

EXOPTERYGOTAN ORDERS-3

DR. NIHAL R

9. Dictyoptera



Synonyms: Oothecaria, Blattiformia

Etymology: Dictyon - net work; ptera - wings

Common names: Cockroaches and preying mantids.

CHARACTERS

- **Head is hypognathous.**
- **Antenna is filiform.**
- **Mouthparts are chewing type.**
- **Tarsus is five segmented.**
- **Forewings are more or less thickened, leathery with a marginal costal vein.**
- **They are called **tegmina**.**
- **Hindwings are large, membranous and folded fanlike and kept beneath the forewings.**
- **Cerci are short and many segmented.**
- **Eggs are contained in an ootheca.**

Classification

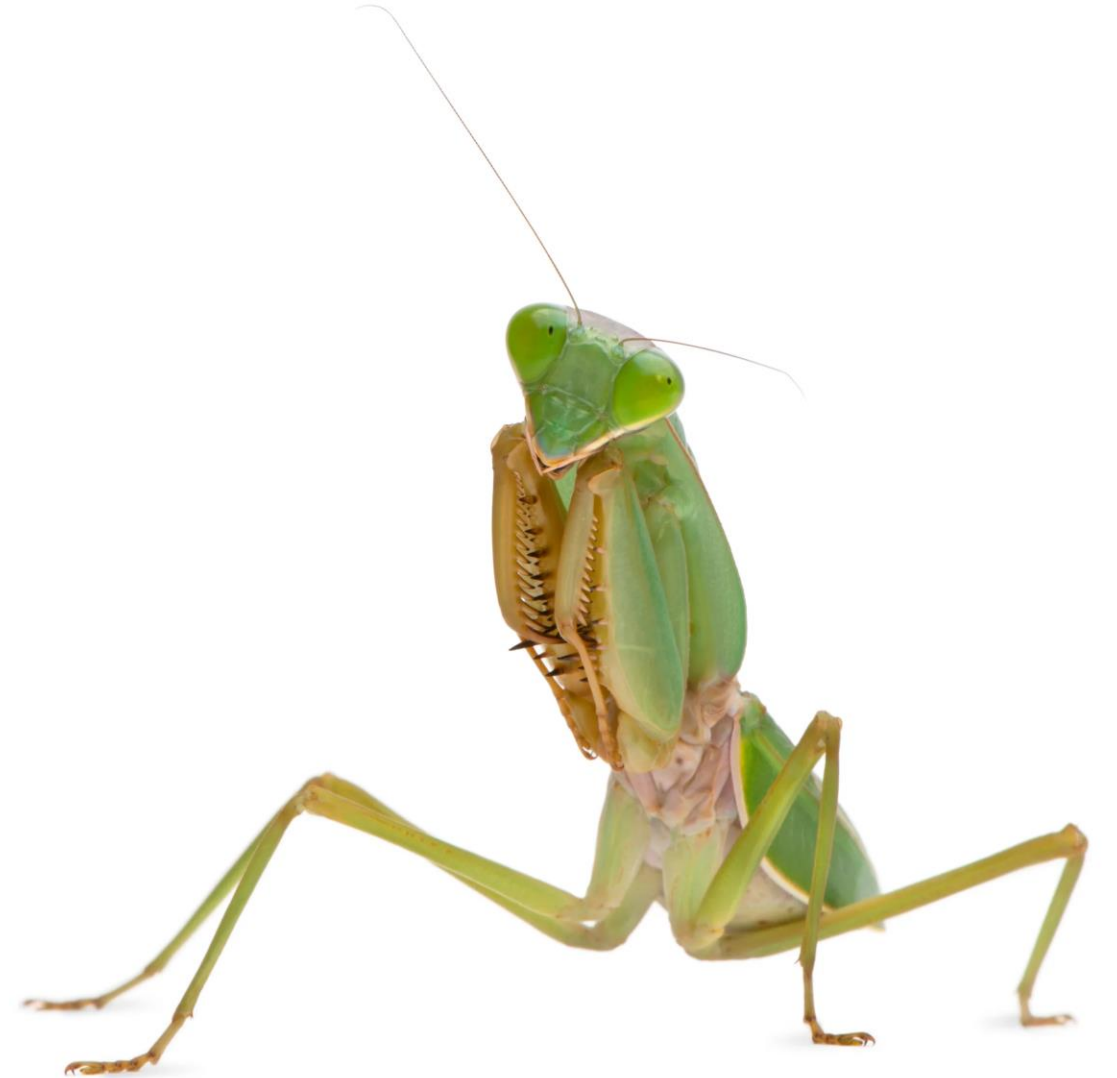
- **Dictyoptera is divided into two suborders viz., Blattaria (Cockroaches) and Mantodea (Preying mantids).**
- **The important families are Blattidae and Mantidae.**

