Course code: ENT304, Industrial Entomology 2(1+1)

Morphological specialties mouth parts, legs and others

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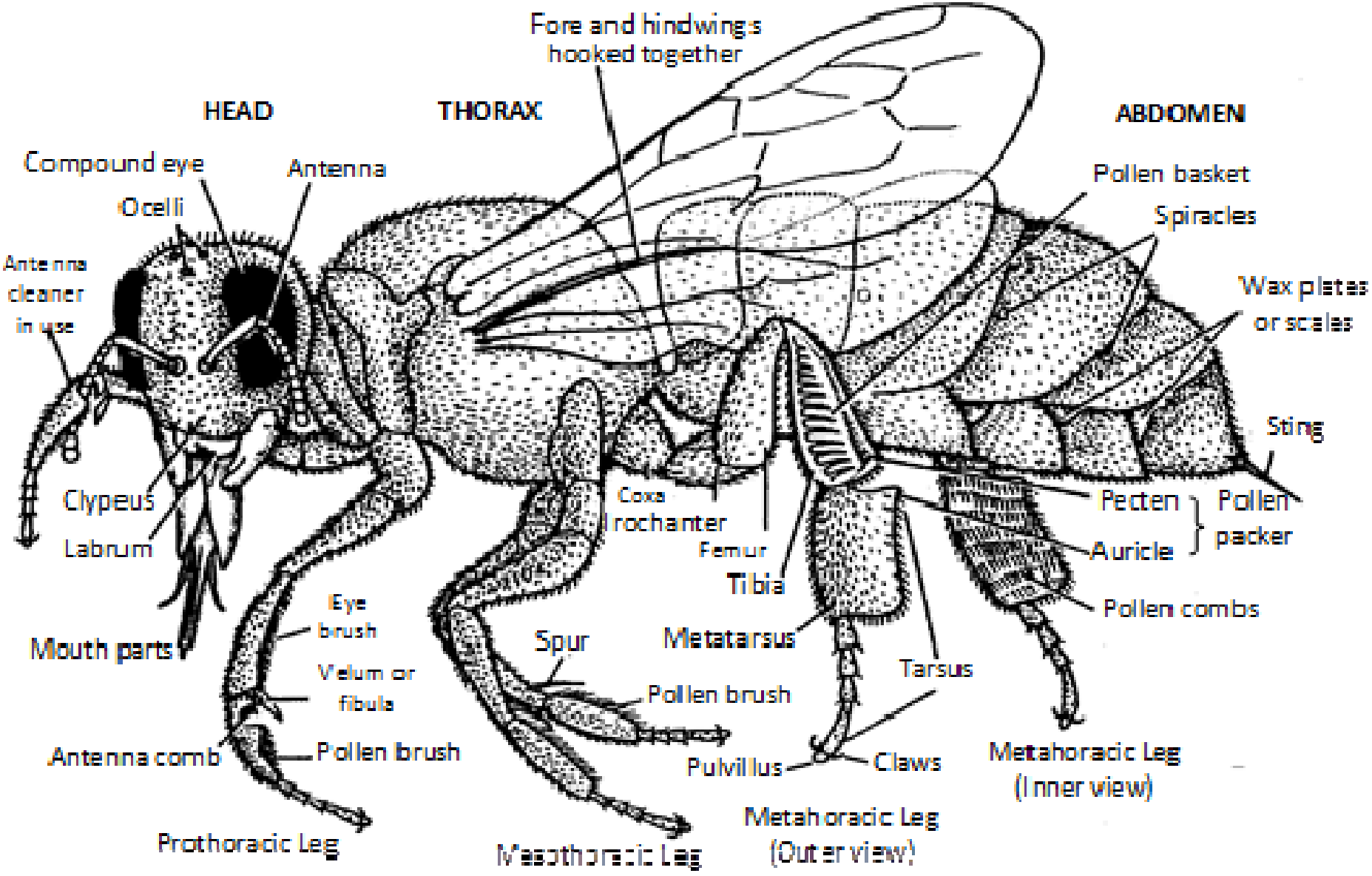
External feature of honey bee



Apis (Honey bee). Worker bee in lateral view

Morphology of honeybees

The honeybee is an insect and has a body divided into three parts: head, thorax, and abdomen.

A. Head

- The head contains the eyes, mouth parts, antennae, hypopharyngeal gland, and salivary gland.

