THE SUCKING LICE OF NORTH AMERICA

An Illustrated Manual for Identification

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V Public Health and Veterinary Importance of Sucking Lice

The prevalence of sucking lice on man dates back to prehistoric times. Numerous stories about sucking lice on man occur in Egyptian, Greek, and Roman writings. Aristotle (384–32 B.C.) vividly describes the sucking lice and their associations with man and domestic animals (Busvine 1976; Parish 1977). Infestations with sucking lice, particularly head lice, occur today in the United States and many other countries despite improved sanitation and high levels of control measures (Gratz 1972; Donaldson 1979). The human body louse is the vector of several historically important epidemic diseases, such as louse-borne typhus, relapsing fever, and trench fever, which have influenced the course of human history (Zinsser 1935). In recent years, outbreaks of head lice and pubic lice have caused great concern in the United States and many other countries.

HUMAN LICE AND PEDICULOSIS

Three different kinds of sucking lice infest man: the body louse (*Pediculus humanus humanus* L.) and the head louse (*Pediculus humanus capitis* DeGeer), both in the family PEDICULIDAE, and the pubic or crab louse, *Pthirus pubis* (L.), in the family PTHIRIDAE.

The body lice are commonly found where clothing comes in close contact with the human body continuously, as in underwear, the fork of trousers, the armpits, the waistline, and the neck and shoulders, whereas the head lice usually occur on the head, about the ears, and on the back of the neck. Although hybridization between body lice and head lice may exist, the two are discretely confined to their habitats. Distantly related to *Pediculus,* the crab louse, *Pthirus pubis,* is also called the pubic louse because of its habitat. These lice are most commonly found on the hair of pubic regions but also in the armpits, mustache, beard, and eyelashes.

Pediculosis (from the generic name of the louse, *Pediculus*) or pthiriasis (after *Pthirus*) means infestation with sucking lice. This condition varies among victims, from only a few lice and no symptoms to severe irritation, hair matted with louse excreta, bleeding from tiny wounds and scratches, and impetigo requiring medical treatment. Louse feeding usually does not produce intense irritation but may produce certain systemic disturbances such as irritability, tiredness, depression, and pessimism. Each feeding puncture develops a red papule, and skin swellings may occur in some people. The person who harbors lice continuously for a long time may develop a hardened and deeply pigmented skin, a condition known as "vagabond's disease" or "morbus errorum."

Historically, pediculosis has been associated with people living crowded together and having limited facilities for regular bathing and laundering, particularly during times of stress such as war and in abnormal environments such as concentration camps, evacuation centers, labor camps, and custodial institutions. However, in recent years the frequency of outbreaks of head lice has increased among school children and of pubic lice among young adults, to the great concern of health departments and the general public.

Head Louse. Head lice have caused problems for centuries. After the widespread use of DDT following World War II, there were relatively few reports of pediculosis in the United States. However, as the use of DDT became restricted, there were increasing reports of pediculosis in schools in the United States. In most of these outbreaks, the number of lice per individual was low and the insect bites caused no discomfort or only moderate irritation. Head lice are confined to the head hairs and scalp. The adult and immature lice, and particularly the eggs (commonly called "nits"), are found fastened to the hairs, especially behind the ears and on the back of the neck. Studies by Buxton (1946) and Busvine (1976) indicate small numbers of adult lice, a dozen or less, in most infestations. The impregnated female louse usually lays her eggs at night, approximately six eggs every 24 hours, with a lifetime total of 50 to 150. She fastens each egg with a cement bond firmly to the base of the head hair close to the scalp. The average incubation time for head louse eggs is about 8–9 days. After eggs hatch, development, which includes three molts, takes about 15 days to adulthood. Thus, it usually takes 3 weeks or more to complete a life cycle, from egg to egg.

Head lice are particular problems among school children whose garments such as caps, scarves, and other outer clothing become infested while hanging in crowded cloakrooms, who use infested combs or brushes, or who lie on carpets, beds, or upholstered furniture previously used by infested persons. Rapid examination of large groups is facilitated by Wood's light examination of the scalp, in which infested hair becomes fluorescent under ultraviolet light.

When head lice are found on a school child, the usual procedure in the United States is to send the child home with a note to the parents requesting that he or she be treated with a recommended insecticide, such as lindane, pyrethrum, or malathion, before being permitted to return to school. Other members of the class, family, or group, should be inspected and treated if necessary. Some authorities recommend a second treatment a week to 10 days after the first, in case the first treatment did not kill all the lice or eggs (Benenson 1981). Based on the sales of insecticides used to control lice and scabies, estimates were made that three to four million cases of all types of pediculosis and scabies occurred in the United States in 1974 and 1975 (Reed and Carnrick 1976).

