 1936 by the workers of the Hamilton Laboratory.

*Dermacentor nigrolineatus* is apparently widely distributed but nowhere very abundant. Banks reports it from New York, Texas, and Wisconsin. We have specimens from Arizona and three records from Oregon (Jackson, Coos, and Curry counties). The hosts are mainly deer, but the Oregon specimens in one case are from a cow and in another case from a horse. It may prove to be only a variety of *Dermacentor albipictus*.
Dermacentor parumapertus occurs on the jack rabbit in Idaho. It is also reported from chickens and occasionally gets on man. It ranges into Eastern Oregon but is rare. Our records are from Vale, Burns, Lakeview, and Heppner. (See Figure 10.) For a list of the known hosts see page 24.

A variety D. p. marginatus, is reported by Banks to be found on rabbits and dogs in the extreme southern portion of Eastern Oregon.

Dermacentor variabilis (Figure 11), the wood tick, or American dog tick, is reported as being common in southwestern Oregon.† It infests the squirrel and dog, and is found less commonly on the rabbit, raccoon, and other hosts as indicated on page 26. The reference to this species being common is apparently in error. We have been able to find only two specific records of its capture in the state, one specimen taken at Eagle Point in Jackson County and another at Riverside in Malheur County. Cooley (1932, p. 13) also reports this species as occurring in Southern Oregon.

LIST OF THE KNOWN HOSTS OF THE TICKS OF OREGON

A list of the recorded hosts of the various species of ticks found in Oregon follows. Those hosts preceded by an asterisk (*) have been found to harbor the parasite in this state.

Hosts of the Fowl tick, Argas manius Koch.
- Canaries (H.B.W.)‡
- *Chickens (Gallus domesticus)
- California quail (Lophortyx californica) (E)
- Meadow lark (Sturnella neglecta) (H.B.W.)
- Jack rabbit (Lepus sp.) (H.B.W.)
- Ostrich (H.B.W.)
- Doves (Zenaridura macroura) (E)
- Pigeons (Columba sp.) (E)
- Wild turkey (Meleagris gallopavo subsq.) (H.B.W.)
- All domestic fowls.

‡ The initials following some names indicate the authority for that host. H.B.W. are records from Hooker, Bishop, and Woods Life History and Bionomics of some N. A. ticks, United States Department of Agriculture, Bureau of Entomology, Bulletin No. 106. O.S.C. are records from Oregon State College. B are records from the various publications of Nathan Banks as listed in the bibliography. H indicates records from the cards in the Spotted tick laboratory, of Hamilton, Montana. E indicates records listed by Essig in Insects of Western North America. C indicates records from the papers of Professor R. A. Cooley as listed in the bibliography.
Hosts of the Spinose ear tick, *Ornithodoros megynini* (Duges)

- Ass (*Equus asinus*)
- Cat (*Felis domesticus*),
- Cow (*Bos*),
- Black-tailed deer (Barber) (*Odocoileus c. columbianus*)
- Dog (*Canis familiaris*)
- Sheep (*Ovis aries*)
- Hog (*Sus scrofa*)
- Horse (*Equus caballus*)
- Mule (*E. asinus X E. caballus*)
- Rabbit (*Lepus*).

Hosts of the Rabbit tick, *Haemaphysalis leporis-palustris* Pack.

- *Black-tailed jack rabbit* (*Lepus californicus* var.)
- Brewer blackbird (*Euphagus cyanocephalus*) (H.B.W.)
- Crissal thrasher (*Toxostoma dorsale dorsale*)
- *Cottontail rabbit* (*Sylvilagus nuttallii*)
- Meadow lark (*Sturnella sp.*) (H.B.W.)
- *Pigmee rabbit* (*Brachylagus idahoensis*)
- Domestic cat (*F. domesticus*) (H.B.W.)
- Quail (H.B.W.)
- Roadrunner (*Geococcyx californianus*) (H.B.W.)
- Robin (*Turdus migratorius*) (H.B.W.)
- *Rufus jack rabbit* (*Lepus*)
- *Ruffed grouse* (*Bonasa umbellus sabini*) (O.S.C.)
- *Sage hen* (*Centrocercus urophasianus*) (H)
- *White-tailed jack rabbit* (*Lepus townsendii townsendii*) (H)

Hosts of the Rabbit *Dermacentor, Dermacentor parumapertus* Neum.