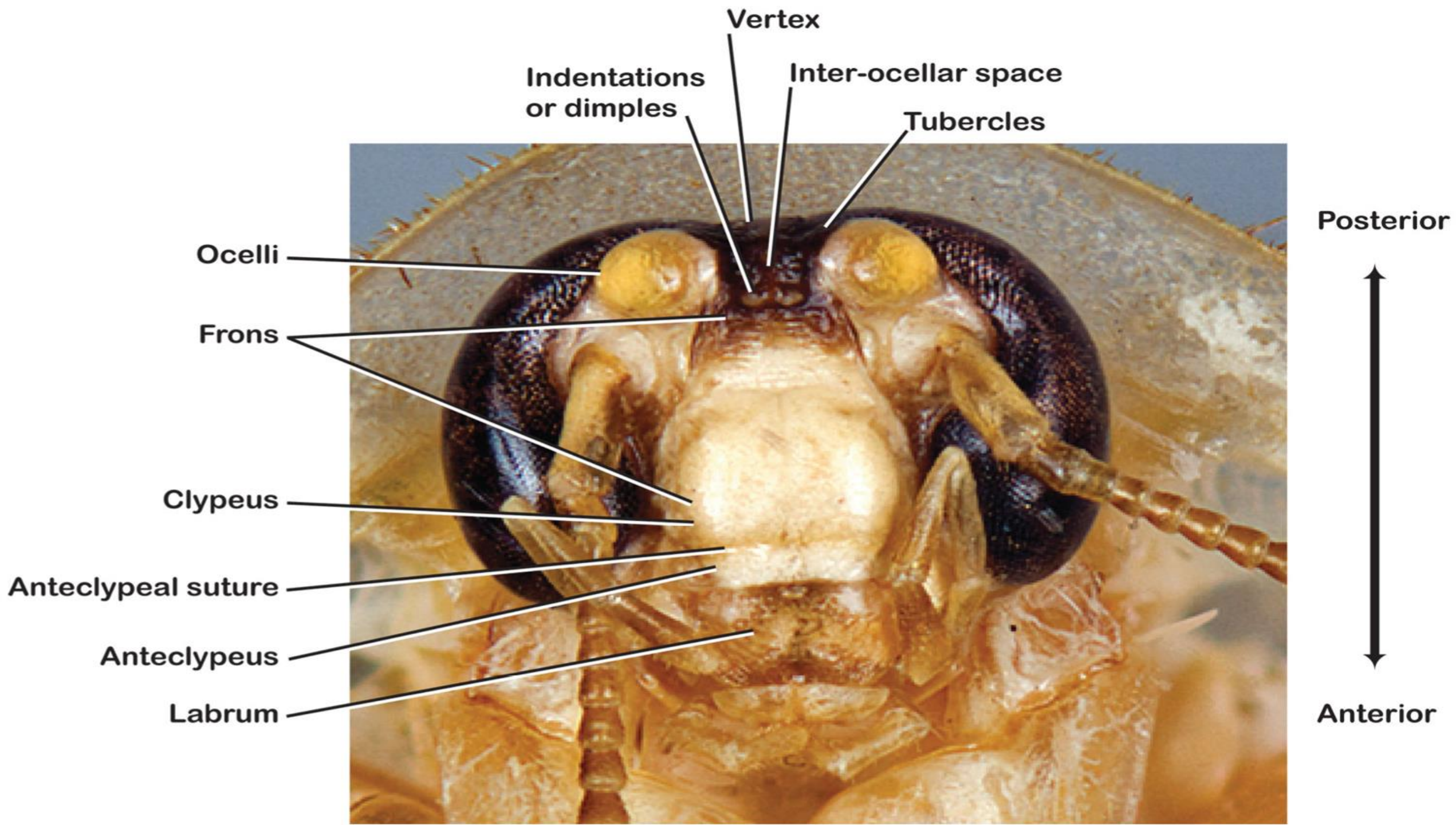
Blattidae

- Head is not mobile in all directions
- Head is hidden by the pronotum
- Have two fenestrae (degenerated ocelli sensitive to light) in the place ocelli
- Pronotum is shield like
- Legs are cursorial and are, adapted for running
- Gizzard is powerfully armed with chitinous teeth to grind food
- Female does not devour the male during mating
- Eggs are laid inside a chitinous **ootheca**
- Nymphs are not cannibalistic
- No mimicry is found
- Omnivorous
- Found in household, dead wood,
- They feed on food stuff, clothes and paper. They impart a foul smell to the food by contaminating with excreta. Hence they are **harmful**.

Mantidae

- Head is mobile in all directions
- Pronotum does not cover the head
- Three ocelli are present
- Pronotum is elongate
- **Forelegs: raptorial; middle and hindlegs: walking.**
- Chitinous teeth are absent in gizzard
- Often (but not always) devours the male during mating
- Eggs are enclosed in solidified foam like egg case, called **Spumaline**.
- Nymphs are **cannibalistic**
- **Mimic leaves and flowers**
- Carnivorous
- Found mostly outdoors litter etc.
- They are predators on moths, flies, grasshoppers, caterpillars, etc. Hence they are **beneficial**.









Blattaria (Oriental cockroaches)





Blattaria
(German cockroaches)



Blattaria
(American cockroaches)
Periplaneta americana



Mantodea
(Preying mantids)



Mantis religiosa



10. ISOPTERA



Synonyms: Termitina, Termitida, Socialia

Etymology: Iso - equal; Ptera - wing.

Common names: Termites, White ants

Characters

- They are small greyish white, soft bodied insects.
- The body is pale yellow in colour because of weak sclerotization.
- **Compound eyes are present in alate forms and usually absent in apterous forms.**