Foreign materials on the hair and hair casts have been mistaken for eggs. A number of cases of pseudo-pediculosis have been reported in which foreign materials such as solidified globules of hair spray were confused with eggs (Osgood et al. 1961; Anderson 1968). The louse egg is easily distinguished from artifacts by distinct characteristics: the cement bond at the base of the egg, by which it is fastened to the hair; the appearance of the egg itself, frequently with the embryo inside; and the cap (operculum), with definite pores (Fig. 11).

Body Louse. Body lice are not found as frequently as head lice in the United States and other developed countries today. Body lice usually stay on clothing worn next to the skin, such as underwear or pajamas, and come into contact with the host's body while feeding. The adults and immatures suck blood periodically and then hide off the body. In heavy infestation they may remain on hairy parts of the body below the neck. The adults,

immatures, and eggs are usually found along the seams of clothing worn next to the skin. Only the widespread use of automatic washing machines, pressing with a hot iron, hot-air dryers, and dry-cleaning of clothes has played an important role in the low incidence of body lice among people of the Western world. Louse infestation is primarily through contact with infested persons or their infested clothing.

A female body louse typically lays 50 to 150 eggs, sometimes as many as 300 eggs, during her lifespan. Accordingly, under favorable conditions a louse population may increase rapidly; a single female louse could give rise to 4,000 to 5,000 lice in 3 months' time. The typical 3-week life cycle of the human body louse is similar to that of the head louse.

Pubic or Crab Louse. Pubic or crab lice are found in the human host's pubic and perianal regions and occasionally in the armpits, on the hairy parts of the chest, and on the eyebrows, eyelashes, beard, and mustache. This distribution on coarse hairs more widely spaced than the fine hairs on the head may be correlated with the very large mid- and hindlegs of the pubic louse. The name "crab louse" refers to its general appearance, i.e., the short, crab-like body and the very large second and third pairs of legs (Fig. 12), in contrast to the more slender, elongate body with three pairs of smaller, subequal legs of the head or body louse. Infestation of crab lice (Pthiriasis) leaves a series of small bluish marks on the skin at the sites of the crab louse bites, often on the abdomen or above the eyebrows. U.S. Public Health Service doctors and inspectors used to watch immigrants for these bluish marks, particularly above the eyebrows, the so-called "hobo's marks." Crab lice are usually transmitted during sexual intercourse (hence the French name *papillon d'amour*), rarely from infested toilet seats. Beginning about the time of the Korean conflict (1950–52), there have been increased reports of pubic lice, perhaps an indication of a more permissive society in recent years. For example, in 1976 and 1977 workers at the Center for Disease Control reported an average of 2.9 cases per men who visited five venereal disease clinics across the United States (CDC 1979).

SUCKING LICE AS VECTORS

The body louse is the only vector of *Rickettsia prowazekii*, which causes louse-borne or epidemic typhus; of *Rickettsia quintana*, which causes trench fever; and of *Borrelia recurrentis*, which causes epidemic or louse-borne relapsing fever. There is no proven case of the transmission of these pathogens by the head louse and the crab louse. Epidemic typhus and epidemic relapsing fever used to occur in the United States, but trench fever has never been reported in this country.

Louse-borne (Epidemic) Typhus. This disease is caused by *Rickettsia prowazekii* transmitted by the body louse (*Pediculus humanus humanus*), usually via its infected feces, though it may be acquired through the body contents of the crushed louse. The louse acquires the pathogen by ingesting infected human blood. The rickettsiae, which are pathogenic to the louse, multiply in its midgut epithelium. Its highly distended epithelial cells rupture and release rickettsiae to the lumen of the gut, where the pathogen contaminates its feces. Man is the reservoir of the pathogen.

Epidemic typhus is of ancient origin and worldwide distribution, mainly in temperate regions of Europe, Asia, and Africa, and at high altitudes in tropical Africa and the

Americas. The great "plague" of the Peloponnesian War in Athens in 420 B.C. was probably the first recorded typhus epidemic (Marks and Beatty 1976). This disease has had a great influence on European history, as described by Zinsser (1935) in his fascinating book, *Rats, Lice, and History:* outbreaks of historical importance occurred during the battle for Naples in 1528, the siege of Vienna in 1683, and Napoleon's retreat from Russia in 1812 (Busvine 1976). During World War I, severe epidemics of louse-borne typhus swept through Europe, particularly Russia, Poland, and the Balkan nations, and took a heavy toll of lives. Two to three million people died in Russia alone. During World War II, this disease was rampant in war zones. In 1942 more than 82,000 cases were reported in North Africa, and in 1943 a typhus epidemic in Naples threatened to wipe out the crowded city of a million people. The effective use of DDT abated the threat (Cushing 1957). One of the public health triumphs of World War II was the use of DDT to control outbreaks of epidemic typhus in North Africa, Italy, and the slave labor and concentration camps of the Nazis in Europe. During the Korean conflict, 100,000 to 160,000 North Korean and Chinese prisoners of war infested with body lice resistant to DDT were deloused with lindane.

