
EXERCISE 16 ARTHROPODA-IV: TWO SOCIAL INSECTS – HONEY BEE AND TERMITE FROM WET PRESERVED OR DRY MOUNTED SPECIMENS

Structure

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16.1 INTRODUCTION

Insects of any species that live together in an organized group or colony in an integrated manner such that each contributes in some specialized way to the welfare of the group as a whole are known as **Social Insects**. Colonies of these social insects are **matriarch** i.e. all members of a colony are the offspring of a single female.

Diversity of castes (polymorphism) is observed in social insects and have a division of labour. Members are differentiated into distinct castes, which are specialized in structure, function (reproduction, feeding, guarding etc.) and behaviour. Principal castes are categorized as **reproductive** (Queen and King) and the **non-reproductive** or sterile members (workers and soldiers). More than 6000 species of insects exhibit social instinct. In this laboratory exercise, you will study two social insects – honeybee ('madhumakhi') and a termite (white ant or 'deemak'). Both these have highly developed social life and they live in societies.

Objectives

After performing this exercise you should be able to:

- identify, classify and give the scientific and common names of the common honeybee (*Apis*) and a termite,
- identify, classify and name the different castes of honeybee and termite,
- describe the distinguishing features of each of the castes identified,
- list the criteria of considering the particular species as an example of social insects and explain the term **polymorphism** as applicable to social insects,
- mention the habitat and geographical distribution of the identified genera, and
- mention the economic importance of honeybee and termites.

16.2 MATERIAL REQUIRED

1. A magnifying glass.
2. Compound microscope,
3. Dried preserved specimens of worker, drone and queen honey bee.
4. Dried preserved specimens of winged (alate) termites.
5. Wet preserved specimens of winged (alate) and queen termite.
6. Permanent whole mounts of worker, soldier and nasute termites.
7. Pencil and eraser.
8. Drawing sheets.

16.3 METHOD

Examine the specimens carefully under dissection microscope or using a hand lens and slides under low power of the compound microscope and compare what you have observed with the description and figures provided in the lab exercise. After viewing one specimen/slide you may move to the next until you complete viewing the entire series.

In your notebook sketch, label and write description of (i) queen, drone and worker castes of honeybee and (ii) queen, king, soldier and worker castes of termites.

16.4 HONEYBEE

16.4.1 General Account

Honeybees are social and colonial found all over the world. Honeybees belong to the order Hymenoptera.

In India, three common species of honeybee are found namely *Apis dorsata* (wild bee), *A. florea* and *A. indica*. *A. indica* is the domesticated species for commercial bee-keeping (apiculture).

Honeybee is characterized by two pairs of membranous wings and chewing and lapping mouth parts. The female has a poisonous sting. You can easily see a bee during flowering season of the year in the garden/park in your neighbourhood. The one you will see on a flower will be a worker bee. Its crop is modified into a honey sac and the ovipositor into the sting. The mouth parts, legs and wings show a high degree of specialization.

The honeybees feed on pollen and nectar of flowers and produce honey and beeswax. They communicate with each other through a sign language. Mating occurs in a nuptial (swarming) flight after which males die. Development occurs through complete metamorphosis including the following stages:

Egg → Larva → Pupa → Adult

Eggs hatch on the third day but for completion of metamorphosis and emergence as an adult or imago it takes on an average 13 days for queen, 18 days for worker and 21 days for drone.

The individuals of a flourishing bee colony belong to three types of castes. There is usually a single fertile female or **queen**, a few hundred fertile males or the **drones** and the rest, sometimes in thousands, are the sterile females or the **workers**.

16.4.2 OBSERVATIONS OF SPECIMENS OF HONEY BEE (*Apis indica*/*Apis dorsata*) – Worker, Queen, Drone

1) Worker bee

Non-reproducing female. Body divided into 3 parts: head, thorax and abdomen. (Fig. 16.1a)

Note the following features:

HEAD is a triangular structure and bears:

- i) a pair of compound eyes;
- ii) a group of three ocelli;
- iii) a pair of short jointed antennae, and

- iv) chewing and lapping type of mouth-parts (a microscopic slide of the permanent mount of mouth-parts of worker honey bee may be available to see the details). (Fig. 16.1 b)

THORAX is divided into 3 segments: anterior prothorax, middle mesothorax and the posterior metathorax, each bears a pair of legs.

