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The Origin of Ticks and the Genesis and Emergence of Lyme Disease

Alan L. Gillen

Matthew Eakin

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Tick-borne diseases like Lyme disease have plagued humans for millennia. Did God make them that way, and what do they teach us about a fallen creation?

by Dr. Alan L. Gillen and Matthew Eakin on August 4, 2021
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Abstract

Ticks are notorious for their capability of transmitting diseases that have debilitated humanity for thousands of years. They can confer lifelong chronic ailments via pathogenic bacterial species that they harbor inside themselves. These parasitic tick species, namely the *Ixodes scapularis* tick is responsible for hundreds of thousands of Lyme disease infections each year. This profound tick continues to produce the highest rate of zoonotic disease in the United States each year. Many may ask why these tick species are so infectious when ticks were originally designed by a benevolent God. Why would a good Creator choose to design a creature ultimately capable of such considerable

virulence? What accounts for the continued resurgence of Lyme disease? There are many contributing factors that help to resolve this complex question, such as its relative displacement and the many compounding mutations on the species itself that attributes to its overall pathogenicity that in turn may violate its original design. One of the primary goals of this article is to elaborate on the early ancestry of these ticks that eventually gave way to the development of critically invasive infections such as Lyme disease.

Introduction

Tick-borne diseases are very common and have spread across the USA during the summers for at least 40 years. They are now quite abundant in Virginia and Pennsylvania, and they have spread to the West Coast (Northern California) this summer. Although COVID-19 gets most of the news, there can be overlap of symptoms of COVID-19 and Lyme disease. In addition to Lyme disease (the number 1 zoonotic disease in the USA), other common tick-borne illnesses include Spotted fever rickettsiosis (Rocky Mountain Spotted fever), typhus, Ehrlichiosis, Anaplasmosis, Babesiosis, Alpha-Gal allergies, and many more.

Lyme disease has been under surveillance of CDC since 1982. Most of the cases are reported in the Northeastern USA. Many states seem to have the disease under control; however, in Pennsylvania (senior author's home state), the cases keep increasing. The most recent annual CDC report (2019) summarized 6,763 confirmed and another 2,235 probable cases, or about 9,000 new cases per year (CDC 2021) in Pennsylvania. Listening to the local Pittsburgh news this year, the number keep rising in the post-pandemic era. The most likely reason is popular outdoor activities in the area, such as hunting, fishing, and camping. Both forest-edge habitats and farms seem to be locations for picking up deer ticks. Outdoor recreation has increased in 2021, following lowered COVID-19 restrictions.

In Virginia, we have observed more college students contracting Lyme disease at Liberty University. Deer are increasing in numbers locally, and acorns (from oak trees) have been observed in record numbers locally (acorns are the primary food for white-footed mice: *Peromyscus leucopus*). **White-footed mice** are the principal natural reservoirs for **Lyme disease** bacteria.) Greater acorns, mice, and ticks transfer the bacteria to deer and then people.

With the abundance of deer and ticks, no wonder tick bites are reported in higher numbers as people look to get outdoors in the post-pandemic era!

Which Came First?

Ticks (fig. 1) are notorious for the diseases they cause. *Genesis 1:31* says that God made everything "very good," but if everything that God made was good, where did disease-causing ticks come from? What is the origin of ticks? In a very good creation, where do ticks fit in? Where did Lyme disease originate? Creation biologists have been asking such questions (Gillen 2020), and more is needed to understand the good purpose of ticks and why new diseases are popping up.

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Figure 1. Photograph of an *Ixodes* tick perched on dry grass. Species of these ticks are responsible for the transmission of Lyme disease. They may be characterized by their partial, inornate, oval-shaped dorsal shield. In their larval state, these ticks will tend to feed on smaller rodents, such as mice, but as the tick matures, it will begin to feed on much larger mammals, namely white-tailed deer. File: *Ixodes ricinus* on dry grass from Wikimedia Commons. Retrieved 21:16, June 19, 2021, from https://commons.wikimedia.org/w/index.php?title=File:Ixodes_ricinus_on_dry_grass.jpg&oldid=564554740.

