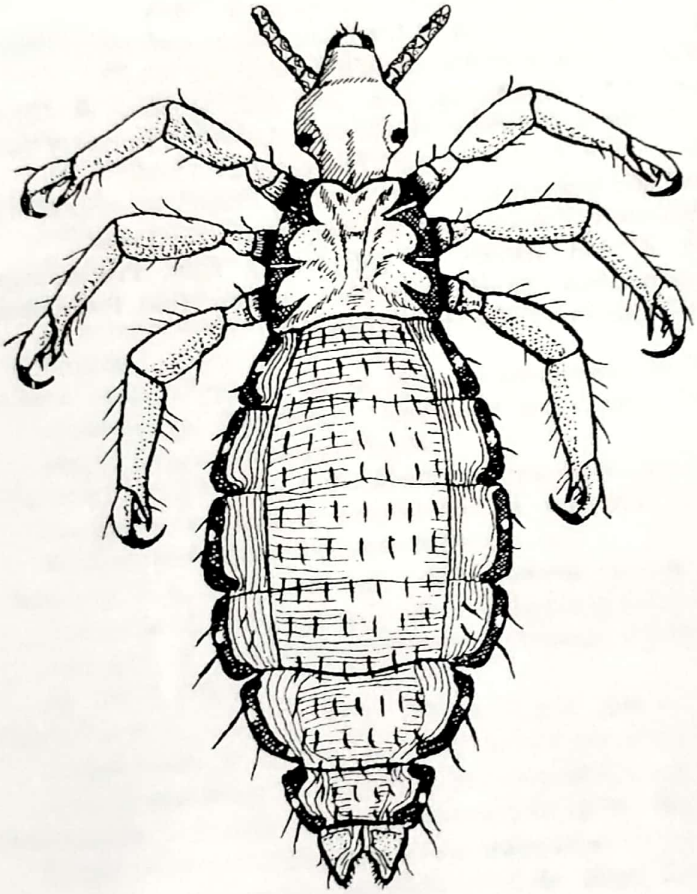
12

Sucking lice (Anoplura)



Three types of blood-sucking lice occur on humans, the body louse (*Pediculus humanus*), the head louse (*Pediculus capitis*) and the pubic or crab louse (*Pthirus pubis*). Morphologically the body and head lice are virtually ***indistinguishable***. In the laboratory the two can interbreed but there is very little evidence they do this outside the laboratory, and here they are treated as two distinct species, although many regard the head louse as a subspecies of the body louse. All three species of lice have a more or less worldwide distribution, but they are often more common in temperate areas.

Body lice are vectors of louse-borne typhus (*Rickettsia prowazekii*), trench fever (*Bartonella quintana*) and louse-borne relapsing fever (*Borrelia recurrentis*).

12.1 The body louse (*Pediculus humanus*)

12.1.1 External morphology

Adults are small, pale beige or greyish wingless insects, with a soft but rather leathery integument, and are ***flattened*** dorsoventrally (Fig. 12.1, Plate 21). Males measure about 2–3 mm and females about 3–4 mm. The head has a pair of small black eyes and a pair of short five-segmented antennae. The three thoracic segments are fused together and the legs are

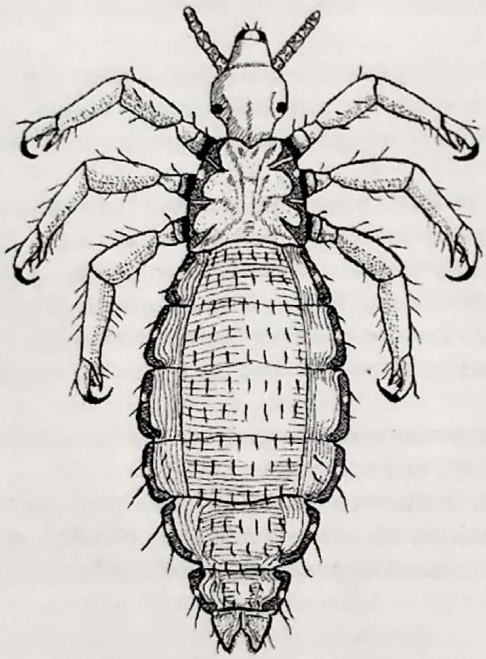


Figure 12.1 Dorsal view of body louse (*Pediculus humanus*). The head louse (*P. capitis*) looks virtually identical.

