



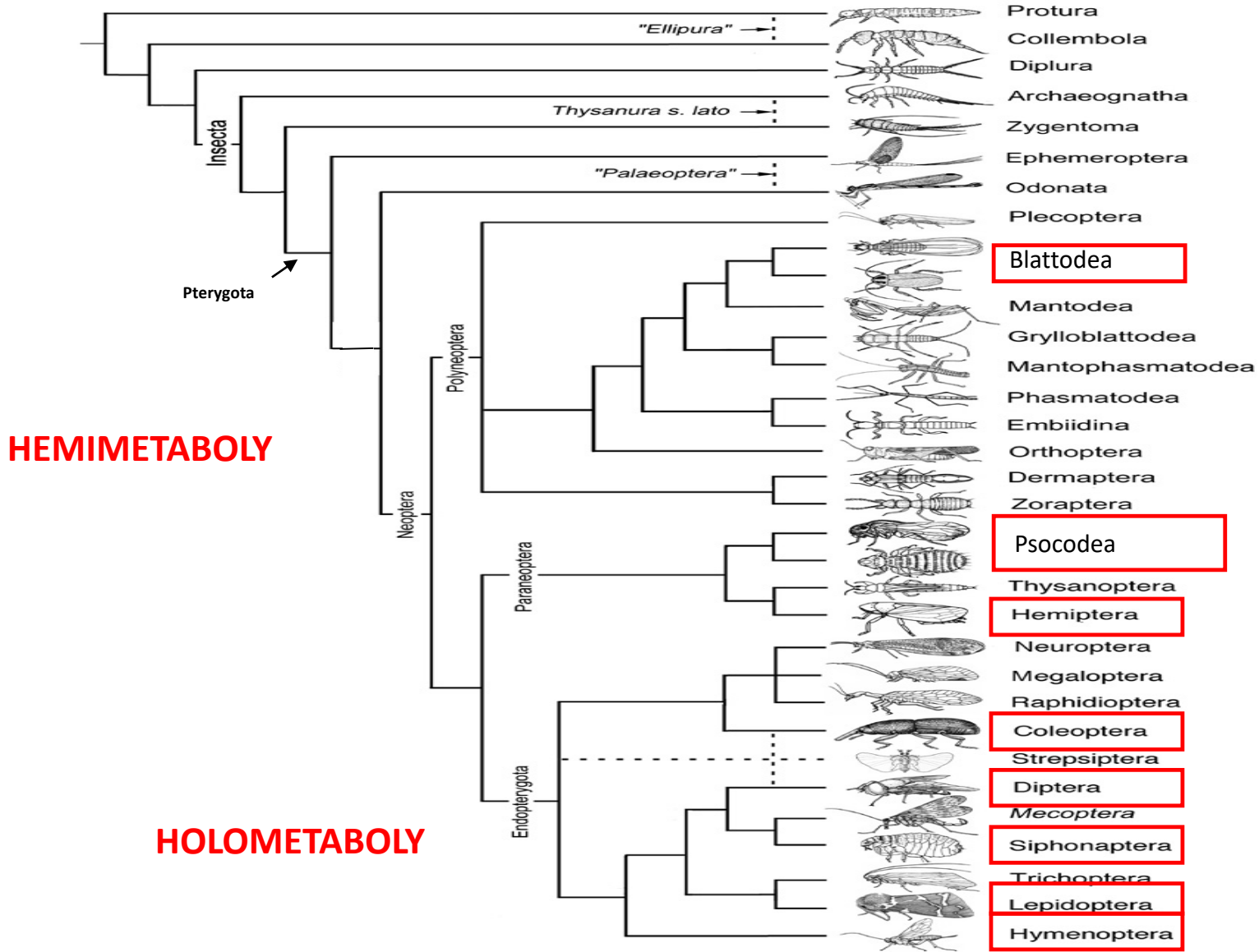
MEDICAL AND VETERINARY ENTOMOLOGY

BLATTODEA & PSOCODEA (PHTHIRAPTERA)

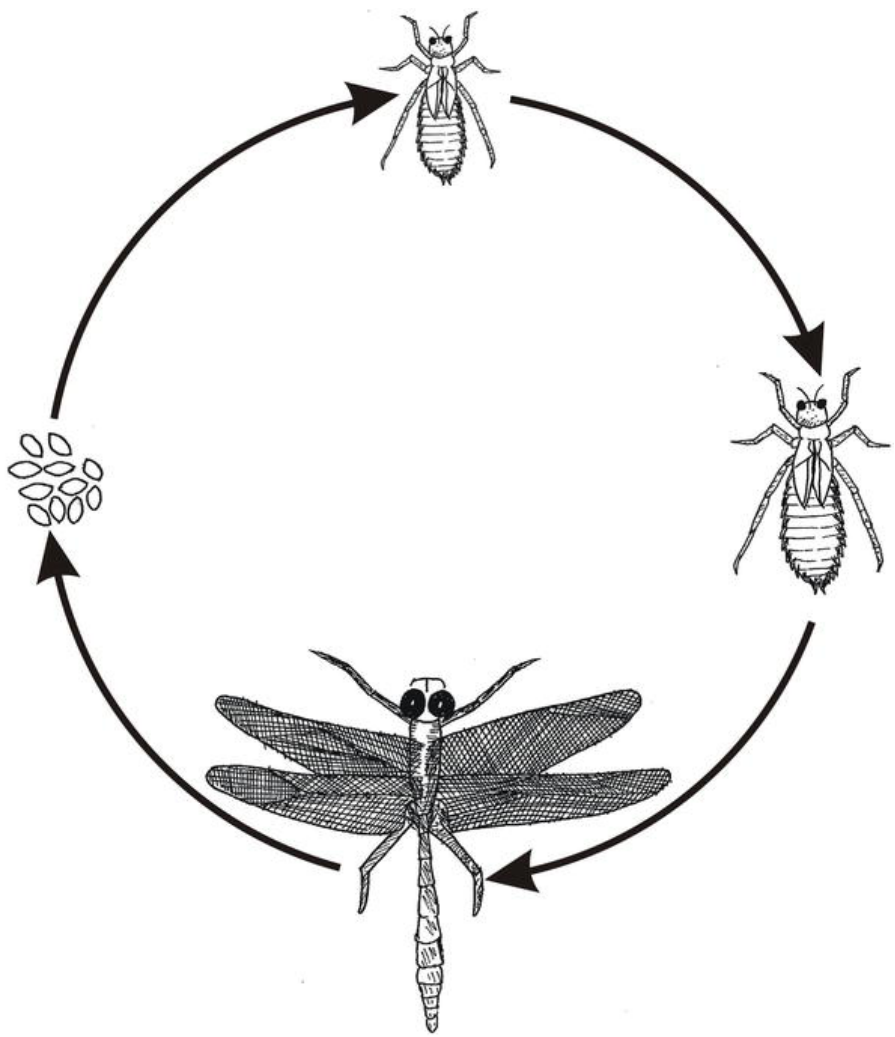
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Medically important Arthropoda - Insecta

