SOCIAL LIFE IN INSECTS

Social insects are those which live in colonies and their members show some kind of division of labour according to which members of the colony are modified according to the duty they perform in the colony.

TERMITES (Isoptera)

Termites are commonly known as white ants and are one of those few animal species that survive exclusively on cellulose and carry cellulose-digesting flagellates inside their intestines. They make underground nests called **termatorium**, in which they maintain constant temperature and humidity, even when outside ground temperature rises to above 60 degrees, by constructing intricate overground natural air conditioners called termite-hills. As the wind passes through the ventilation galleries of the termite hill, the temperature of the nest drops fast. They never venture out in the open and construct earthen passageways on the trees, walls or on ground and move in the darkness of these tunnels.

No wonder their eyes are rudimentary and they communicate almost exclusively in the chemical language. This peculiar underground habitat and shy nature has evolved in them due to a large number of predatory animals like giant anteaters, scaly anteaters, spiny anteaters etc. which exclusively live on termite diet and are always looking for them.

SOCIAL STRUCTURE

They were the first animals which started living in colonies and developed a well organised social system about 300 million years ago, much earlier than honey bees and ants. Although termites do not exceed 3-4 mm in size, their **queen** is a 4 inch long giant that lies in the royal chamber motionless since its legs are too small to move its enormous body. This phenomenon of enormous enlargement of abdomen in termite queen is called **physogastry**.

Workers have to take care of all its daily chores. Termite queen is an egg-laying machine that reproduces at the astonishing rate of one egg per second, 24 hours a day and for about 20 years of life. Some Australian species are known to lay up to 60,000 eggs per day. Producing eggs is the only mission in the life of a termite queen. The other castes, **workers** and soldiers are highly devoted to the colony, working incessantly and tirelessly, demanding nothing in return from the society.

Soldiers have long dagger-like mandibles with which they defend their nest and workers chew the wood to feed to the queen and larvae and grow fungus gardens for lean periods. **Nasutes** are specialized soldiers which specialize in chemical warfare. They produce a jet of highly corrosive chemical from their bodies that can dissolve the skin of enemies and can also help in making galleries through the rocks. They are bulldozers of the colony. In breeding season which usually coincides with the rains, newly produced **males** and **females** grow wings and have nuptial flight to disperse to long distances. They make pairs and find a new place to start a colony by digging a shallow gallery and laying eggs that all hatch into workers to expand the nest.

There are some termites such as those belonging to families Kalotermitidae and Hodotermitidae that do not build underground nest but live on the trees in temporary nests. Termite **nymphs** are diploid males as well as females that develop into sterile adults except those growing into nuptials in rainy season. There are 7 instars of nymphs and the last three instar nymphs function as workers.

Unlike honey bees, termite adults are diploid in both sexes as they develop from fertilized eggs. Queen secretes inhibiting hormones that do not allow nymphs to develop into new queens. Differentiation of different castes in termites takes place by feeding the larvae with saliva of workers. Larvae that are fed on more saliva develop into sexual forms while nymphs that are fed on wood and fungus develop into workers and soldiers.

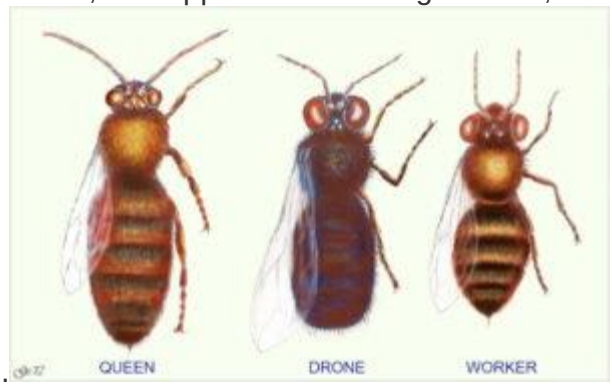
HONEY BEE (Hymenoptera)

Honey bees are colonial insects that visit flowers, collect nectar and convert it into a golden-yellow aromatic viscous fluid called honey, which is also called the liquid gold of

nature. Honey contains about 80% sugars, mainly glucose and fructose. Harmful sucrose is only 1-2% in honey. In addition, honey contains all essential vitamins, minerals and proteins. It has antiseptic properties, is a good blood-purifier, removes gastric problems and corrects metabolic imbalances in the body. It gives instant energy to sportspersons.

SOCIAL STRUCTURE

A bee colony has about 20,000 workers, one queen and about two dozen drones. If there is more than one queen in a hive, as happens in breeding season, then the phenomenon is known as **pleometrosis**.



Queen is the fertile female and can lay up to 3000 eggs per day, which is twice the weight of her body but normal fecundity is about 600 eggs per day. Queen can produce male or female offspring by choice; unfertilized eggs develop into males and fertilized ones into females. Growing larvae, both of which are genetically females, can be developed into queens or workers by feeding them with royal jelly or pollen and honey by the workers.

Queen produces a number of pheromones which attract workers and keeps the colony together. The secretions of **mandibular glands**, **tergal** and **tarsal glands** of queen are licked by the workers and passed to other members of the colony and larvae through food exchanges called **trophallaxis**. If a queen is killed, workers in the absence of queen pheromones, rear a new queen from the developing female larvae. Queen pheromone also inhibits development of ovaries in workers.

Queen pheromone has stimulating effect on the activities of workers, such as comb building, brood rearing, foraging and honey making. If a queen dies or disappears,

workers rear a new queen by selecting a larva and modifying its cell to make a queen cell and feed it exclusively with royal jelly.