1. Eye

- The honeybee has two flat oval compound eyes at the side of head and three simple eyes (ocelli) located in a triangular pattern between the compound eyes.
- The compound eyes can detect the shape and colour of objects, but not light intensity, and are used for distant sight. The simple eyes detect light intensity and are used for near sight.
- Bees can distinguish different colours but are red blind and can perceive ultraviolet rays

2. Antenna

- The head contains a pair of antennae which are used to detect smells, for touching, and to help balance the body during walking and fighting.
- Head Bears a pair of geniculate antennae

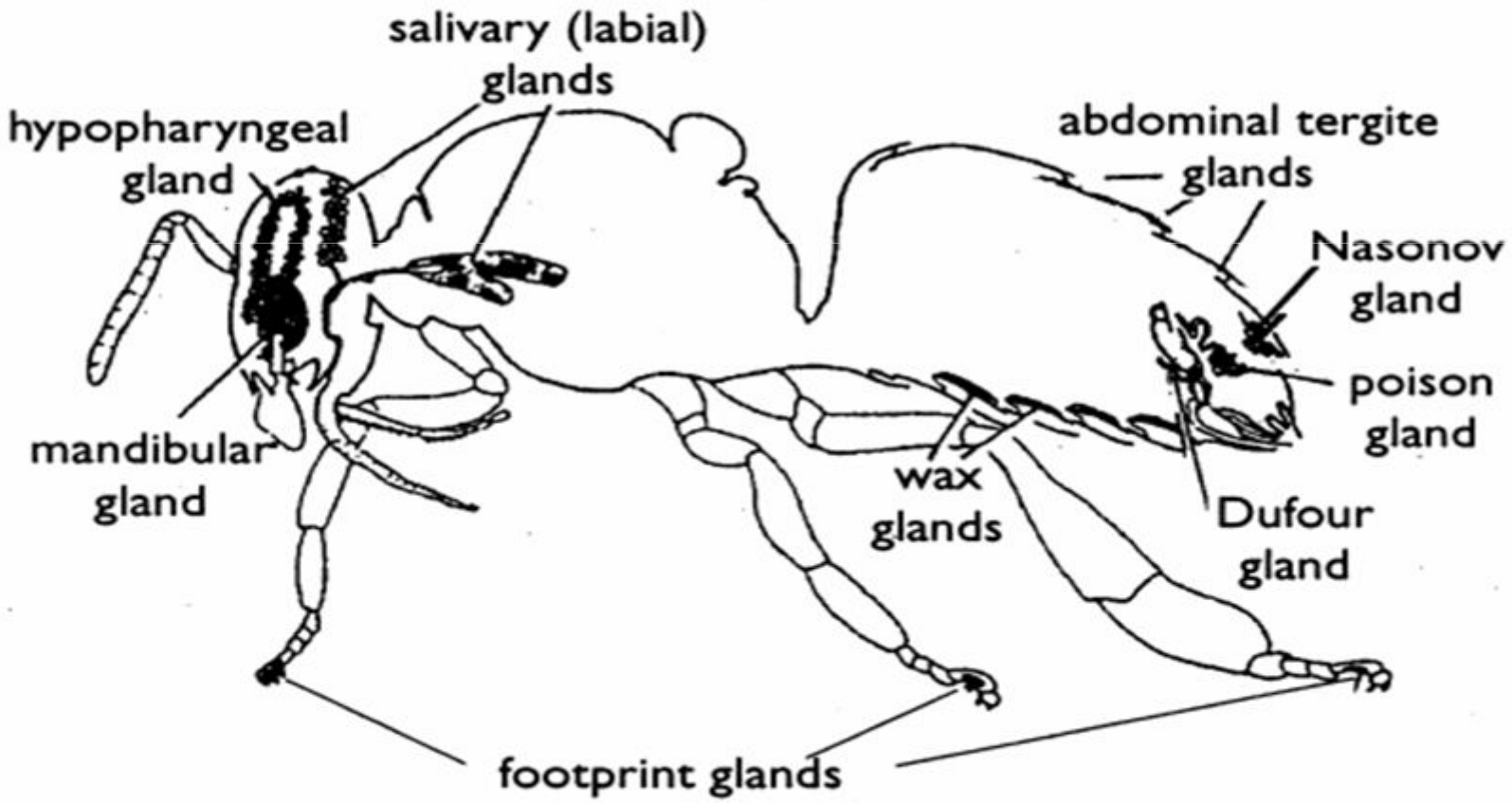
3. Hypopharyngeal glands

- Worker bees have a pair of hypopharyngeal glands on the head which secrete the food called royal jelly.
- Hypopharyngeal glands are large and active during the period in the worker bee's life when they are feeding royal jelly and then dry and inactive.

4. Salivary glands

- Worker bees have salivary glands in their mouth connected with the glossa ('tongue'). They produce saliva containing enzymes which is mixed with the food called 'bee bread' that worker bees prepare by grinding honey and pollen in the mouth. The enzymes help in food digestion.

Major Glands



5. Mouth

- The mouth is composed of the proboscis, mandibles, labrum, and labium.
- Two mandibles are attached to ventro-lateral part of head capsule. Mandibles differ in shape in three castes. Workers use mandibles for grasping and scrapping pollen from anthers, feeding of pollen and in manipulation of wax scales during comb building.