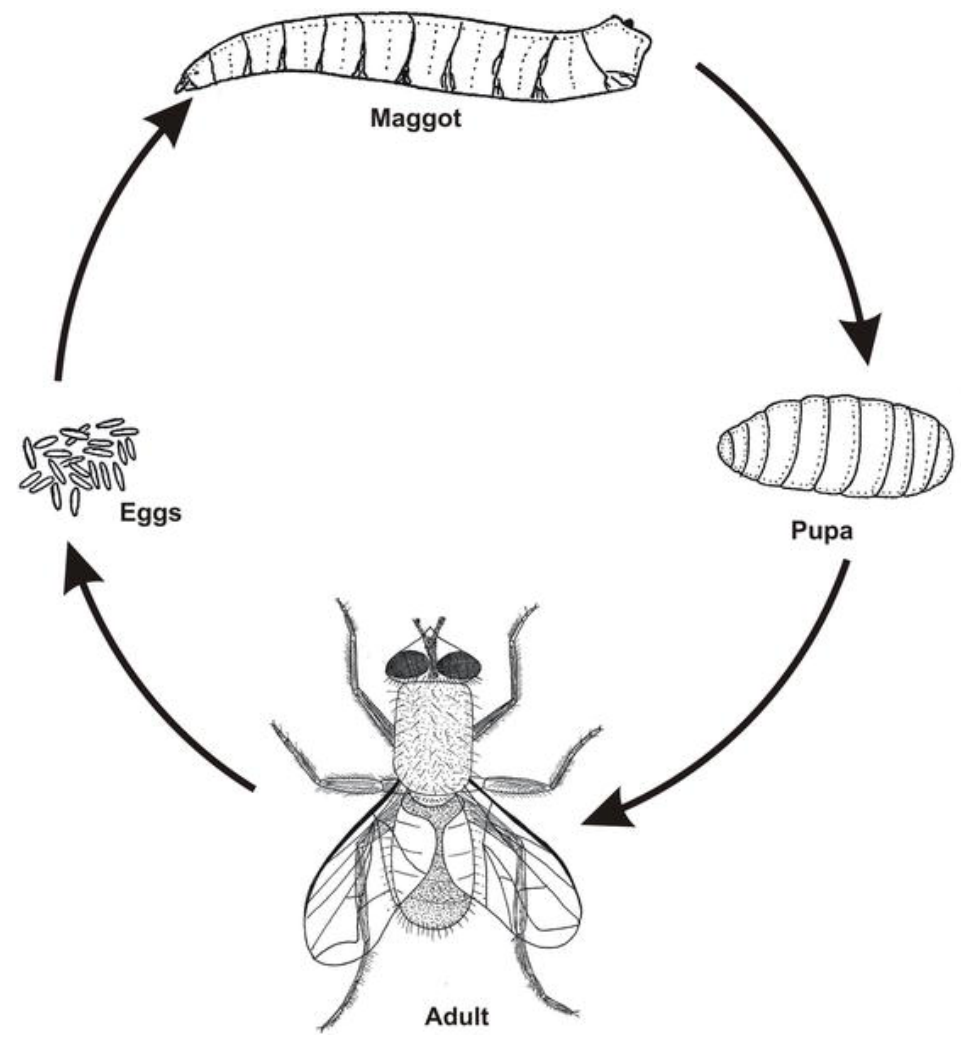
BLATTODEA & PHTHIRAPTERA



Development of insects



HEMIMETABOLY

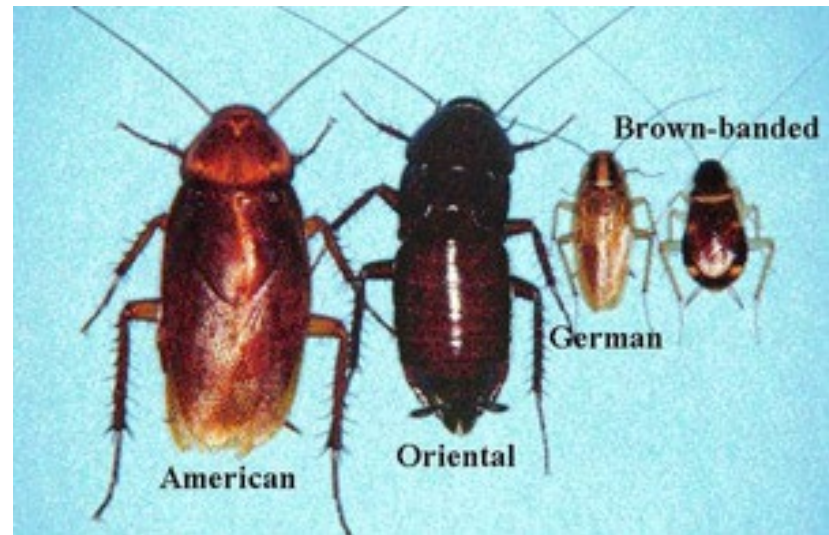
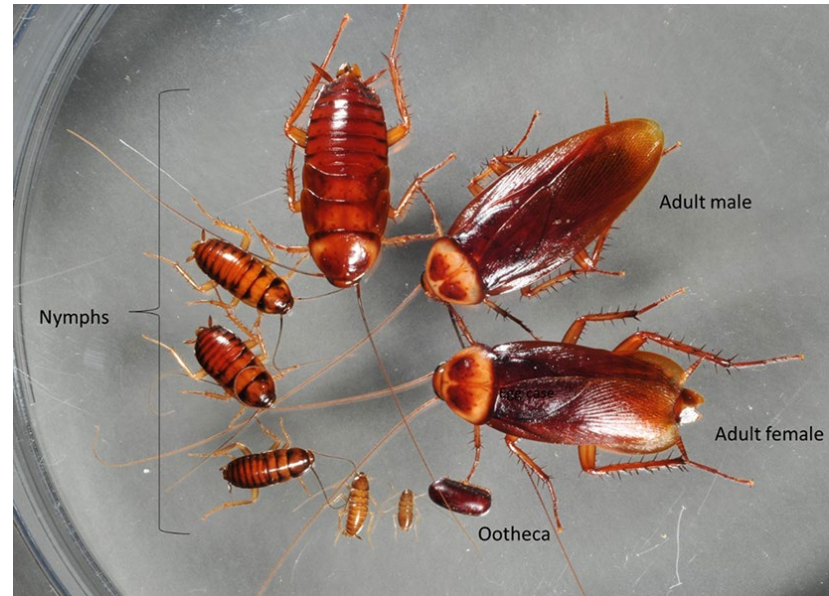


HOLOMETABOLY

Order Blattodea or Blattaria



- Termites also belong to the order Blattode
- Wings most often present in adults
- Dorso-ventrally flattened body with pronounced pronotum covering the head
- Hemimetabolic life cycle, they live from 1 week to a year
- > 4500 species – only 17 species of pests within the families Blattidae, Blattellidae and Blaberidae
- They don't bite people, but there is information about biting nails, eyelashes,...
- The most important species are: American cockroach (*Periplaneta americana*), German or brown cockroach (*Blattella germanica*) and Oriental cockroach (*Blatta orientalis*)



Order Blattodea or Blattaria

- They feed on anything organic, they will eat practically anything they can get their hands on
- Most harmful species are cosmopolitan and their medical importance is related to:
- Mechanical transmission of infectious pathogens/particles
- Allergies



Order Blattodea or Blattaria



- Mechanical transmission of pathogens is particularly problematic in:
- Hospitals: Immunocompromised patients can more easily become infected with fungi and bacteria (e.g. *Candida albicans*, *E. coli*, *Staphylococcus aureus*)
- Food production industry: Transmission of intestinal bacteria such as *E. coli*, *Salmonella* spp., *Entamoeba histolyca* (causes dysentery) and viruses (e.g. Hepatitis virus, Poliomyelitis virus)
- High population density with low sanitary conditions inside restaurants and homes



Order Blattodea or Blattaria

Pathogenic bacteria isolated from cockroaches

Pathogen	Associated Disease	Cockroach Species
<i>Acinetobacter</i> sp.	Nosocomial infection	<i>Blattella germanica</i> , <i>Periplaneta americana</i>
<i>Aeromonas</i> sp.	Wound and other infections; diarrhea	<i>B. germanica</i> , <i>Diploptera punctata</i>
<i>Alcaligenes faecalis</i>	Gastroenteritis, secondary infections, urinary tract infections	<i>Blatta orientalis</i> , <i>P. americana</i>
<i>Bacillus subtilis</i>	Conjunctivitis, food poisoning	<i>Blaberus craniifer</i> , <i>B. orientalis</i> , <i>B. germanica</i> , <i>P. americana</i>
<i>Bacillus cereus</i>	Food poisoning	<i>B. craniifer</i>
<i>Campylobacter jejuni</i>	Enteritis	<i>B. orientalis</i> , <i>P. americana</i>
<i>Citrobacter</i> sp.	Urinary tract infections, infant meningitis	<i>B. germanica</i> , <i>D. punctata</i> , <i>P. americana</i>
<i>Clostridium novii</i>	Gas gangrene	<i>B. orientalis</i>
<i>Clostridium perfringens</i>	Food poisoning, gas gangrene	<i>B. orientalis</i> and other species
<i>Enterobacter</i> sp.	Bacteremia	<i>B. germanica</i> , <i>D. punctata</i> , <i>P. americana</i>
<i>Enterococcus</i> sp.	Urinary tract and wound infections	<i>B. germanica</i> , <i>P. americana</i>
<i>Escherichia coli</i>	Diarrhea, wound infection	<i>B. orientalis</i> , <i>B. germanica</i> , <i>D. punctata</i> , <i>P. americana</i>
<i>Hafnia alvei</i>	Diarrhea	<i>B. germanica</i> , <i>P. americana</i>
<i>Klebsiella</i> sp.	Pneumonia, urinary-tract infections	<i>B. germanica</i> , <i>D. punctata</i> , <i>P. americana</i>
<i>Leptospira</i> ssp.	Leptospirosis	<i>Periplaneta</i> spp.
<i>Mycobacterium leprae</i>	Leprosy	<i>B. germanica</i> , <i>P. americana</i> , <i>P. australasiae</i>
<i>Nocardia</i> sp.	Actinomycetoma	<i>P. americana</i>
<i>Morganella morganii</i>	Wound infection	<i>B. germanica</i> , <i>P. americana</i>
<i>Oligella urethralis</i>		<i>P. americana</i>
<i>Pantoea</i> sp.	Wound infection	<i>B. germanica</i>
<i>Proteus rettgeri</i>	Wound infection	<i>P. americana</i>
<i>Proteus vulgaris</i>	Wound infection	<i>B. craniifer</i> , <i>B. orientalis</i> , <i>D. punctata</i> , <i>P. americana</i>
<i>Proteus mirabilis</i>	Gastroenteritis, wound infection	<i>P. americana</i>
<i>Pseudomonas</i> sp.	Respiratory infections, gastroenteritis	<i>D. punctata</i> , <i>Blaberus craniifer</i> , <i>B. orientalis</i> , <i>B. germanica</i> , <i>P. americana</i>
<i>Salmonella</i> sp.	Food poisoning, gastroenteritis	<i>D. punctata</i>
<i>Salmonella bredeney</i>	Food poisoning, gastroenteritis	<i>P. americana</i>
<i>Salmonella newport</i>	Food poisoning, gastroenteritis	<i>P. americana</i>
<i>Salmonella oranienburg</i>	Food poisoning, gastroenteritis	<i>P. americana</i>
<i>Salmonella panama</i>	Food poisoning, gastroenteritis	<i>P. americana</i>
<i>Salmonella paratyphi-B</i>	Food poisoning, gastroenteritis	<i>P. americana</i>
<i>Salmonella pyogenes</i>	Pneumonia	<i>B. orientalis</i>
<i>Salmonella typhi</i>	Typhoid	<i>B. orientalis</i>
<i>Salmonella typhimurium</i>	Food poisoning, gastroenteritis	<i>B. germanica</i> , <i>Nauphoeta cinerea</i>
<i>Salmonella bovis-morbificans</i>	Food poisoning, gastroenteritis	<i>P. americana</i>
<i>Salmonella bareilly</i>	Food poisoning, gastroenteritis	<i>P. americana</i>
<i>Sphingobacterium</i> sp.	Sepsis	<i>B. germanica</i> , <i>P. americana</i>