- **Antennae are short and moniliform.**
- **Mouthparts are adapted for biting and chewing.**
- Two pairs of wings are present which are identical in size form and venation.
- **Wings are membranous and semitransparent.**
- **Venation is not distinct.**
- Veins near the costal and anal margin alone are distinct.
- Anterior veins are more sclerotized.



Characters

- **Wings are flexed over the abdomen at rest.**
- **They are extended beyond the abdomen.**
- **Wings are present only in sexually mature forms during swarming season.**
- **Wing shedding takes place along the basal or humeral suture, after swarming.**
- **The remanent or the stump remaining behind is called `scale`.**
- **Abdomen is broadly jointed to the thorax without constriction.**
- **External genital organs are lacking in both the sexes. Cerci are short.**



Specialities

- **They are ancient polymorphic, social insects living in colonies.**

Internal characters

- **Salivary glands are well developed.**
- **Rectum is distended forming rectal pouch to accommodate large number of intestinal symbionts.**
- **Fat body development is extensive in male and female reproductive.**
- **Soil inhabiting termites construct earthen mounds called **termitaria**.**
- **They have evolved complex relationships with other organisms like bacteria, protozoa and fungi which help them in the digestion of wood.**
- **Incessant food sharing (**trophallaxis**) occurs between the members of the community by mouth-to-mouth and anus-to-mouth food transfer.**

Importance

- **Termites are nature's scavengers.**
- **They convert logs, stumps, branches etc. to humus.**
- **Many are injurious to crops, furniture and wood works of buildings..**



What Do Termites Eat?