- Mouth parts of worker bees are modified for sucking and lapping. Tongue or proboscis (formed by medium labium and two lateral maxillae) is used for ingesting liquids. Labium has long median glossa and spoon shaped lobe (flabellum) at the end

- The proboscis is a flexible tube used to suck up liquids (nectar, water, honey) into the mouth. It is a temporary structure formed from the glossa, paraglossa, and galea and is folded behind the head when not in use.

- Inside the head there are long coiled strings of small lobes known as hypopharyngeal glands which secrete glandular food known as royal jelly that is fed to queen and young larvae.

- The glossa is composed of an array of hairs that form a tube at the centre and a sponge-like structure at the end. The spongy hairs absorb the liquid which is sucked upward through the tube. The glossa functions as a tongue and can ‘taste’. The sucking capacity of a honeybee depends upon the length of its proboscis.

- *Apis cerana* has a shorter proboscis (3.5–4 mm) and smaller nectar collection capacity; *Apis mellifera* has a longer proboscis (6.5 mm) and greater collection capacity.

- The sickle-shaped mandibles are like paired ‘teeth’, one on each side of the mouth. They are used to collect pollen and propolis, to soften and manipulate wax by chewing, to clean other bees, and to bite workers from other colonies or pests.

- The labium is formed from two fused secondary maxillae and is equivalent to the floor of the mouth; it assists in chewing.

- The labrum is equivalent to the upper lip and supports the sucking process.

Head and mouth parts of honey bee

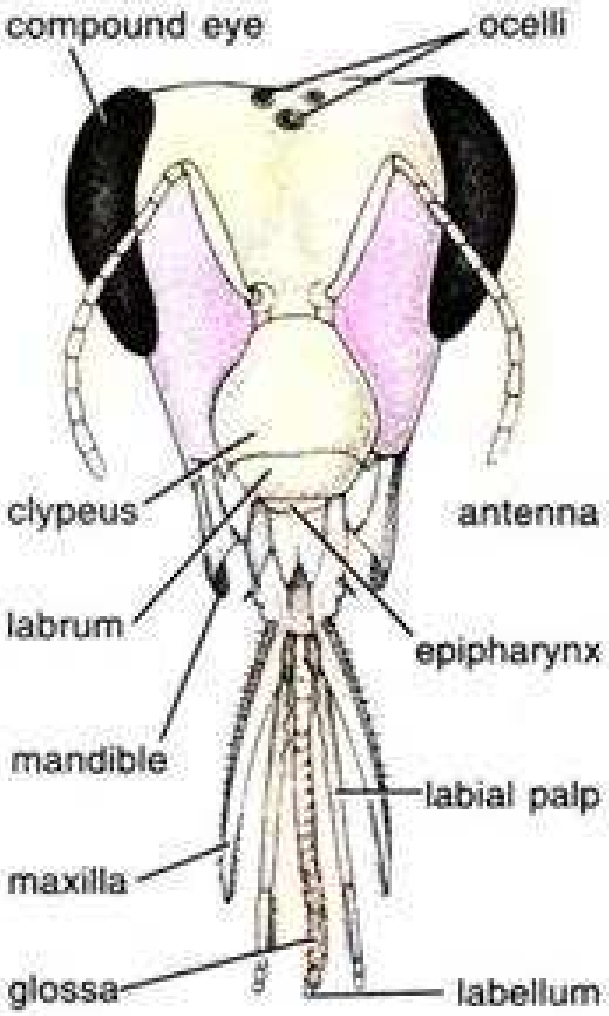


Fig. 77.3. Honeybee. Head and its appendages (Dorsal view)