Mesothorax and metathorax carry a pair of wings on each.

LEGS

All the three pairs of legs are densely covered with hairs which aid in gathering pollen and are variously adapted. Each of the three legs show some characteristic features.

A) Fore (prothoracic) legs

- i) **Eye brush** on the distal part of tibia for removing pollen and other particles from the surface of the compound eye.
- ii) Distal posterior end of tibia has **velum** and **antennae comb** to clean the antennae.
- iii) Posterior face of the metatarsal segment bears bristles forming a **pollen brush**. (Fig. 16.1c)

B) Middle (Mesothoracic) legs

In **mesothoracic** legs, the inner distal end of tibia is located a long **spine** like **pollen spur**. These are used to remove pollen from baskets and to dislodge wax from wax pockets on the ventral surface of the abdomen and transferring it for comb-building. (Fig. 16.1c)

C) Hind (Metathoracic) legs

- i) **Pollen basket** on the outer surface of tibia. It is a depression partially covered by rows of long curved bristles arising from its margin.
- ii) Inner surface of the **metatarsus** bears a series of transverse rows of hard bristles forming the **pollen combs**. (Fig. 16.1c)

WINGS

2 pairs of narrow wings, **membranous** and transparent. The two wings are coupled together by a series of minute hooks, called **hamuli**, so that they work together as one unit during flight.

ABDOMEN consists of six segments and bears the wax-glands (on the underside) and the sting (at the end).

Wax-glands are modified cells on the ventral surface of the last four segments of abdomen.

Sting is the modified **ovipositor**.

Worker bees are sterile or neuter females arising from **fertilised** eggs laid by the queen and they live for 4-6 weeks.

The worker bees are repairers, keepers, feeders, fanners, foragers and defenders of the colony.

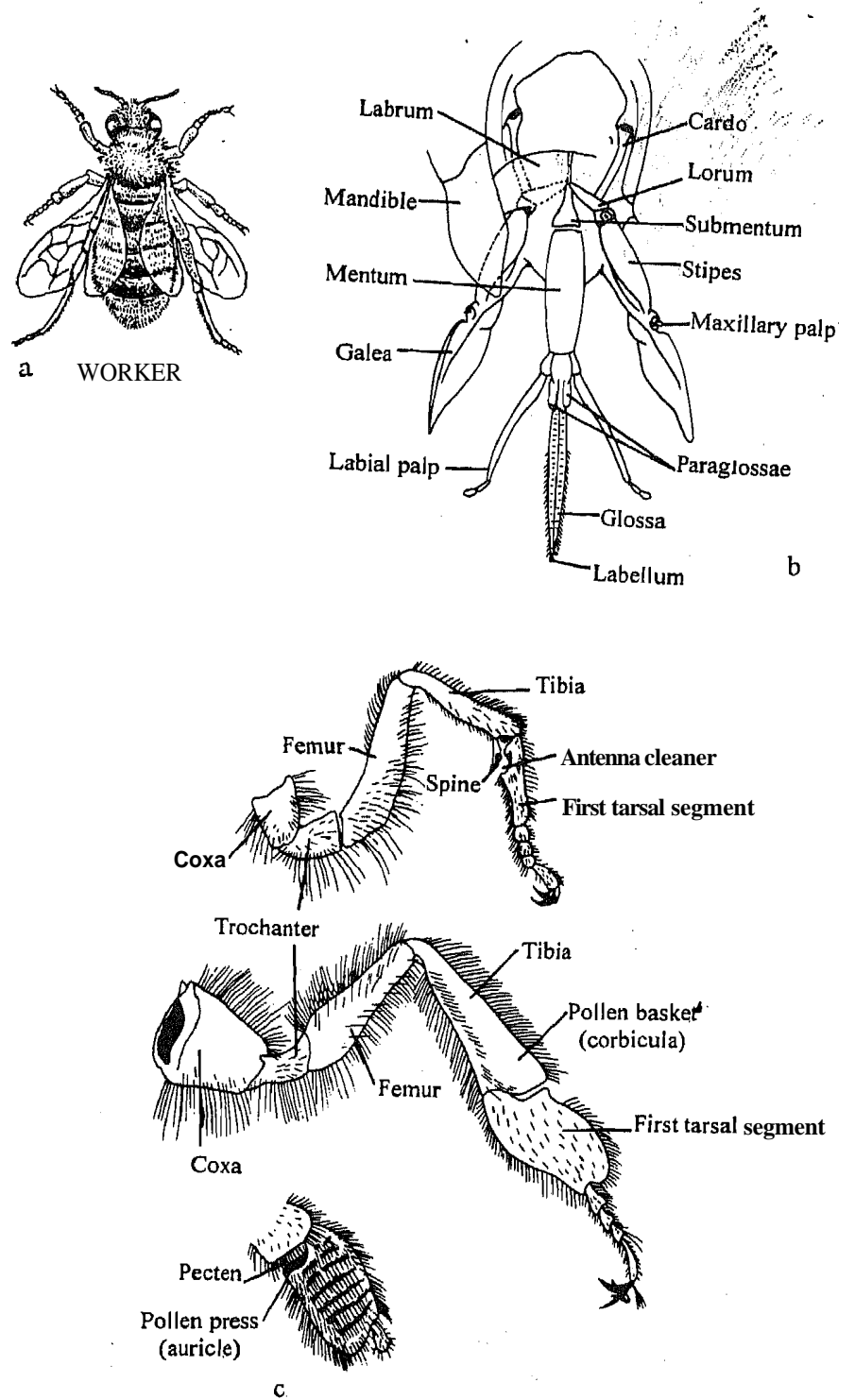
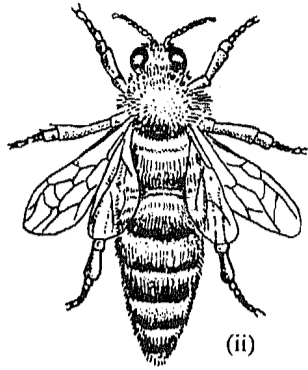