Order Blattodea or Blattaria



- Intermediate hosts of parasites
- Only *Gongylonema pulchrum* and *Abbreviata caucasica* found in humans
- *Physaloptera rara* and *P. praeputialis* are the most widespread - cats and dogs
- Very rarely possible infection with the protist *Lophomonas blattarum* that lives in the intestines of cockroaches and termites (infection occurs by eating cockroaches or termites - Asia - China) - bronchopulmonary infections - treatment with metronidazole

Cockroaches as intermediate hosts of parasites of veterinary importance

TABLE 6.3 Cockroaches as Intermediate Hosts of Parasites of Veterinary Importance

Phylum and Parasite	Scientific Name	Definitive Hosts	Cockroach Intermediate Host
ACANTHOCEPHALA (thorny-headed worms)			
	<i>Moniliformis moniliformis</i>	Rat, mice, dog, cat (primates)	<i>Blatta orientalis</i> , <i>Blattella germanica</i>
	<i>Moniliformis dubius</i>	Rat	<i>B. germanica</i> , <i>Periplaneta americana</i> , <i>Periplaneta brunneus</i>
	<i>Prosthenorchis elegans</i> <i>Prosthenorchis spirula</i>	Captive primates	<i>B. germanica</i> , <i>Leucophaea maderae</i> , others
PENTASTOMIDA (tongue worms)			
	<i>Raillietiella hemidactyli</i>	Reptiles	<i>P. americana</i>
NEMATODA (round worms)			
Gastric metazoan parasites	<i>Abbreviata antarctica</i>	Reptiles	<i>Nauphoeta cinerea</i>
Esophageal and gastrointestinal worm	<i>Abbreviata caucasica</i>	Primates (humans)	<i>B. germanica</i>
Stomach worm	<i>Cyanea colini</i>	Prairie chicken, turkey, bobwhite, quail	<i>B. germanica</i> , <i>P. americana</i>
Esophagus worm	<i>Gongylonema neoplasticum</i>	Rodents, rabbit	<i>B. orientalis</i> , <i>P. americana</i>
Gullet worm	<i>Gongylonema pulchrum</i>	Cattle (humans)	<i>B. germanica</i>
Gullet worm	<i>Gongylonema</i> sp.	Marmosets and Tamarins	<i>P. americana</i>
Stomach worm	<i>Mastophorus muris</i>	Rodents, cat	<i>Leucophaea maderae</i> , <i>P. americana</i>
Eye worm	<i>Oxyspirura mansoni</i>	Chicken, turkey	<i>Pycnoscelus surinamensis</i>
Eye worm	<i>Oxyspirura parvorum</i>	Chicken, turkey	<i>P. surinamensis</i>
Esophageal worm	<i>Physaloptera rara</i>	Dog, cat, raccoon, coyote, wolf, fox	<i>B. germanica</i>
Esophageal worm	<i>Physaloptera praeputialis</i>	Dog, cat, coyote, fox	<i>B. germanica</i>
Round worms	<i>Protospirura bonnei</i> <i>Protospirura muricola</i>	Monkeys	<i>B. germanica</i> , <i>Supella longipalpa</i>
Stomach worm	<i>Spirura rytleurites</i>	Cat, rat	<i>B. orientalis</i>
Stomach worm	<i>Tetrameres americana</i>	Chicken, bobwhite, ruffed grouse	<i>B. germanica</i>
	<i>Tetrameres fissipina</i>	Ducks, geese, waterfowl, chicken, turkey, pigeon, quail	Various species



Order Blattodea or Blattaria



- Allergies
- The exoskeleton of larvae and feces are known allergens in 50% of asthmatics
- ~ 10% of people will develop an allergy to cockroaches after long-term exposure to them
- The second most common allergy, after dust mites
- Positive health aspect - the American cockroach isolate kangfuxin is used in the treatment of wounds, ulcers and burns - in China



Order Blattodea or Blattaria

- Bites
 - Very rare, but proven to feed on nails, eyelashes, calluses, thickened skin, etc.
 - Bites on the body, most often around the mouth in small children (very dirty and inadequate living conditions)
 - Related species are the American and Australian cockroaches
- Psychological stress



Order Blattodea or Blattaria

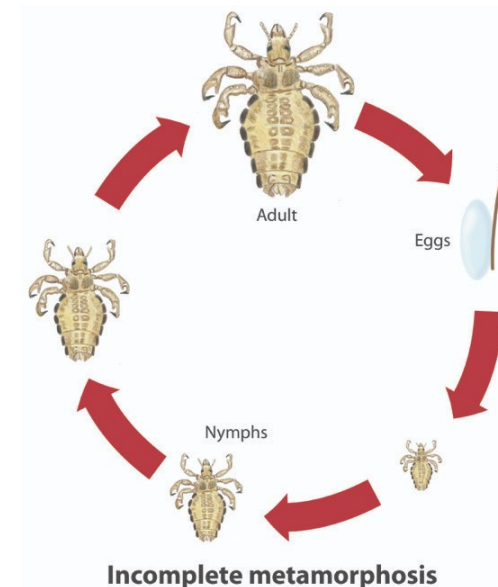
- Prevention and control
- Cleaning - especially the parts of the house/apartment where food is prepared and stored
- Reduction of humidity in the house/apartment
- Insecticides – neurotoxic insecticides, metabolic inhibitors
- Growth inhibitors (analogues of juvenile hormones) or chitin synthesis inhibitors
- Biological control with the help of parasitic wasps (*Aprostocetus hagenowii*, ...) - they cannot solve the problem completely





Order Psocodea – Phtiraptera

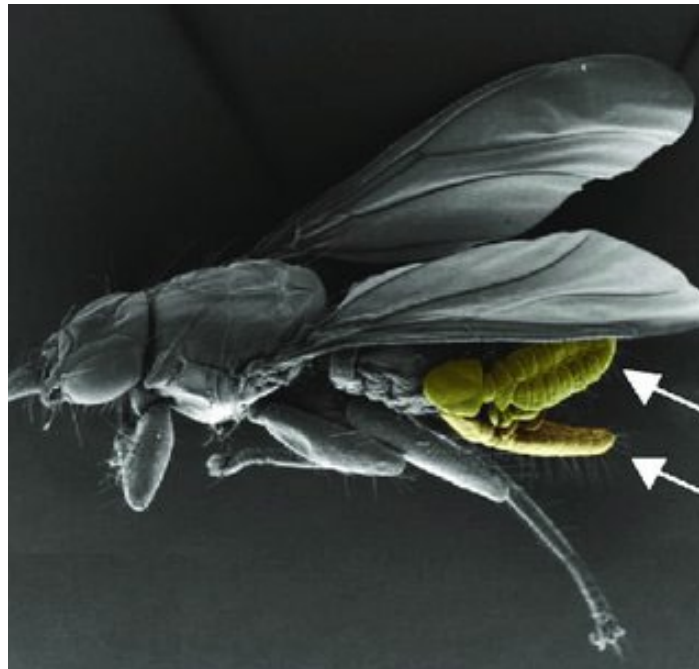
- Includes free-living and parasitic species (Anoplura - "animal lice" and Amblycera, Ischnocera and Rhynchophthirina (formerly Mallophaga) - "fluids")
- Suborder Phtiraptera - wingless and dorsoventrally flattened species
- Hemimetabolous and close connection with the host through entire life cycles
- ~ 5000 species – ectoparasites on vertebrates (birds and mammals)