Fabric



Water



Drywall



Fungus



Paper/Cardboard



Dead Plant



Wood



Termite Culture

Termite castes

worker



soldier



reproductive



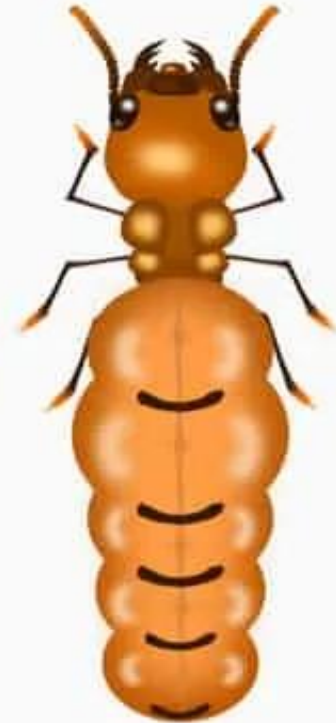
**winged
reproductive**



king



queen



**secondary
queen**



Termite castes

- Each group of individuals that perform the same function is called **caste**.
- There are four distinct castes in a termite colony viz., **king, queen, workers and soldiers**.
- There are two major types of termite castes based on their reproductive ability.
- They are **reproductives** and **non-reproductives**.
- Late stage nymphs with developing wing buds differentiate into reproductives which are seasonally produced.
- Larvae (immature without developing wing buds) give rise to non-reproductives which are regularly produced. They may be of either sex.
- The non reproductive are sexually sterile, apterous (without wing) and such individuals develop from immature larva which have no wing pads.
- **Majority of larvae differentiate into Workers, followed by Soldier.**
- **Normally the soldier strength is less than 5 per cent of the total colony strength.**

Reproductives

- There are two types viz., **Primary reproductives** and **secondary reproductives**.
- In **primary reproductive** body is dark, well sclerotised with well developed compound eyes and wings. They are fertile.
- They are the original founders of the colony.
- In **secondary reproductives** body is pale because of poor sclerotization.
- Both compound eyes and wings are not well developed.
- They replace the primary reproductive when they die.
- They are called supplementary reproductives or replacement reproductives.

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Reproductive caste



King

- It **intermittently fertilizes the queen.**
- It helps the queen in the **construction of nuptial chamber.**
- It also helps the queen in **rearing the first brood.**





Queen

- There is a **single queen**.
- After fertilization the queen attains **enormous proportions**.
- The abdomen becomes bloated due to the stretching of intersegmental membranes to accommodate the well developed ovaries and fat bodies.
- This obesity is known as **physogastry**.
- **In Odontotermes the queen is 12 cm long with 5000 ovarioles.**



Non-reproductives

- Many larvae differentiate into **workers** and others develop into **soldiers**.
- A right proportion of workers to soldiers is always maintained.
- **They are sterile because their reproductive organs are atrophied.**
- **They are usually blind and apterous.**



Workers

- **They dominate the colony.**
- **Body is soft and unpigmented.**
- **Mandibles and salivary glands are well developed.**
- **They excavate earth and build earthen mounds mainly with soil and saliva.**
- **They also repair the termitaria.**
- **They go out for foraging.**
- **They cultivate fungus garden.**
- **They feed the king, queen and soldiers.**
- **They care for the eggs and young ones.**
- **They are mainly responsible for the damage caused to timber and crops.**

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Soldiers

- There are two types of soldiers viz., **Mandibulate and Nasute.**
- They **defend the colony.**
- In **mandibulate soldiers** head is large, well sclerotized with well developed mandibles.
- In **nasute soldiers** head is drawn into a nozzle shaped projection at the tip of which opens frontal **gland.**
- Frontal gland is large projecting posteriorly into the abdomen.
- The glandular secretions are used during defense.

