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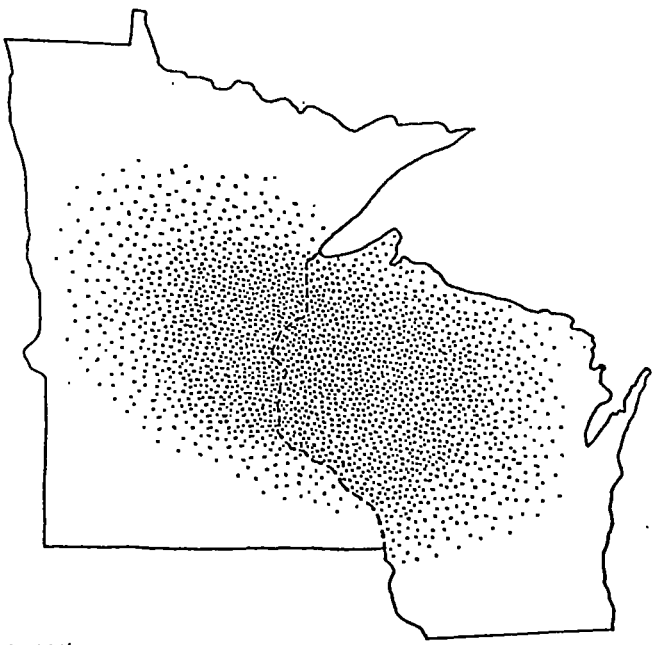
Lyme Disease

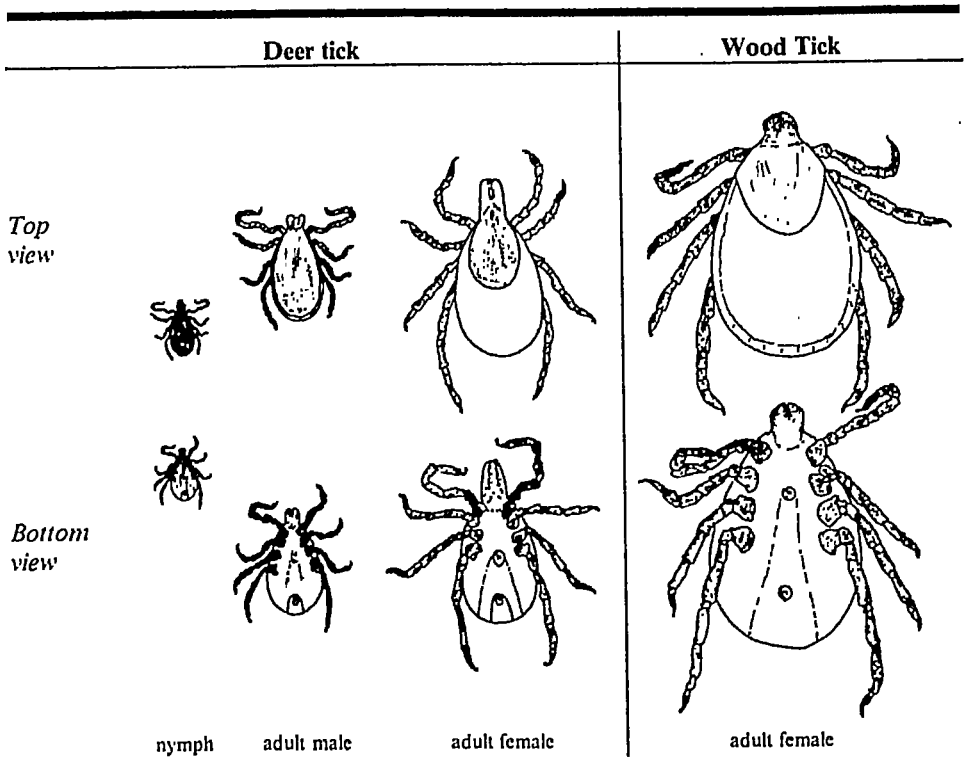
by William D. Schmid



Midwest focus of Lyme disease.

Lyme disease has become the most important tick-borne disease of humans, although it has been recognized and understood for fewer than a dozen years in the United States. The disease, also called ECM (for its distinctive rash, *erythema chronicum migrans)*, has been known in Europe since about the turn of the century. The first probable report of the disease in the United States was made in 1969. Serious concern was not shown, however, until 1975 when an apparent outbreak of rheumatoid arthritis near Old Lyme, Connecticut, was ascribed to what was then called Lyme arthritis. Not until 1982 was a bacterial pathogen discovered in ticks and related to this disease, and only in 1985 did the spirochete receive its scientific name *Borrelia burgdorferi.*

That spirochete is the same organism that causes ECM in Europe, so the disease is virtually worldwide at north temperate latitudes, and it has been found recently in Australia. There were three original foci of Lyme disease in the United States: eastern seaboard (Connecticut, Massachusetts, New York, New Jersey), western seaboard (California, Oregon), and midwest (Minnesota, Wisconsin). It has now been reported from more than half of the continental states. Lyme disease is new; it is spreading; it is increasing in established areas; and it has serious consequences if not detected early and treated properly.



Comparison of the common wood tick and the Lyme disease-carrying deer tick.