- *Cottontail rabbit* (*S. n. nuttallii*)
- *Jack rabbit* (*Lepus sp.*)
- *Ground hog* (*Marmota sp.*)
- *Pigme rabbit* (*B. idahoensis*)
- Chicken houses (B)
- Man (*H. sapiens*) (B)

*Dermacentor parumapertus var marginatus*;

- *Cottontail rabbit* (*S. n. nuttallii*)
- *Jack rabbit* (*Lepus sp.*)

Hosts of the Rocky Mountain spotted-fever tick, *Dermacentor undersoni* Stiles.

- Ass (*Equus asinus*)
- Antelope (*Antilocapra americana*)
- Black bear (*Euarctos americanus*)
- *Black-tailed jack rabbit* (*Lepus californicus* var.)
- Badger (*Taxidea taxus* var.)
- Columbia ground squirrel (*Citellus columbianus*) (C)
- *Cow* (*Bos*)
- Coyote (*Canis lestes*) (C)
- *Chipmunk* (*Eutamias a. luteiventris*) and (*E. m. pictus*) (C)
- *Cottontail rabbit* (*Sylvilagus n. nuttallii*) (O.S.C.)
- Douglas ground squirrel (*Otospermophilus douglasii douglasii*) (O.S.C.)
- Domestic cat (*Felis domesticus*) (H)
Cony or Pika (Ochotona princeps) (H)
*Dog (Canis familiaris) (H)
Flying squirrel (Glaucopsia sabrinus alpinus)
Elk (Cervus canadensis) (C)
Pocket gopher (Thomomys fuscus) (H)
*Golden-mantled ground squirrel (Callospermophilus chrysodeirus chrysodeirus)
*Gopher (Thomomys nevadensis townsendii) (H)
*Gray-headed cony (Ochotona femina fumosa) (H)
*Goat (Capra hircus) (H)
Long-tailed meadow mouse (Microtus mordax mordax) (H.B.W.)
*Horse (Equus caballus) (C)
Sawatch meadow mouse (Microtus p. modestus)
*Man (Homo sapiens)
Gray meadow mouse (M. Nanan canescens)
*Mule deer (Odocoileus hemionus)
White-tailed deer (O. v. leucurus)
*Mule (Equus assimus x caballus)
Mouse (Mus musculus musculus)
Rocky Mountain jumping mouse (Zapus p. princeps)
Oregon ground squirrel (Citellus oregonus)
*Painted chipmunk (Eutamias minimus pictus)
*Porcupine (Erethizon epizanthus)
*Richardson's pine squirrel (Sciurus hudsonicus richardsoni) (C)
Red-backed mouse (Clethrionomyys idahoensis)
*Rufus jack rabbit (Lepus sp.)
Rocky Mountain goat (Oreanomos montanus) (C)
Montana mantled ground squirrel (Callospermophilus l. cinerascens)
Sheep (Ovis aries)
Shrew (Sorex sp.)
Snow-shoe rabbit (Lepus bairdi)
Uinta chipmunk (E. unbrinus)
*White-tailed jack rabbit (Lepus t. townsendii)
*Woodchuck (Marmota flaviventris)
Wood rat (Neotoma cinerea) (C)
White-footed mouse (Peromyscus m. artemissiae)
Weasel (Mustela arizonensis)
Muskrat (Ondatra (Fiber) zibethica)
Bats (Vespertilionidae spp.)
Richardson's ground squirrel (Citellus richardsoni) (C)
Ox (Bos taurus)
Hog (Sus scrofa)
Wildcat (Lynx rinta)

Hosts of the Pacific Coast tick, Dermacentor occidentalis Neum.
*Brush rabbit cottontail (Sylvilagus bachmani)
*Chipmunk (Eutamias sp.)
*Cow (Bos)
*Coyote (Canis latrans lestes)
Deer (Odocoileus sp.) (Type)
*Deer mouse (Peromyscus sp.)
*Silver gray squirrel (S. griseus griseus)
*Ground squirrel (Citellus spp.)
*Horse (E. caballus)
*Lizard (Crotaphytus sp.)
*Man (H. sapiens)
Mule (E. asinus x E. caballus) (H.B.W.)
*Pack rat—wood rat (Neotoma)
*Rabbit (Lepus spp.)
Siskiyou chipmunk (E. t. siskiyou)
*Wood rat (Neotoma spp.)
Dog (C. familiaris) (H.B.W.)
Sheep (O. aries) (H.B.W.)
Ass (E. asinus) (H.B.W.)