Mandibulate soldiers



Nasute soldiers



Social life among termites

- Termites are ancient **eusocial insects**.
- Truly social insects have the following characters.
 - (i) The individuals Co-operate
 - (ii) There is well defined caste system with specific colony work.
 - (iii) There is overlapping of generation and the off springs assist the parents.

Termitaria

- It is the living place of termite.
- The soil inhabiting termites build either mounds either below the ground or above the ground.
- **Soil, saliva and excreta are used for constructing the termitaria.**



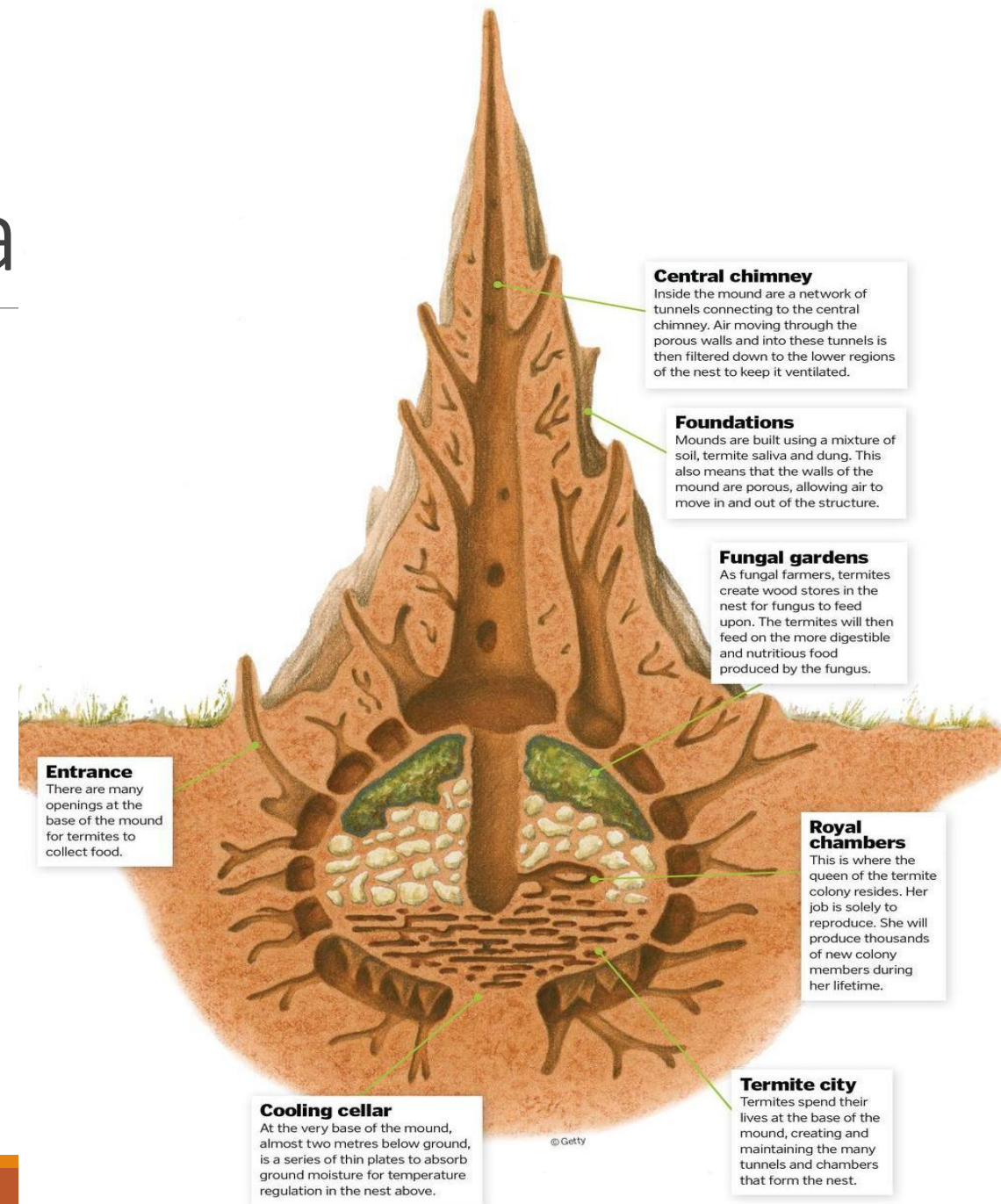


Purpose of mound

- (i) Give protection against predators and adverse conditions.**
- (ii) They reach their food only through a mound trail**
- (iii) The nest temperature and humidity is regulated by thick wall (**Homeostatis**).**