Order Psocodea – Phtiraptera

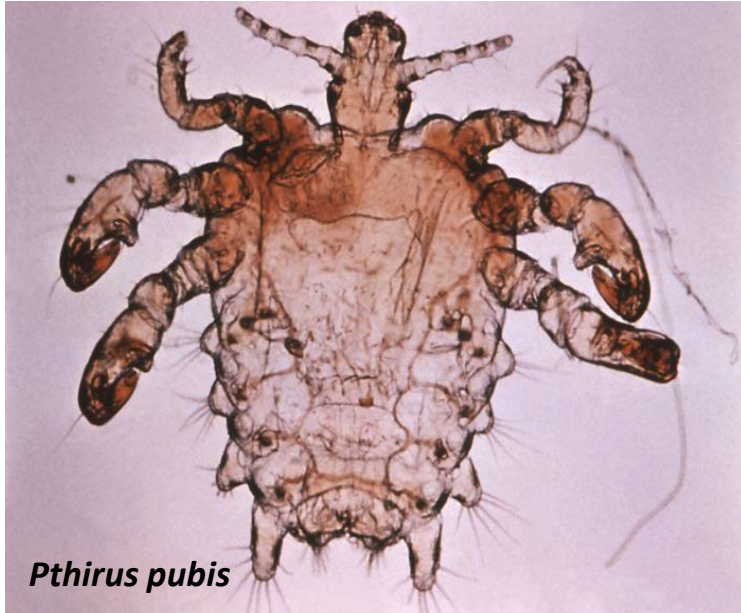
- Drinking blood or feeding on parts of living organisms (feathers, fur, skin) – attachment to a specific host
- The entire life cycle on the housekeeper, spread through direct contact between animals, but also through **PHORESIA** - an association of two organisms in which one travels on the body of the other without parasitism, only as a passenger - Ischnocera and flies of the Hippoboscidae family)





Order Psocodea – Phtiraptera

- Three species important to humans: Pubic louse (*Pthirus pubis*), Head louse (*Pediculus humanus capitis*) and Body louse (*Pediculus humanus humanus*) - all three species suck blood exclusively from humans and are widespread throughout the world



Pthirus pubis



Pediculus humanus humanus

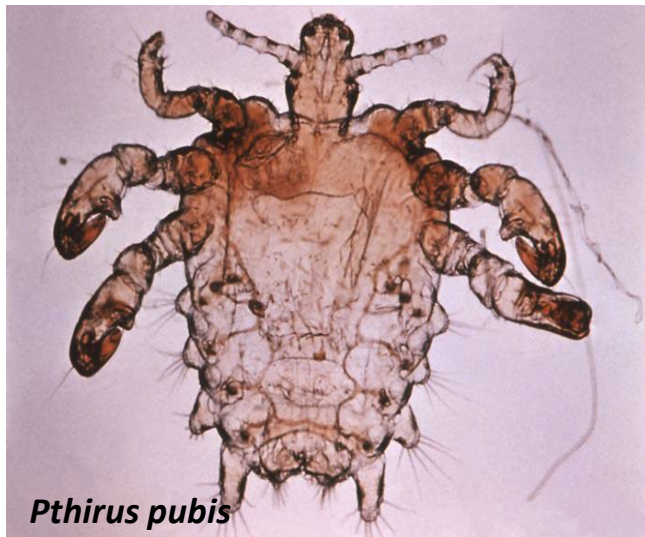


Pediculus humanus capitis



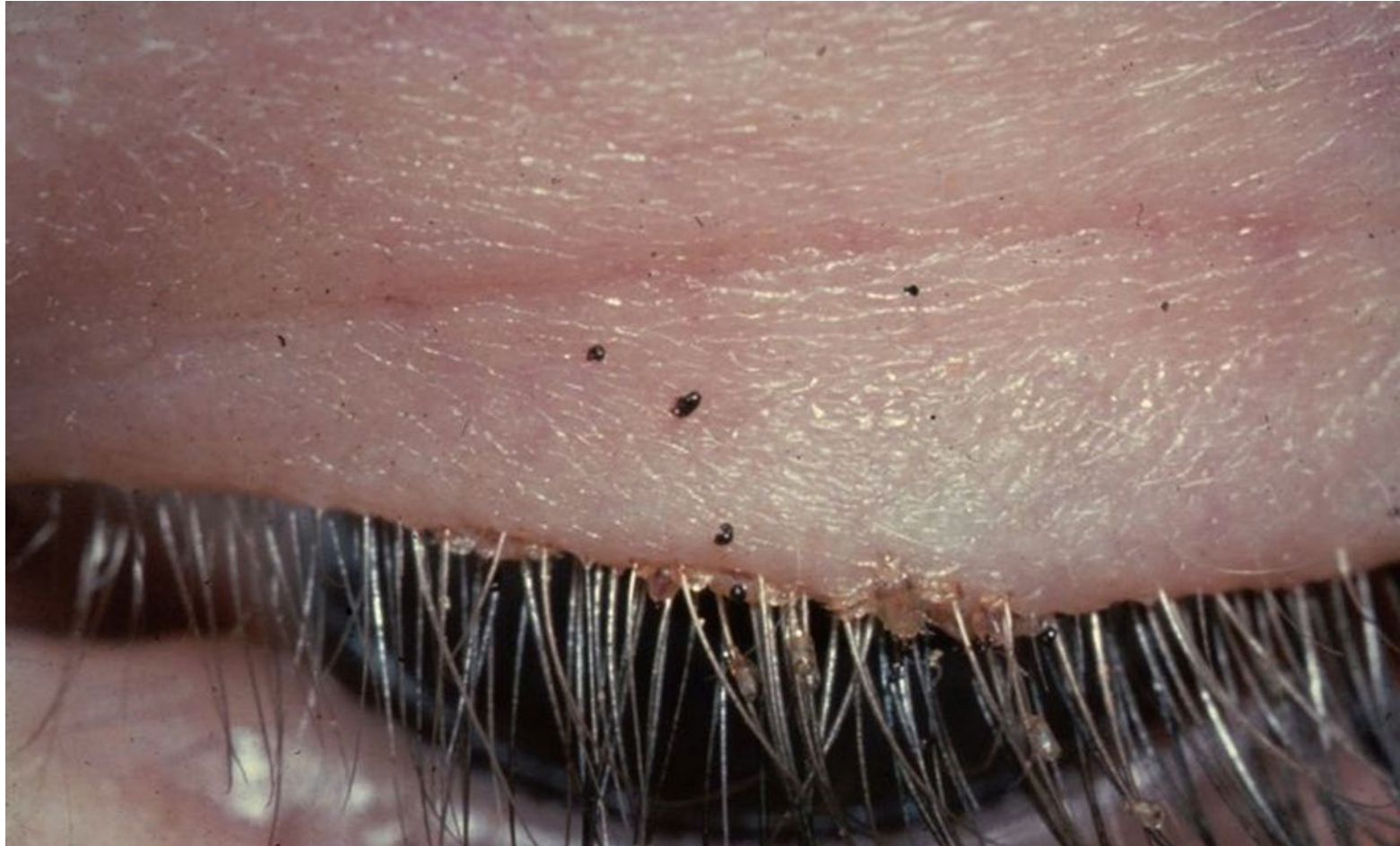
Order Psocodea – Phtiraptera

- Pubic louse (*Pthirus pubis*) – fran. „papillons d’amour”(butterflies of love)
 - Causes Phthiriasis
 - They mostly appear in the pubic area, but they can also be found on other parts of the body where there is hair, they are transmitted most often by sexual contact, but also by sleeping in the same bed.
 - It survives only a few hours without its host
 - Injecting saliva during feeding causes itching and red dots
 - It is treated with insecticidal lotions (permethrin and other neurotoxic pyrethroids)



Order Psocodea – Phtiraptera

- Pubic lice infestation of eyelashes, eyes itch and water, nits are located at the base of the eyelashes - they can also be on the eyebrows, chin, mustache, chest hair or under the armpits



Order Psocodea – Phtiraptera

- Sudden decrease in cases of infection in Europe and North America, why?