Hosts of the American dog tick, Dermacentor variabilis Say.
Ass (E. asinus) (H.B.W.)
Badger (Taxidea sp.) (H.B.W.)
Coyote (Canis latrans) (H.B.W.)
Wood mouse (Peromyscus leucopus) (L.K.W.)*
Deer (Odocoileus sp.) (H.B.W.)
*Dog (C. familiaris)
Fox squirrel (Sciurus niger subsp.) (H.B.W.)
Fox (Vulpes sp.) (H.B.W.)
Hog (S. scrofa) (H.B.W.)
Horse (E. caballus) (H.B.W.)
Opossum (Didelphis virginiana) (H.B.W.)
Mexican lions (Felis hippocastanis aztecus) (H.B.W.)
Man (H. sapiens) (H.B.W.)
Swamp rabbit (Sylvilagus aquaticus)
Ox (Bos) (H.B.W.)
Rabbit (Lepus sp.) (H.B.W.)
Raccoon (Procyon sp.) (H.B.W.)
Skunk (Mephitis sp.) (H.B.W.)
Weasel (Mustela sp.) (H.B.W.)
Wildcat (Lynx sp.) (H.B.W.)
Western Peromyscus (Peromyscus maniculatus rubidus)
Wolf (Canis sp.) (H.B.W.)

Host of the Elk or Winter tick, Dermacentor albipictus Packard.
Beaver (Castor canadensis) (B)
*Black-tailed deer (O. c. columbianus) (O.S.C.)
*Cow (Bos)
*Mule deer (O. hemionus macrotis) (O.S.C.)
*Elk (Cervus canadensis var.)
*Horse (E. caballus) (O.S.C.)
Man (H. sapiens)
Moose (Alces americana)
Mountain goat (Oreamnos americanus)
Ox (Bos)

Hosts of the Black-lined tick, Dermacentor nigrolineatus Packard.
Cow (Bos)
Deer (O. columbianus)
*Horse (E. caballus)

Hosts of *Ixodes auritulus* Neum.
- *English sparrow* (*Passer domesticus*) (H)
- *Golden-mantled ground squirrel* (*C. c. chrysodeirus*) (H.B.W.)
- *Junco* (*Junco hyemalis*) (H.B.W.)
- *Song sparrow* (*Melospiza sp.*) (H.B.W.)
- *Woodchuck* (*Marmota flaviventris*) (H.B.W.)

- Deer (*Odocoileus sp.*) (H.B.W.)
- Sheep (*B. aries*) (H.B.W.)
- Horse (*E. caballus*) (H.B.W.)
- Opossum (*Didelphis sp.*) (H.B.W.)
- Dog (*C. familiaris*) (H.B.W.)
- Rock squirrel (*Otospermophilus sp.*)
- Ruddy deer mouse (*Peromyscus m. rubidus*)
- Wood mouse (*Peromyscus sp.*)
- Cattle (*Bos spp.*) (H.B.W.)
- Quail (*H.B.W.*)
- Blue jay (*Cyanocitta sp.*) (H.B.W.)
- Thrush (H.B.W.)

Hosts of the Rotund tick, *Ixodes kingi* Bishop.
- Pika (*Ochotona princeps*)
- Badger (*Type *) (*Taxidea taxus neglecta*)
- Chipmunk (*Eutamias sp.*)
- Dog (*C. familiaris*)
- Wolf (*Canis sp.*)
- Ground squirrel (*Citellus columbianus*)
- Pine squirrel (*Sciurus hudsonicus richardsoni*)
- *Pocket mouse* (*Perognathus parvus parvus*)
- Pocket gopher (*Thomomys c. ocicus*)
- Mink (*Lutreola sp.*)
- Prairie dog (*Cynomys sp.*)
- Marmot (*Marmota flaviventris*) (H.B.W.)
- Kangaroo rat (*Peridipus richordsoni*)
- Skunk (*Mephitis sp.*)