Fig. 16.1: Worker bee. (a) Dorsal view, (b) Dorsal view of the head and mouth parts of worker bee, (c) Each of the three pairs of legs showing special modification.

- 2) Queen bee
 - i) Only fertile female with immensely developed ovaries.
 - ii) Has elongated body with tapering abdomen and short legs and wings.
 - iii) Mandibles, mouth parts and stings are shorter than those of the worker bee (Fig. 16.2).
 - iv) Can not produce wax or honey.

- v) Can not collect nectar or pollen as legs are devoid of pollen basket, pollen brush etc.
- vi) Queen is specialized to lay eggs and mother of all members of the hive.
- vii) Queen is a somewhat degenerate individual with a small brain and without salivary glands.
- viii) Arises from the fertilized egg and larva that is specially fed on "royal jelly".
- ix) Lives for about 5 years and lays several hundreds of eggs per day.

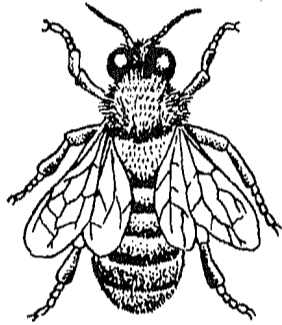


QUEEN

Fig. 16.2: Queen bee.

'3) Drones

- i) These are sexual male bees.
- ii) Have stouter and broader built.
- iii) Possess very large eyes, small pointed mandibles.
- iv) Devoid of wax glands, no pollen collecting apparatus and no sting (Fig. 16.3).
- v) Develop parthenogenetically from the unfertilized eggs laid by the queen.
- vi) Function is only to mate with queen.
- vii) Do not share any other job inside the hive.
- viii) Cannot feed themselves, have to be fed by worker bees.
- ix) Live for about five weeks.



DRONE

Fig. 16.3: Drone – male bee.

