

HUMAN BORRELIOSIS (RELAPSING FEVER)

RELAPSING FEVER (borreliosis) may appear either in louse-borne epidemics or in sporadic tick-borne instances. The disease is characterized by recurring attacks of fever, usually of decreasing intensity and duration. Relapsing fever, however, may be of sufficient intensity as to terminate in death.

The disease has been named "febris recurrens," "recurrent fever," "famine fever," "spirillum fever," "spirochetal fever," "vagabond fever" (Spain), "fowl nest fever" (China), "gharib gez" (Iran), "Giesinger's bilious typhoid" (Egypt), "carapata" (Africa), "kinputu," "gorgoya" (South America), "tick fever." It has also been given other *epitheton ornans*-es taken from local picturesque descriptive designations and from more or less fortunate combinations of greco-neo-latin terms. The generally accepted name, however, is relapsing fever and, in countries adhering to Latin nomenclature, "febris recurrens."

The causative agent, *Borrelia*, is insect-borne and is transferred from man to man directly only under unusual circumstances. The disease acquires epidemiologic importance principally among people who are compelled to live under unfavorable hygienic conditions. The epidemiologic aspects of endemic or tick-borne relapsing fever that is carried by some species of *Ornithodoros* depend upon the interrelationship of man and ticks, and often also on a mammalian host. There are challenging features and many little known aspects of this disease. The widespread relapsing fever outbreaks

that developed during the end of and after World War II, the constant occurrence of the infection in Africa and Asia, and the apparent hitherto confused picture of vectors and agents in Central and South America have not as yet stimulated many researchers

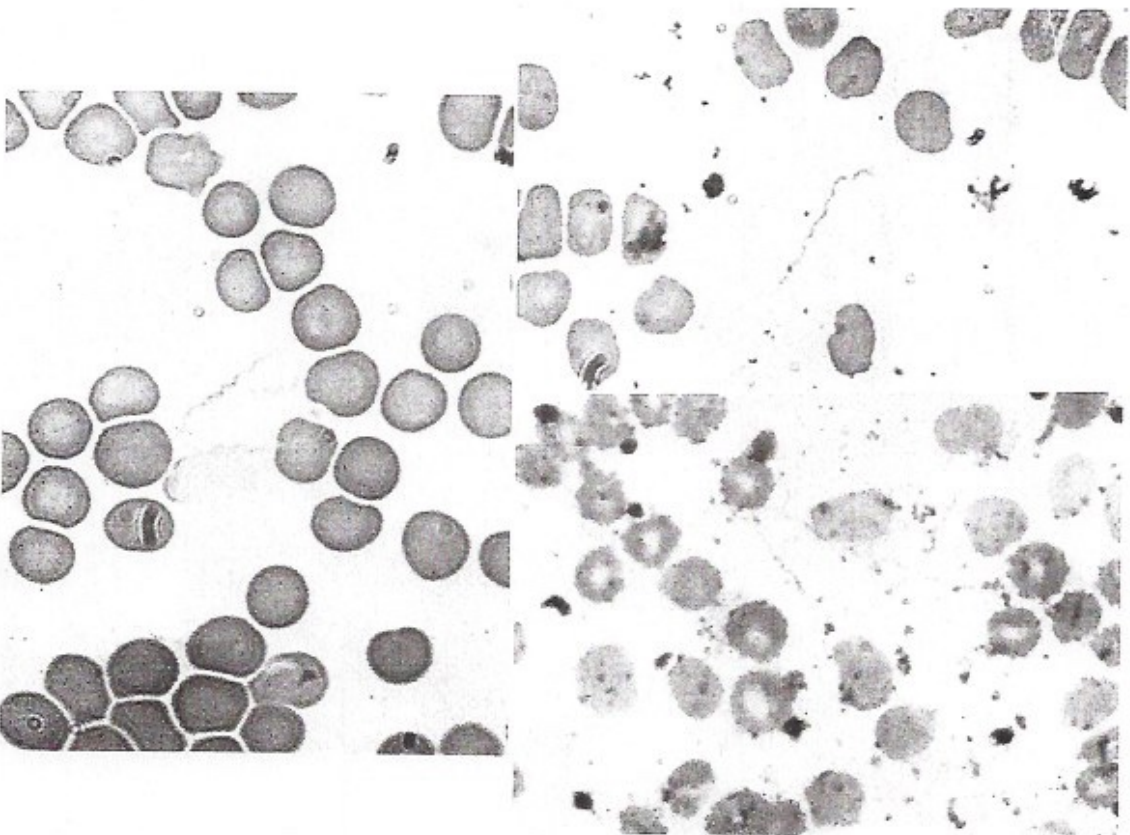


Figure 1. *Borrelia* in blood. Giemsa stain. x 950.

