**Borrelia burgdorferi** sp. nov.: Etiologic Agent of Lyme Disease

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A review of reports on the genetic and phenotypic characteristics of strains of the spirochete which causes Lyme disease revealed that these organisms are representative of a new species of *Borrelia*. We propose the name *Borrelia burgdorferi* for this species. The type strain of *B. burgdorferi* is strain B31 (= ATCC 35210). In two separate studies the guanine-plus-cytosine content of the deoxyribonucleic acid of the type strain was determined to be 29.3 to 30.5 mol% (thermal denaturation method).

Erythema chronicum migrans, the skin lesion characteristic of Lyme disease, was first reported by Swedish physician Arvid Afzelius in 1909 (1). Subsequently, erythema chronicum migrans, occasionally accompanied by neurological symptoms, was recognized throughout Europe (Schmid, Yale J. Biol. Med., in press). In 1970, the first case of erythema chronicum migrans acquired in the United States was reported (11), and in 1977 researchers investigating an unusual cluster of cases of childhood arthritis described the entire symptom complex now called Lyme disease (14).

In his original description, Afzelius recognized that the skin lesions occurred after the bite of a tick, and *Ixodes ricinus* was subsequently established as the vector of the disease in Europe. In the United States, *Ixodes dammini* and *I. pacificus* were established as vectors (13). Despite these observations, the observation that erythema chronicum migrans could be transmitted between human volunteers (4), and the fact that the disease could be treated with antimicrobial agents (7, 15), a suspected infectious etiologic agent eluded researchers until 1982.

In 1982, Burgdorfer et al. reported finding spirochetes in *I. dammini* ticks which were collected on Shelter Island, N.Y., a known endemic area for Lyme disease; these spirochetes reacted immunologically with the sera of patients with Lyme disease, and Burgdorfer et al. suggested that this organism was the etiologic agent of Lyme disease (6). This suggestion was strongly supported by the subsequent isolation of seemingly identical spirochetes from the blood (3, 12), cerebrospinal fluid (12), and skin (12) of patients acutely ill with Lyme disease and the further demonstration of immunological reactivity of patient sera with the spirochetes (12). In 1983, similar spirochetes were isolated by the Burgdorfer group from *I. ricinus* ticks collected in Switzerland (2).

In the absence of taxonomic studies, the spirochetes which have been isolated have been termed Lyme disease spirochetes, *Ixodes dammini* spirochetes, or *I. ricinus* spirochetes. We have reviewed reports of the immunological and phenotypic characteristics of these spirochetes, as well as the deoxyribonucleic acid (DNA) nucleotide relationships of these spirochetes to other spirochetes and among themselves. These reports indicate that all of the isolates thus far studied belong to one species and that this is a new species of *Borrelia*. For this species we propose the name *Borrelia burgdorferi* sp. nov. (burg.dorf.er.i. N.L. gen. n. burgdorferi in honor of Willy Burgdorfer, who first discovered the organism in *I. dammini* ticks at the Rocky Mountain Laboratories, National Institutes of Health, Hamilton, Mont.).

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spirochetes are chemoorganotropic, when carbohydrates such as D-glucose are used as energy and carbon sources. D-Glucose is fermented to lactic acid (Johnson et al., in press). In contrast to the antigenic variability of the relapsing fever borreliae, this organism is antigenically stable. It is pathogenic for humans (3, 12) and animals (6). Infections are acquired from several tick species of the genus Ixodes which are parasitized by the spirochete. Transovarial transmission of the spirochete in ticks is infrequent and inefficient (W. Burgdorfer, Yale J. Biol. Med., in press). The type strain of B. burgdorferi is strain ATCC 35210. The guanine-plus-cytosine content of B. burgdorferi DNA is 27.3 to 30.5 mol%, as determined by thermal denaturation.

Description of the type strain. The type strain of B. burgdorferi is strain B31 (= ATCC 35210). This strain was the first isolate of B. burgdorferi and was isolated from a tick (I. dammini) collected on Shelter Island, N.Y. The guanine-plus-cytosine content of this strain is 29.0 to 30.5 mol%, as determined by the thermal denaturation method in two separate studies (8, 10).

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LITERATURE CITED