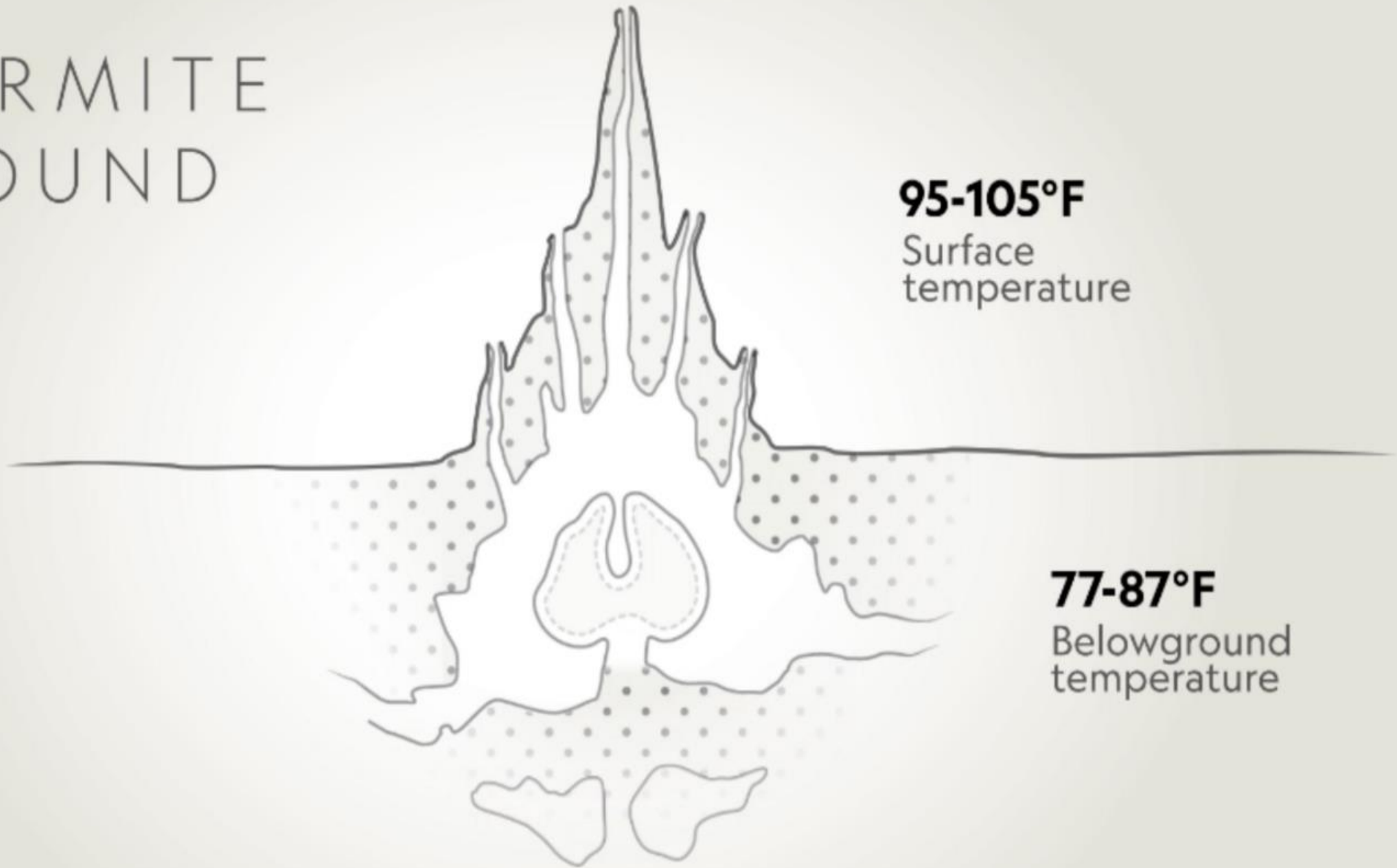
Structures of termitaria

- **Royal cell** where king and queen dwell.
- **Fungal garden:** found distributed around the royal cell.
- **Forage tunnel:** found radiating from different direction.
- Inside the termitarium along with termites other organisms (Fauna) are also found, which are called as **Termitophiles**.
- Termites are predated by scaly ant eater, amphibians, and reptiles.





TERMITE MOUND



95-105°F

Surface
temperature

77-87°F

Belowground
temperature



Colony founding

There are three mechanisms by which they form colonies.

Swarming:

- **Most common method.**
- **Under favorable condition winged reproductive emerge during rainy season at late evening hours.**
- **They fly after their emergence which aids in dispersal.**
- **Later they loose their wings by pressing against hard substrate.**
- **Pairing occurs and usually male is attracted by the female.**
- **Both join together and build a nuptial chamber.**
- **Mating occurs inside several times. The king frequently fertilizes the queen.**
- **The first batch of brood is reared by the royal pair.**

Colony founding

Budding:

- **A group of population becomes isolated from the parent colony and the new colony is formed.**
- **The replacement reproductive differentiate into primary reproductive.**

Sociotomy:

- **Colony formation is by deliberate fragmentation of the society.**
- **A large population of termites consisting of all castes leave or depart from the parental colony to form a new colony.**