Mites are tiny eight-legged animals that share common anatomy with ticks. We believe they give clues to pre-fall functions and purposes for ticks on earth as decomposers. Although mites and ticks may be in different baramins, their functions in the ecosystem may parallel one another and might provide clues to their original very good purpose. More research on this topic is needed. Even though they are quite small, **mites** are important to humans and other animals. Most species are beneficial

decomposers, breaking down organic matter and allowing nutrients to be used by plants again. Ticks are ectoparasites, feeding on the blood of mammals, birds, and sometimes reptiles and amphibians. The timing of the parasitic origin of ticks is uncertain. Most likely they were decomposers living off dead plant and organic matter, recycling the elements in nature. At some time after Adam's sin and the curse, they lost their ability to extract necessary materials from plant hemoglobin and started depending upon animal blood. All female ticks need animal blood to make eggs. Many male ticks exist merely to mate and do not necessarily feed on animals.[1]

What Good Are Ticks?

Like most living things, ticks serve a purpose in the balance of the ecosystem and have a role in the animal kingdom. They provide food for other animals. Ticks may feed on a lot of mammals, but they often become a meal themselves. Many animals eat ticks, including reptiles and birds.

Scientists monitor tick populations to assess ecosystems. Where ticks are abundant, populations of smaller mammals, such as rodents and rabbits, may also be high. A low-tick population can indicate that predators may be getting out of control. Everything is interconnected in the animal kingdom.

History of Lyme Disease

A team of researchers from the Yale School of Public Health has reported that "the Lyme disease bacterium is ancient in North America, circulating silently in forests for at least 60,000 years—long before the disease was first described in Lyme, Connecticut, in 1976," and long before the arrival of Europeans in the U.S. In a biblical timeline, this might correspond to a time shortly after Noah's worldwide flood (post-flood). This is long before the disease (fig. 2) was first described in Lyme, Connecticut, in 1976 by Allen Steere, M.D. This early diversity suggests that the recent epidemic of

human Lyme disease has been fueled not by adaptive changes in the bacteria but by ecological change—driven by ecosystem disruption from human activity, such as increased deforestation and hunting, and by changes in weather ("long-term climate change")—which has influenced the movement of Lyme-hosting birds and mammals (esp. deer and white-footed mice).

Figure 2. Photograph of erythema migrans on the epidermis, also known as bull's eye rash. This may be characterized as an expansive skin rash that is indicative of the early signs of Lyme disease. The rash can spread up to 12 inches in diameter and is caused by the gradual radial movement of *Borrelia burgdorferi*, as the bacteria move outwardly from the site of the tick bite. File: Bullseye rash linked to Lyme disease from Wikimedia Commons. Retrieved 21:14, June 19, 2021,

from https://commons.wikimedia.org/w/index.php?title=File:Bullseye_rash_linked_to_Lyme_disease.jpg.

Table 1. Fast Facts About Ticks and Lyme Disease

- There are approximately 476,000 people diagnosed and treated with Lyme Disease each year.
- Most humans are infected via immature ticks called nymphs (less than 2 mm in size).
- Various animals rely on ticks as a source of food.
- White-tailed deer serve as the definitive host for *Ixodes* spp.
- Humans serve as the amplifying host for *Borrelia burgdorferi*.
- Ticks in many instances function as environmental markers for the surrounding animal population.
- Ticks' pre-fall, good function were decomposers in the environment based upon similar anatomy and ecological niche with mites.
- The *Borrelia* bacteria that frequently lead to Lyme disease have non-pathogenic strains even today.

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Lyme Disease

In 1975, the Health Department received hundreds of calls about cases of what appeared to be arthritis in children in Lyme, Connecticut. Despite assurance from physicians that arthritis was not infectious, the callers were not satisfied. A state epidemic investigation was begun. Public health officials began trying to locate all those who had a sudden onset of swelling and pain in the knees or other joints. This old disease seemed to cluster in late spring and summer and last from a week to a few months. Most patients had symptoms in stages, the first one typically beginning with a skin rash. The rash (fig. 2) began as a red spot or bump and slowly enlarged. In the second stage, symptoms were influenza-like fatigue, chills, fever, headache, stiff neck, joint and muscle pains, and backache.

Joint pain, swelling, and tenderness, usually of a large joint (e.g., the knees) characterized the third stage. These symptoms developed beginning about six months after the rash, and slowly disappeared over years. Later it was found that bacteria injected by an infected tick multiplied and spread across the skin, disseminated into body tissues by the bloodstream, and resulted in an immune reaction that caused tissue damage. But in the 1970s, this disease became known as Lyme disease. Its technical name is Lyme Borreliosis.