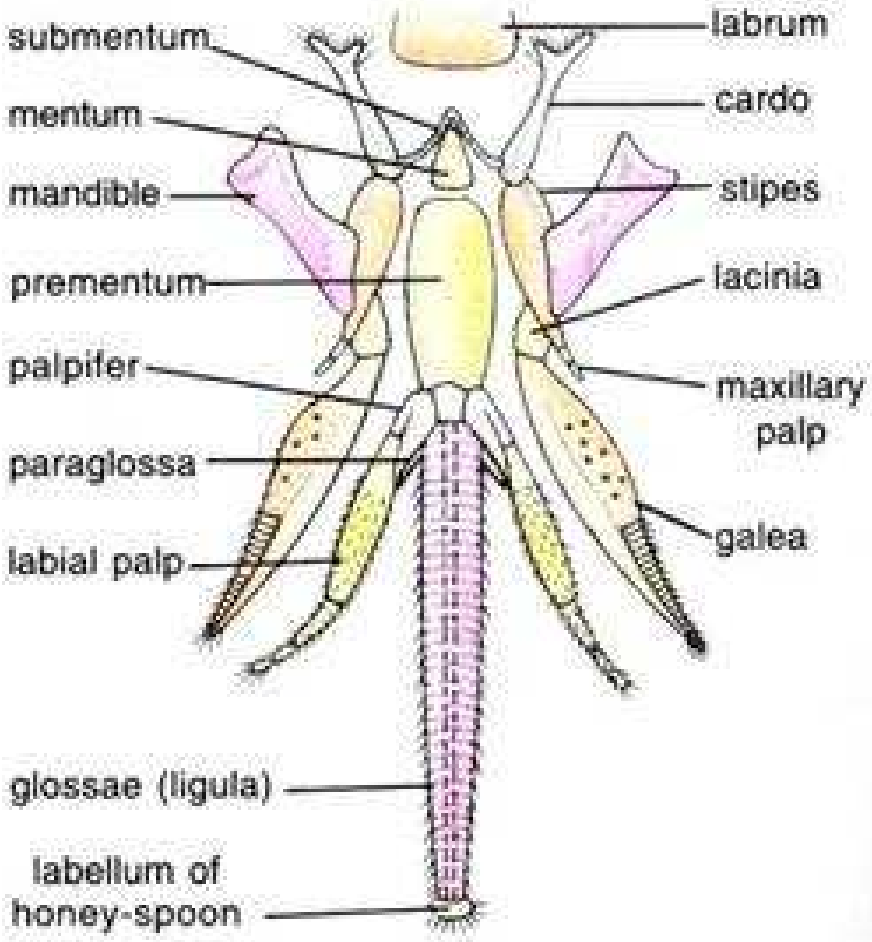
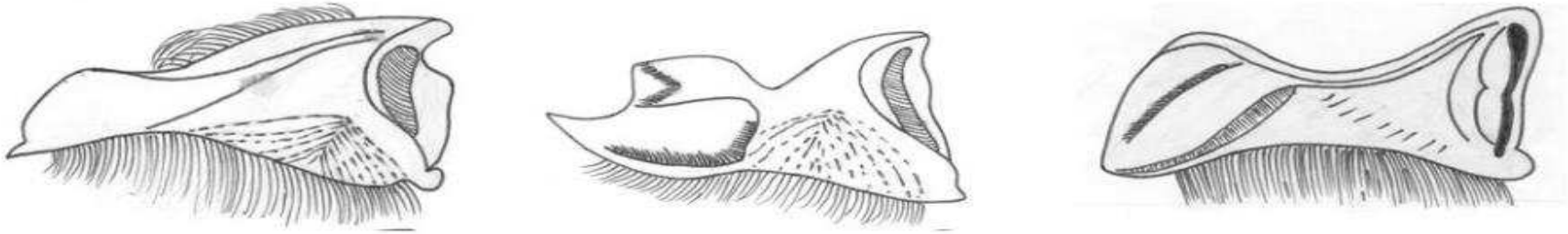
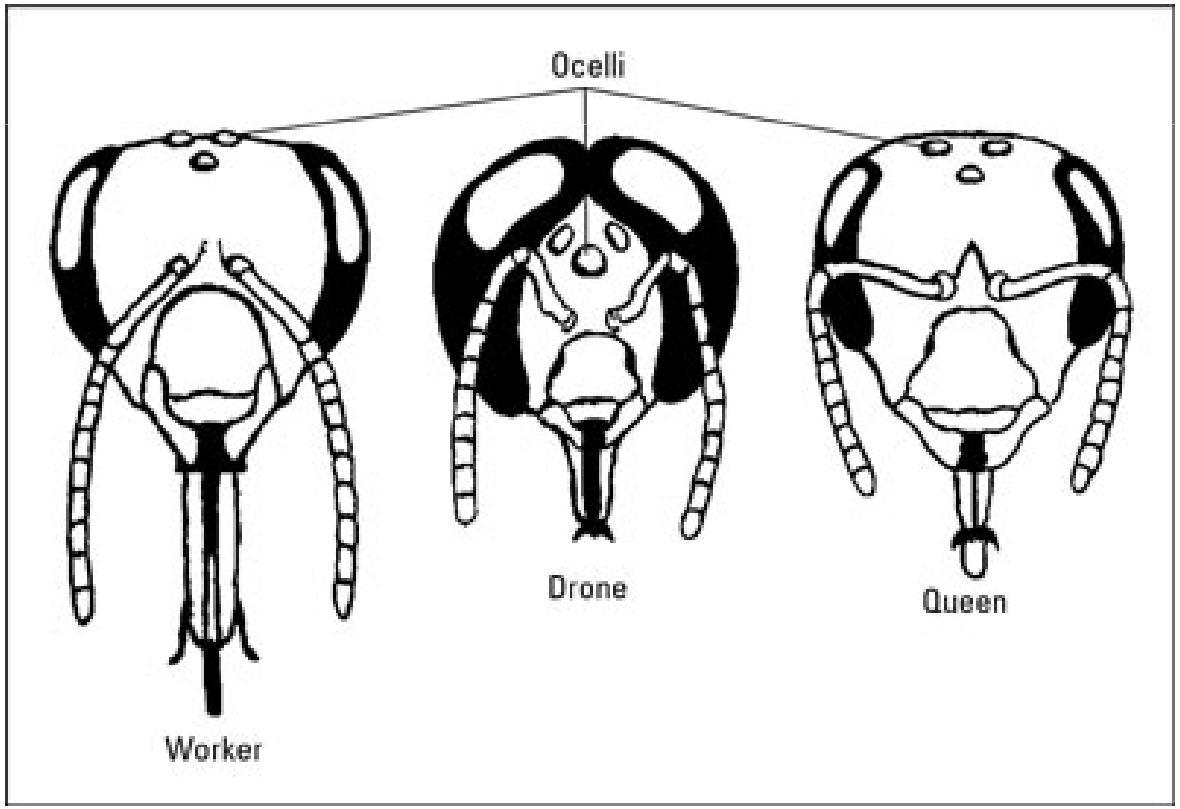