Hosts of the California Ixodes (*Ixodes californicus* Banks)
- Black-tailed deer (*O. c. columbianus*)
- Alligator lizard (*Gerrhonotus s. scineicauda*) (Jellison)*
- Blue-bellied lizard (*Sceloporus o. occidentalis*) (Jellison)
- Burrowing owl (*Speotyto cunicularia*)
- Cottontail rabbit (*S. n. nuttalii*)
- *Rabbit* (*Lepus sp.*)
- *Cow* (*Bos*)
- *Dog* (*C. familiaris*)
- Fox (*Vulpes fulvus var.*)
- Ground squirrel (*Citellus sp.*)
- *Horse* (*E. caballus*)
- Jack rabbit (*Lepus sp.*)
- *Man* (*H. sapiens*)
- Meadow mouse (*Microtus mordax sp.*)
- Mouse (*Mus m. musculus*)

---

Hosts of the Castor bean tick, *Ixodes ricinus* (Linn.)
*California lizard (*Sceloporus occidentalis*)
*Coyote (*Canis sp.*)
*Cougard (*Felis c. oregonensis*)
*Cat (*F. domesticus*)
*Cow (*Bos*)
*Cottontail rabbit (*S. n. nuttallii*)
*Chipmunk (*Eutamias sp.*)
*Fox (*Vulpes sp.*)
*Mole (*Scapanus sp.*)
*Skunk (*Mephitis sp.*)
*Rat (*Rattus sp.*)
*Dog (*C. Familiaris*)
*Deer (*Odocoileus sp.*)
*Gray squirrel (*Sciurus sp.*)
*Jack rabbit (*Lepus sp.*)
*Man (*H. sapiens*)
*Sheep (*O. aries*)
*Siskiyou chipmunk (*E. t. siskiyou*)
*Wildcat (*Lynx sp.*)

Hosts of Brunner's tick, *Ixodes brunneus* Koch.
*Coast jay (*Cyanocitta stelleri carbonacea*)
*Golden-crowned sparrow (*Zonotrichia coronata*)
*Sparrow
*Hermit thrush (*Hylocichla guttata*)
*Violet-green swallow (*Tachycineta thalassina lepida*)
*Western robin (*Tundus niigratorius Propinquus*)

Hosts of the Narrow tick, *Ixodes angustus* Neum.
*Chipmunk (*Eutamias sp.*)
*Golden-mantled squirrel (*C. c. chrysodeirus*)
*Man (*H. sapiens*)
*Meadow mouse (*Microtus mordax var.*)
*Western bushy-tailed wood rat (*Neotoma c. occidentalis*) (type)
*Rabbit (*Lepus sp.*)

Hosts of the Hexagonal tick, *Ixodes hexagonus* Leach.
*Ground hog (*Marmota sp.*)
*Rabbit (*Lepus sp.*)
*Sheep (*Ovis aries*)
*Squirrel (*Citellus sp.*)

Hosts of Cook's tick, *Ixodes cookei* Packard.
*Cat (*F. domesticus*)
*Cougard (*Felis concolor oregonensis*)
*Dog (*Canis familiaris*)
*Fox (*Vulpes sp.*)
*Mink (*Lutreola vison energumenos*)
*Porcupine (*Erethizon epicanthus epixanthum*)
*Pocket gopher (*Thomomys sp.*)
*Raccoon (*Procyon lotor pacifica*)
Robin (*Turdus migratorius* var.)
Ground squirrel (*Citellus* sp.)
Skunk (*Mephitis* sp.)
*Woodchuck (*Marmota* sp.)
Weasel (*Mustela* sp.)

Hosts of *Ixodes diversifossus* Neum.
*Black-tailed jack rabbit (*Lepus californicus* var.)
*Fox sparrow (*Passerella iliaca* subsp.)
Raccoon (*Procyon l. pacifica*)
Wood rat (*Neotoma* sp.)

Hosts of *Ixodes texanus*
Chipmunk (*Eutamias* sp.) (H)

**BIBLIOGRAPHY**

Badger, L. F. and Dyer, R. E.

Banks, N. A.

Bishopp, F. C.

Chandler, A. C.

Cogswell, W. F.

Cooley, R. A.

Cornwall, J. W. and Nuttall, G. H. F.

Ewing, H. E.
Gahan, A. B.

Graybill, H. W.