- **The original colony will be headed by the replacement reproductive.**

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Food digestion

- **Cellulose** is the organic food available for termites.
- The lower termites depends on **flagellate protozoans** in the digestion of cellulose.
- In higher termites, **fungus and bacteria helps in the digestion of cellulose.**
- They develop fungal garden called as **termitomycetes.**
- These fungi are cultivated by the worker on a special substrate (reddish brown coral like vegetables material) derived from the **faeces.**
- These fungus produce conidia and conidiophores.
- **These fruiting bodies are important source of vitamins and organic nitrogen.**
- The fungus produces **ligninase** which acts on lignin and produces **cellulose.**
- This **cellulose** is acted upon by the **cellulase** produced by the **bacteria** found in the **gut.**

Trophallaxis

- **Mutual exchange of alimentary fluid is called trophallaxis.**

It serves two functions

- **Provide nutrients**
- **Control caste differentiation.**

It occurs by two means.

- **Oral trophallaxis** (mouth to mouth feeding and the food shared is called stomodeal food).
- **Anal trophallaxis** (anus to mouth feeding and the shared food is called proctodeal food).

Trophallaxis



11. Psocoptera



Synonyms: Corrodentia, Copeognatha

Etymology: Psoco-rub small; ptera – wings
;Psochos-dust like.

Common names: Book lice, Bark lice, Dust lice.