Fig. 77.4. Honeybee. Mouth parts.



Mandible of drone Mandible of queen Mandible of worker

Figure 3.2 Mandibles of different castes of honey bees



B. Thorax

The thorax is divided into three parts. It has three pairs of segmented legs and two pairs of wings.

1. Legs

- The three pairs of legs have different functions. The forelegs hold an antennae cleaner or pollen comb, the middle legs are used to clean the thorax, and the hind legs have a pollen basket for collection and carrying of pollen.

2. Wings

- The two pairs of wings are mounted on the dorsal (rear) segments of the thorax. The front (fore) wings are larger than the back (hind) wings. The pairs are connected by hamuli (hooked structures) which enables flight.

1. Legs of honey bee

The three pairs of legs have different functions. The forelegs hold an antennae cleaner or pollen comb, the middle legs are used to clean the thorax, and the hind legs have a pollen basket for collection and carrying of pollen

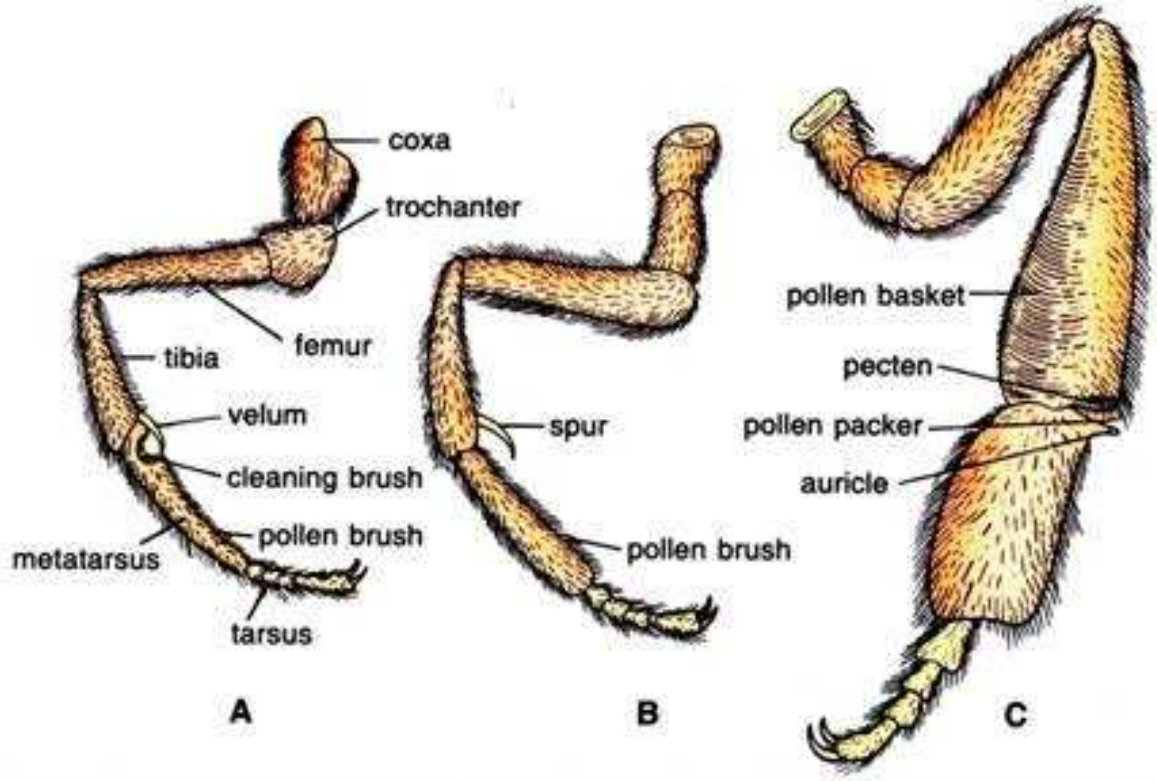


Fig. 77.5. Honeybee. Legs. A—Prothoracic leg; B—Mesothoracic leg; C—Metathoracic leg.

2. Wings

- Two pairs of wings arise from sides of meso and metathorax. Fore wings are stronger than hind wings.
- Series of upturned hooks (hamuli) are present on front margin of each hind wing.
- Decurved fold on rear margin of fore wing works as coupling apparatus for holding hamuli and this result in unity of action of the wings in flight.