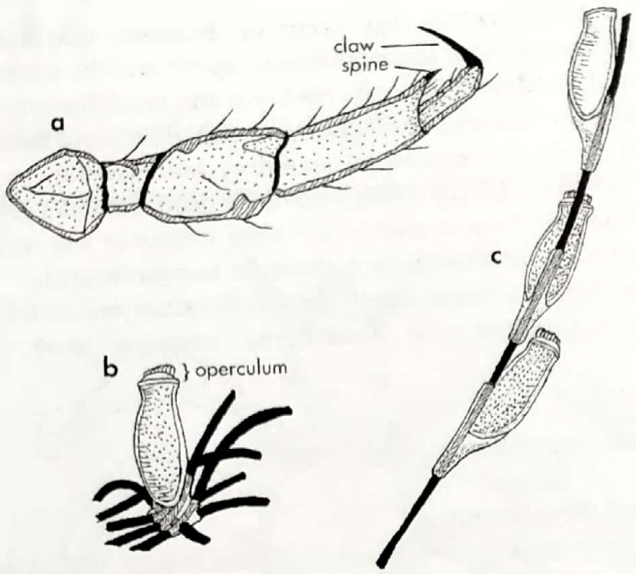


Figure 12.2 Head louse (*Pediculus capitis*) and body louse (*P. humanus*): (a) leg of a body louse, showing tarsal claw and tibial spine; (b) unhatched egg of a body louse glued to fibres of clothing; (c) one hatched (upper) and two unhatched (lower) eggs of the head louse cemented to a hair. For convenience these three eggs are shown very close together, but in practice they are rarely this close on a head hair.

stout and well developed. The short thick tibia has apically a small ***spine*** on its inner side, and the short tarsus ends in a curved ***claw*** (Fig. 12.2a). Hairs of the host, or clothing, are gripped between this tibial spine and tarsal claw.

Mouthparts of the louse differ from those of most blood-sucking insects in that they do not form a projecting proboscis, but consist of a sucking snout-like projection called the ***haustellum***, which is armed on the inner surface with minute teeth that grip the host's skin during feeding. Needle-like stylets are thrust into the skin and saliva is injected into the wound to prevent blood from clotting. Blood is sucked up and passes into the stomach for digestion.

The lateral margins of the abdominal segments are sclerotized and often appear darker than the rest of the segments.

In males there are dark transverse bands on the dorsal surface of the abdominal segments and the tip of the abdomen is rounded, whereas in females it is ***bifurcated*** and used to grip fibres of clothing during egg-laying.

12.1.2 Life cycle

Both sexes take blood-meals, and feeding occurs at any time during the day or night. Both adults and immature stages live permanently on humans,

clinging mainly to fibres of their clothing and usually only to body hairs during feeding. Female lice glue about 6–10 eggs per day very firmly on clothing fibres, especially on those along the seams of underclothes, such as vests and pants, but also on shirts and very occasionally on body hairs. The egg, commonly called a *nit* (though some apply this term only to the hatched egg), is oval, white, about 1 mm long, and has a distinct *operculum* (cap) containing numerous small perforations which give the egg the appearance of a minuscule pepper pot (Fig. 12.2b). Intake of air through these holes not only supplies the tissues of the developing embryo with oxygen but aids hatching in the following way. Just prior to hatching, the fully developed louse within its eggshell swallows air, which distends the body against the eggshell, thus building up a back pressure causing the head of the louse to be pushed up against the operculum and forcing it off. Female lice live for 2–4 weeks and may lay 150–300 eggs.