The clustering of cases was most reported in wooded areas along lakes and streams. This suggested that the disease was transmitted by an arthropod. It was also found that affected people were more likely to have a household pet than non–pet owners. Pet owners are more likely to encounter ticks (fig. 3) that had been picked up in the woods by their pets. Most patients reported that their arthritic symptoms were preceded by an unusual bull's-eye skin rash that spread to a six-inch ring. Concurrently, scientists found spirochete bacteria in the guts of many of the ticks sent from Connecticut. The spirochete, named *Borrelia burgdorferi*, was later determined to be the cause of Lyme disease (fig. 4 and 5).

Figure 3. The blacklegged tick, *I. pacificus*, is a vector for B. *burgdorferi*, which causes Lyme disease. Photo credit: James Gathany, CDC, https://phil.cdc.gov/Details.aspx?pid=7663

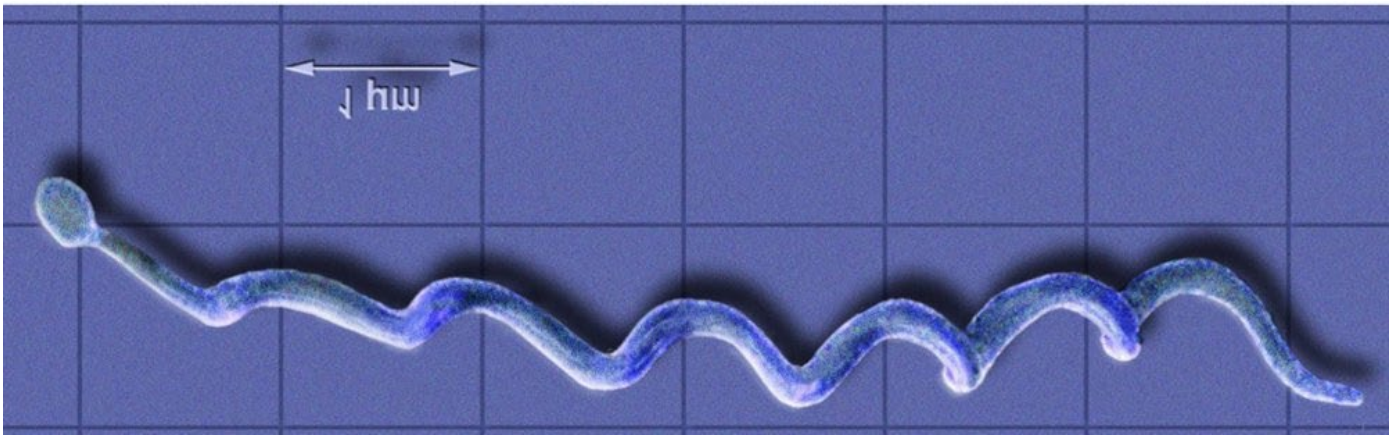

Figure 4. Illustration of the *Borrelia burgdorferi* structure. This bacterium is the pathogenic agent for the transmission of Lyme disease infection. This bacterial species is distinguished by its spirochete physiology that attributes to its spiral-like and elongated appearance. File: Borrelia Drawing from Wikimedia Commons. Retrieved 21:13, June 19, 2021,

from https://commons.wikimedia.org/w/index.php?title=File:BorreliaDrawing.jpg&oldid=546265005.