Hadwen, S.

Hadwen, S. and Nuttall, G. H. T.

Henshaw, H. W. and Birdseye, E.

Herms, W. B. and Wheeler, C. M.

Herms, W. B. and Howell, D. E.

Hooker, W. A. and Bishopp, F. C.

Hooker, W. A.


Howard, L. O.


Hunter, W. D. and Hooker, F. C.

McClinic, T. B.

Maver, M. B.

Montana
Montana State Board of Entomology Biennial Reports, especially the 4th, 6th, 7th and 8th—1921, 1927, 1929 and 1930. Numerous papers on all phases of Rocky Mountain Spotted Fever and its carrier *Dermacentor andersoni*.

Montana
Nutthall, G. H. F. and Warburton, C.  

Parker, R. R.  
1929. Quail as a Possible Source of Tularaemia Infection in Man. U. S. Public Health Reports. 44 (17) : 999-1000.  

Spender, R. R.  

Stiles, C. W.  

Temple, I. U.  

Smith, T. and Kilbourne, F. L.  

Todd, J. L.  

Weller, B. and Graham, G. M.  

Wheeler, C. M.  

Wolbach, S. B.  

Wood, H. P.  
BIBLIOGRAPHY OF THE MORE IMPORTANT EARLY WRITINGS ON THE SPOTTED-FEVER TICK

1903. Anderson, J. F.
Spotted fever (tick fever) of the Rocky Mountains. A new disease.

1905. Stiles, Ch. Wardell.
A zoological investigation into the cause, transmission and source of Rocky Mountain "spotted fever." Bul. 20, Hygienic Laboratory, U. S. Public Health and Marine-Hospital Service, p. 121.
(A valuable bibliography is included.)

1906. Ricketts, H. T.

1906. King, W. W.

1906. Ricketts, H. T.

1906. Ricketts, H. T.

1907. Ricketts, H. T.

1907. Ricketts, H. T.

1907. Ricketts, H. T.

1908. Maxey, E. E.
Rocky Mountain spotted (tick) fever with special reference to causal factors, mortality and geographical distribution in Idaho. Medical Sentinel, Portland, Oregon, December.

1908. Stewart, J. L. and W. F. Smith
Clinical phases of Rocky Mountain spotted fever. Medical Sentinel, Portland, Oregon, December.

1908. Ricketts, H. T.
Recent studies of Rocky Mountain spotted fever in Montana and Idaho. Medical Sentinel, Portland, Oregon, December.
1908. Tuttle, T. D.
Some indications for State control of Rocky Mountain tick fever. Medical Sentinel, Portland, Oregon, December.
(The four preceding papers were republished by the Medical Sentinel with continuous pagination under the title "Symposium on Rocky Mountain Tick Fever.")

1908. Banks, Nathan

1908. Smith, W. F. (See Stewart, J. L.)

1909. Rickette, H. T.
A microorganism which apparently has a specific relationship to Rocky Mountain spotted fever, carried on during 1906-1907. 4th Bien. Rept. State Board Health Montana, pp. 87-130.

1909. Ricketts, H. T.
(The two papers above constitute the most detailed and comprehensive of Dr. Rickett's various reports on his investigations in Montana.)

1909. Cooley, R. A.
(This paper was published as Bulletin 75 of the Montana Agriculture Experiment Station, together with the following:)

1909. Cooley, R. A.

1910. Stiles, Ch. Wardell.
The taxonomic value of the microscopic structure of the stigmal plates in the tick genus Dermacentor. Bul. 62, Hygienic Laboratory U. S. Public Health and Marine-Hospital Service, p. 72, pls. 43.

1911. Bishop, F. C.

1911. Tuttle, T. D.
Rocky Mountain spotted (tick) fever. 5th Bien. Rept. State Board Health Montana, pp. 9-12.

1911. Mauer, Maria B.

1911. Mauer, Maria B.

1911. Moore, Josiah, J.
1911. Cooley, R. A.

1911. Hunter, W. D. and Bishop, F. C.

1911. Henshaw, Henry, W., and Birdseye, Clarence

RECENT ARTICLES ON TICK FEVER

1933. Parker, R. R., Phillip, C. B. and Jellison, W. L.

Ticks of the United States in Relation to Disease in Man. Journ. Econ. Ent. 30: 51-69. (Bibliography).