The egg stage lasts about 5–11 days, except that eggs on discarded clothing may not hatch until 2–3 weeks; or in cool conditions not at all. Because eggs cannot survive longer than four weeks there is little danger of acquiring body lice from clothing not worn for over a month.

Lice have a *hemimetabolous* life cycle. The louse hatching from the egg is termed a *nymph* and resembles a small adult. It takes a blood-meal and passes through three nymphal instars, and after about 7–14 days becomes an adult male or female louse. Duration of the nymphal stages depends on whether clothing is worn continuously. If it is discarded at night and nymphs are subjected to lower temperatures, this may slow their development. A louse usually takes 3–5 blood-meals a day from its host. The life cycle from egg to adult is about 2–3 weeks.

The body louse is an ectoparasite of humans. Away from humans, unfed lice die within 2–4 days, but blood-fed individuals may survive for 5–10 days. On their hosts, blood-feeding adults probably live for about 30 days. Lice are very sensitive to changes in temperature. They quickly abandon a dead person to seek new hosts. They also leave a person with a high temperature, being unable to feed at temperatures above about 40 °C.

A very heavily infested person may have 400–500 lice on his or her clothing and body. In very exceptional conditions some 20 000 lice have been recorded from a single person! Usually, however, less than 100 lice are found on any one individual, and many have considerably fewer than this.

Body lice are spread by close contact and are especially prevalent under conditions of overcrowding and in situations where people rarely wash or change their clothes. They are therefore commonly found on people in primitive jails, in refugee camps and in trenches during wars, and also after disasters such as floods or earthquakes when people are forced to live in very overcrowded, and usually insanitary, conditions. People living in mountainous areas in East Africa, Ethiopia, Sudan, Burundi, Nepal, India and Andean regions of South America, where cold weather necessitates

wearing several layers of clothes which may be rarely changed or washed, often have lice. In more developed countries body lice are found mainly on homeless people, and infestations may reach a peak in cold weather when several layers of woollen underclothes are worn.

12.1.3 Medical importance

Pediculosis

Presence of body, head or pubic lice on a person is sometimes referred to as ***pediculosis***. The skin of people who habitually harbour large numbers of body lice may become pigmented and tough, a condition known as vagabond's disease, hobo disease or sometimes as morbus errorum.

Because lice feed several times a day, saliva is repeatedly injected into individuals, and its toxic effects may cause weariness, irritability or a pessimistic mood: the person feels lousy. Some people develop allergies such as dermatitis or severe itching, or have a type of asthmatic bronchitis. Secondary infections such as impetigo, which is very contagious, can also result from large numbers of biting lice.

Louse-borne epidemic typhus

Rickettsiae of louse-borne typhus, *Rickettsia prowazekii*, are ingested with blood-meals taken by both male and female lice, and also by their nymphs. They invade the epithelial cells lining the stomach of the louse and multiply enormously, causing the cells to become greatly distended. About four days after the blood-meal the ***gut cells*** rupture and release the rickettsiae back into the lumen of the insect's intestine. Due to these injuries the blood-meal may seep into the haemocoel of the louse, giving the body a reddish colour. Rickettsiae are passed out in the ***faeces*** of the louse, and people become infected when these are rubbed or scratched into abrasions, or come into contact with delicate mucous membranes such as the conjunctiva. Infection can also be caused by ***inhalation*** of the very fine powdered dry faeces. Also, if a louse is crushed, such as by persistent scratching, rickettsiae in the gut are released and may cause infection through abrasions etc. Rickettsiae can remain infective in dried louse ***faeces*** for about 60 days.

Humans, therefore, become infected with typhus either by the faeces of the louse or by crushing it, not by its bite. An unusual feature of louse-borne epidemic typhus is that it is a disease of the louse as well as of humans. Rupturing of the intestinal epithelial cells caused by multiplication of the rickettsiae frequently kills the louse after about 8–12 days. This may explain why people suffering from typhus are sometimes found with remarkably few, or no, lice on their bodies or clothing. Epidemic typhus is much less common than previously. However, an outbreak of epidemic typhus occurred in Russia in 1997, and in 1999 5600 cases were reported from

China. However, the disease mainly occurs in cool mountainous regions of Africa, Asia, and Central and South America.

