California State University, Northridge

THE GEOGRAPHY OF ROCKY MOUNTAIN SPOTTED FEVER

A thesis submitted in partial satisfaction of the requirements for the degree of Master of Arts in Geography

by

Virginia Irvin Huber

January, 1976
The thesis of Virginia Irvin Huber is approved.

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ABSTRACT

THE GEOGRAPHY OF ROCKY MOUNTAIN SPOTTED FEVER

by

Virginia Irvin Huber

Master of Arts in Geography

January, 1976

Rocky Mountain spotted fever is a tick borne ricketsial disease first recognized in the western United States in the latter part of the nineteenth century. The distribution of the disease is dependent upon man's intrusion into the normal tick habitat. Man's attitudes, beliefs, and activities have influenced the distribution of the cases in the United States and Rocky Mountain spotted fever has become increasingly a disease of rural and suburban residents of the South Atlantic states and the Southern Midwest. The widespread use of antibiotics and insecticides following World War II led to a decrease in the number of cases to 199 in 1959. Disenchantment with these products and changes in land use during the last few years has led to an increase in the number of reported cases to 774 in 1974.
CHAPTER ONE
INTRODUCTION

Rocky Mountain spotted fever is a tick borne rickettsial disease which was first reported from the Rocky Mountain area of the United States in the latter part of the nineteenth century and until 1930 was considered unique to the western United States. Since 1931 the disease has become an increasingly important public health problem in the south Atlantic and south central states, and immunologically identical rickettsial diseases have been recognized in all parts of the world where ticks are present in large numbers.

The epidemiology of Rocky Mountain spotted fever is complex, involving the relationship between a rickettsia, which is the causative organism, several species of ticks, various animal hosts, and man. Man is an incidental host and the disease could be maintained without his presence.

All studies of Rocky Mountain spotted fever have been directed toward understanding and eventual control of the disease. Control may be accomplished by reducing the number of rickettsia, vectors, or hosts, below the level necessary for survival of the disease. An alternative is to prevent man from contacting the tick or to immunize him against the disease.

In 1939 E.N. Pavlovskii proposed the theory of the focality of vector borne diseases. His theory is that vector borne diseases exist only in foci where the "association
between vegetation, the animals inhabiting it and an area of the earth's surface, its climate (microclimate), geologic structure, soil and water supply" are conducive to the survival of the pathogen. ¹ "In order to arrive at rational classification of natural foci of infection their characteristics (the diseases) have to be defined from different points of view, e.g. biological, abiotical and geographical (topographical) and in relation to their connection with the activities of man." ²

A review of the literature shows that investigators have studied the life support requirements of the tick, the hosts, and the rickettsia, and their relationship with the environment, but there has been no comprehensive study of the relationship between Rocky Mountain spotted fever and the activities of man.

There have been major changes in the distribution of reported cases since 1890, and the changes have often been the result of man's activities. Changing economic patterns, changing land use patterns and modification of the environment have led to changes in reported case rates. Individuals have not often been aware that their activities influenced the presence of Rocky Mountain spotted fever. There is evidence that changes in the cattle and sheep industry, mining, and lumbering contributed to a decrease in the number of reported cases in the Rocky Mountain states. During the same time, suburbanization, the abandonment of crop
lands and development of new recreational facilities have led to an increase in the number of reported cases in the eastern and south central states. A drop in the number of reported cases occurred during the nineteen fifties and early sixties when man began to indiscriminately use insecticides and antibiotics. When disenchantment with the widespread use of these products set in during the latter part of the nineteen sixties there was an increase in the number of reported cases of Rocky Mountain spotted fever.

In this paper I will discuss changes in the distribution of the disease and place emphasis on those activities and attitudes of man which have influenced the changes.

A review of the literature, especially regional and state medical journals, popular magazines and newspapers, has provided the bulk of the information for this paper. The statistical information from 1920 to the present was acquired from Federal government sources and, while incomplete, provides a good indication of the extent of the problem. The eventual control of Rocky Mountain spotted fever requires public awareness of the disease and an understanding of those activities of man which bring him into contact with infected ticks.
FOOTNOTES FOR CHAPTER ONE


CHAPTER TWO
EPIDEMIOLOGY

Rocky Mountain spotted fever is a tick borne disease, and the life support requirements for both the rickettsia and the tick must be considered in order to understand its distribution. It is generally acquired from a tick bite, but some studies show that man can also acquire the infection from newly deposited tick fecal material, aerogenically or through the skin from a smashed tick. Dried fecal material or dead ticks are not infective, because the rickettsia cannot survive for an appreciable length of time outside of a live host.

Symptoms

The incubation period of the infection is three to fourteen days in moderate cases, and two to five days in severe cases. The onset may be gradual, with malaise, lack of appetite, headache, and muscle pains, but is generally rapid with vomiting, headache, photophobia and very severe joint pains. Temperatures are almost always very high, and range from one-hundred three to one-hundred six degrees Fahrenheit. There is generally a very severe frontal headache which is not helped by aspirin. In fatal cases, death usually occurs between the tenth and fifteenth day. In people who recover, the fever generally remains high for three or more weeks, and is followed by a slow convalescence which may last a year or more. Recovery from a case
of Rocky Mountain spotted fever apparently provides life- 
time immunity and the existence of sub-clinical cases has 
not been confirmed but appears likely.

A death rate over eighty percent was reported from 
western Montana in the latter part of the nineteenth cen-
tury; however, modern treatment has reduced this to below 
ten percent. The death rate is highest in individuals 
over seventy and in children under one year. Most author-
ities believe that prompt identification of the disease fol-
lowed by appropriate treatment would reduce the death rate 
to near zero.

The most characteristic symptom of the disease is a 
rash which appears between the second and fifth day after 
the fever begins. The rash resembles the rash of measles 
and typhus, except that it starts at the ankles and wrists 
and moves inward toward the trunk and outward to the hands 
and feet until it covers the soles of the feet and palms of 
the hands.

Symptoms of Rocky Mountain spotted fever resemble both 
viral and bacterial infections, so it is recommended that 
where laboratory findings rule out these other forms of in-
fecion, and the patient was in a tick area, Rocky Mountain 
spotted fever must be suspected because laboratory tests 
which confirm the presence of the rickettsia cannot be per-
formed for two to three weeks after the onset of symptoms.

The Rickettsia

The causative organism, Rickettsia rickettsii, is a
member of a family of one-celled organisms responsible for a number of animal and human diseases including Murine typhus, Q fever, louse borne typhus and Tsutsugamushi. All are endemic diseases, can become epidemic and several have moderate to high death rates. Man is never the preferred host of *R. rickettsii*, but is always an accidental victim.⁹

*Rickettsia* are defined by their characteristics. They are considered transition organisms between viruses and bacteria, and have some characteristics of each. They are small, less than one micron long, parasitic, and cannot survive outside of a living cell. They have a low resistance to drying, rapid temperature change, high temperature or disinfectants, but survive freezing for several months.¹¹

*R. rickettsii* does not remain in the blood or lymph of the host animal and can be found only in the tissues of the host after the incubation period has passed.¹² The only time a tick can pick up the infection from a host animal is during the incubation period while the rickettsia are in the blood. *R. rickettsii* can be found in both the cytoplasm and nuclei of the tick cell, and are found in all types of tick tissues.¹³

*R. rickettsii* has adjusted its life cycle to that of the tick, and is inactive during the tick's dormant periods. During hibernation and fasting, the rickettsia become less virulent. Then, when the tick warms up or begins to feed in the spring, the rickettsia are reactivated. The exact mode of reactivation is not known, but it is known that the
tick must feed for four to ten hours before *R. rickettsii* can be passed to a victim. It is known that the season and air temperature also influence the length of time required for reactivation. As the summer proceeds the rickettsia become more virulent, reach a peak, and then decline. Why or how the virulence cycle is controlled has not been discovered.

Rocky Mountain spotted fever is normally considered a disease of spring and early summer. The cases reported during other times of the year have generally been contracted from ticks which were out of their normal environment. Cases have been traced to the ticks hibernating on fur coats in cabins, or on animal skins in storage areas or from ticks brought into warm well lit homes by dogs.

There are no known animal reservoirs. The disease is maintained by the feeding of non-infected ticks upon newly infected animals. Ticks will feed on almost any mammal; however, there are preferred hosts (Fig. 1). The only mammals known to develop symptoms of the disease are man, other primates, and possibly dogs, although guinea pigs and some species of white mice develop some symptoms and can be used as laboratory specimens.

Vectors

Hard shelled ticks are the only known vectors of *R. rickettsii*. Three species have been confirmed as vectors in the United States: *Dermacentor variabilis*, the American
**FIGURE 1**

**COMMON HOSTS OF ROCKY MOUNTAIN SPOTTED FEVER TICKS**

<table>
<thead>
<tr>
<th>Nymph</th>
<th>Larva</th>
<th>Adult</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amblyomma americanum</strong></td>
<td>rabbits, foxes, squirrels, hares, raccoons, skunks, quail, cattle, deer, horses, dogs, wild turkeys</td>
<td>cattle, deer, horses, dogs</td>
</tr>
<tr>
<td><strong>Dermacentor andersoni</strong></td>
<td>squirrels</td>
<td>rabbits</td>
</tr>
<tr>
<td></td>
<td>mice</td>
<td>porcupines, badgers, hares</td>
</tr>
<tr>
<td><strong>Dermacentor variabilis</strong></td>
<td>Primarily on mice and voles but also on rats, rabbits, hares, squirrels and cats</td>
<td>Primarily dog but also cattle, sheep, horses, mules, coyote, opossum</td>
</tr>
<tr>
<td><strong>Haemaphysalis leporispalustris</strong></td>
<td>rabbits, hares, birds; occasionally</td>
<td>rabbits hares</td>
</tr>
<tr>
<td></td>
<td>mice, voles and shrews</td>
<td></td>
</tr>
</tbody>
</table>

Source: Footnote 16
dog tick; *Dermacentor andersoni*, the wood tick; and *Amblyomma americanum*, the lone star tick. A fourth, *Haemaphysaliscsalim leporispalustris*, does not infect man, but is considered a prime reservoir of Rocky Mountain spotted fever. Several other species are suspected vectors or are known vectors in other parts of the world (Fig. 2).