to delve into this problem. Neither have some interesting observations made during and after World War II fully penetrated into the world literature. While important basic research on *Borrelia* and its vectors is being performed in several institutions, the influence of the host-parasite relationship on the epidemiology of relapsing fever and the course of the disease in individual patients are stressed only in a few textbooks. It seemed desirable, therefore, to survey the literature on these aspects of relapsing fever, and to present such knowledge in a critical review which may assist scientists who wish to approach this manifold problem.

Several chapters in textbooks and review articles deal with more than one aspect of relapsing fever, as those of Hindle (363, 364, 365), Mühlens (509), Walters (709), Simmons (647), Geigy and Herbig (308), Mooser (500), Felsenfeld (264), Whitmore (731, 732), the Symposium on Relapsing Fever in the Americas in 1942, sponsored by the American Association for the Advancement of Science, and others. Geigy (303) summarized his long experience with relapsing fever in Africa, and Southern and Sanford (659) recently surveyed pertinent data on relapsing fever. Other reviews, dealing with specific problems of borreliosis, will be noted in the respective chapters.

HISTORY

Many historical accounts of relapsing fever are based on the studies of Scott (634).

Epidemic relapsing fever was recorded and described by Hippocrates in Thasos as "ardent fever" (308, 634). Bryceon *et al.* (127) believe that the "yellow fever" experienced in Europe during the VIth century may have been relapsing fever. The five epidemics of "sweating sickness" that swept England between 1485 and 1551 included outbreaks of relapsing fever (127, 491). Louse-borne typhus also prevailed at that time and "famine fever" was the common designation of both infections. Gloucestershire was wiped out in the beginning of the XVIIIth century by "famine fever." England and Ireland suffered from this disease also in the XVIIth and XVIIIth centuries. The first well-documented epidemic of relapsing fever was described in Ireland between 1739 and 1741 when Rutty recorded its clinical features. The epidemic then spread

from Ireland to Scotland and England. The outbreak in 1834-1848 in Edinburgh was particularly severe. The designation "relapsing fever" was first used by Craigie in 1843.

The Scandinavian countries became infected in 1788 from Russian ships that made port in Sweden. The last epidemic in Germany occurred from 1867 to 1868, in Ireland from 1868 to 1871. Later, improving hygienic conditions kept the disease from West Europe.

Louse-borne relapsing fever was imported into the United States from England and in 1844 caused the famous Philadelphia epidemic. This infection persisted in the eastern region of the United States for about 30 years. In 1874, there was a similar outbreak among Chinese laborers in California (193). Tick-borne relapsing fever was recognized soon after the West was settled (727).

The causative agent of epidemic relapsing fever was discovered in 1868 by Obermeier who did not publish his paper on this subject, however, until 1873 (507). This organism is now designated as *Borrelia recurrentis*. In the past, it was called *Spirocheta obermeieri*, *Protonyctium recurrentis*, *Spirocheta recurrentis*, and other names (128).

Little is known about louse-borne relapsing fever before the XVIIIth century except that it prevailed in cold and poor countries where lice were common. It was known to have occurred in Africa and in China (149, 363, 641).

Carlisle (145), Geigy (303), and others agree that Livingstone was the first to note in 1857 that tick-borne relapsing fever was present in Angola and Mozambique and that the disease was familiar to the local African and Portuguese inhabitants. Lamoureaux (430) reported that Drury had observed tick-borne relapsing fever during his trip to Madagascar in 1702-1720 but it remained for Cook (198) in Uganda to notice the presence of *Borrelia* in the blood. Ross and Milne (613) in the same area and simultaneously Dutton and Todd (250) in the Congoes, as well as Koch (417) in East Africa, confirmed these findings and demonstrated that tick-borne *Borrelia* may cause disease in monkeys and man. Both Dutton and Todd contracted the disease, and Dutton died of it (303).

The "bilious typhoid" in Egypt, described by Griesinger in 1857 (617) appears to have been relapsing fever, but Napoleon's surgeons were the first to diagnose relapsing fever correctly in that country (395).