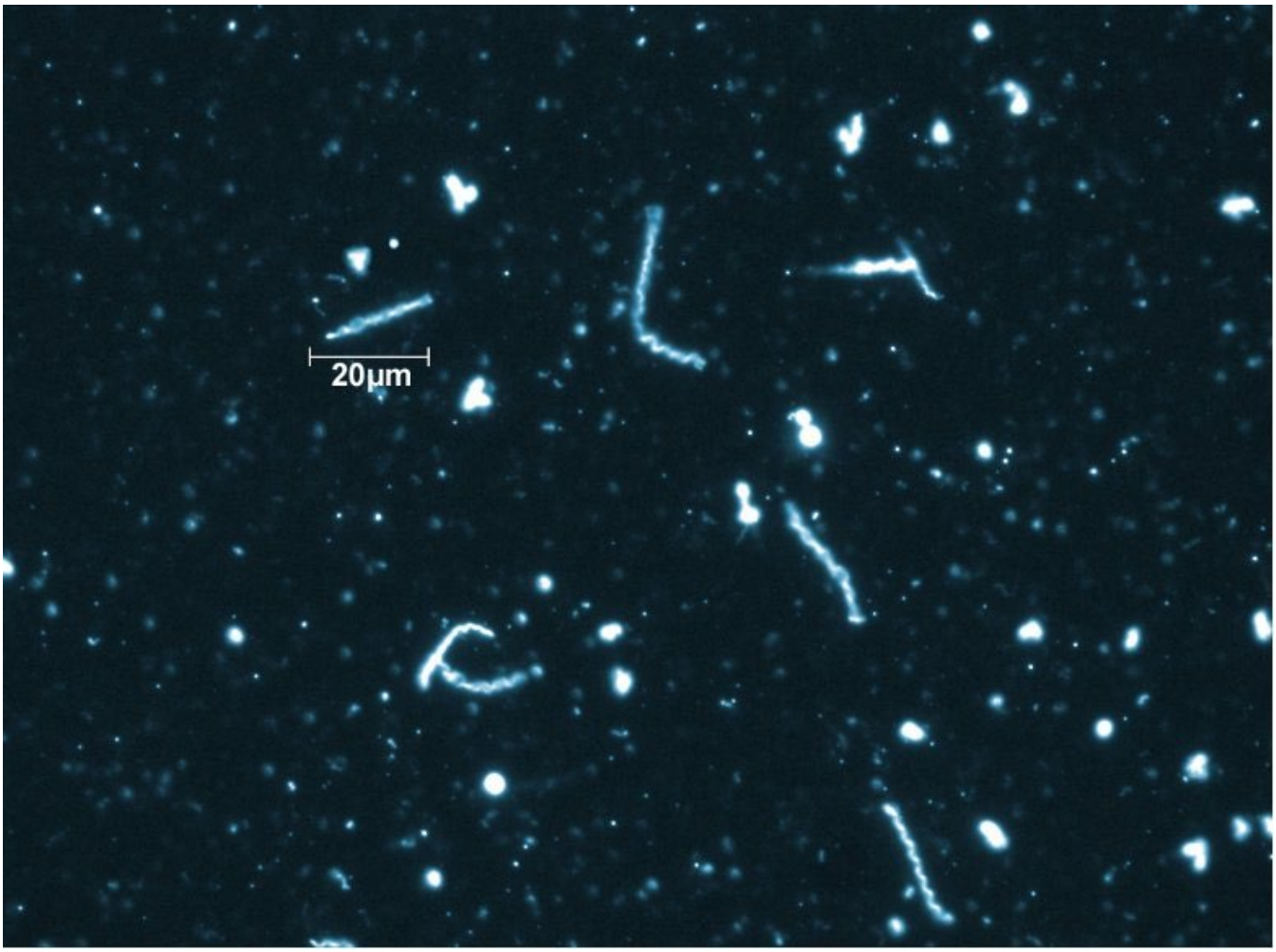

Figure 5. Darkfield microscopy image of *Borrelia Burgdorferi*. These strains of bacteria typically vary in size and magnitude, ranging anywhere from 10 to over 20 µm in size, but are generally no greater than 0.3 µm in overall diameter. File:Borrelia burgdorferi (CDC-PHIL -6631) lores from Wikimedia Commons. Retrieved 21:10, June 19, 2021, from https://commons.wikimedia.org/w/index.php?title=File:Borrelia_burgdorferi_(CDC-PHIL_-6631)_lores.jpg.

Dr. Allan Steere suspected an infectious agent associated with the ticks in the Lyme, Connecticut, area based upon history and epidemiological data; however, he could not find the pathogen. A few years later, Dr. Willy Burgdorfer, working in the Rocky Mountain Laboratories in Montana, invented the technique of snipping tick legs and looking through a microscope at the body juice (hemolymph).

In the body juice, he consistently saw long spiral bacteria (spirochetes) coming from the black-legged ticks (*Ixodes scapularis*) associated with people who had arthritic symptoms. By 1981, he would prove that these were the bacteria causing Lyme disease. The bacteria (*Borrelia burgdorferi*) would be named in his honor. Dr. William Burgdorfer was an Episcopalian Christian who studied ticks and tick-borne illnesses for most of his 50-year career. His discovery led to modern medical treatments for Lyme disease.

In Lyme Disease, white-tailed deer (fig. 6) are the "normal" definitive host (final host), as they are a host for the tick host (hence the commonly used name "deer" tick). This is where the parasite attains sexual maturity and *Ixodes* ticks mate. After mating, the female tick (fig. 3) produces eggs, and the cycle of larva, nymph, and adult continue. Deer rarely experience symptoms of Lyme disease like humans. White-footed mice (fig. 7) are the typical reservoir hosts and serve as a source of infection for humans or another species. Small mice and chipmunks are the primary hosts that keep the *Borrelia* bacteria going in the woods and the edge habitat (high grass) across the U.S. and world. The small mammals are the reservoir host for the ticks. But the high numbers of ticks with their bacteria in rodents rarely, if ever, cause disease in these small mammals.