Ticks are small blood sucking arthropods which carry a number of diseases and cause anemias in mammals and birds. They are rarely larger than 15mm in diameter, but are capable of taking up to two grams of blood at a feeding, and several thousand may attach to a single bird or animal. They are extremely hardy, may go long periods of time without feeding, and can survive temperatures to minus fifty degrees Fahrenheit. Most hard shelled ticks have a wide host range, a long life span and the female may lay up to 18,000 eggs at a time. Their only known enemies are some species of birds and a few insect-eating rodents. Fortunately, they do have very specific weather and climate requirements; consequently, drought, rain storms, mild winters and other weather phenomena can cause a drop in the tick population.

The life cycle of the tick is quite complicated and often involves more than one kind of host. Generally, the ticks which are important in the passage of Rocky Mountain spotted fever are three-host-ticks which may infect or become infected while biting any mammal during any stage of
<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Pest of Man</th>
<th>Geographic Distribution</th>
<th>Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. americanum</td>
<td>Lone Star tick</td>
<td>yes</td>
<td>southeastern United States and Mexico</td>
<td>Confirmed vector in the south Atlantic states, Oklahoma, Texas and Arkansas.</td>
</tr>
<tr>
<td>A. cajennense</td>
<td>Cayenne tick</td>
<td>yes</td>
<td>southern U.S., Mexico, Central and South America, West Indies</td>
<td>Confirmed vector in Panama and Brazil. Suspected vector in the United States.</td>
</tr>
<tr>
<td>D. andersoni</td>
<td>Rocky Mountain Wood tick</td>
<td>yes</td>
<td>Rocky Mountain and Pacific States</td>
<td>Confirmed vector in the Pacific and Rocky Mountain states.</td>
</tr>
<tr>
<td>D. occidentalis</td>
<td>Pacific Coast tick</td>
<td>yes</td>
<td>coastal areas of Oregon and California</td>
<td>Suspected vector on west coast of United States.</td>
</tr>
<tr>
<td>D. paramapertus</td>
<td>rabbit dermacen-</td>
<td>very rarely</td>
<td>desert areas of southwest U.S. and northern Mexico</td>
<td>Maintains the disease in nature</td>
</tr>
</tbody>
</table>
FIGURE 2 (cont.)
ROCKY MOUNTAIN SPOTTED FEVER TICKS

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Pest of Man</th>
<th>Geographic Distribution</th>
<th>Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. variabilis</td>
<td>American dog tick</td>
<td>yes</td>
<td>eastern U.S., Canada and Mexico</td>
<td>Major vector in the midwest and southeast United States.</td>
</tr>
<tr>
<td>H. leporispalustris</td>
<td>rabbit tick</td>
<td>very rarely</td>
<td>anywhere there are rabbits; Alaska to South America</td>
<td>Maintains the disease in nature—reservoir</td>
</tr>
<tr>
<td>R. sanguineus</td>
<td>brown dog tick</td>
<td>yes</td>
<td>humid areas of southeast U.S. and Mexico</td>
<td>Confirmed vector in Mexico. Suspected vector in the United States</td>
</tr>
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</table>

Source: Footnote 19
the ticks' life cycle. The life cycles have been studied, and while variations exist, especially in host preference and the length of time necessary to complete the cycle, there is considerable similarity.

All three ticks will feed on a variety of mammals. *D. andersoni* and *D. variabilis* can only exist where both large and small animals are available, but since the immature stages of *A. americanum* are willing to feed on large as well as small mammals, this tick can survive in areas where a single mammal species is present. *H. loriispalustris* prefers to feed on ground nesting rabbits, but will feed on other small mammals or ground frequenting birds, and, as with *A. americanum*, all stages can be found on a single animal.

Ticks mate on a large mammal. The male may mate with more than one female, and an infected male may infect a female, who, in turn may pass the rickettsia to the eggs. The eggs are deposited in a protected place on the ground, and hatch into small, six-legged larvae (seed ticks), which crawl onto low brush or grass, and wait for the passage of a small mammal. They crawl onto the animal, attach, feed and drop to the ground, where they molt into eight-legged nymphs. These nymphs crawl up onto low brush and wait the passage of a mammal. They attach, feed, drop to the ground, and molt into adults. The adults generally feed on large mammals, mate and drop to the ground. Adult ticks feed only once after reaching adulthood and die within a
month or so of feeding whether or not they have mated.\textsuperscript{24}

Ticks do not fly nor do they drop onto their victims. They crawl along the ground toward animal trails, paths or roads, and then onto low vegetation. Ticks move only short distances and are attracted by animal odors, vibrations, shadows or carbon dioxide. When a victim brushes against the vegetation the tick crawls onto the body and then wanders around until it finds a suitable attachment site.

The site differs with conditions, but on man the tick prefers to become attached in warm protected parts of the body such as the groin or under the arms.\textsuperscript{25} An adult tick may wander over the body for several hours before attachment, and may change his position during the course of a meal. If two potential hosts are in close proximity, as for example, two people sleeping in the same bed, the tick may change hosts. The victim is often unaware that he has been bitten. There is no pain or itching when the tick attaches or leaves, and only occasionally does a lesion develop at the site of the bite.\textsuperscript{26}

All of the tick species responsible for the transmission of Rocky Mountain spotted fever have a large range (Fig. 3) but are found in large enough numbers to maintain a disease focus only where the life support requirements are ideal. These conditions are not all known exactly, but \textit{D. andersoni}, \textit{D. variabilis} and \textit{A. americanum} all require a moist environment and either live in a humid area or spend much of their time burrowed under organic ground litter.
CONFIRMED VECTORS OF ROCKY MOUNTAIN SPOTTED FEVER IN THE UNITED STATES

D. andersoni
A. amblyomma
D. variabilis

All three ticks hibernate during the low photoperiods of winter and are more responsive to light than to temperature. They actively seek hosts only during spring and summer, beginning their activity as soon as the light requirements are met, and ceasing activity and passing into a resting stage (aestivohibernation) when the relative humidity begins to drop as a result of high summer temperature. They pass from aestivohibernation into hibernation when their light requirements are no longer being met.28

There are no vegetation associations specific to any of the ticks, but since climate influences both ticks and vegetation, the ticks will be found more commonly in some types of vegetation than others. D. andersoni is most often found in the ecotones between grasslands and forests and D. variabilis is most common in the deciduous forest.29 A. americanum is most often found in transition areas between the forests and prairies in the western part of its range, and in areas of tropical or semi-tropical vegetation on the Atlantic and Gulf coasts.30

D. andersoni is found only where there are cold winters and less than twenty inches of rainfall.31 The tick is the main vector in the Rocky Mountain states. It is found in higher elevations in the southern part of its range than in the northern part, occurring above eight thousand feet in Arizona and down to 4500 feet in Montana.32 Large concentrations of D. andersoni are found in sagebrush areas, along river and stream banks, and in
unimproved pasture lands. In forests this tick is found along paths, roads and in clearings.

D. variabilis is found in large numbers only where there are sunny, moist springs and moist winters. Heavy concentrations are found on abandoned cropland, along roads and paths, and in clearings inland in the mid-Atlantic states. Large numbers of ticks are also present along the Atlantic and Pacific coasts, and inland in the mid-west, along rivers, streams and where the vegetation is especially heavy.

A. americanum requires high relative humidity and is generally found where the vegetation is dense or there is heavy ground litter. Large concentrations are found along the south Atlantic coast, the Gulf coast and inland in parts of Texas, Oklahoma and Arkansas, where their preferred habitat is forested areas, unimproved pasture land, and river and stream banks.

H. leporispalustris is found from Alaska to South America, and can survive any place rabbits live. This tick is considered the prime reservoir for Rocky Mountain spotted fever, and infected rabbit ticks have been recovered from every area where the disease is considered a public health problem. As far as is known, this tick never bites man, but if rabbits are not available, H. leporispalustris will feed on ground frequented birds or small mammals. Infected ticks are sometimes introduced into new areas by birds. D. andersoni, D. variabilis and A.
Americanum will all feed on rabbits, and the disease can be passed from *H. leporispalustris* to these vectors when they feed upon infected rabbits.

The infection rate for a given pool of ticks is generally quite low, except for the west side of the Bitterroot Valley in Montana, where infection rates of thirteen percent have been reported. It has been estimated that about one in four hundred tick pools is infected. The disease continues to be a public health problem because of the large number of ticks present in some areas, five thousand ticks have been recovered from a single rabbit.

Distribution of Cases

The United States Government has kept statistics on Rocky Mountain spotted fever since 1920. Doctors are now required to report cases to their local health departments which in return report to the Center for Disease Control in Atlanta, Georgia (Figs. 4-10).