Epidemic typhus occurred in the United States prior to 1900 particularly among foreigners, such as Irish immigrants during and following the Potato Famine of 1845–50. The last recorded outbreak of epidemic typhus in the United States occurred on the San Juan Indian Reservation in New Mexico, Utah, and Arizona in 1920 and 1921, consisting of 63 cases with 27 deaths. It was stopped by louse control measures (Armstrong 1922). Some Europeans who survived attacks of epidemic typhus and emigrated to the United States, apparently fully recovered, harbored the rickettsiae for many years and later had a recrudescence known as Brill-Zinsser disease. Cases of this disease have been controlled with tetracycline or chloramphenicol.

Murine or Flea-borne Typhus. The oriental rat flea (*Xenopsylla cheopis*) is usually considered the main vector to man of *Rickettsia typhi* (formerly known as *R. mooseri*), which causes murine, endemic, or flea-borne typhus. However, Traub et al. (1978) reported: "Rat lice (*Polyplax* and *Hoplopleura*) have been found both naturally infected and capable of transmitting experimental infection and must be considered as potentially important intramurid vectors and, perhaps, also as possible sources of transmission to man via the aerosol route," i.e., the inhalation of dust containing louse feces infected with murine typhus rickettsiae.

Epidemic Relapsing Fever. Epidemic or louse-borne relapsing fever is strictly a human disease transmitted from man to man via the human body louse (*Pediculus humanus humanus*) and caused by the spirochaete *Borrelia recurrentis*. The body louse acquires the pathogen by feeding on an infected person. The spirochaetes pass through the louse stomach wall to the hemolymph, where they rapidly multiply without harming the louse. Man acquires the pathogen by crushing the louse.

This disease, formerly widely distributed in most parts of the world, is now restricted to Africa, primarily Ethiopia and Sudan. Epidemics frequently occurred in Europe during the eighteenth and nineteenth centuries. In the twentieth century major epidemics occurred during and after World War I in Russia, Central Europe, and North Africa; in World War II; and in the Vietnam conflict (Felsenfeld 1973). Several epidemics, not laboratory confirmed, probably occurred in the United States between 1844 and 1874, particularly among immigrants from Ireland following the Potato Famine of the late 1840s (Palmer et al. 1933). In the twentieth century there were seven major epidemics of this disease in the Old World, resulting in an estimated 16 million cases and 5 million

deaths (Brycesson et. al. 1970). This disease has not been reported in the United States in the twentieth century except for one imported case in Dayton, Ohio, in April 1976, in an 18-year-old woman who had emigrated from Ethiopia three weeks previously. Although she had a light infestation of lice, *Borrelia* organisms were found in her blood and in hemolymph of the lice (CDC 1976).

Epidemic relapsing fever and typhus were formerly two of six quarantined diseases under International Health Regulations, the other four being cholera, smallpox, plague, and yellow fever. As of January 1, 1971, epidemic relapsing fever and typhus became "Diseases under surveillance by the World Health Organization," together with malaria, poliomyelitis, and influenza (Benenson 1970). Modern control of louse-borne diseases has been revolutionized by the development of effective residual insecticides and drugs. Epidemic relapsing fever and typhus continue to occur in remote regions of the world, such as Ethiopia and the high mountain country of Central and South America, where people wear the same clothing for long periods of time and have few opportunities for regular bathing.

Sporadic Epidemic Typhus. In recent years, a disease that some public health workers call "sporadic epidemic typhus" has been reported in at least 33 persons in the United States, caused by an organism indistinguishable at this time from *Rickettsiae prowazekii*, the causative organism of epidemic typhus (CDC 1984). None of these patients was infested with body lice, the classical vector of epidemic typhus in a man-louse-man cycle. Some of the victims lived in houses infested with the southern flying squirrel (*Glaucomys volans*) and some reported being bitten by fleas. Sometimes the "flea bites" were reported to have occurred outside in the yard. Squirrel fleas have not been shown to be capable of typhus transmission. Since flying squirrels are infested with both the squirrel flea (*Orchopeas howardi*) and at least four species of sucking lice—*Hoplopleura sciuricola* Ferris, *Hopopleura trispinosa* Kellogg and Ferris, *Microphthirus uncinatus* (Ferris), and *Neohaematopinus sciuropteri* (Osborn)—future research may indicate that these lice play a role in the epidemiology of "sporadic epidemic typhus" just as the body louse does in epidemic typhus. It is possible that sucking lice acquire their rickettsiae from flying squirrels and transmit the infection to man by biting or scratching in of infected louse feces, or that humans inhale dust containing infected louse feces (Bozeman et al. 1975; Duma et al. 1981).