People are usually considered to be the reservoir hosts of typhus. Those who have recovered from an infection often harbour *R. prowazekii* in their lymph nodes and later, sometimes after more than 30 years, the rickettsia may reinvade other body cells. Such ***recrudescence*** of typhus is termed Brill–Zinsser disease. This can occur many years after the primary attack, and may lead to the spread of epidemics.

Louse-borne epidemic relapsing fever

Borrelia recurrentis is ingested with the louse's blood-meal from a person suffering from epidemic relapsing fever, but within about 24 hours all spirochaetes have disappeared from the lumen of the gut. Many have been destroyed, but the survivors have passed through the stomach wall to the *haemocoel*, where they multiply to reach enormous numbers after 10–12 days. The accepted way that someone can be infected is by the louse being crushed and the released spirochaetes entering the body through abrasions or mucous membranes, or less commonly through intact skin. The habit of crushing lice between the fingernails, or the less desirable habit of killing them by cracking them with the teeth, is clearly dangerous if lice are infected with relapsing fever or typhus. Recently, it has been shown that faeces of infected lice can contain live *B. recurrentis*, and so transmission may also involve the faeces.

Louse-borne relapsing fever has disappeared from Europe but remains common in Central and East Africa, Sudan, Ethiopia, Afghanistan and Peru. Ethiopia has about 1000–5000 cases annually; this is about 95% of worldwide infections. As with *R. prowazekii*, infection is ultimately fatal to the louse.

Trench fever

Trench fever is a relatively uncommon and non-fatal disease which was first recognized during World War I (1914–18) among soldiers in the trenches, and then reappeared in eastern Europe during World War II (1939–45). The disease disappeared again, only to reappear later in North America and Europe in the 1980s, occurring mainly in homeless people and those who were HIV-positive. In the 1990s and 2000s it was also reported from many parts of the world, including the USA, Canada, Mexico, Peru, Bolivia, France, Japan, China, Australia, North Africa, Burundi and other sub-Saharan countries.

Trench fever is caused by *Bartonella quintana*. The bacteria are ingested by the louse during feeding and become attached to the walls of the gut cells, where they multiply. They do not penetrate the cells, as do typhus rickettsiae, and consequently they are not injurious to the louse. After 5–10

days the *faeces* are infected. Like typhus, the disease is conveyed to humans either by crushing the louse or by its faeces coming into contact with skin abrasions or mucous membranes. Bacteria persist for many months, possibly even a year, in dried louse faeces, and it is suspected that infection may also commonly arise from ***inhalation*** of the dust-like faeces. The disease may be contracted by those who have no lice, but are handling louse-infected clothing contaminated with faeces.

12.1.4 Control

If louse-infested clothing is subjected to a minimum temperature of 70 °C for at least an hour body lice are killed. In epidemic situations, however, such measures may be impractical and immediate reinfestation may occur, so insecticides are usually used for louse control.

Lice are killed when insecticidal dusts, such as carbaryl, propoxur, malathion or permethrin, mixed with an inert carrier (e.g. talc), are blown by a plunger-type duster between a person's body and his or her underclothes. However, checks should firstly be made to determine whether lice in the area have developed resistance to any of the insecticides to be used.

Impregnation of clothing with a pyrethroid insecticide may provide long-lasting protection against louse infestations, and such treated clothing may remain effective after several washings. Probably the best pyrethroid for this is permethrin

Trials have shown that orally administered ivermectin kills body lice, and also head lice, but it is not yet universally approved for control of human lice.

12.2 The head louse (*Pediculus capitis*)

12.2.1 External morphology

Only very minor morphological differences separate body and head lice (Plate 22). In practice, these differences are not very important because lice found on clothing or on the body are invariably body lice, whereas those on the head are head lice.