Prior to 1931 all cases of Rocky Mountain spotted fever were reported from the western states. The disease has ceased to be of major importance in the west and has become increasingly a disease of the south Atlantic and the south central states. These changes in distribution and the fluctuations in the number of cases are in large part the result of man’s activities.
REPORTED CASES ROCKY MOUNTAIN SPOTTED FEVER: 1930—1974

Footnote 47
REPORTED CASES ROCKY MOUNTAIN SPOTTED FEVER: 1930—1974

IN NUMBERS

YEARS

Atlantic States
Midwest States
Mountain and Western States

Footnote 48
ROCKY MOUNTAIN SPOTTED FEVER
REPORTED CASES 1930—1939

Average number of cases per year

- 1 - 9
- 10 - 29
- 30 - 49
- Over 50

Compiled from morbidity and mortality reports. Footnote 49
ROCKY MOUNTAIN SPOTTED FEVER
REPORTED CASES 1940–1949

Average number of cases per year

- 1 — 9
- 10 — 29
- 30 — 49
- Over 50

Compiled from morbidity and mortality reports

Footnote 50
ROCKY MOUNTAIN SPOTTED FEVER
REPORTED CASES 1950–1959

Average number of cases per year

- 1 – 9
- 10 – 29
- 30 – 49
- Over 50

Compiled from morbidity and mortality reports. Footnote 51
ROCKY MOUNTAIN SPOTTED FEVER
REPORTED CASES 1960–1969

Average number of cases per year

- 1–9
- 10–29
- 30–49
- Over 50

Compiled from morbidity and mortality reports. Footnote 52
ROCKY MOUNTAIN SPOTTED FEVER
REPORTED CASES 1970—1974

Average number of cases per year

1 — 9
10 — 29
30 — 49
Over 50

Compiled from morbidity and mortality reports. Footnote 53
FOOTNOTES FOR CHAPTER TWO


42. Parker, "Rocky Mountain Spotted Fever," 1933, p. 344.


46. The Center for Disease Control in Atlanta, Georgia is the agency which compiles statistics on health for the government. They also maintain investigative laboratories and investigative teams which respond to health emergencies.


H.E.W., Annual Supplements, volumes 1-24.

49. H.E.W., Selected Notifiable Diseases, pp. 222-223.

50. H.E.W., Selected Notifiable Diseases, pp. 222-223.

H.E.W., Annual Supplements, volumes 1-9.

52. H.E.W., Annual Supplements, volumes 10-19.

CHAPTER THREE
ROCKY MOUNTAIN SPOTTED FEVER 1880-1920

Early Reports

Rocky Mountain spotted fever was first clinically described by Edward R. Maxey in 1899 after he had treated a number of cases among sheepherders in the vicinity of Boise, Idaho. He described an acute, incapacitating fever which occurred during the spring and early summer of each year. Dr. Maxey did not consider the disease to be terribly serious and he reported that the death rate was under three per cent.

The first written reports of a more virulent strain were made in 1902 by George T. McCullough, a doctor practicing in the Bitterroot Valley, south of Missoula, Montana. He reported that he had treated thirty-six cases with a death rate of eighty per cent.

By 1900 it was known that the disease had been present in the Rocky Mountains for at least fifty years prior to the first published reports. Some early Mormon settlers, California gold seekers and army medical personnel from frontier military posts apparently had contact with Rocky Mountain spotted fever, but considered that they were dealing with a familiar disease, flea borne typhus, with slightly different symptoms. They believed the disease had changed because of the differences in climate.

A spotted fever was known to at least some of the In-
dians in the vicinity of the Bitterroot Valley (Fig. 11). The Nez Perce and Flathead tribes both collected the bitterroot plant for making medicines. However, neither tribe would go into the valley during the spring or early summer because they believed that the area was inhabited by evil spirits during that part of the year. Aged Indians living in the vicinity in the early twentieth century could not recall the disease, but were convinced that the valley was a dangerous place to go.7

Europeans began to settle the area in the early eighteen eighties. These early settlers planted pear, plum, cherry and apple orchards for marketing in the western United States. Most also had domestic animals which they pastured in the foothills. By 1890 a number of lumber mills had been established along the Bitterroot River and a thriving lumber industry existed.8

Early settler's journals had described the disease as a spotted fever carried by ticks, but by 1901 the residents had changed their minds and were convinced that the disease was contracted from either melted snow or damp sawdust.9

By 1901 there had been nearly two hundred cases of Rocky Mountain spotted fever with a death rate of over eighty per cent and the citizens were alarmed.10 In the spring of 1901 they contacted the governor of Montana and requested help. The Montana State Board of Health was created in March of 1901 and Rocky Mountain spotted fever was the first problem it faced. By the following winter
BITTER ROOT VALLEY

MISSOULA

Ravalli County
Continental Divide

Source: Author
Doctor Longway, the first secretary of the Montana Board of Health, realized that he needed help and requested assistance from the Minnesota Board of Health, which sent two highly competent pathologists, Doctors Wilson and Clowning.

Early Investigators

Louis Wilson and William Clowning presented the first clear picture of the virulent form of what they named the Spotted Fever of the Rocky Mountains, a disease which occurred in the spring and early summer of each year. They described an infectious disease contracted by individuals of any age or sex which was not passed from individual to individual, but was probably acquired from a tick, and they erroneously reported that the causative agent was a protozoan similar to the organism that causes tick borne Texas fever.\textsuperscript{11}

The theory that diseases could be carried by ticks was a new one and had not been widely accepted by 1901. The existence of vector borne diseases had been recognized in 1878 when it was reported that malaria was mosquito borne.\textsuperscript{12} Information on the first tick borne disease was not published until 1893.\textsuperscript{13}

The people of the Bitterroot did not believe nor want to believe that the spotted fever was carried by ticks. Ticks were everywhere and if they were the culprits there could be serious economic difficulties.

In 1904 the United States Public Health Service sent C.W. Stiles, a zoologist, to the area to confirm the work
of Wilson and Clowning. Doctor Stiles was unable to find the protozoan in the blood. He refuted the work of Wilson and Clowning and stated that, not only was there no protozoan, but the disease was not tick borne, and was acquired from the melted snow. ¹⁴

The controversy which ensued retarded the identification, reporting, and control of Rocky Mountain spotted fever elsewhere. People in areas where the disease had not been reported proudly proclaimed that their ticks were disease free. Railroad interests, land speculators and residents of Bitterroot fought politically, and in some cases physically, against the tick theory and tick eradication.

By 1905 land on the west side of the Bitterroot River was virtually worthless; sawmill operators could not get employees, and businessmen and visitors avoided the area in spring and early summer. ¹⁵ In areas outside the Bitterroot valley some doctors who treated cases did not admit the existence of the disease for fear there would be economic problems. The controversy existed well into the nineteen twenties, and more than one tick eradication team was either run out of town or had their dipping vats destroyed. ¹⁶

The controversy greatly interested Harold T. Ricketts, who came from the University of Chicago to check the work of previous investigators. During the next four years Ricketts established a number of important facts. He proved that the tick, which he called *Dermacentor occidentalis*, later shown to be *Dermacentor andersoni*, carried the
disease in nature through several stages, and could pass
the organism to the eggs.\(^1\) He identified the organism
which caused the spotted fever, and he properly described
the class of organisms which have been named Rickettsia in
his honor.

He noticed that the ticks were especially abundant in
the foothills of the Bitterroot Valley, and he suggested
that the large number of cattle pastured in the area were
the main hosts of the ticks. While waiting for funds to
implement his tick eradication plan, he went to Mexico to
study typhus and died of it.\(^1\) His plan was dropped, but
his findings were considered conclusive by the United States' Public Health Service, the United States Bureau of Entomology, and most of the medical profession.

*Early Control Attempts*

By 1911 the number of ticks had increased, so tick
eradication was started. Ranchers were extremely hostile
to the idea and attempted to stop the program in any way
possible, but by 1915 they were willing to admit that tick-
free cattle were healthier.

The cost of eradication was borne by the state of Montana through 1913, after which the federal government funded the program.\(^1\) Several different approaches were tried. Open range land was brought under cultivation and brush was burned in the foothills in order to destroy the habitat of the tick. Both methods were expensive and neither was
totally successful. The topography of the foothills did not allow large tracts of land to be plowed and the ticks continued to thrive on the unimproved land. The burning of the brush was only a temporary measure and had to be repeated each spring. 20

The more successful phases of the plan included the destruction of wild animals by poisoning, trapping and shooting, the dipping of domestic animals in arsenical solutions and the introduction of large herds of sheep.

The sheep were used because early settlers had noticed that land used to graze sheep had fewer ticks than land used to graze cattle. Several explanations were given for this phenomenon. The sheep, generally in bands of about two hundred, were moved from the floor of the valley into the higher mountains for summer pasturing. The animals generally grazed about a week in an area before being moved. They ate all of the vegetation down to ground level, thereby temporarily destroying the area as a habitat for other mammals or ticks. 21

Ticks which crawled onto the sheep had difficulty getting through the heavy coats of the animals to feed. Many became tangled in the wool and died. Those that did succeed in feeding often dropped off after the sheep had been moved. The moves were always to higher elevations and many of the ticks were unable to survive in the new environment.

It was generally believed during this period that sheep were naturally immune to ticks, because the lanolin
in the wool would kill them. However, it was discovered later that sheep are susceptible to tick borne diseases, and that the majority of people contracting Rocky Mountain spotted fever in the period prior to 1920 had contact with sheep.