Classification and its Justification

Kingdom	Animalia	Animals, multi-cellular organisms with cells that lack a cell wall, many capable of movement or movement of some of their body parts or capable of movement at some time of their life cycle; heterotrophic nutrition.
Phylum	Arthropoda	Bilaterally symmetrical, triploblastic and segmented. Body with chitinous exoskeleton. Jointed appendages.
Class	Insecta	Body differentiated into head, thorax and abdomen, 3 pairs of legs.
Division	Endopterygota	Wings develop internally and metamorphosis complete.

Order	Hymenoptera	Membranous wings, mouthparts rasping and lapping type (biting and sucking type), hind wings hooked to articulate with forewings.
Family	Apidae	
Genus	<i>Apis</i>	
Species	<i>indica</i>	
Common name	Honey bee	

16.5 TERMITE

The termites are the social insects living in colonies with an elaborate polymorphism. The termites occur throughout the tropics and warm temperate countries. More than 2300 different species are known to exist and they belong to class Insecta, order Isoptera.

16.5.1 General Account

The termites are greatly specialized and destructive insects and are remarkable for their social habits and the elaborate caste system. They either burrow in wood or make sub-terranean nest called **termatarium**. They feed mainly on wood (cellulose). The development occurs through incomplete metamorphosis. Winged termites are the sexual forms which swarm and make pairs of male and female which burrow in the soil and start new colonies.

Body size is small but slightly variable. Termites are soft-bodied insects with a delicate, thin and highly sensitive skin and often blind. Colour of the body is yellow, brown, black or pale but never white though they are called white ants.

Body is distinctly divided into head, thorax and abdomen. Mouth-parts are adapted for biting and chewing with greatly developed mandibles.

The termites exhibit polymorphism. Unlike bees each termite caste comprises both male and female individuals. The principal castes belong to two main categories *fertile castes* and *sterile castes*. The fertile individuals are queen and king while sterile castes are workers, soldiers or nasutes in some species. As opposed to worker bees which are sterile females, the worker, soldiers or the nasutes of termites are of both sexes. Of all the social insects only the termites have a king.

The eggs are pale, smooth, oval or elongated. The development is gradual, there is no larval or pupal stage. The *nymph* which hatches from the egg is like the adult except that it is smaller, has no traces of wings and is sexually immature. After moulting several times it reaches the adult stage. Each colony is founded by a **royal** couple (queen and king). In early years, only workers and soldiers are produced but later, *alates* or the winged forms are also produced. Sometimes, a colony contains several reproductive couples.

16.5.2 Observation of Specimens – Alates, Soldiers, Workers, Queen (physogastric) and King

- 1) Winged termite (alates)
 - i) Fertile or reproductive female which leaves in parent nest in swarming.
 - ii) Winged individual but wings are shed soon after swarming and only their truncated bases remain.
 - iii) Two pairs of wings are very similar in appearance, with strongly pigmented veins in the anterior portion and a basal (humeral) suture along which fracture of the wings occurs, wings are longer than the body (Fig. 16.4 a).
 - iv) Head is round or oval, carries well developed compound eyes, paired ocelli, moniliform (bead-like segmented) antennae and mandibulate mouth parts.
 - v) Legs (3 pairs) are very similar, having large coxae and segmented tarsi.

- vi) Abdomen with ten obvious segments and 11th tergum having fused with the tenth and 11th sternum being represented by the paraprocts.
- vii) Short, segmented cerci are present.
- viii) External genitalia are absent.

In **physogastric** queen (advanced in age), abdomen becomes enormously swollen through hypertrophy of the ovaries and consequent stretching of the intersegmental membrane (Fig. 16.4 b).

- i) 20 to 30 times larger than the worker.
- ii) Lives for 6 to 9 years and lays several thousands eggs per day.

King termite looks like alate, its abdomen is not enlarged as seen in physogastric queen. Lives together with the queen, mating at frequent intervals.