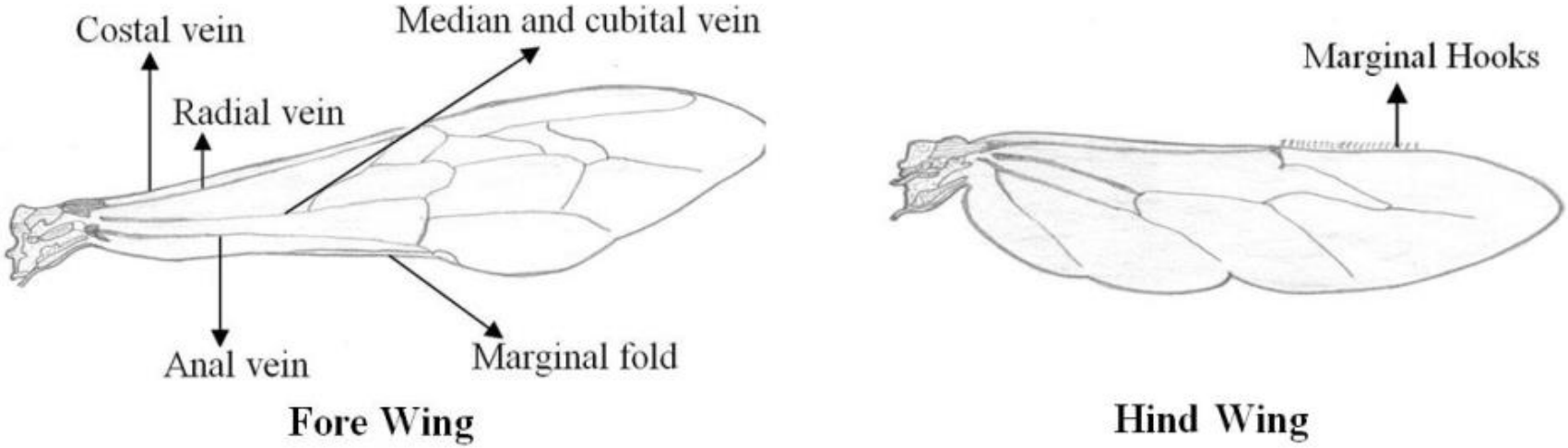


Figure 3.5 The wings of a worker honey bee

C. Abdomen

- First abdominal segment is united with the metathorax and forms anatomically a part of thorax known as propodeum

- Bee larva has 10 abdominal segments but in adult workers abdomen appears 6 segmented; segments 8-10 are reduced in size and first segment (propodeum) is transferred to thorax during pupal stage

- Abdomen bears sting, wax glands (on sternites 4 to 7) and scent glands (on last two terga) and genitalia in addition to other viscera

- In workers egg laying apparatus (ovipositor) is modified into sting

- Queen uses ovipositor for egg laying and for stinging rival queen.

1. **Wax gland**

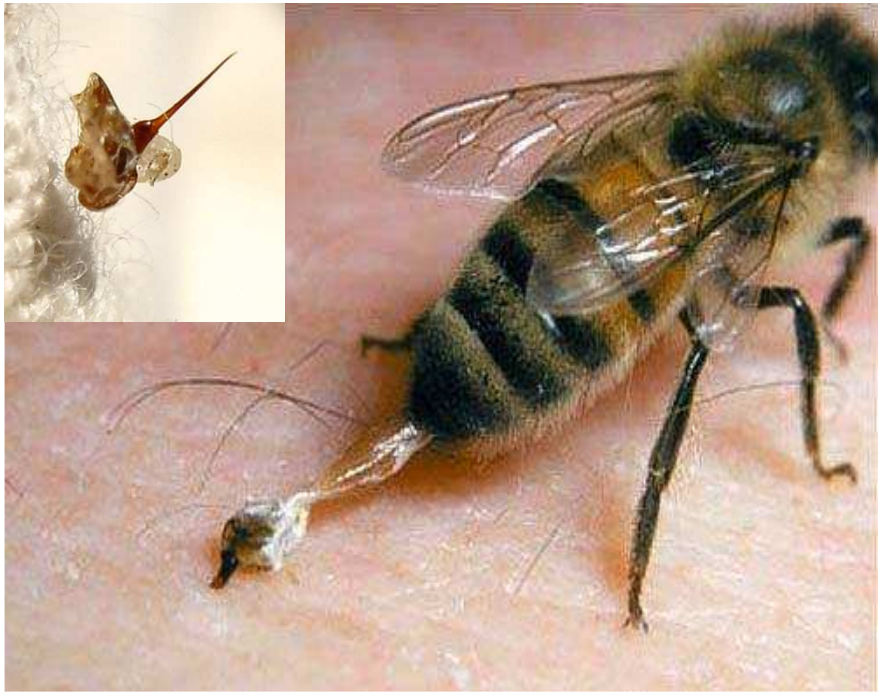
- The fourth to seventh segments of the abdomen have white shiny wax mirrors located on their lower parts connected to four pairs of wax glands, which secrete liquid wax onto the mirrors to form wax plates. The pollen combs on the forelegs are used to scrape the wax off and move it to the mandibles where it is ground and mixed with the secretion from the salivary gland (saliva) before being used to build combs.