Distribution of Cases

Studies conducted during World War I established that the disease was more widespread and had affected more people than had previously been realized (Fig. 12). In 1914 D.B. Wollbach began a study of the disease by requesting information from health officers on the status of the disease in their areas. A number of studies were completed and published and Wollbach published his comprehensive report in 1919. 23

He discovered that cases had been diagnosed in all of the Rocky Mountain states and the three Pacific states. He reported that the death rate varied from a low of three to five percent in Idaho to a high of over seventy-five percent in the Bitterroot Valley of Montana. 24

It was established that a major focus of the disease existed along the Snake River in Idaho in those areas undergoing settlement. It was estimated that about 750 people a year were becoming ill with the disease. In Montana the only area of infection was in the vicinity of the Bitterroot Valley. In Wyoming, where the death rate was rarely under twenty per cent, foci of infection existed in a number of river basins and were quite localized. 25
FIGURE 12
INCIDENCE OF ROCKY MOUNTAIN SPOTTED FEVER PRIOR TO 1916

<table>
<thead>
<tr>
<th>State</th>
<th>Earliest Known Cases</th>
<th>Cases Prior To-Date</th>
<th>Number</th>
<th>Cases in 1915</th>
<th>Deaths in 1915</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>1903</td>
<td>1915</td>
<td>26</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>Colorado</td>
<td>1885</td>
<td>1912</td>
<td>56</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>Idaho</td>
<td>1877</td>
<td>1909</td>
<td>6000(est.)</td>
<td>700(est.)</td>
<td>10</td>
</tr>
<tr>
<td>Montana</td>
<td>1872</td>
<td>1914</td>
<td>366</td>
<td>37</td>
<td>8</td>
</tr>
<tr>
<td>Nevada</td>
<td>1880</td>
<td>1911</td>
<td>317</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>New Mexico</td>
<td>1898</td>
<td>not avail</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Oregon</td>
<td>1887</td>
<td>1913</td>
<td>351</td>
<td>29</td>
<td>6</td>
</tr>
<tr>
<td>Utah</td>
<td>1908</td>
<td>not avail</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Washington</td>
<td>1904</td>
<td>1912</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wyoming</td>
<td>1877</td>
<td>1914</td>
<td>387</td>
<td>59</td>
<td>8</td>
</tr>
</tbody>
</table>

Source: Footnote 22
Occasional cases were also reported from the eastern counties of Oregon and Washington, and five foci had been identified in California. Cases had also been reported from the higher elevations of Utah, Nevada and Colorado.26

Populations Effected

In the latter part of the nineteenth century and early part of the twentieth century the victims of Rocky Mountain spotted fever were generally older teenage boys and adult males. The areas reporting the disease and demanding assistance were all areas of family settlement. Adult males and older children were necessary to the establishment and continued operation of the family farm or ranch. In areas where herding, lumbering or mining were the prime activities, victims were generally single men, often new to the area, and their illness or death was hardly noticed.

Very few doctors were available to the residents of the Rocky Mountains and those who were present did not generally keep records nor file reports. States did not require the reporting of the disease until the late nineteen twenties and statistics available prior to that time are incomplete and generally the result of personal communication between investigators and individual doctors.27 These communications led to the realization that most of the victims of Rocky Mountain spotted fever during this period were associated with either the sheep or cattle industries.

Both cattlemen and shepherders began their activities in the spring at about the same time the D. andersoni ticks
began seeking hosts. The men stayed with their animals throughout the summer season and slept on the ground near the herds. They often went days without removing their clothes, especially during lambing and calving season, and they seldom made any effort to remove attached ticks. Few of these men considered ticks a hazard.

Three other groups were liable to Rocky Mountain spotted fever during this period; lumbermen, miners and dam workers. All three groups lived under primitive frontier conditions and generally began their work activities in the spring as soon as the snow melted. The lumbermen often worked in clearings or along logging roads, both of which make ideal tick habitats. The miners followed mineral strikes and at least one outbreak occurred after news of a gold find. The dam workers almost all became ill after working on irrigation projects in Wyoming. The remaining victims were nearly all permanent residents and members of families engaged in ranching, farming or construction. Only rarely was the victim a visitor to the area.

By 1920 investigators knew what caused the disease and that it was widespread in the West, sometimes fatal, and an economic as well as a medical problem. They did not know how to cure it, and the only means known to prevent it were tick eradication, avoidance of tick areas or the wearing of heavy protective clothing. They also knew that the tick had to remain attached for several hours before the rickettsia could be passed to man and so they suggested that
individuals in tick infested areas check their bodies regularly for the presence of ticks and remove them.

Doctors had not found a satisfactory treatment, although many had been tried, including the Indian methods of sweating and of giving large doses of sagebrush tea. They ordered good nursing care and hoped the patient would survive.
FOOTNOTES FOR CHAPTER THREE


7. Aikawa, Rocky Mountain Spotted Fever, p. 5.


12. Herms, Medical Entomology, p. 466.

13. Herms, Medical Entomology, p. 9.


18. Aikawa, Rocky Mountain Spotted Fever, p. 28.


23. Wolbach, "Rocky Mountain Spotted Fever," p. 3.


In 1921 a Montana state senator and his wife, who was the president of the Montana State Federation of Women's Clubs, contracted Rocky Mountain spotted fever after a visit to the Bitterroot Valley and died of it. The citizens of Montana were aroused and demanded of their political leaders that something be done.

The Montana Board of Health, the United States Public Health Department, and the Bureau of Entomology all increased their efforts to find an answer to the problem, and in 1927 the state of Montana funded a laboratory at Hamilton, forty-five miles south of Missoula on the Bitterroot River. The local citizens did not want the laboratory and they insisted that it be surrounded by a moat.

The facilities built by the Montana Health Department were bought by the United States Public Health Department in 1928 because Rocky Mountain spotted fever was by then considered a regional problem. The Rocky Mountain laboratory has become world famous and continues to investigate rickettsial and other vector-borne disease. The laboratory has the largest tick collection in the world, over eight-hundred species, and has been instrumental in demonstrating that the disease is found in many different parts of the world.
Parker-Spencer Vaccine

In 1913 R.R. Parker, an entomologist, arrived in Montana to work for a summer on the vector of Rocky Mountain spotted fever. He stayed with the project until his death in 1949. Roscoe Spencer, a medical doctor, began his work in 1915, and he also devoted most of his professional life to the eradication of the disease.

Parker worked at Hamilton, and Spencer studied in Washington D.C. Spencer developed a vaccine in the fall of 1924 and vaccinated himself. He notified Parker, who was unable to convince anyone to try the vaccine. The death rate among accidentally infected lab workers was nearly one-hundred per cent, but taking the chance of contracting the disease appeared preferable to being injected with phenolized ground-up tick.

The death of a lab worker, Henry Cowan, in the fall of 1924 changed things, and in 1925 thirty-four laboratory workers were vaccinated. By 1926 some of the residents of the Bitterroot Valley were willing to receive the vaccine, and by 1948 one-hundred and forty thousand doses a year were being prepared.

The use of the vaccine produced a dramatic drop in the death rate from eighty-five per cent in unvaccinated people to ten per cent in those who had received at least one dose. The complete program is two or three doses the first year and a booster shot each spring.
Cases Reduced in the West

During the period 1920 to 1945 there was a change in the distribution of reported cases of Rocky Mountain spotted fever. The disease was brought under control in western Montana and southern Idaho but cases were reported from new areas of the west and after 1931 from many of the eastern states.

The control of the disease in the Bitterroot Valley was accomplished by a vigorous campaign of public information, rodent control and a massive vaccination program; 83,000 doses had been administered by 1939. Only occasional cases of the disease have been reported from this part of Montana since 1940, although research on both D. andersoni and R. rickettsii show that the disease is still present in the area.

During this entire period investigators have tried to discover why cases were only reported from the west side of the Bitterroot River. Several hundred cases have been reported with the possibility that less than ten were acquired on the east side of the river. Ticks are prevalent on both sides of the river and people get bitten on both sides of the river, but people bitten on the east side rarely get sick, while people on the west side have often died. Ticks on the west side show an infection rate up to 13.5 per cent, while ticks on the east side seldom show evidence of the presence of the rickettsia. No acceptable explanation has ever been made of this phenomenon.
In Idaho, there was a reduction in the number of reported cases from an estimated high of seven-hundred and fifty cases in 1914 to forty-four in 1933. This reduction was the result of several factors: 1) agricultural activities which led to unsuitable tick habitats, 2) a vigorous anti-rodent campaign, and 3) changes in the livestock industry.

Agricultural activities increased along the Snake River after the completion of several irrigation projects. By 1930 several hundred thousand acres of land in southern Idaho were under cultivation or had been converted to controlled pasture land.

Temporary localized outbreaks of Rocky Mountain spotted fever occurred as workers came into the area but the conversion to agriculture quickly destroyed the tick habitat. Removal of sagebrush reduced the shade and ground litter necessary for summer survival, flooding of the fields drowned some of the ticks, and large animal hosts were driven off by man’s activities.

During the early nineteen twenties extensive anti-rodent campaigns were conducted against jack rabbits and squirrels because they were considered agricultural pests as well as possible carriers of disease. Thousands of the animals were destroyed by poisoning, trapping and shooting. These animals were the hosts of the immature forms of *D. andersoni*.

Sheep raising remained the most important economic
activity on the Columbia Plateau, but there were a number of changes in the sheep and cattle industries which led to a lessening of liability to Rocky Mountain spotted fever by all animal handlers. Some changes, such as the fencing of sheep and the use of fodder crops, were most important in southern Idaho. Other changes, such as the introduction of the camp wagon, the realization of the importance of tick borne diseases, and the widespread use of the vaccine, affected workers in all of the Rocky Mountain states.

As federally owned range land was converted into farmland and sold, sheep owners were required to confine their animals. The Two Mile Limit Law of 1875 prohibited the grazing of sheep on lands owned by others, or within two miles of a dwelling, so the practice of allowing the sheep to graze along the river during the winter and in high mountain meadows during the summer was no longer possible. The conversion to sedentary sheep raising led to better living conditions and increased efforts to keep the sheep healthy.