1933. Parker, R. R. and Davis, G. E.
Articles on Rocky Mountain Spotted Fever

1933. Dyer, R. E.

1933. Badger, L. E.

1933. Parker, R. R.
OREGON STATE BOARD OF HIGHER EDUCATION

Willard L. Marks............................................Albany
Herman Oliver..............................................John Day
Edward C. Pease.............................................The Dalles
F. E. Callister............................................Albany
Beatrice Walton Sackett.................................Marshfield
G. A. Brand.................................................Roseburg
E. C. Sammons...............................................Portland
Robert W. Ruhl..............................................Medford
Walter E. Pearson..........................Chancellor of Higher Education
Frederick M. Hunter, Ed.D., LL.D........Chancellor Emeritus, Director of Research
in Production and Marketing

STAFF OF AGRICULTURAL EXPERIMENT STATION

Staff members marked * are United States Department of Agriculture investigators stationed in Oregon

Geo. W. Peavy, M.S., Sc.D., LL.D. President of the State College
Wm. A. Schoenfeld, B.S.A., M.B.A. Director
R. S. Besse, M.S. Vice Director
Esther McKinney Accountant
Mary Woodcock, B.S. Secretary

Division of Agricultural Economics

E. L. Potter, M.S. Agricultural Economist; In Charge, Division of Ag. Economics
W. H. Dreesen, Ph.D. Agricultural Economist

Division of Farm Management

A. S. Burrier, M.S. Economist (Farm Management)
H. D. Scudder, B.S. Economist (Farm Management)
G. W. Kuhlmans, M.S. Associate Economist (Farm Management)

Division of Animal Industries

P. M. Brandt, A.M. Dairy Husbandman; In Charge, Division of Animal Industries
O. M. Nelson, M.S. Animal Husbandman
R. G. Johnson, B.S. Assistant Animal Husbandman
A. W. Oliver, M.S. Assistant Animal Husbandman

Division of Food and Game Management

R. E. Dimick, M.S. Wildlife Conservationist in Charge
A. S. Einarson, B.S. Associate Biologist

Division of Poultry Husbandry

H. E. Cosby Poultry Husbandman
F. L. Knowlton, M.S. Poultry Husbandman
F. E. Fox, M.S. Associate Poultry Husbandman

Division of Veterinary Medicine

B. T. Simms, D.V.M. Veterinarian
W. T. Johnson, B.S., D.V.M. Assistant Veterinarian
J. N. Shaw, B.S., D.V.M. Associate Veterinarian
R. M. Bolin, D.V.M. Assistant Veterinarian
O. H. Muth, D.V.M., M.S. Assistant Veterinarian
R. Dougherty, D.V.M. Assistant Veterinarian
A. S. Rosenwald, B.S., D.V.M. Assistant Poultry Pathologist
O. L. Searcy, B.S. Technician

Division of Plant Industries

G. R. Hyslop, B.S. Agronomist; In Charge, Division of Plant Industries
H. A. Schoth, M.S. Agronomist; Forage Crops and Disease Investigation
D. D. Hill, Ph.D. Associate Agronomist
R. E. Fore, Ph.D. Assistant Agronomist
B. B. Robinson, Ph.D. Assistant Plant Breeder, Fiber Flax Investigations
Grace Cole Fleischman, A.B. Assistant Botanist, Division of Seed Investigations
H. H. Rampton, M.S. Assistant Agronomist; Forage Crops and Disease Investigation
L. E. Harris, M.S. Assistant Agronomist

Division of Horticulture

W. S. Browu, M.S., D.Sc. Horticulturist
A. G. B. Bouquet, M.S. Horticulturist (Vegetable Crops)
E. H. Wiegand, B.S. Horticulturist (Food Products Industries)
H. Hartman, M.S. Horticulturist (Pomology)
C. E. Schuster, M.S. Horticulturist (Div. Fruits and Veg. Crops and Diseases)
W. P. Dursut, Ph.D. Plant Propagation
G. F. Waldo, M.S. Assistant Pomologist (Div. Fruits and Veg. Crops and Diseases)
T. Unsoloff, M.S. Assistant Horticulturist (Food Products Industries)
E. Hansen, M.S. Assistant Horticulturist (Pomology)
STATION STAFF—(Continued)