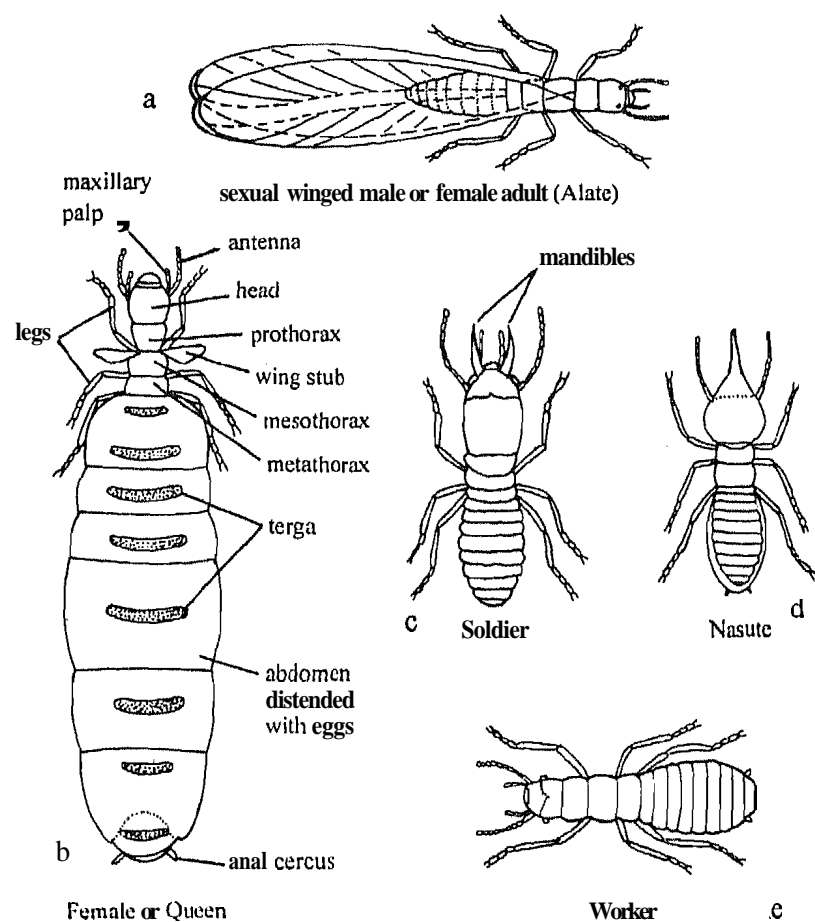


Fig. 16.4: a) Winged termite (Alate). b) Queen termite (Physogastric female). c) Soldier termite. d) Nasute soldier (*Eutermes*). e) Worker termite (much enlarged).

2) Soldier termite

- i) Wingless body with rudimentary reproductive organs.
- ii) Body is divided into head, thorax, and abdomen with 3 pairs of legs (16.4 c).
- iii) Head is large, well pigmented and bears a pair of antennae and mouth parts, eyes not well developed.
- iv) Mandibles are very large and modified for biting and piercing (pincers).

In nasute soldiers of some other species, e.g. *Eutermes* the frons (front of head capsule) is enlarged to form a pointed rostrum containing frontal gland (Fig. 16.4d).

These soldiers are highly specialized for defence function. Sticky secretion of the gland is inflicted upon their enemies in warfare.

- 3) Worker termites
 - i) Wingless body with rudimentary reproductive organs.
 - ii) Body is generally pale and weakly pigmented.
 - iii) Body divided into head, thorax and abdomen with 3 pairs of legs (Fig. 16.4e).
 - iv) Head resembles that of a reproductive caste except that the compound eyes are reduced or absent and the mandibles are more powerful.
 - v) Carry out functions of keepers, feeders, foragers, nurses, etc.

Classification and its Justification

Kingdom	Animalia	Animals, multi-cellular organisms with cells that lack a cell wall, many capable of movement or movement of some of their body parts or capable of movement at some time of their life cycle; lieterotrophic nutrition.
Phylum	Arthropoda	Bilaterally symmetrical, triploblastic and segmented. With chitinous exoskeleton and joined appendages.
Class	Insecta	Body differentiated into head, thorax and abdomen, 3 pairs of legs.
Division	Exopterygota	Wings develop externally as buds.
Order	Isoptera	Social and polymorphic insects with two pairs of similar wings which are often shed.
Two common genera	<i>Microtermes, Odontotermes</i>	
Common name	Termites (White ant) (English) 'Deemak' (Hindi)	

16.6 TERMINAL QUESTIONS

1. Define the term "polymorphism" in relation to social insects and name various castes of honeybees and termites?

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