Figure 6. Image depicting white-tailed deer in the wilderness. These animals directly function as the definitive hosts for *Ixodes scapularis*. White-tailed deer exhibit virtually no symptoms of Lyme disease infection. White-tailed deer that mainly reside in taller grass environments are more prone to harbor an increasing presence of black legged ticks known for transmitting Lyme disease. SFWS Mountain-Prairie, Public domain, via Wikimedia Commons

Figure 7. Close-up image of *Peromyscus leucopus*, commonly referred to as the White-footed mouse. These species of mice, among other smaller rodents, function as primary reservoir hosts for *Borrelia Burgdorferi* to amplify to increased numbers. These mice do not typically manifest any signs or symptoms related to Lyme disease, regardless of bacterial prevalence in the host itself. Likewise with white-tailed deer, these creatures will express higher levels of *Borrelia* in high grasslands surrounding the east coast. (File: Peromyscus leucopus.JPG. (2021, May 21). Wikimedia Commons, the free media repository. Retrieved 20:59, June 19, 2021
from https://commons.wikimedia.org/w/index.php?title=File:Peromyscus_leucopus.JPG.)

The Human Factor

Humans are the amplifying host for Lyme disease. *Merriam-Webster* defines *amplifying host* as “an organism in which an infectious agent (such as a virus or bacterium) that is pathogenic for some

other species is able to replicate rapidly and to high concentrations." It is not until the tick attaches and infects humans that the *Borrelia* bacteria multiply by the billions. Therefore, humans experience disease. The displacement of *Borrelia* from their natural hosts is what leads to major disease issues (figs. 3 and 4).

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Lyme Disease is the number one zoonotic disease in the U.S., and it appears that both displacement and mutation explain its pathogenicity. Studies have found that there are nonpathogenic *Borrelia burgdorferi* found in ticks and have established that there is also a normal tick microbiome that provides health to the tick. Male ticks do not feed on blood and do not infect (Anderson, Barthold, and Magnarelli 1990). A nonarthritic variant of *Borrelia burgdorferi* (strain 25015), previously isolated from an *Ixodes scapularis* larva from upstate New York, was infectious but failed to produce arthritis or carditis in laboratory rats and mice. By contrast, pathogenic strain *Ixodes scapularis* N40 invariably caused arthritis (Anderson, Barthold, and Magnarelli 1990). This variant shows that *Borrelia burgdorferi* may have originated as a good strain for a normal microbiome in the tick and originally caused no disease in animals nor humans.

Mutation of the *Borrelia* bacteria have added to the complexity of Lyme disease. For a long time, it was believed that one main species caused Lyme disease until *B. mayonii* was discovered. The life cycle was found to be similar to that of *B. burgdorferi*, even having the same vector to transmit the disease. Many of the symptoms are the same as *B, burgdorferi* but *B. mayonii* also causes nausea and vomiting, diffuse rashes instead of a "bull's eye" rash, and a higher concentration of bacteria in the blood. *B. mayonii* was discovered in 2016 by routine diagnostic testing of patients in the United States.

Like other microbes undergoing mutation and variation, we also see this in Lyme disease today. The typical creation model for explaining infectious diseases would include microbe modification and

displacement (Francis 2002; Gillen 2020). I would like to add "weather change" as another major factor that contributes to new, emerging, and re-emerging diseases. Secular scientists would refer to this as "climate change"; however, I believe it is an exaggeration that man can control global weather on an extended time frame. My own research (Gillen 2021; Western and Gillen 2021) on *Giardia* and *E. coli* showed that these microbes' abundance changed significantly with rainfall that nearly doubled over a three-year period. Beavers, *Giardia*, *E. coli*, and other coliforms increased over time as rainfall stirred sediments and habitats changed. Clearly rainfall influenced abundance of potential pathogens: *Giardia* and *E. coli*. In another study of *Serratia marcescens*, extended drought followed by an abundance of rain seemed to lead to a new strain of *Serratia marcescens* (Gillen, Morgante, Augusta, and MacKay 2018). I believe that, along with habitat change, weather changes have also led to new Lyme disease variants and range expansion.