SUCKING LICE OF VETERINARY IMPORTANCE

Sucking Lice of Domestic Animals. Sucking lice in the genera *Haematopinus, Linognathus,* and *Solenopotes* are important ectoparasites of many domestic animals. Heavy infestations cause unhealthiness and contribute to anemia. They lower production of meat, milk, leather, and wool. Matthysse (1946) wrote, "The amount of money lost through these parasites (cattle lice) cannot be estimated, since it is not known how much loss in milk flow lousiness causes, nor how much extra feed is required to maintain and fatten a lousy steer or heifer. Nevertheless it is generally accepted that louse infestations lower milk production and retard gains in both dairy and beef cattle. In rare cases, extremely heavy infestations may be a contributing factor to death losses." In 1965 the U.S. Department of Agriculture estimated that losses caused by sucking lice (Anoplura) and biting lice (Mallophaga) were for cattle, $47,000,000; sheep, $47,000,000; swine,

$3,000,000; and goats, $800,000 (U.S. Dept. Agr. 1965).

Cattle lice include five species: (1) the little blue cattle louse, *Solenopotes capillatus* Enderlein; (2) the long-nosed cattle louse, *Linognathus vituli* (L.); (3) the short-nosed cattle louse, *Haematopinus eurysternus* Denny; (4) the cattle tail louse, *Haematopinus quadripertusus* Fahrenholz; and (5) the buffalo louse, *Haematopinus tuberculatus* (Burmeister), which is distributed in the Old World (Meleney and Kim 1974). Populations of the first three of these cattle lice in temperate North America build up in late autumn and continue to multiply throughout the winter into early spring. The lice glue their eggs to the host animal's hairs, particularly on the head, ears, neck, and fore part of the body. Depending on many factors, particularly temperature and humidity, their eggs hatch in 1 to 2 weeks and the three nymphal stages require another 1 to 2 weeks, so that a complete life cycle averages 3 to 4 weeks. Shedding of cattle hair in the spring results in tremendous loss of louse eggs. Usually in summer only a few lice can be found, possibly due to factors of temperature and humidity (Matthysse 1946; Jensen and Roberts 1966).

Sheep are infested with two species, the sheep foot louse, *Linognathus pedalis* (Osborn), and the sheep louse, *Linognathus ovillus* (Neumann), usually found on the face, head, and neck. Goats are infested with two species of goat sucking lice, *Linognathus africanus,* Kellogg and Paine and *Linognathus stenopsis* (Burmeister). The hog louse, *Haematopinus suis* (L.), infests swine and is considered the worst enemy of these animals except for hog cholera. Hog lice are also vectors of pox virus in pigs. The horse sucking louse, *Haematopinus asini* (L.), occurs on horses, donkeys, mules, and asses. The dog sucking louse, *Linognathus setosus* (von Olfers), is a parasite of dogs. Domestic rabbits are occasionally infested with the rabbit louse, *Haemodipsus ventricosus* (Denny).

Sucking Lice of Zoo Animals. Sucking lice of Linognathidae and Haematopinidae may occur on zoo animals. *Echinophthirius horridus* (von Olfers) is often found on various seals in captivity, such as the harp seal and harbor seal, and *Antarctophthirus microchir* (Trouessart and Neumann) is found on the California sea lion and Northern sea lion in zoos. Occasionally, cervids in many zoos are infested with various *Solenopotes*. It would not be surprising to find that many other zoo animals are infested with sucking lice without showing any ill symptoms.

Sucking Lice of Laboratory Animals. Endothermal laboratory animals are often infested with sucking lice of *Polyplax, Hoplopleura, Linognathus, Haemodipsus, Pediculus,* and *Pedicinus* (Flynn 1973). Laboratory mice are sometimes heavily infested with *Polyplax serrata* (Burmeister), and such infestation causes debilitation and anemia (Bell, Jellison, and Owen 1962). *P. serrata* is also a vector of the agent of murine eperythrozonosis. *P. spinulosa* (Burmeister) is a common ectoparasite of the laboratory rat, and a vector of *Rickettsia typhi* to rats. *Hoplopleura acanthopus* (Burmeister), *H. captiosa* Johnson, and *H. pacifica* Ewing are also common ectoparasites of many different laboratory rodents. Rabbits are infested with *Haemodipsus ventricosus* (Denny), whereas dogs are infested with *Linognathus setosus* (von Olfers). New World monkeys, such as spider monkeys, *Ateles geofroyi,* in captivity sometimes are infested with *Pediculus humanus* Linnaeus (= *Pediculus mjobergi*) (Ronald and Wagner 1973), whereas Old World monkeys, such as macaques and langurs, are parasitized by *Pedicinus* (Kuhn and Ludwig 1967).