Soil Science

W. L. Powers, Ph.D.................................................................Soil Scientist
C. S. Rusek, M.S.................................................................Soil Scientist (Fertilizers)
M. R. Lewis, C.E............................................................Irrigation and Drainage Engineer, Bur. of Agric. Engineering
R. E. Stephenson, Ph.D......................................................Associate Soil Scientist
E. F. Forngerson, B.S......................................................Associate Soil Scientist (Soil Survey)

Other Departments

Agricultural Chemistry

J. S. Jones, M.S.................................................................Chemist in Charge
R. H. Robinson, M.S............................................................Chemist (Insecticides and Fungicides)
J. R. Haag, Ph.D.............................................................Chemist (Animal Nutrition)
D. F. Buhis, M.S.................................................................Associate Chemist (Food Products Industries)
M. B. Hatch, M.S.................................................................Assistant Chemist

Agricultural Engineering

F. E. Price, B.S.................................................................Agricultural Engineer in Charge
H. R. Sinnard, M.S.........................................................Assistant Agricultural Engineer (Farm Structures)
C. I. Branton, B.S............................................................Assistant Agricultural Engineer

Bacteriology

D. C. Mote, Ph.D.................................................................Entomologist in Charge
W. J. Chamberlin, Ph.D....................................................Associate Entomologist; Truck Crops and Garden Insects
B. G. Thompson, M.S..........................................................Assistant Entomologist
S. C. Jones, M.S.................................................................Assistant Entomologist
K. W. Gray, M.S.................................................................Field Assistant (Entomology)
W. D. Edwards, B.S............................................................Field Assistant (Entomology)

Home Economics

Maud M. Wilson, A.M.....................................................Home Economist

Plant Pathology

C. E. Owens, Ph.D...............................................................Plant Pathologist in Charge
S. M. Zeller, Ph.D...............................................................Plant Pathologist
F. F. McWhorter, Ph.D..........................................................Plant Pathologist
B. F. Dana, M.S.................................................................Associate Plant Pathologist (Div. Fruits and Vegetable Crops Diseases)
F. D. Bailey, M.S.................................................................Associate Plant Pathologist (Insecticide Control Division)
P. W. Miller, Ph.D.................................................................Associate Pathologist (Div. Fruits and Veg. Crops and Dis.)
G. R. Hoerner, M.S.............................................................Agent (Hop Disease Investigations)
A. R. Sprague, Jr., Ph.D....................................................Assistant Pathologist (Cereal Diseases)
H. H. Millsap.................................................................Agent (Division of Fruits and Vegetable Crops and Diseases)

Publications and News Service

C. D. Byrne, M.S.................................................................Director of Information
E. T. Reed, B.S., A.B......................................................Editor of Publications
D. M. Goode, B.A.................................................................Editor of Publications
J. C. Burtner, B.S.................................................................Associate in News Service

Branch Stations

L. Childs, A.B.................................................................Superintendent, Hood River Br. Expt. Station, Hood River
F. C. Reimer, M.S.................................................................Superintendent, Southern Oregon Br. Expt. Station, Talent
H. K. Deam, B.S.................................................................Superintendent, Umatilla Br. Expt. Station, Hermiston
O. Shattuck, M.S.................................................................Superintendent, Harney Valley Br. Expt. Station, Burns
R. G. Johnson, B.S.............................................................Acting Supt., Squaw Butte Range Experiment Station
G. G. Brown, A.B., B.S..................................................Horticulturist, Hood River Br. Expt. Station, Hood River
Arch Work, B.S.................................................................Associate Irrigation Engineer, Medford
W. W. Aldrich, Ph.D..........................................................Assistant Horticulturist, Bureau of Plant Industry, Medford
L. G. Gentner, M.S.............................................................Associate Entomologist, So. Or. Br. Expt. Sta., Talent
M. J. Costin, M.S.................................................................Junior Agronomist, Div. Cereal Crops and Dis., Pendleton
M. M. Oveson, M.S.............................................................Assistant to Supt., Sherman Br. Experiment Station, Moro
R. B. Webb, M.S...............................................................Jr. Agronomist, Sherman Branch Experiment Station, Moro
R. E. Hutchinson, B.S........................................................Assist. to Supt., Harney Branch Expt. Station, Burns