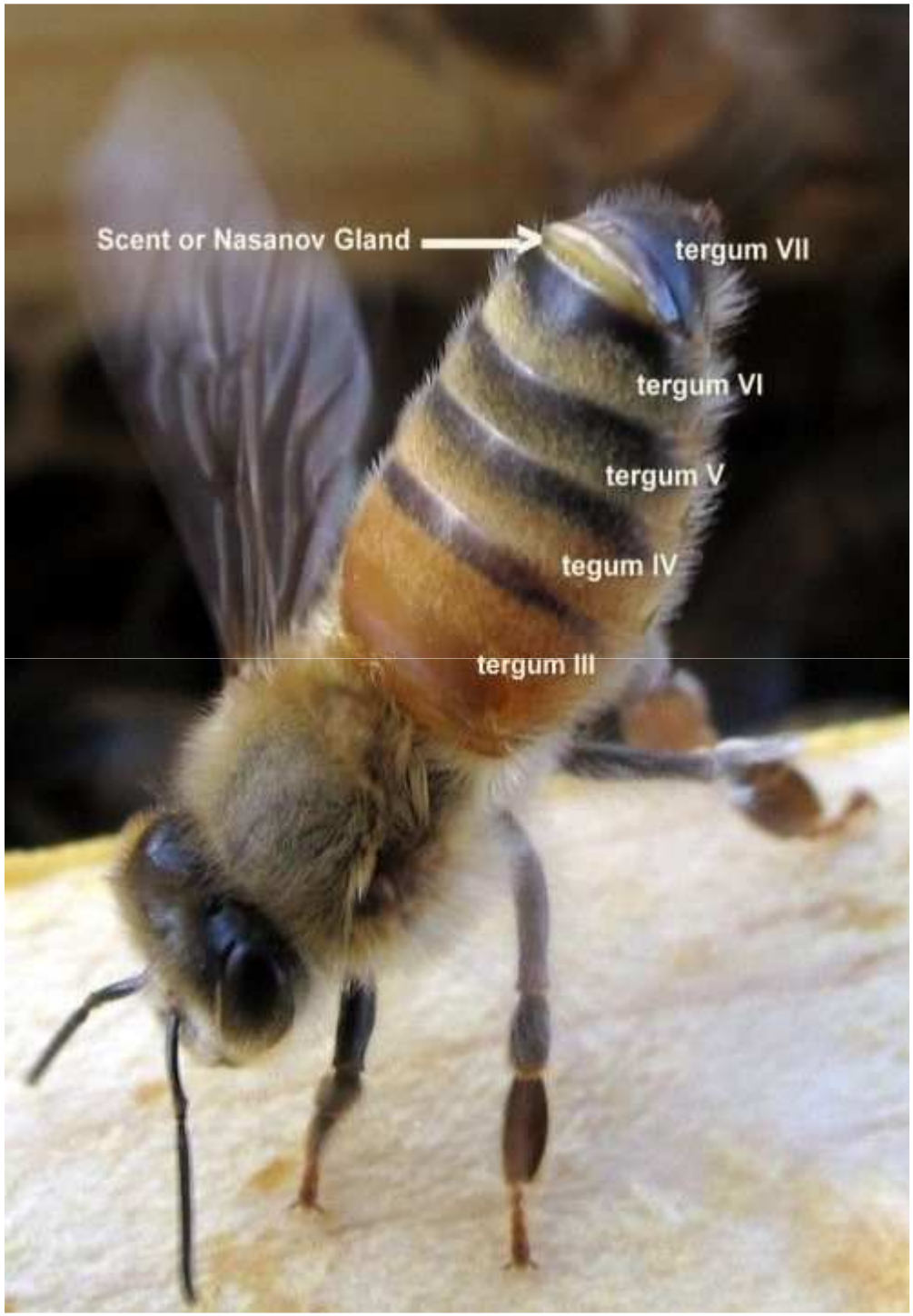
2. **Scent gland**

- The seventh abdominal segment contains a wide pale-yellow stripe connected to a scent-producing gland inside. The scent is used for the identification of friends and foes.

3. **Poison gland and sting**

- The seventh abdominal segment contains a pair of poison glands (made from merging the eighth and ninth segments) connected to a sting. The sting has curved barbs which stick in the bodies of mammals. When the bee flies off after stinging, the sting usually separates from the brackets, pulling out part of the bee's abdomen, and the bee dies.
- Bee venom (apitoxin) is a complex mixture of proteins (enzymes), peptides, amines, and other compounds.