Lyme Disease Keeps Emerging

Human, animal, and environmental health are intricately interwoven, inextricably interrelated, and providentially designed. All life on earth is connected by the Creator's plan. Secular scientists (including the CDC) recognize the connection for the biosphere and call it One Health (Cowan and Smith 2021). This is the idea that all three interacting components are connected, and good stewardship recognizes the importance of all. The reasoning is that microorganisms (and parasites) circulate among human hosts, animal hosts, and environmental reservoirs. Changes in the environment can lead to the transmission of pathogens to animals and humans that previously were not exposed to them. It might be helpful to visualize One Health (fig. 3) as three overlapping spheres. A change in any one of the spheres influences the others as it happens continuously. The mixing of microbes in different animal hosts (displacement) and under different environmental conditions can lead to the adaptation ("evolution" so-called) of new and potentially new pathogens and parasites.

Ticks need to draw blood from a mammal host that can harbor *B. burgdorferi*. On the East Coast, that is commonly deer and white-footed mice. In California, that would include deer, as well as western gray squirrels, voles, and mice—none of which lives in seaside grasslands.

COVID, Lyme, and 2021

Summer is tick season, and with it comes an increased risk of Lyme disease and another tick-borne illness. Most tick bites are innocuous and do not transmit an infection. In the US, there are 16 different tick-borne diseases according to the Center for Disease Control and Prevention (CDC).

There are a rising number of cases from larger ticks in Northern California.

There are a rising number of cases from larger ticks in Northern California (*Ixodes pacificus*). The CDC estimates that approximately 476,000 Americans are diagnosed and treated for Lyme disease each year due to prolonged heat spells out west. Additionally, diagnosing the disease can be trickier since COVID-19, as some of the symptoms are similar. “There’s a lot of overlap,” Dr. Amesh Adalja, senior scholar at the Johns Hopkins Center for Health Security, said of the symptoms between Lyme disease and COVID-19. Both can cause fever, aches, and pains. But each have symptoms that distinguish one from the other, such as a bull’s-eye skin rash with Lyme disease. With COVID-19, the flu-like symptoms are generally accompanied by respiratory problems.

Summary and Conclusions

The pathological effects derived from Lyme disease are best explained by way of displacement, modification (mutation), weather, and habitat changes. Ticks may not have been originally parasitic, as it is widely understood that male ticks do not possess any parasitic function. After the fall,

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Ticks have experienced a profound change in metabolic dependencies (diet) induced by ecological variation (changing forests, mammal hosts). The gradual mixing of different microbiota (bacteria) found in various animal hosts (rodents, deer, large mammals) have conferred a novel (new) dimension of virulence (degree of pathogenicity) within the host tick as it progressively integrated itself with opportunistic pathogens over the course of time.

In the case of the culprit of Lyme Disease (*Borrelia burgdorferi*), it is acknowledged that there are various non-pathogenic strains that are incapable of causing arthritic pain, as well as some that are clearly capable of it. This could explain how the bacterium harbored in *Ixodes scapularis* was not always virulent. However, as it stands today, Lyme disease remains the most common zoonotic disease in the United States, manifesting itself symptomatically through an enlarged red bump, a bullseye "rash," fever, fatigue, chills, headache, stiff neck, joint pain, myalgia, and backache. With the current onset of COVID-19 and some of its similar symptoms, it may be considerably more difficult to properly diagnose Lyme Disease.

As for ticks, their pre-fall, good function may have been as decomposers and plant consumers in the environment, based upon their similar anatomy and niche with some mites. Ticks still have a regulatory positive value in ecosystems today. When confronted with debilitating diseases that disrupt the fabric of humanity, those who believe the Bible must be steadfast and lean on our Creator. Romans 8 says, "I consider that the sufferings of this present time are not worth comparing with the glory about to be revealed to us. For the creation waits with eager longing for the revealing of the

children of God; for the creation was subjected to futility, not of its own will but by the will of the one who subjected it" (Romans 8:18). As Christians, we do not elude the grip of these futilities subjected onto us by ourselves. We must not live in fear but rather study the irreducible complexity of our benevolent God's creation and be transformed by the renewal of our minds (Romans 12:2), trusting in God's perfect will. In the present, we can observe and study the multifaceted complexity and intricacy of ticks, bacteria, and ecosystems.

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Previous ArticleWhy New Diseases Keep Popping Up

Footnotes

1. Plants, like humans, contain hemoglobin. Three distinct types of hemoglobin exist in plants: symbiotic, non-symbiotic, and truncated hemoglobins. In symbiotic hemoglobins (leghemoglobins), ligand-binding regulatory mechanisms have been shown to differ dramatically from myoglobin and red blood cell (RBC) hemoglobin.