Beginning in the early nineteen twenties the camp wagon was introduced into areas where transhumance was still being practiced. The use of the horse-drawn wagon, and later the truck, allowed the workers to sleep off the ground and to carry additional supplies, including changes of clothing, which led to improvement in the standard of living of both cattle and sheep herders.

As the livestock owners became increasingly aware of
the problems of tick borne diseases, they began to educate their workers to check regularly for the presence of ticks. After about 1929 many owners made vaccination a condition of employment.17

During the nineteen thirties there was not always enough vaccine available for all who desired it, so priorities were established in some states with sheep and cattle workers and their families getting what vaccine was available.18

As the supply of vaccine increased, doctors became aware that the arrival of the vaccine each spring coincided with lambing and calving season, and some workers were missing their vaccination because they were too busy to make weekly trips to a doctor. By 1939 the vaccine was made available in rural areas in early February.

While the disease was being brought under control on the Snake River Plateau and in western Montana, it became increasingly evident that the disease was present or being spread into a much larger geographic area, and was becoming a significant health problem in eastern Montana. By 1935 cases had been reported from most of the counties lying within the range of D. andersonii.

Generally the increase in reported cases had been gradual and either followed the trails used by grazing animals or occurred after an influx of new settlers into an area. However, the spread into eastern Montana caused considerable concern, because prior to 1914 only three cases
had been reported and in the year 1935 there were more than one-hundred cases in eastern Montana.\textsuperscript{19}

One of the most common economic activities in eastern Montana during the latter part of the nineteenth century and the first part of the twentieth century was cattle ranching. There were more than 600,000 head of cattle in Montana by 1883, and most were on open rangeland in the eastern parts of the state.\textsuperscript{20} There is evidence that ticks were present during that period. However, no identification of species was made until the twentieth century. There is general agreement that Rocky Mountain spotted fever was not present in eastern Montana in the nineteenth century, but was introduced, probably by the rabbit tick.

The Rabbit Tick

Parker demonstrated in 1923 that \textit{H. leporispalustris} was a vector of \textit{R. rickettsii}.\textsuperscript{21} He showed that, while rabbits do not normally migrate long distances, in times of food shortage, fire or other disaster, they will move out of their normal range, taking their ticks with them. He concluded that the rabbit tick was responsible for carrying the infection into eastern Montana. \textit{D. andersoni} were already present in the area and quickly spread the infection throughout the state. The virulence of the rickettsia in eastern Montana was never high, and the death rate was consistently lower than the death rate in the Bitterroot Valley.\textsuperscript{22}

During the nineteen thirties, large numbers of cases
were reported from the eastern United States after the publication of a report by D.E. Rumrich of the United States Public Health Service in 1931. He noticed that there had been an unusually high number of severe cases of endemic typhus (murine typhus) reported, and he suspected that they might be cases of Rocky Mountain spotted fever.

Endemic, or flea borne typhus, is a rickettsial disease carried by *Xenopsylla cheopis* (the oriental rat flea), and is generally contracted in rat infested urban areas. Rocky Mountain spotted fever and endemic typhus have similar symptoms, except that in endemic typhus the rash appears first on the body, the course of the disease is milder, and the death rate rarely rises above three per cent.

Doctor Rumrich compared fifty suspected cases of Rocky Mountain spotted fever in Delaware, Maryland, Pennsylvania, Virginia and the District of Columbia with fifty suspected cases of endemic typhus, and concluded that Rocky Mountain spotted fever was a potentially serious health problem in all of the investigated areas.

Other investigators checked the records in their areas and it became increasingly clear that Rocky Mountain spotted fever had been present in the easternmost states since at least 1912. During 1931 it was demonstrated that *D. variabilis*, the American dog tick, was the vector for Rocky Mountain spotted fever in the eastern United States. The tick was a well known pest living in close proximity to man because the dog was the prime host of the adult form of the
R.R. Parker believed that the disease had been present in the east all along, because, if introduced, it should have spread along stock shipment routes and become evident first in the midwest. There is some evidence that the disease could have been introduced into the mid-Atlantic states between 1880 and 1920. In 1898 Theodore Roosevelt and his Rough Riders trained in Suffolk County, Long Island for the invasion of Cuba. Their horses were brought from western states just prior to the training period, and the first reports of ticks on Long Island occurred at about this time. The first reported case of Rocky Mountain spotted fever in the area occurred in 1913 in a game keeper who had been hired to tend deer imported from the western United States.

Between 1880 and 1920 a number of wild west shows traveled through the eastern United States. The shows had as many as one-hundred wild and domestic animals, and it would have been possible for D. andersoni to have dropped off the show animals, molted and then fed on local animals which were the natural hosts of D. variabilis.

Some of these shows traveled from New York City to Atlanta, Georgia through the Piedmont counties of the south Atlantic states. The majority of reported cases of Rocky Mountain spotted fever in the mid-Atlantic and south Atlantic states during the nineteen thirties were within these counties.
There is also evidence that Rocky Mountain spotted fever was introduced into many of the east south central and southern states during the nineteen thirties. The first reported cases in this area were from western Tennessee where two children contracted the disease in 1931. The children lived in a small town and had not been in a rural situation for several months, but they lived next door to hunting dogs which had recently been acquired from western Montana.32

In 1934 the Federal government purchased nearly 300,000 cattle, sheep and goats from ranchers in the drought stricken northwest and mid-western states.33 Many of the animals were slaughtered locally, but large numbers were shipped into southern states. Some were in poor condition and immediately slaughtered. Others were given or sold to farmers. It is known that at least some endemic foci were established as a result of their presence.34

In 1937 the first case of Rocky Mountain spotted fever was reported from southeastern Massachusetts.35 For a number of years prior to that time rabbits were imported from the western United States to improve hunting, and it is assumed that the establishment of the only New England endemic focus of Rocky Mountain spotted fever was the result of the importation of either infected rabbits or infected rabbit ticks.

In 1943 it was determined that the Lone Star tick (A. americanum) was a vector of Rocky Mountain spotted fever
after outbreaks of the disease in Bryan County, Oklahoma, and Brazzaria County, Texas. In Oklahoma six members of one family, their doctor and a neighbor all contracted the disease and four of them died. In the Texas outbreak four young children living in a trailer park constructed on abandoned pasture land became ill and two of the cases were fatal.

A tick survey showed that the only ticks present in either location were *A. americanum*. It had been established in 1932 that the Lone Star tick could pass the rickettsia under laboratory conditions, and further investigations showed that there were infected pools in several different states.

**Populations Affected**

Investigators were also learning during this period that Rocky Mountain spotted fever was not affecting the same kinds of people in the east and south east as had been effected in the Rocky Mountain and western states. The disease in the west affected primarily adult males who contacted the tick during the course of their employment, but in the south and east most of the victims were women or children. Many of the women contracted the disease after gardening or de-ticking their dogs, and the children came into contact with ticks while playing.

In the Midwest children and adult males living in rural areas were most apt to contract the disease. The men came into contact with ticks during employment and the children
during play.\textsuperscript{41}

In was believed that the disease was less severe in the eastern United States than in the west until Norman Topping completed a study in 1941 which showed that death rates for the east and west were essentially the same when corrected for age differences.\textsuperscript{42} The death rate among children is low and increases with the age of the victim. Only occasionally do patients over seventy survive Rocky Mountain spotted fever.\textsuperscript{43}

Various state health departments considered that some groups were more liable to the disease than others, and administered warnings and in some cases allocated vaccine, to the special groups. Oklahoma warned oil workers to check for ticks, and North Dakota warned of the danger of infected ticks coming in on feeder lambs from Montana.\textsuperscript{44} Kentucky allocated vaccine to youth groups going into specific camping areas, and California purchased 16,000 doses of vaccine to be given to Civilian Conservation Corps workers.\textsuperscript{45}

It was never considered desirable to attempt to vaccinate everybody, and the usual method was to vaccinate the family and neighbors of victims, or people living or working in known endemic areas. As long as it was believed that the eastern strain was milder it was recommended that what vaccine was available should be used in the Rocky Mountain states.

The large number of reported cases in the east led
medical investigators to renew efforts to develop a cheap effective vaccine, and in 1939 the Cox vaccine was placed on the market. The vaccine was inexpensive and safe to produce, and was widely used, especially in the east.

Status of the Disease in 1945

By 1945 Rocky Mountain spotted fever cases had been reported from all states except Maine and Vermont, and over half of all cases reported during the period 1931-1945 were contracted in the east (Fig. 13). The only recognized endemic focus of Rocky Mountain spotted fever in New England was in the Cape Cod area of Massachusetts and all New England cases were either contracted in southeastern Massachusetts or out of the area.

By 1945 cases had been reported from all three Mid-Atlantic states. The only New York focus was in southeastern Suffolk County on Long Island. Cases in Pennsylvania were being reported from counties surrounding Philadelphia, and several cases had been contracted in rural New Jersey.

The largest number of cases were reported from the Piedmont counties of the south Atlantic states and major endemic foci had been identified in Delaware, Maryland, Virginia, North Carolina and in the suburbs of Washington, D.C. The majority of cases in the central United States were coming from an area which extended roughly from the easternmost counties in Texas and Iowa to the foothills of the Appalachian Mountains, and from the southern half of Indiana and Ohio to the northern counties of Louisiana,
## REPORTED CASES OF ROCKY MOUNTAIN SPOTTED FEVER 1931-1945

### New England
- Maine: none
- New Hampshire: 2
- Vermont: none
- Massachusetts: 5
- Rhode Island: 4
- Connecticut: 3

### Middle Atlantic
- New York: 106
- New Jersey: 142
- Pennsylvania: 87

### North Central
- Ohio: 63
- Indiana: 80
- Illinois: 163
- Michigan: 2
- Wisconsin: 2
- Minnesota: 8
- Iowa: 131
- Missouri: 62
- N. Dakota: 11
- S. Dakota: 56
- Nebraska: 4
- Kansas: 1

### Pacific
- Washington: 50
- Oregon: 495
- California: 76

### South central
- Kentucky: 68
- Tennessee: 172
- Alabama: 36
- Mississippi: 14
- Arkansas: 17
- Louisiana: 11
- Oklahoma: 105
- Texas: 11

### South Atlantic
- Delaware: 56
- Maryland: 706
- Washington, D.C.: 100
- Virginia: 753
- N. Carolina: 481
- S. Carolina: 29
- Georgia: 63
- Florida: 3
- W. Virginia: 71

### Mountain
- Montana: 656
- Idaho: 383
- Wyoming: 847
- Colorado: 200
- New Mexico: 14
- Arizona: 3
- Utah: 193
- Nevada: 116

Source: Footnote 47
Mississippi and Alabama.