12.2.2 Life cycle

The life cycle is very similar to that of the body louse, except the eggs (*nits*) are not laid on clothes but are cemented to the hairs of the head, especially at their base (Fig. 12.2c), and normally hatch after 6–7 days. Usually a single egg is laid on each hair. The distance between the scalp and the furthest egg glued to a hair may provide an approximate estimate of the duration of infestation, on the basis that a human hair grows about 1 cm per month. However, eggs may also be laid on long hairs when they are near or

touching the scalp, so that unhatched eggs may be some distance from the base of the hair. Only very occasionally are eggs laid on hairs elsewhere on the body.

Most infected individuals have only 10–20 head lice, but in very severe infestations the hair may become matted with a mixture of nits, nymphs, adults and exudates from pustules resulting from bites of the lice. In such cases bacterial and fungal infections may become established, and an unpleasant crust may form on parts of the head, underneath which are numerous head lice. Empty, hatched *nits* remain firmly cemented to the hairs of the head. A female lays about 6–8 eggs per day, amounting to about 50–150 eggs during her lifetime, which is about 2–4 weeks. Eggs hatch within 5–10 days and the duration of the nymphal stages is about 7–10 days. Away from people head lice die within 2–3 days.

As with body lice, dissemination of head lice is only by close contact, such as children playing together with their heads frequently touching. Girls often have more head lice than boys because they have more intimate play, with their heads frequently touching, and also because girls often play with their friends' hair. Infestations are often more common in women than in men, but are usually highest in children. Outbreaks of head lice often occur when people are crowded together, such as in prisons or refugee camps. Catching head lice from inanimate objects such as hats, scarves or chair backs is considered unlikely.

12.2.3 Medical importance

In many areas of the world head lice are a serious public health problem, and in many countries prevalence has been increasing. In some schools in the USA and the UK almost 50% of pupils have head lice. Often there are higher infestation rates in overcrowded homes and where hygiene is poor. There is little evidence that head lice are natural vectors of the diseases transmitted by body lice – for example, typhus epidemics are always associated with body lice – but they may occasionally be minor vectors in some outbreaks of louse-borne relapsing fever.

12.2.4 Control

Regular combing with an ordinary comb, although not removing the eggs, may reduce the number of nymphs and adults. A plastic ***louse comb*** with very closely set fine teeth is much better but may not remove all lice and their eggs. Alternatively, the head can be shaved!

Most commercial preparations for controlling head lice contain pyrethroids such as phenothrin or permethrin, or organophosphates such as malathion. Insecticidal formulations include dusts, emulsions and lotions. The choice depends on the availability of proprietary brands,

preference of patients and costs. Although insecticidal dusts are efficient, they are not acceptable to most people because they give the head a greyish appearance, signalling that the person has lice. Shampoos which are applied and then washed off after a few minutes are not usually very effective. Some commercial preparations proclaim that lotions need only remain on the head for 10 minutes or two hours, but it is better to leave the insecticidal lotion on the head for about 12 hours, e.g. overnight, before washing it off.

Although some insecticides, such as malathion and permethrin, are reputed to be ovicidal, a ***second*** treatment after 7–10 days is recommended whatever insecticide is used, because it is difficult to kill all eggs with just a single application. None of the compounds will remove eggs cemented to the hairs, but these can be removed with a louse comb. As lice are readily transmitted between people, it is recommended that all members of a household are treated, not just those detected as having lice.

Insecticide resistance, especially to the pyrethroids, is widespread and is the main reason for the increase in head louse infestations worldwide, but a novel treatment consists of dimethicone (a common commercial name is Hedrin), and this is now widely used in many countries. It is usually formulated as a 4% lotion, and is normally sprayed on the head. It is not a conventional insecticide but a silicone compound that coats the lice and kills them by suffocation. After about an hour the hair can be combed with a louse comb to remove dead lice and their eggs, after which the hair can be washed. Retreatment after seven days kills newly hatched lice from residual eggs. It is unlikely that resistance will evolve against dimethicone, as it is not a typical insecticide. Presently Hedrin is not cheap, and it may be too expensive for poorer communities.