The disease develops in three stages. The **first stage** is usually characterized by a rash around the tick bite that spreads, often to a diameter of six inches, with the perimeter showing greatest inflammation. Sometimes secondary rashes occur away from the site of infection, and sometimes no rash appears. This stage is usually accompanied by fever, headache, muscular aches, and flulike feelings of discomfort and tiredness. After a few weeks these symptoms disappear, but if the disease is recognized during this phase, treatment is simple and effective; more important, later complications will be avoided by an early cure.

The **second stage** includes more serious symptoms, as the bacterium interferes with nerves and muscles by activating chemicals and cells of the immune system. This can lead to encephalitis, if the central nervous system is affected, to arrhythmic heartbeat and angina pectoris-like heartpain, if the heart muscle is affected, and to variable paralysis of facial muscles. Joint aches and severe migrating muscular pain are also common in this stage. Some of these symptoms may persist until the **third stage,** which involves continued activation of the immune system in response to the prolonged infection, eventually resulting in arthritis. Because treatment of this arthritis is not completely effective, early diagnosis is especially important. This sequence of symptoms is typical, not unvarying; encephalitis or arthritis may occur without other indicators of Lyme disease, such as its hallmark rash. Therefore, knowledge of the natural history of the disease vector, ticks of the genus *Ixodes,* and its hosts aids our recognition and understanding of this infectious disease.

The deer tick, *I. dammini,* is the primary vector in the midwest. This tick requires three hosts and two years to complete its

life cycle. Each host harbors a different stage (larva, nymph, or adult), which drops off after a blood meal. Engorged adult female ticks lay eggs in early summer. After hatching, the larval ticks must find a blood meal that summer, often attaching to a mammal, such as the white-footed mouse, infected with the Lyme pathogen. Larvae will then carry the infection throughout their lives. Other small mammals, such as eastern chipmunks, short-tailed shrews, and red-backed voles may serve as hosts for the larvae—and for the bacterium. In fact, almost every species of mammal living in regions of high incidence of Lyme disease has been found to carry larval ticks.

Infected larvae overwinter and, the following spring, molt and metamorphose into nymphs. Nymphs must feed to gain energy for their molt and metamorphosis into adults. Adult females require a blood meal, in the fall or following spring, to gain nutrients for egg-laying. The danger to humans comes when we are accidental hosts to infected nymphs or infected adults.

The white-tailed deer seems to be important to maintenance of adult ticks. In addition, more than two dozen species of migratory birds have been found with attached immature stages of the deer tick, which means that there is a great potential for spread of the disease if the birds carry infected ticks during their seasonal travels. Although our understanding of the natural history of this disease is rudimentary, we can expect continued outbreaks and spread across the North American continent wherever suitable habitats exist for *Ixodes* ticks and their hosts.

Another factor that will contribute to the spread of this disease among humans and our domestic animals, especially dogs and horses, is the development of surburban areas bordering good tick habitat. Lyme disease has been reported from suburbs of both Hennepin and Ramsey Counties. In the fall of 1985, a team of researchers from the University of Minnesota surveyed Fort Snelling State Park and Cedar Creek Natural History Area to check for the disease. Tissue samples from deer killed during control hunts in November were cultured for the bacterium. The cultures were negative, but some ticks taken from those deer harbored the bacterium, so the disease may be present. Native mammals, such as deer and mice, continue to be tested for the bacterium and an intensive year-round study has been started at a suburb in northern Ramsey County. These investigations should provide useful information about the natural history of the disease and its potential for transmission to humans and domestic animals, eventually leading to effective measures for prevention and control.

It is impossible to find periods free of infective ticks during most of the year: adults feed in March, April, May, and June; nymphs feed in June, July, and August; and adults feed again in August, September, October, and November. Since we can not avoid potential exposure to infected ticks, we must use caution whenever in woodland regions of Minnesota and Wisconsin where the ticks are established. Insect repellent and fresh tick collars are effective deterents, but a thorough inspection after a day in the field is most important. Ticks usually move about on your body before they attach their mouthparts to feed. Attached ticks should be removed by pulling gently with tweezers. Put any ticks found on your body into a small vial and put the capped vial in a freezer. Infected ticks may not always cause disease because the spirochete does not move into the body at the moment of tick attachment. One tentative guess is that a tick must be attached to a human for at least 12 hours before infective transfer occurs. The nymphal stage of *Ixodes* is quite small, so careful inspection is important. A

Three prominent scientists in the study of Lyme disease, from left: Willy Burgdorfer (for whom the spirochete was named), Allen Steere, and Russell Johnson. Photo by William D. Schmid.

spreading rash at the site of a tick bite is a warning that treatment should be sought immediately, bringing along the tick if possible.

Current research provides a hopeful outlook on the future of Lyme disease. New and more effective antibiotics for treatment of the disease have been tested in animals and soon will be in humans. A vaccine that could provide complete protection against infection has been developed and is undergoing tests for use on dogs. Finally, better methods of detection using more sensitive and specific antibodies than are now available are being developed and tested. A recent finding of spirochete antigens in the urine of infected animals may provide another way to recognize Lyme disease. For now, recognizing the early symptoms and seeking prompt medical attention should enable an infected person to avoid dangerous later complications. Better still, careful body inspection after time spent in deer habitat may catch ticks before they have had a chance to transmit the disease.

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Further Reading

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