Treatment

During the entire period 1920 to 1942 efforts had been made to find an effective treatment and as new drugs were developed they were tested on patients with Rocky Mountain spotted fever. Most produced no change in the illness, but sulfanilamide made the disease more severe and is now known to stimulate the growth of the rickettsia under laboratory conditions. 48

In 1942 doctors began reporting that the use of para-aminobenzoic acid was aiding in the recovery of patients with Rocky Mountain spotted fever. The drug was difficult to use because it had to be administered every few hours and the dosage had to be closely monitored, but it was the first drug in seventy years to be of any real value in the treatment of Rocky Mountain spotted fever. The use of para-aminobenzoic acid caused the temperature to fall, the patient to feel better, and most importantly, the death rate to drop. 49

The real breakthrough in treatment occurred in 1945 when it was discovered that either tetracycline or chloromycetin would control rickettsial diseases. 50 When the antibiotic was administered early in the course of the disease there was no development of symptoms such as headache, high fever or rash. Penicillin, the most widely used antibiotic, did not affect the rickettsia, but was often given to prevent secondary infections. 51
FOOTNOTES FOR CHAPTER FOUR


7. Aikawa, Rocky Mountain Spotted Fever, p. 53.


39. Justin Older, "Epidemiology of Rocky Mountain Spotted Fever and Murine Typhus," Texas Medicine, 66(1970),

41. Older, "Epidemiology," p. 43.


43. Topping, "Rocky Mountain Spotted Fever," 1941, p. 1702.


46. Aikawa, Rocky Mountain Spotted Fever, p. 64.

47. H.E.W., Selected Notifiable Diseases, pp. 222-223.


CHAPTER FIVE
ROCKY MOUNTAIN SPOTTED FEVER 1945-1974

Suburbanization

During the period 1945-1974 numerous cases of Rocky Mountain spotted fever were reported from endemic areas undergoing suburbanization, where the suburbs have slowly encroached into woods or abandoned cropland. Millions of acres of cropland have been abandoned and allowed to revert to natural vegetation. There were more than fifteen million acres of unused cropland in 1959 located in states east of the Mississippi River and nearly all of it was located in the South Atlantic and Central states. This is the same area where there has been an increase in the number of reported cases of Rocky Mountain spotted fever.

Several years after a field has been abandoned grasses and herbs become dominant. Small rodents, the immature hosts of D. variabilis, find this association an ideal habitat, and dogs which are allowed to roam in the fields bring ticks into housing areas.

Where houses were either widely placed in order to retain a rural atmosphere, or initial building took place along roads and highways, and the land in between remained vacant for several additional years, cases continued to be reported. However, Rocky Mountain spotted fever foci have been destroyed in areas where suburbanization has been completed, because the small rodent population has been driven off and the tick population destroyed.
Treatment

The availability of antibiotic treatment led many medical men to believe that all rickettsial diseases would soon be controlled. Tetracycline and chloromycetin were used for a variety of diseases and if the symptoms were alleviated a confirmed diagnosis was not made. The serological tests to prove the patient had Rocky Mountain spotted fever could not be run until several weeks after the onset of symptoms, and most doctors did not bother if the patient had recovered.

Beginning in the nineteen sixties there were reports of adverse reactions to some antibiotics, and in 1961 it was reported that chloramphenicol occasionally caused a patient to develop aplastic anemia and doctors were warned to be more selective in its use. Tetracycline causes the mottling of teeth in children, and doctors have been urged not to use it on individuals under eight years of age.

The beginning symptoms of Rocky Mountain spotted fever are the same as many bacterial and viral infections and the initial drug of choice is generally penicillin or some other wide-spectrum antibiotic. Chloromycetin and the tetracyclines are generally administered under careful supervision and in most cases are not administered unless a positive diagnosis of a rickettsial disease is made. It is probable that more cases of Rocky Mountain spotted fever are being reported because more cases are developing to the point where a positive identification can be made.
The Role of Pesticides

DDT was made available for civilian use in the fall of 1945 and it was thought that vector borne diseases would soon be controlled, because insect populations would be reduced.\(^7\) During the spring and summer of that year spraying by government agencies began and plans were formulated for the destruction of all sorts of pests. Long Island fogged its beaches each week so that swimmers would not be bothered by mosquitos or gnats and plans were made to spray all wooded areas where ticks were apt to be present.\(^8\)

As information on tick reaction to DDT became available, people realized that ticks, because of their hard shells, were more resistant to DDT than most insects. Therefore more complete coverage and a higher concentration of insecticides was required. Agencies then began to spray DDT for the control of ticks along either side of roads and paths used by large numbers of people.\(^9\)

DDT and other chemicals came into widespread use and less attention was paid to the destruction of specific pests. It became common for both rural and suburban residents to use them indiscriminately and in large doses in an effort to rid their areas of all insects. As insects became resistant to DDT, other substances were developed. By 1963 over $440 million worth of insecticides were produced each year in the United States with few controls on their sale or use.\(^10\)

Studies undertaken by the Federal Government have
shown that the household use of pesticides was very high and in some parts of the United States exceeded agricultural uses. No specific studies were completed showing the impact of indiscriminate use of these chemicals on household pests. However, it is clear that millions of them were destroyed.

Agricultural producers used pesticides in large amounts to protect crops and animals. They were sprayed on crops and in National Forests, and farm animals were sprayed, dipped and painted in an effort to keep them free of pests, including hard shelled ticks. Ticks not only carry disease, but can bleed an animal to the point where anemia becomes a problem and the animal becomes prone to other diseases.

Beginning in the mid-sixties the public began to be aware that problems had arisen as a result of the use of these chemicals. Insects had become resistant, animals were dying, and water quality was being adversely affected. A change in attitude occurred and groups began to push for governmental controls and public restraint.

By 1969 the use of pesticides was being limited and a number of the more persistent ones had been banned. Biological and non-persistent pesticides were being substituted for the all-purpose ones formerly in use. Many of these are ineffective against the hard shelled tick. Home gardeners now rely heavily on systemic insecticides to protect their plants against insects. The tick feeds only upon mammals and is not affected by these products. Sprays
and dusts now being used are often only effective against ticks when used in amounts far in excess of what is recommended.

In agricultural areas chemical insecticides were placed under strict control and a virtual ban on the use of DDT was imposed on 500 million acres of federal land.\textsuperscript{13}

Continued high agricultural production is dependent upon the control of insects, so ranchers and farmers switched to the use of specific pesticides for specific problems. Because one of the main problems of the livestock industry continued to be the control of hard-shelled ticks, there has been continual research on the development of chemicals or biological substances which will prevent tick infestations on the animals. Cattle and sheep are still painted, sprayed, dipped and fed systemic insecticides in an effort to keep them tick free.\textsuperscript{14}

The drop in the use of generalized pesticides, some of which were effective against ticks in suburban and non-agricultural areas, has been the probable cause of the increase in cases of Rocky Mountain spotted fever in non-agricultural areas. At the same time, in agricultural areas the transfer to specific pesticides and the continued high use of these chemicals has contributed to the continuing low rate of the disease in these areas.

Distribution of Cases

During the period 1945-1974 there were changes in the distribution of Rocky Mountain spotted fever. The disease
ceased to be important in the Rocky Mountain states, but became a serious problem in the south Atlantic states and parts of the Middle West. There has also been a slight increase in the number of cases reported from the coastal areas of the far Western states and the south Atlantic states.

Only occasional cases of Rocky Mountain spotted fever have been reported from the western states of Washington, Oregon, and California since 1945. The areas infested with D. andersoni have never been heavily populated and most of the land has been used for ranging cattle and sheep and every effort has been made to keep the animals tick free. The other main economic activity in the area, especially in north eastern Oregon, was lumbering, but changes in the industry has led to reduced employment during the last twenty years.\textsuperscript{15}

Since 1960 a few cases of Rocky Mountain spotted fever have been reported from the coastal and central counties of California and coastal counties of Oregon. There have only been about forty cases and it is not known if the people had contracted the disease after exposure in the endemic areas or if D. variabilis or D. occidentalis have become infected.

There was a drop in the number of reported cases in the Rocky Mountain states during World War II and the rise in the number of cases after the war was only slight, followed by a drop to below twenty-five cases per year. The
number of reported cases remains low, with nine cases in 1973.

The decrease in the number of reported cases was the result of several factors. The drop during World War II was primarily the result of a shift in the population, and the continuing low rate is a result of the widespread use of agricultural pesticides, mechanization of many economic activities, and the continued awareness of the medical profession and many residents.

During the war there was a decrease in the farm population in the mountain states. For example, in Wyoming the farm and ranch population dropped from seventy-two thousand in 1940 to fifty-three thousand in 1945.16 Many of the agricultural workers either moved to the west coast to work in defense plants or joined the service, and a large number of them never returned to Wyoming except as visitors.17

The mining, timber, and ranching industries have all become more mechanized, and very few workers now live under the primitive conditions which formerly brought them into contact with infected ticks. Airplanes, helicopters and jeeps now make it possible for rural employees to return to town on a regular basis.