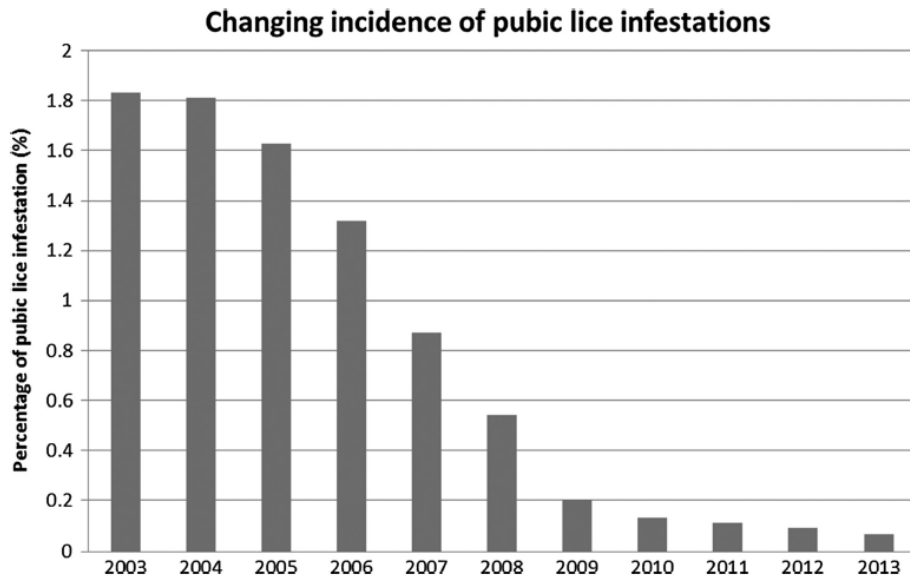


Figure 1. The changing incidence of patients affected with confirmed pubic lice infections over the 10-year period.

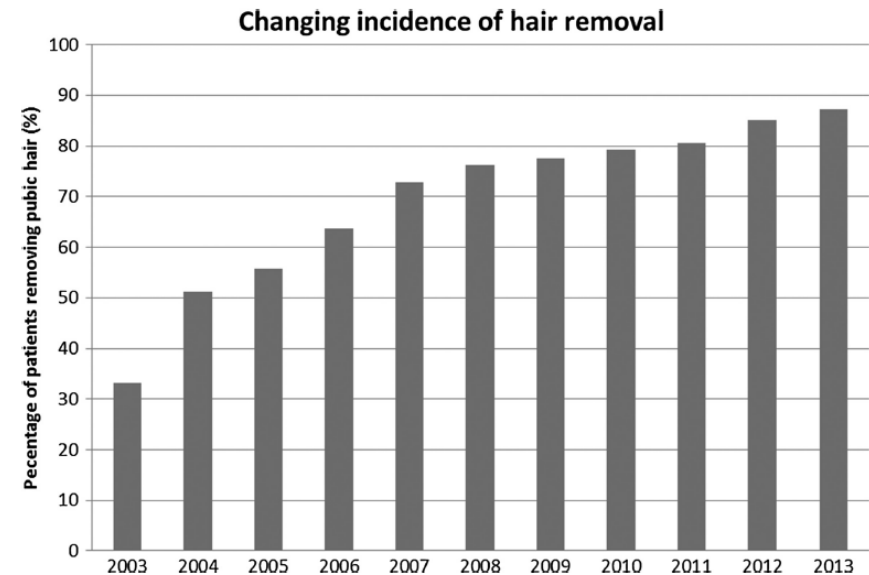


Figure 2. The changing incidence of hair removal within our patient group.

Order Psocodea – Phtiraptera

- Sudden decrease in cases of infection in Europe and North America, why?

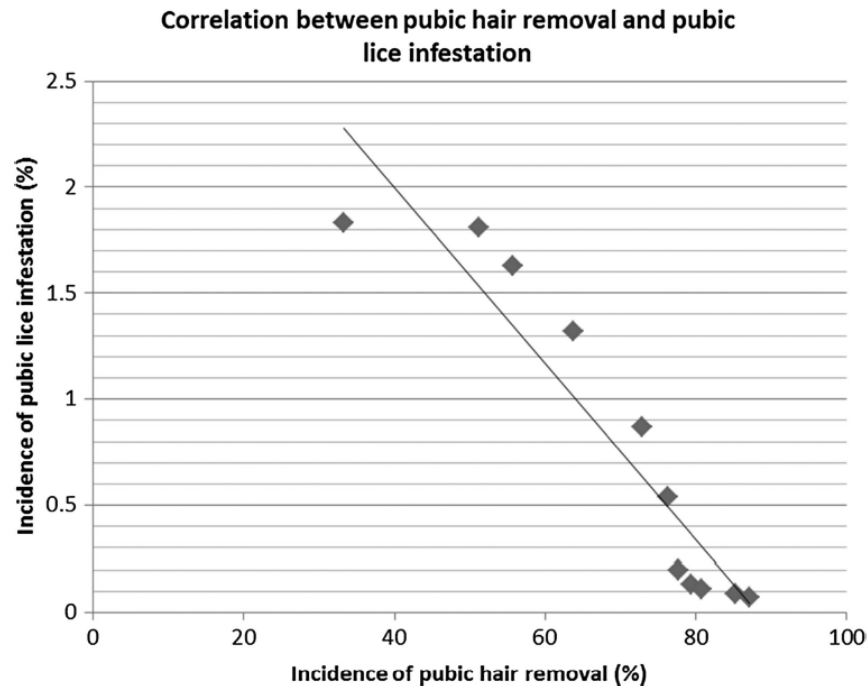


Figure 3. Correlation between pubic lice infection and pubic hair removal.

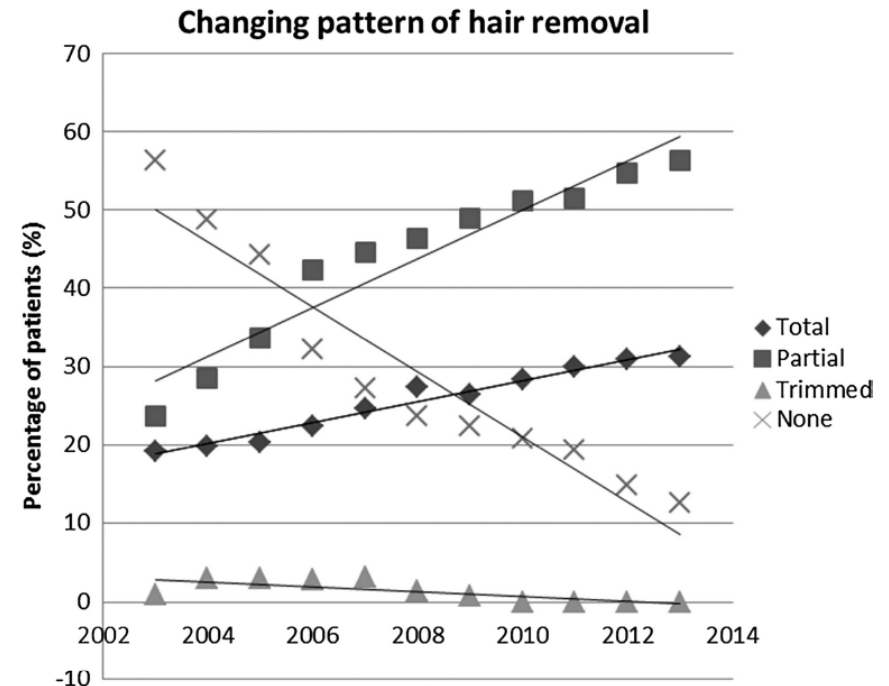
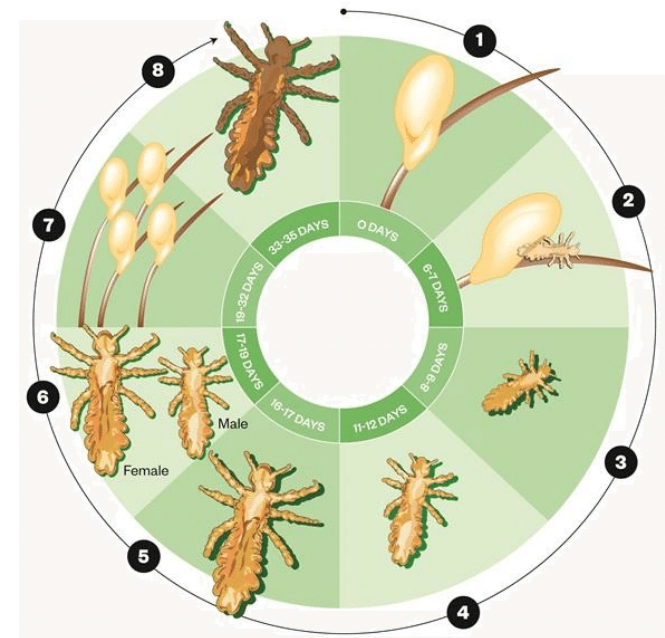


Figure 5. The changing pattern of hair removal.