Males are called **drones**, which are darker, robust and hairy and larger than workers. They develop from unfertilised eggs and are haploid. There are about two dozen of them in a hive and chase the queen in air every time she ventures on nuptial flight. The secretions of **mandibularglands** and that of sting apparatus of queen attract drones during nuptial flight. One of them manages to mate with her during such flight and dies in the process. Drones are not tolerated in the hive once the queen is fertilized and are generally driven out of hive, where they eventually die of starvation.

The **workers** are genetically females but sterile as they are not fed on royal jelly in the larval stage. They have a lifespan of 6 weeks, the first half of which is spent in the hive attending to household chores, secreting wax and building hive, producing a highly nutritious royal-jelly and converting nectar into honey. They become foragers in the later part of life and tirelessly collect nectar and pollen throughout life. Towards the end they become incapable to collect nectar and therefore become water-carriers.

They eventually die in work, an excellent example of selfless service for the society. An amazing phenomenon that has been observed in honeybees is their capacity to reverse their age should a catastrophe struck the colony. In case of a crisis, such as destruction of the hive, the 4-5 week old foragers start reversing their age and become younger to secrete **royal jelly** and wax, repair their hive, rear a new queen from the larvae and rebuild their colony. Members of a colony are heavily dependent on one another and cannot survive in isolation, even if kept in the best of conditions. They communicate by ultrasound signals, pheromones, dancing and gestures.

Workers possess morphological adaptations to carry out their duties. Their **mandibular glands** secrete wax softening substance, **pharyngeal glands** secrete a gelatinous highly nutritious substance called Royal Jelly and stomach contains several glands that help in converting nectar into honey. There are **wax glands** on abdominal segments 4-7 which open by several ducts on to the sternites 4-7. Hind legs have tibia and basitarus modified to form a **pollen basket** and pollen press. Mouth parts are chewing and lapping type.

Workers are sterile females and hence their ovipositors are modified to form **sting** and accessory reproductive glands get modified to form poison glands.

A worker in its entire lifespan makes about a spoonful of honey. To make 500 grams of honey, bees have to extract nectar from more than 4 million flowers, for which they have to make about 50,000 trips of the foraging area 5 km away. Alarm and aggression pheromones are released by the worker bees from the abdomen by raising the tip of abdomen and protruding the sting apparatus.

Two species of honeybees, namely, the native Indian species, *Apis cerina indica* and the American species or the Italian bee*, Apis mellifera,* are reared in closed wooden hives for commercial production of honey as they are docile in nature and build their hives in enclosed spaces. The two other species are wild bees having ferocious temperament and cannot be domesticated. The larger rock bee, *Apis dorsata,* builds huge hives on the rock cliffs or on the high branches of trees whereas the smaller species, the bush bee, *Apis florea,* builds a small hive, the size of human hand among the bushes.

ANTS (Hymenoptera)

Ants are cousins of honeybees as they belong to the same order Hymenoptera, but while the honeybees are diurnal and sleep in the night, ants are busy working day and night. Ants have no wings, except in winged sexual forms that are produced in breeding season.

SOCIAL STRUCTURE

Ants have the highest developed social system, next only to man, with no apparent conflict seen in the society. A colony may have few thousand to over 500,000 individuals. The nests are built in various designs and are called **formicaria**. Like honeybees, they have **polyethism**, which means castes are specialized to carry out specialized duties in the colony.

For example, the **queen** has large abdomen to lay a lot of eggs (2-3 million in a year), **males** fertilize her, **workers** have broad, sharp mandibles for cutting and chewing and the **soldiers** have large head that bears sharp dagger-like mandibles for fighting. Workers and soldiers are sterile females. Soldiers of the door-keeping ant *(Colobopsis etiolata)* have such gigantic heads that they use it for blocking the entrance of the nest. They are extremely powerful creatures that can easily lift 20 times their own weight.

Ants have poor eyesight and are deaf but have a highly sophisticated chemical language for communication. They possess glands that secrete pheromones or messengers of chemical language that is perceived by one of antennae or feelers located on head. They trade food, glandular secretions and enzymes, which is called **tropholaxis**.

The course of migrating ant columns is directed by the chemical trail left by the scouts and constant body contacts among the following foragers. Sometimes if their chemical trail is washed away by rain, they are doomed to follow each other's trail in circular tracks with eccentrically high speed.

Most species excavate nests in the ground or wood but some construct suspended nests on trees made of earth, carton, wax or silk, while some, like safari ants, do not build nests at all. Desert ants build crater-like nests or mounds in which they are able to maintain temperature much below the outside heat of deserts. However, workers of the colony are allowed entry after they gently tap on the head of doorkeeper soldier. The tropical ant *Oecophylla* makes nest by webbing the leaves together with silken thread that is produced by their larvae. While many workers hold the leaves close together, some workers hold the larvae in their mandibles and use them like living thread balls to spin web to attach the leaves together.

Almost all ants store food for the lean periods but in the Australian honey pot ants *(Myrmecocystus hortideorum* and *Camponotus inflatus),* also called honey barrels, some members are specially modified to store honey. Their bodies are sac-like and appendages modified as hooks. They store honey in their enormously large abdomen and hang from the ceiling and perform no other apparent function. These casts are called **Repletes** which are specially adapted to store honey stolen by foragers from the bee hives.

Ants are also known to cultivate grasses and harvest and store their seeds. Some species raid the nests of other species of ants and rob them of stored food and keep their members as slaves in their own nests.