Trials using orally administered ivermectin show that the drug kills both head lice and body lice, but it is not yet universally approved for control of human lice.

12.3 The pubic louse (*Pthirus pubis*)

12.3.1 External morphology

The pubic louse is smaller (1.3–2 mm) than *Pediculus* species and is easily distinguished from them. In the pubic louse the body is nearly as broad as long, making it almost round. Whereas all three pairs of legs are more or less of equal size in the body and head louse, in the pubic louse the middle and hind-legs are much thicker than the front legs and have massive claws (Fig. 12.3, Plate 23). Presence of a ***broad squat*** body and ***very large*** claws, together with more sluggish movements, has resulted in the pubic louse being aptly called the crab louse.

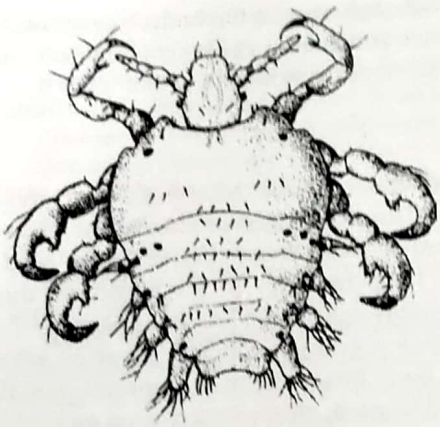


Figure 12.3 Dorsal view of pubic louse (*Pthirus pubis*), showing very large claws on mid- and hind-legs.

12.3.2 Life cycle

Females lay about three eggs a day, totalling some 150–200 in their lifetime. They are slightly smaller than those of the body and head louse and are cemented to the coarse hairs of the genital and perianal regions of the body, and unlike head lice several eggs may be laid on a single hair. Pubic lice may be found on other areas of the body having coarse and not very dense coverings of hair, for example the beard, moustache, eyelashes, underneath the arms and occasionally on the chest, but they are very rarely found on the finer hair of the scalp. Eggs take about 6–8 days to hatch and the duration of the three nymphal stages is about 10–17 days; consequently the life cycle is about 16–25 days. Adults can live up to 30 days.

Pubic lice are considerably less active than *Pediculus*. Infestation with crab lice is usually through sexual intercourse, and characteristically the French call them '*papillons d'amour*'. However, it is wrong to suspect that this is the only method. Young children sleeping with parents can catch crab lice from them, and infestations can arise from discarded clothing, infested bedding, or even ***rarely*** from lavatory seats. Adults survive two days or less away from their hosts.

12.3.3 Medical importance

Although in the laboratory pubic lice can transmit louse-borne typhus, there is little evidence that under natural conditions they spread any disease to humans, although it has been suggested that they have been responsible for typhus outbreaks in China. Severe allergic reactions (***pruritus***) can develop in response to their bites, due to the injection of saliva and the deposition of faeces around the feeding sites. Small characteristic bluish spots (***maculae***

caeruleae) may appear on infested parts of the body. Infestations of pubic lice are sometimes known as pediculosis pubis or phthiriasis (note that, unlike the generic name of the louse, this is spelt with a 'phth').

12.3.4 Control

Originally control involved shaving pubic hairs from the body, but this method has been replaced by the application of insecticidal lotions.

Basically insecticides used for head louse control can be used against pubic lice. Application of 1% permethrin or 5% malathion should kill nymphs and adults and possibly eggs, but a ***second*** application 7–10 days later is advisable in case some eggs are not killed. It may be advisable to treat all hairy areas of the body below the neck. ***Aqueous***, not alcoholic, insecticidal solutions should be used, otherwise irritation may arise due to sensitivity of the genital region. Although resistance to pyrethroids has been reported, insecticide resistance in pubic lice appears to be rare. Infestations on the eyelashes can be treated by applying a small amount of a vaseline ointment or petroleum jelly twice a day for 8–10 days, after which the lice can be carefully pulled off.