Order Psocodea – Phtiraptera

- Head louse (*Pediculus humanus capitis*)
 - Most often in the area of the scalp and head
 - More than 10% of children infected (significantly less in children of African descent - thicker hair)
 - Injecting saliva during feeding causes itching, but only after the feeding is over
 - Severe infection can cause terrible irritation
 - Phylotypes (phenetic similarity) A, B and C, ...
 - Rare mechanical transmission of *Staphylococcus aureus* and *Streptococcus pyogenes* (Impetigo)
 - Due to itching secondary infection



Order Psocodea – Phtiraptera

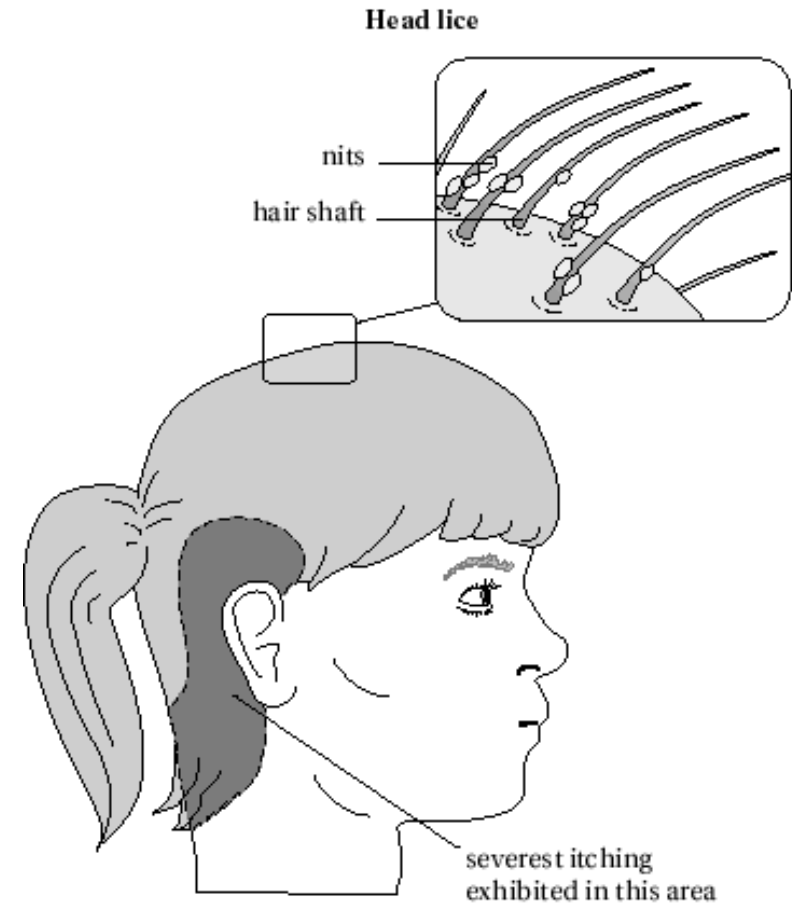
- Head louse (*Pediculus humanus capitis*)
 - It is transmitted by close contact
 - Death occurs within 24 hours after being separated from the hosts
 - It is best removed by shaving or using special combs designed for this
 - Treatment with insecticidal shampoos based on pyrethroids



Pediculus humanus capitis

Order Psocodea – Phtiraptera

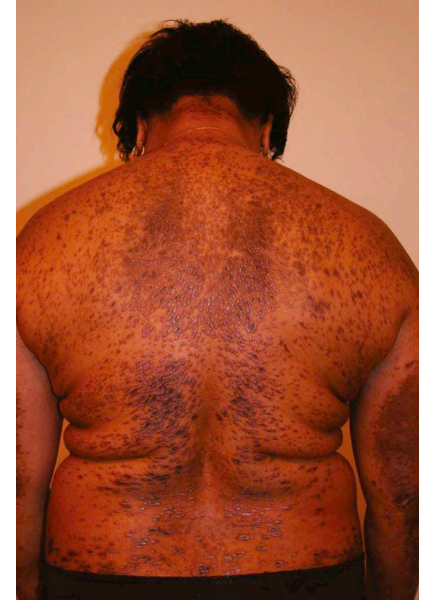
- Head louse (*Pediculus humanus capitis*)





Order Psocodea – Phtiraptera

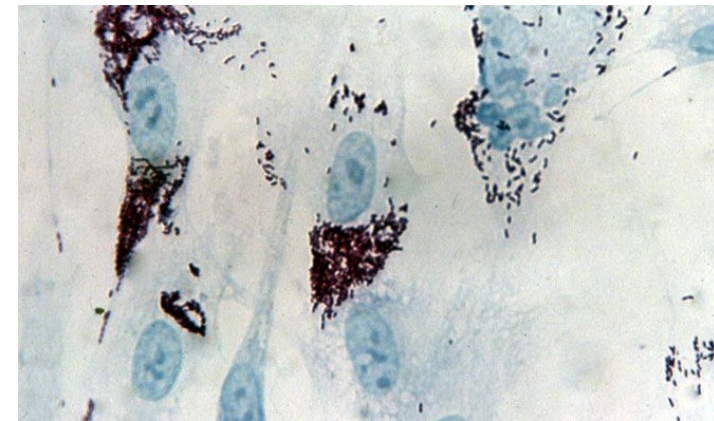
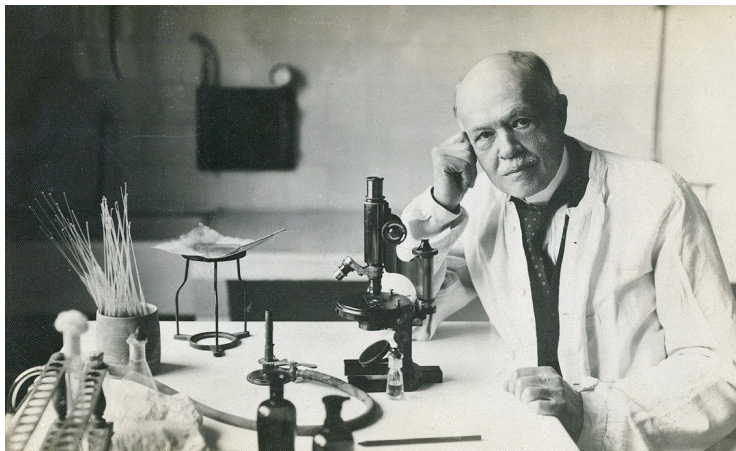
- Body louse (*Pediculus humanus humanus*)
 - It looks the same as a head louse - the hypothesis is that it originated from head lice due to poor human hygiene and is related to the beginning of wearing clothes in humans $72,000 \pm 42,000$ years ago
 - It causes pediculosis corporis
 - It is found on body hair and clothing
 - Transmission by close contact and clothing - today only in unsanitary conditions - chronic exposure causes thickening and discoloration of the skin (Hobo's disease - "Hobo's disease")
 - Disease vector (**epidemic typhus, trench fever, relapsing fever**), severe irritation and itching during feeding





Order Psocodea – Phtiraptera

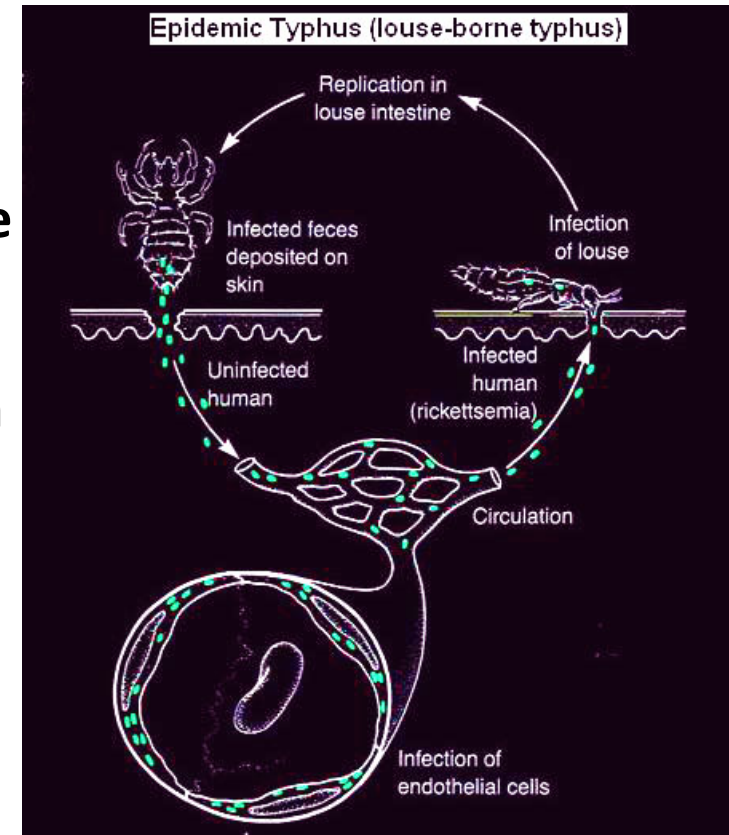
- **Body louse (*Pediculus humanus humanus*)**
 - Epidemic typhus (European, classical, louse-borne typhus or gaol fever)
 - Mostly in overpopulated areas and poor sanitary conditions
 - It is caused by the bacterium *Rickettsia prowazekii* – discovered by Charles Nicolle in 1909 – awarded the Nobel Prize in 1928.
 - Named after scientists H.T. Ricketts and S. von Prowazek - in their honor (died from epidemic typhus)