Characters

- **They are minute and soft bodied insects.**
- **Head has a distinct `Y' shaped epicranial suture.**
- **Clypeus is swollen. Mouthparts are biting and chewing type.**
- **Mandibles are with well developed molar and incisor areas.**
- **Lacinia is rodlike ('pick') which is partially sunken into the head capsule.**
- **Legs are slender. Wings may be present or absent.**
- **Forewings are larger than hind wings.**
- **Wings are held roof like over the abdomen.**
- **Cerci are absent. Psocids are frequently gregarious.**
- **Some psocids have the ability to spin silk.**
- **Dorsal pair of labial glands are modified into silk glands.**



Importance

- **The common book louse is *Liposcelis* sp.**
- **They feed on paper paste of book binding, fragments of animal and vegetable matter and stored products.**
- **They are also damage dry preserve insects and herbarium specimens.**



12. Mallophaga



Synonyms: Phthiraptera

Etymology: Mall-wool; phaga-eat.

Common names: Chewing lice, Biting lice, Bird lice.

Characters

- They are minute insects. Body is dorsoventrally flattened.
- Head is large triangular and broader than thorax.
- Compound eyes are reduced.
- Mouthparts are biting type with large dentate mandibles.
- Mandibles are useful to clip off the host's skin debris or feather and cling to the host.
- Prothorax is invariably free and not fused with pterothorax.
- Meso and metathorax may be free or fused.
- Legs terminate in a pair of claws usually which are adapted for clinging to feathers.
- The tarsus is either unsegmented or two segmented.
- Wings are absent and are secondarily wingless.
- Eggs are called nits and are cemented to the feathers.

1 mm



Species B male (dorsal)
[Host: Larus canus]

Importance

- **They are obligate parasites on birds and less frequently on mammals.**
- **They severely infest the poultry bird.**
- **Affected birds will become restless and peck at one another continuously, leading to loss of plumage.**
- **Louse infestation results in reduced body weight and decline in productivity. Bird lice feed on feathers, hairs, skin scales, scabs and possible blood clots around wounds.**
- **They cause irritation while feeding and crawling.**
- **In order to obtain relief, birds have dust bath.**

e.g. *Menopon pallidum* and *M. gallinae* are the two common lice associated with poultry.



1000 μ m

13. Siphunculata



Synonyms: Anoplura

Etymology: Siphunculus - a little tube

Common names: Sucking lice

Characters

- They are minute insects. **Body is dorsoventrally flattened.**
- **Head is small, conical and narrower than thorax.** Mouth is surrounded by a row of hooks which are anchored in the host skin while feeding.
- **Mouthparts are piercing and sucking type.** There are three slender stylets which are withdrawn into a pouch in the head capsule at rest. **This pouch is variously called stylet sac, buccal sac and trophic sac.**
- **Legs are scansorial, inwardly bent and adapted for clinging to mammalian hair.** **Tarsus is one segmented and ends in a single large claw which folds back on a thumb like projection of tibia forming an efficient organ of clinging.**
- **Wings are absent. They are secondarily wingless.** Thoracic spiracles are dorsally located.
- **Abdominal pleurites are highly sclerotised.**
- **Eggs are called nits and are strongly glued to the base of the hairs.**





Importance

- They are obligate blood sucking ectoparasites on mammals.
- The Presence of lice lesions on the skin is known as **pediculosis**.
- Louse infestation causes **itching** and **anaemia**.

The following lice are associated with man.

1. **Head louse:** *Pediculus humanus capitis*. Eggs are glued to **hairs**. It is also called **cootie**.
2. **Body louse:** *Pediculus humanus corporis*. It infests **neck, armpits and crotch**. It transmits epidemic **typhus, relapsing fever and trench fever**, which are serious and often fatal diseases to humans. Eggs are attached to **clothing**.
3. **Crab louse:** *Phthirus pubis*. It infests **armpits, pubic and perianal regions**. **Pthiriasis** causes intense **itching**.



Head louse



Body louse



Crab louse