Pesticides are still used by ranchers, and grain farmers continue to attempt to keep their fields free of the small rodents which serve as hosts for the immature forms of *D. andersoni*. The reduction in the use of pesticides in the national forests has not led to an increase in the
number of reported cases in vacationers because these visitors do not normally arrive before the middle of June, and most D. andersoni ticks have ceased host seeking activities by that time.

Both the medical profession and the permanent residents of the mountain states are aware of the seriousness of tick borne diseases, and many receive the vaccine each year. The number of doctors is small (330 in Wyoming), and most have either treated cases of Rocky Mountain spotted fever or have other personal knowledge of the disease.

The distribution of reported cases of Rocky Mountain spotted fever in the Middle West is essentially the same as it was in 1945. However, some areas are reporting more cases than before, and there has been a drop in the number of cases in several other areas. The decrease in reported cases has occurred in Iowa, South Dakota, and other states in which agriculture is the most important economic activity. The drop corresponds with the drop in reported cases in other agricultural areas where pesticides are in widespread use.

An increase in reported cases has occurred in Tennessee, the southern parts of Illinois, Indiana and Ohio, and eastern Oklahoma and central Arkansas. A. americanum is the prime vector in Arkansas, eastern Oklahoma, and along the Gulf Coast, and D. variabilis is the main vector in all other parts of the central United States.

The increase in reported cases in Tennessee is
statewide and small endemic foci exist in nearly every county. Some of these foci have existed for a number of years because the climate, vegetation and weather are ideal for tick survival.

Rural residents, especially children, continue to be most liable to the disease, and most contact the ticks near their homes. The problems in West Virginia, Kentucky and the northern counties of Alabama, Louisiana and Mississippi are similar to the problems of Tennessee, but are less widespread.

The majority of cases in Ohio, Indiana and Illinois are contracted in the southern parts of these states in areas where the vegetation is fairly heavy and drainage is poor. Suburbs are being constructed on abandoned crop-land in a number of counties, and workmen and children moving into these areas are coming into contact with infected ticks.

The increase in reported cases in eastern Oklahoma and central Arkansas is, in part, the result of the completion of recreation projects which led to improved tick habitats. The development of large reservoirs has produced a mild, moist climate near the edges of these waterways, enabling more *A. americanum* ticks to survive the dry summers. These projects have not only reduced the threat of drought, but have also reduced localized flooding which formerly caused a tick reduction by either destroying the tick or the small mammal hosts.
The heavy infestations which now exist in some of the recreational areas have led to economic concern. Many permanent residents are able to ignore the presence of a tick, but the urban visitor will not willingly go into an area he considers tick infested.21

Considerable effort has gone into removing ticks from areas where large numbers of people are expected to congregate.22 Coordinated plans for brush removal, spraying and small animal control have been tried on a small scale, but the cost is very high and there are millions of acres involved.

In the past, Rocky Mountain spotted fever was primarily a disease of permanent residents, but enough cases have been reported from vacationers to make investigators well aware of the potential for a serious outbreak of either Rocky Mountain spotted fever or some other tick borne disease. The publicity surrounding such an outbreak could affect efforts to make these recreational facilities a major economic force in the region.

Rocky Mountain spotted fever is not a significant health problem in the New England states. There have only been a total of fifty-two cases reported since 1930, none in either Maine or Vermont.

The mid-Atlantic states of New York, New Jersey and Pennsylvania all have a moderate public health problem with Rocky Mountain spotted fever. The responsible tick, D. variabilis, is not found inland in this area because of the
cold dry winters. Therefore, almost all of the reported cases have been contracted within ninety miles of the Atlantic Ocean. Cases have been reported from most counties in New Jersey, but the problems of Pennsylvania and New York are more localized.

Suffolk County, Long Island, New York, reported more cases of Rocky Mountain spotted fever during the period 1950-1970 than any other county in the United States and the problem has been extensively studied. The first case was reported from Gardiner's Island, but the main focus since 1934 has been in East Hampton Township (Fig. 14).

The northeastern peninsula, Southhold Township, has only reported a few cases. John Miller feels that this is the result of the extensive truck farming which has gone on in the area for many years. Cultivation has lowered the population of both wild rodents and deer.

Most of the southern peninsula, and particularly, East Hampton, is either wooded or open unimproved beachland. There are numerous public and private camping areas, picnic grounds and beaches. Many of the homes in East Hampton are vacation homes owned by residents of New York City and are only occupied during summer months.

Because an increase in the number of reported cases occurred in the early nineteen forties, a co-ordinated program for correcting the situation was begun in 1947. It was decided that the education of the public and the medical profession was a necessity. Newspapers were requested
to run articles, radio spot announcements were made and local service organizations distributed booklets describing the situation.

Citizens were told to de-tick their dogs by using sprays or dips, and they were warned to check themselves, their children and their animals regularly for the presence of ticks and to remove the ticks without crushing them. They were also urged to remove brush from around their homes and to prevent its regrowth. The New York Bureau of Entomology began regular spraying with insecticides four to ten feet on either side of paths and roads which were used by large numbers of people.28

Many of the permanent residents and regular visitors were vaccinated, but it was not considered practical or desirable to vaccinate occasional visitors.29 Miller noted that, of the one hundred seven cases he investigated between 1941 and 1949, only fifteen had occurred among these occasional visitors.30 He estimated that several hundred thousand people use the recreation facilities in a summer, but very few of them come to Long Island before the fourth of July,31 while most D. variabilis have ceased host seeking activities by late June.

The program was evaluated after several summers and it was decided that the educational program should be continued and intensified, especially among medical personnel. There was only one large hospital in the county and most of the victims sought aid there. Misdiagnosis was high,
thirty-three per cent,\textsuperscript{32} and victims were not receiving proper treatment. It was decided that heightened general perception would result not only in a reduction in the number of cases, but also an increase in the number of victims informing their doctors that they had been in a known endemic area so that the doctor would be alerted to the possibility of Rocky Mountain spotted fever.

There has been a drop in the case rate for the entire county during the last twenty years, but the total number of cases is still high and a major focus of infection still exists in Suffolk County. The major increases in population have occurred in the western sections of the county, where seventy per cent of the population now live.\textsuperscript{33} The main areas of infestation are still rural and recreation is the main land use. There is no reason to believe that the situation on Long Island will change significantly in the future.

The eight Piedmont counties of southeastern Pennsylvania reported one hundred eighty-five of the two hundred cases of Rocky Mountain spotted fever found in the state during the period 1950-1970.\textsuperscript{34} The case rate of .92/100,000 inhabitants each year is high, but considering that the area is highly urbanized and most of the people who live in cities (ninty-six per cent of Delaware County and one-hundred per cent of Philadelphia County) are never exposed to the disease, then the case rate for the population at risk must be one of the highest in the nation.
In contrast to the localized distribution in New York State, cases have been reported from nearly every county in New Jersey. The highest case rate is in the northern coastal counties, but the largest number of cases is reported from the southern counties nearest the Piedmont.

Rocky Mountain spotted fever has not been extensively studied in either of these states. The common practice of reporting disease by state, or as cases per hundred thousand inhabitants has given a distorted, non-geographical, view of the problem.

The information which is available indicates that the pattern of cases is similar to the pattern in other Atlantic states. Victims are generally local inhabitants who contact the tick near their homes, while at work, or during the pursuit of such recreational activities as swimming, hiking or while picking wild berries.

South Atlantic States

Rocky Mountain spotted fever has become an increasing problem in the South Atlantic states, and well over fifty per cent of all cases reported since 1950 have come from this region. In the nineteen thirties the major foci existed in the Washington, D.C. and Baltimore, Maryland suburbs. The disease has now been reported from nearly every county in Virginia, Maryland, North Carolina, and South Carolina. The disease is less widespread in West Virginia and Florida and the only major focus in Georgia is located in the northeast portion of the state.
The prime vector in the south Atlantic states has been *D. variabilis*, which is very abundant in the Piedmont counties. *A. americanum* is also present in most of these states, especially in the coastal areas. An increase in the number of cases during the month of May has led to the conclusion that *A. americanum* is becoming a more important vector, especially in coastal Virginia.

The first reported cases came from the Piedmont counties and the highest case rates are still reported from this region. The majority of mountain cases occur in those parts of the counties nearest the Piedmont, especially in the southernmost states. In the more northerly states *D. variabilis* does not survive the dry inland winters and is generally only found in the Piedmont and coastal areas in large enough numbers to maintain disease foci.

There was concern that the building of suburbs in the Washington, D.C. and Baltimore areas would increase the number of cases reported. This did not happen. It is believed that the rapid suburbanization which occurred after World War II destroyed the tick foci. Fairly large tracts of land were cleared and housing built. In many of these tracts little, if any, natural flora or fauna remained after the building was completed.

Further south in other parts of Maryland, Virginia and Georgia, suburbanization was slower and far less complete and abandoned crop land far more common. The tracts were built further apart and efforts were made to retain
the rural atmosphere. The local flora and fauna survived the suburbanization process and tick foci were not destroyed.

The presence of Rocky Mountain spotted fever in these states has caused alarm and sometimes economic difficulties. An outbreak of fourteen cases in Dekalb and Fulton counties in Georgia in 1947 led to considerable economic loss.\textsuperscript{36} A suburban tract was started and when cases of Rocky Mountain spotted fever began to be reported the property values in the tract and surrounding areas dropped. A tick eradication plan was developed and then implemented, and when there were no additional cases reported the land returned to its original value.