Order Psocodea – Phtiraptera

- **Body louse (*Pediculus humanus humanus*) – Epidemic typhus**
 - The body louse picks up the bacteria by feeding on the blood of an infected person (human-louse-human)
 - The bacterium reproduces in the cells of the lice's intestine and when the cells burst, through the feces, they come out onto the human skin (the bacterium kills the louse in the end, within 14 to max. 20 days)
 - The bacterium remains active in feces for < 60 days
 - Infection occurs by scratching and introducing feces into wounds or by "inhaling" feces or body lice themselves (very rare)
 - The bacterium multiplies in human endothelial cells and enters the blood by bursting the cell





Order Psocodea – Phtiraptera

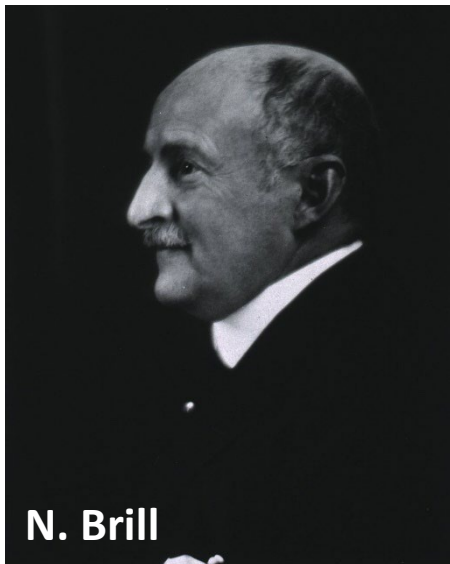
- **Body louse (*Pediculus humanus humanus*) – Symptoms Epidemic typhus**
 - Sudden onset of fever, severe headache and muscle aches 10 to 14 days after infection
 - Appearance of a rash on the body 4-5 days after the fever and lasts for 2 weeks
 - Gradual healing or worsening of symptoms - delirium, coma and death (10 to even 50% of untreated patients)
 - Survivors develop non-sterile immunity (the bacterium can still penetrate the cell)
 - Diagnosis: clinical symptoms, presence of body lice, skin biopsy for bacteria and PCR, serological tests
 - Treatment with antibiotics (tetracycline, doxycycline), there are vaccines, but they are not widely used





Order Psocodea – Phtiraptera

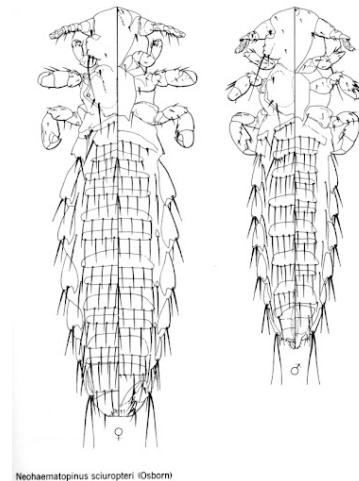
- Body louse (*Pediculus humanus humanus*) – Symptoms Epidemic typhus
- People who recover from epidemic typhus carry the bacteria in their lymph nodes and other tissues for months or even years, which makes it possible for the disease to recur
- **Brill-Zinsser's disease or the re-emergence of epidemic typhus** - survivors of the original infection carry the bacteria, which after many years (even after 30 years) is reactivated and the disease occurs again, the symptoms are usually milder than in the original disease





Order Psocodea – Phtiraptera

- Body louse (*Pediculus humanus humanus*) – Symptoms Epidemic typhus
 - Zoonotic transmission of disease – humans were once thought to be the only organisms where the bacterium *R. prowazekii* reproduces (along with the louse), but in 1963 it was determined that southern flying squirrels (*Glaucomys volans*) are also a reservoir and are responsible for "**sporadic or sylvatic epidemics typhus**" in the USA. Transmission to humans probably through feces of lice (*Neohaematopinus sciuropteri*) and fleas specific to squirrels
 - "**The host's multiplier**" - increases the number of parasites (or vectors) - often develops disease symptoms
 - "**Host's reservoir**" - promotes the development of parasites, but often asymptomatic, most often with long-term infections, can serve as a source of infection for vectors



Neohaematopinus sciuropteri (Osborn)

Order Psocodea – Phtiraptera

- Body louse (*Pediculus humanus humanus*) – Epidemic typhus
- Most often present in colder climates and higher altitudes in Africa (it was not present in the New World until 1500 - the arrival of the Spaniards)
- Epidemic of 1576-1577 killed 2 million natives in Mexico (??? Hemorrhagic fever)
- Napoleon's army decimated and defeated in 1812 with winter and thanks to epidemic typhus
- 1816 - 1819 - 700,000 cases in Ireland - departure to North America and transmission of infection



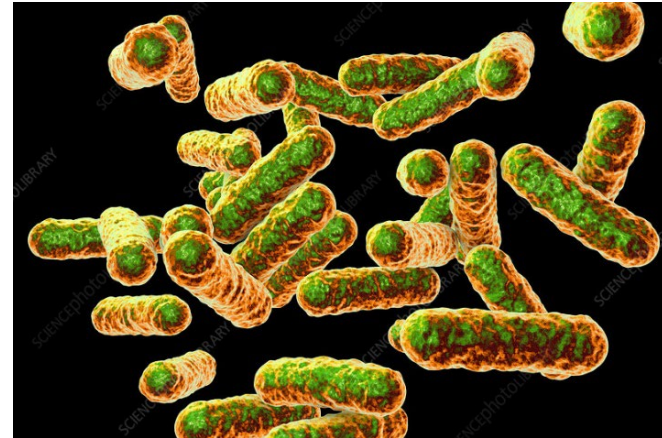
Order Psocodea – Phtiraptera

- **Body louse (*Pediculus humanus humanus*) – Epidemic typhus**
 - **World War I > 3 million deaths in Russia and Eastern Europe (Serbia, Poland, Romania) – after the war from 1919 to 1923, another 2-3 million deaths in Russia**
 - **II. World War – Operation Barbarossa 1941 – German Army**
 - **1942 and 1943 North Africa and the Mediterranean**
 - **Concentration camps (Auschwitz, Theresienstadt and Bergen-Belsen)**
 - **Warsaw Jewish Ghetto - prevention of typhus epidemic**
 - **1943 epidemic typhus in Naples - first use of DDT in an epidemic**
 - **1997 - 1998 - Burundian migrant camps - 50,000 people**



Order Psocodea – Phtiraptera

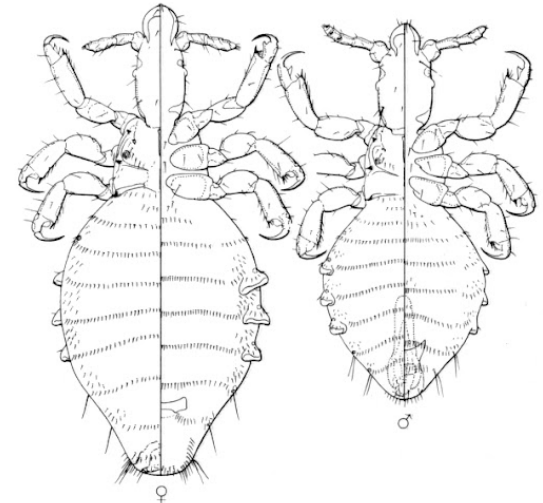
- Body louse (*Pediculus humanus humanus*)
 - **Trench fever** (Wolhinia or Quintana fever)
 - the causative agent is the bacterium *Bartonella quintana*
 - it was first observed in soldiers in the First World War in 1916 (on the western battlefield more) - reappeared in the Second World War
 - A relatively rare disease nowadays
 - **Urban trench fever** - homeless people in cities - manifests differently - skin lesions, endocarditis, chronically swollen lymph nodes





Order Psocodea – Phtiraptera

- Body louse (*Pediculus humanus humanus*) – **Trench fever**
 - It is transmitted when the feces of an infected louse is rubbed into damaged skin or conjunctiva
 - After 14–30 days of incubation, there is a sudden onset, with fever, weakness, dizziness, headache and severe pain in the lower back and legs. The fever can rise to 40.5 °C and last for 5–6 days and return
 - Also present in macaque monkeys in SE Asia - transmitted by louse *Pedicinus obtusus* - possibility of zoonotic origin of the disease



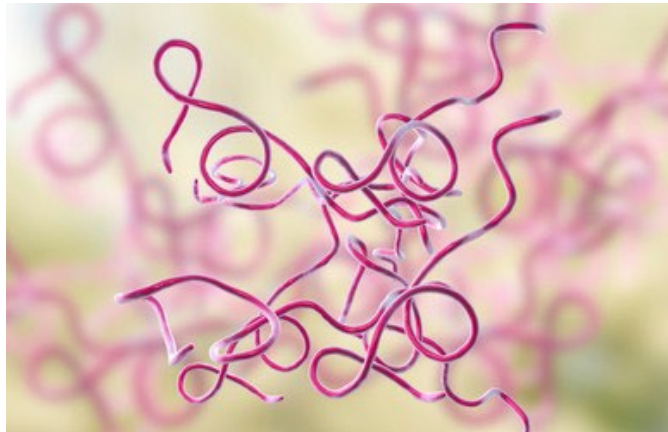
Pedicinus obtusus (Rudow)





Order Psocodea – Phtiraptera

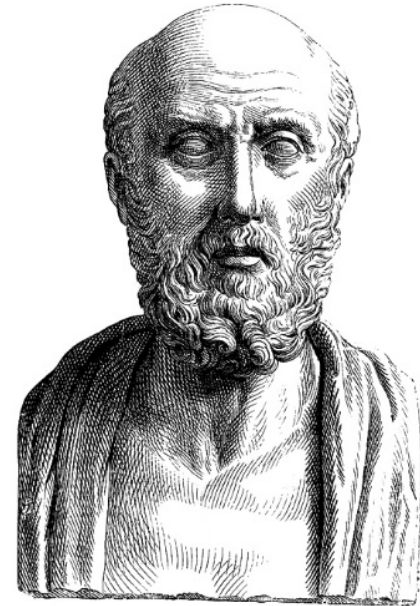
- Body louse (*Pediculus humanus humanus*)
 - **Relapsing fever (epidemic relapsing fever or famine fever)** – only in humans
 - It is caused by the spirochete bacterium *Borrelia recurrentis*
 - Symptoms include sudden fever, headache, muscle pain, anorexia, dizziness, nausea, cough and vomiting, even thrombocytopenia (a decrease in the number of blood platelets)
 - Fever lasts from 8 to 12 days, then 2-8 days without fever and then again and so from 2 to 5 times
 - If untreated, mortality up to 40% - treatment with penicillin and tetracycline





Order Psocodea – Phtiraptera

- Body louse (*Pediculus humanus humanus*) – **Relapsing fever**
 - Transmission occurs by crushing the lice and the transfer of bacteria from the hemolymph of the lice to a damaged area on the human skin or by penetrating undamaged skin
 - Body lice eventually die due to bacterial infection
 - Hippocrates described the disease as "fiery fever"
 - 1727-1729 epidemic in England
 - An epidemic in Eastern Europe and Russia from 1919 to 1923 infected 13 million people - 5 million died
 - In recent times, most epidemics in Africa, currently still an epidemic in Ethiopia
- Potential transmission of other pathogens – *Yersinia pestis*



Order Psocodea – Phtiraptera

- **Veterinary importance:**
- **Lice that drink blood and bite cattle**
- **Pets can develop dermatitis, allergic reactions or secondary infections due to constant scratching of the skin**
- **Loss of hair or feathers, disfigured appearance of livestock**
- **Blood feeding can lead to weight loss and have a negative impact on milk and egg production**

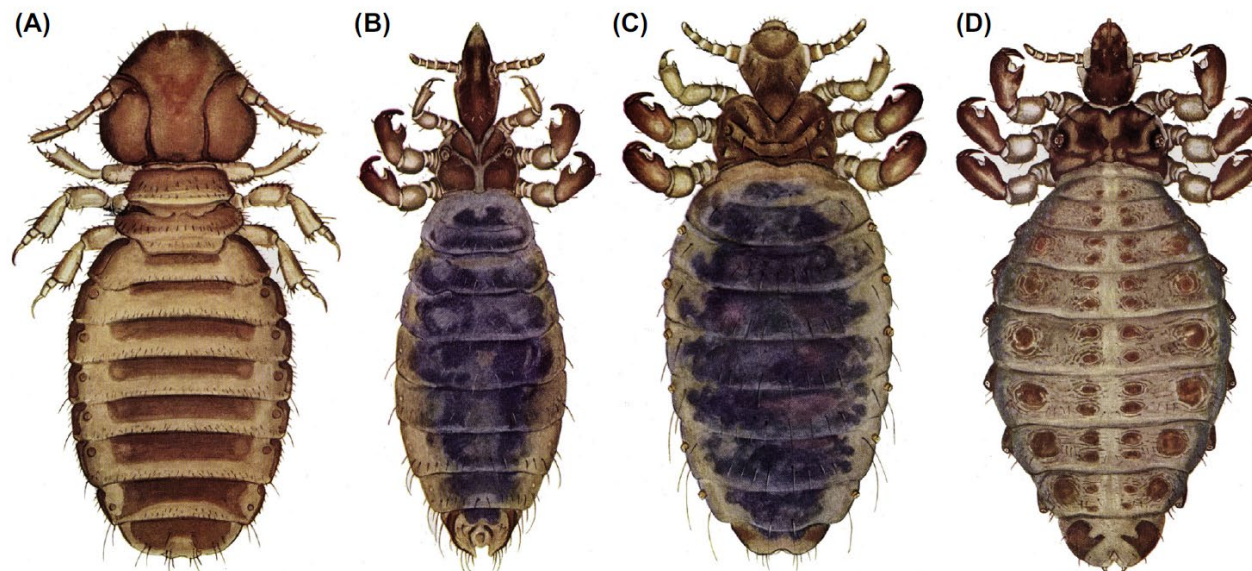


FIGURE 7.11 Lice (all females) of cattle. (A) Cattle biting louse (*Bovicola bovis*). (B) Longnosed cattle louse (*Linognathus vituli*). (C) Little blue cattle louse (*Solenopotes capillatus*). (D) Shortnosed cattle louse (*Haematopinus eurysternus*). From Mathysse, 1946; original illustrations by Ellen Edmonson.

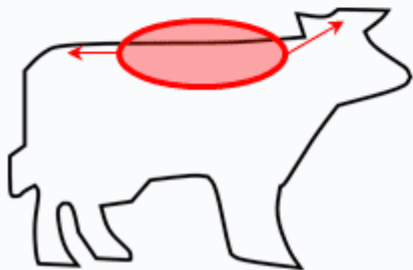
Order Psocodea – Phtiraptera

- Veterinary importance:

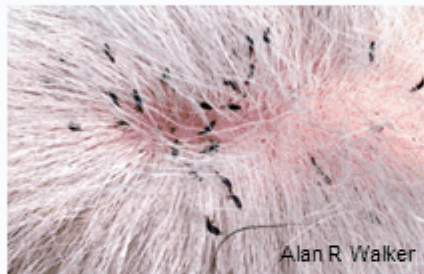
Cattle biting louse



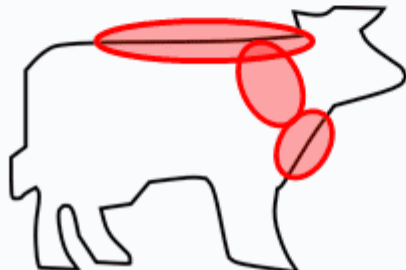
Topline of back



Long-nosed cattle louse



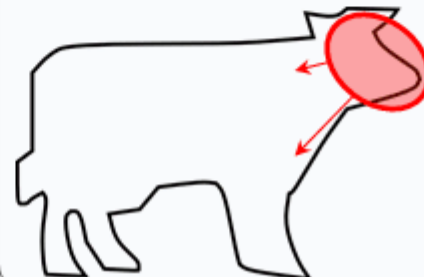
Back, shoulder, neck, dewlap, (face)



Little blue cattle louse



Face (muzzle, cheek, eye area)



Short-nosed cattle louse



Top of neck, dewlap, brisket, ears