The major foci of infection have moved south since the disease was first recognized in the nineteen thirties, when Washington, D.C. and north central Maryland reported the most cases. In the last several years this distinction has fallen to either Virginia or North Carolina.\textsuperscript{37}

The weather, climate, vegetation, and fauna of the south Atlantic states is ideal for tick survival, and there is no reason to believe that Rocky Mountain spotted fever will not be an increasing Public Health problem at least in the states of Maryland, Virginia, South Carolina, and Georgia. A great deal of effort is going into informing the medical profession and general public of the problem, but there is little hope that the disease can be eradicated in any of the south Atlantic states.
FOOTNOTES FOR CHAPTER FIVE


3. Aikawa, Rocky Mountain Spotted Fever, p. 117.


19. Calvin Linneman; Paul Jansen, and Gilbert Schiff, Rocky Mountain Spotted Fever in Clermont County, Ohio; American Journal of Epidemiology, 97(1973), p. 128.


34. Center For Disease Control, Atlanta, Georgia: Personal Communication.
CHAPTER SIX
OVERVIEW

The distribution of cases of Rocky Mountain spotted fever has changed since the recognition of the disease in 1890 in the Bitterroot Valley. The disease is no longer a significant medical problem in the Rocky Mountains, but has become an increasingly important disease in the South Atlantic and South Central states.

The mapping and charting of cases reported to the federal government since 1920 indicates the extent of these changes (Figs. 4-10, pp. 19-25). In the Rocky Mountain states there was an increase in reported cases in the early nineteen-thirties when the disease spread into eastern Montana and Wyoming, a drop in the last half of the decade as a result of the use of the vaccine and the reduction in rural employment as a result of the depression. The increase in reported cases in 1941 is the result of an ideal spring which led to an especially heavy tick population at the same time that employment opportunities increased. Beginning in 1942 there was a drop in the number of cases and the rate has remained low. The population of the mountain states dropped during the war as defense plant workers and members of the military left the area, and by the time the population reached pre-war levels antibiotic treatment and the use of pesticides had become widespread. The continuing low rate is the result of continuing efforts to destroy
ticks in the livestock industry, destroy small rodents in grain fields, and the continued awareness of the medical profession to the dangers of tick borne diseases.

Cases of Rocky Mountain spotted fever began to be reported from Atlantic states in 1931 and the disease was an increasing problem until nineteen forty. The reduction in the number of cases during the period 1940-1942 was, in part, a result of the hurricane of 1939 which destroyed millions of ticks and their rodent hosts. Davis theorized that it took until the spring of 1942 for the tick and mammal populations to reach pre-hurricane levels. By 1947 antibiotic treatment and insecticides were available and the number of reported cases began to drop. The rise in the last few years has coincided with the reduction in the use of generalized pesticides and the more discriminatory use of chloromycetin and tetracycline. The higher than expected number of cases in 1969 is also partially a result of mild spring weather in the Piedmont counties of Virginia which resulted in a very high tick population.

The number of cases reported from the Mid-western states remained fairly low until the end of World War II, when suburbanization brought large numbers of people into contact with infected ticks. The drop in the latter part of the forties coincides with the introduction of antibiotics and insecticides. The rise in the number of cases in the last several years has occurred primarily in those areas undergoing suburbanization or in the newer recrea-
tional areas of Oklahoma and Arkansas, but has remained low in those areas where the agricultural use of pesticides remains high.

Since 1890, when cases of Rocky Mountain spotted fever first began to be reported, certain groups of people have been considered more liable to contract the disease than others. The victims have most generally been new but permanent or semipermanent residents. They spent time in tick infested areas and were more often than not unaware of the potential hazard. In the early part of this century most victims were on the frontier living under primitive conditions, for example, dam workers in Wyoming, sheep herders in Idaho, and ranchers and lumbermen in the Bitterroot Valley. By the nineteen thirties cases were being reported from oil camps and from among Civilian Conservation Corps workers.

During World War II cases were contracted in temporary quarters near defense plants and by summer residents of the suburbs of Long Island, Washington, D.C. and Baltimore. The suburban cases continue to be reported from what Linne-man calls the interface between the suburban and rural environment.

The majority of victims have contracted the disease within a few miles of their homes, and the typical Eastern victim has been described as a child who contacted an infected tick within twenty-five miles of his home while engaged in recreation or at work. The Mid-western victim is
generally either an adult male who contracts the disease while working or a child who comes into contact with a tick while at play. The Western victim was and still is most apt to be an adult male who contracts the disease while at work.

Since 1910, when it became clear that the tick was the vector and that it must feed for several hours before passing the rickettsia, investigators have been warning that the potential victim must be aware that ticks are carriers of disease and must take precautions. He should dress properly, check himself and his children for the presence of ticks, be vaccinated if he is going into a tick infested area and inform his doctor if he becomes ill within two weeks of being in such an area.

A survey of popular literature for the period 1950 through 1973 shows that it would be difficult for a potential victim to get the information necessary to follow these instructions. Some camping guides and articles give part of the information and some give misinformation. The Sierra Club camping guide describes some of the early symptoms of Rocky Mountain spotted fever and suggests that they are due to altitude sickness and does not offer the alternative that a serious illness could exist. Several of the articles and books do not give adequate information on geographic distribution, do not warn of the possibility of disease, nor tell the reader to inform his doctor.

Since education is considered the most effective
method of preventing the disease, potential victims and doctors must be made aware that the disease is present in nearly every state, not just the Rocky Mountains, and is a suburban as well as a rural problem. Cases have been diagnosed in nearly every state, and ticks carrying R. rickettsia have been recovered from areas where the disease has not yet been diagnosed. 8

Since the mid-nineteen thirties when it was realized that the disease was not limited to the Rocky Mountain states, some individuals have urged that the name of the disease be changed to tick typhus or some other non-geographic term. Those urging a change believe that medical men skip over articles on diseases that they do not believe that they will come into contact with, and that the general public is not concerned about diseases which it believes happen somewhere else.

Those who prefer the old name believe that all of the efforts which have gone into identification, treatment and education would be lost if the name was changed. Journal articles now appear under a variety of names. 9 Medlars, the major medical index, used Rocky Mountain spotted fever, 10 and the Center for Disease Control in Atlanta, Georgia, which compiles government statistics, reports the disease as Typhus Fever (tick-borne, Rocky Mountain spotted). 11 Some sort of standardization is necessary if doctors and other medical personnel are to be adequately informed.
Popular literature has generally used the term Rocky Mountain spotted fever, but only occasionally is the entire geographic distribution reported. Newspaper articles often report an outbreak in a single area and imply that the disease is localized. Camping guides and magazine articles are even more vague, and generally state that the disease can be found anywhere wood ticks are found. People in general equate wood ticks with the rural environment. They do not realize that the ticks which the dog brings into the suburban home are also wood ticks.

Most literature intended to inform backpackers and campers stresses that getting away from civilization is getting into a healthy environment. There are only occasional references to diseases which can be acquired from vectors or animals. The symptoms of Rocky Mountain spotted fever, such as fever, headache, nausea and rash are often discussed and attributed to changes in water, altitude or to contact with plants.

The low rate of infection among vacationers has in part been the result of the general dislike, and hence prompt removal, of ticks by urban residents, and in part the result of the timing of vacations. Most urban residents vacation in the summer after the ticks have gone inactive.

There is concern that increased backpacking activities will lead to a relaxed attitude toward ticks, and that increased leisure time will bring more people into tick
areas during the spring months.

Since the tick must be attached for several hours before the rickettsia can be passed, information on the importance of prompt removal must be included in any educational program. Information on proper removal will be difficult to acquire since most tick experts have relied on woodsmen's views for their information. It has been suggested that ticks can be removed by smearing them with peanut butter, nail polish remover, mineral oil, or turpentine, or by holding a lighted match, burning cigarette or blown out match to their bodies, and, in any case, you wait for them to leave. Others recommend that you grab the tick firmly with a piece of paper or tweezers and pull firmly, while twisting clockwise or counter-clockwise. Most agree that the head must be removed in order to assure that the rickettsia will not be passed, and that a localized infection will not ensue.

Misdiagnosis has been high in Rocky Mountain spotted fever, and part of the problem has been that doctors and potential victims do not often think of a tick-borne disease. The problem is aggravated when several members of a family or a group of neighbors become ill at the same time. Both doctors and victims think of a communicable, not a vector borne, disease. There are reports of outbreaks which occurred after a number of people participated in a single activity and where the correct diagnosis was not usually the initial diagnosis.
An educational program for doctors should include information on its distribution, diagnosis and treatment. It should be stressed that while the disease is still comparatively rare, there has been an increase in the number of cases, and in the death rate in the last few years, and that proper diagnosis and prompt treatment can reduce the death rate to near zero.13

The major educational program should be directed toward the general public. In endemic areas information on tick removal, tick eradication and symptoms could be distributed by civic groups, preferably youth groups, since children are the most likely victims. Camping guides and general first aid books need not overly alarm the public, but should stress that ticks are potential disease carriers, and should avoid misinformation.

The July 1974 Readers Digest, "Guide to First Aid," discusses prompt tick removal and warns of the necessity of handling the tick carefully. They do not discuss the geographic distribution, nor name the tick borne disease. However, in two sentences they convey the information which the general public, not living in endemic areas, needs to know. "Ticks can transmit several diseases, but usually don't if removed soon after they've become attached. If the bite becomes inflamed and swollen, or if the patient has a fever, notify a doctor."14 Education of the potential victim and the doctor is the only known effective method of controlling Rocky Mountain spotted fever.
FOOTNOTES FOR CHAPTER SIX


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