Scent or Nasanov Gland
tergum VII
tergum VI
tergum V
tegum IV
tergum III

Honey stomach or crop

The honeybee alimentary canal passes from the mouth through the thorax to the fourth segment of the abdomen where it connects to an enlarged sac called the honey stomach or crop. Nectar is stored in the crop temporarily after collection and regurgitated after the bee returns to the hive, where it is passed to a house bee who stores it in a honey cell. A thick membrane inside the crop prevents the nectar from passing into the intestine.

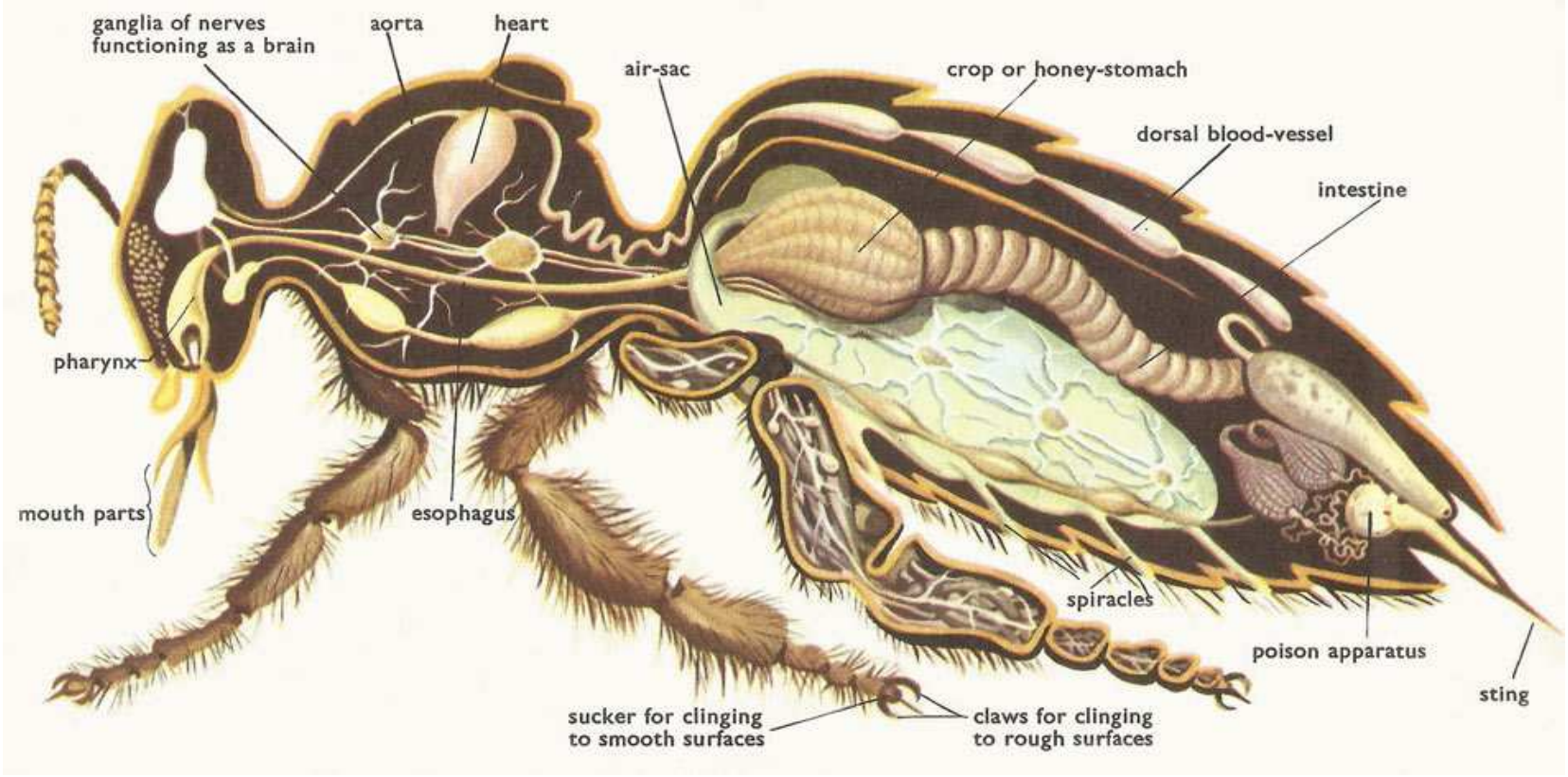


TABLE 1.—*Queen pheromones*

Gland or source and chemical	Behavior reactions in colonies	Citations [1]
Mandibular:		
9-oxodecenoic acid 10-hydroxydecenoic deconic acid	Recognition of queen and reduction of egg laying by workers.	Butler (*1964*).
9-oxodec-trans-2-enoic acid	Mating attractant	Gary (*1962*).
Do	In combination with worker bees, scent gland holds swarming bees together.	Morse (*1971*).

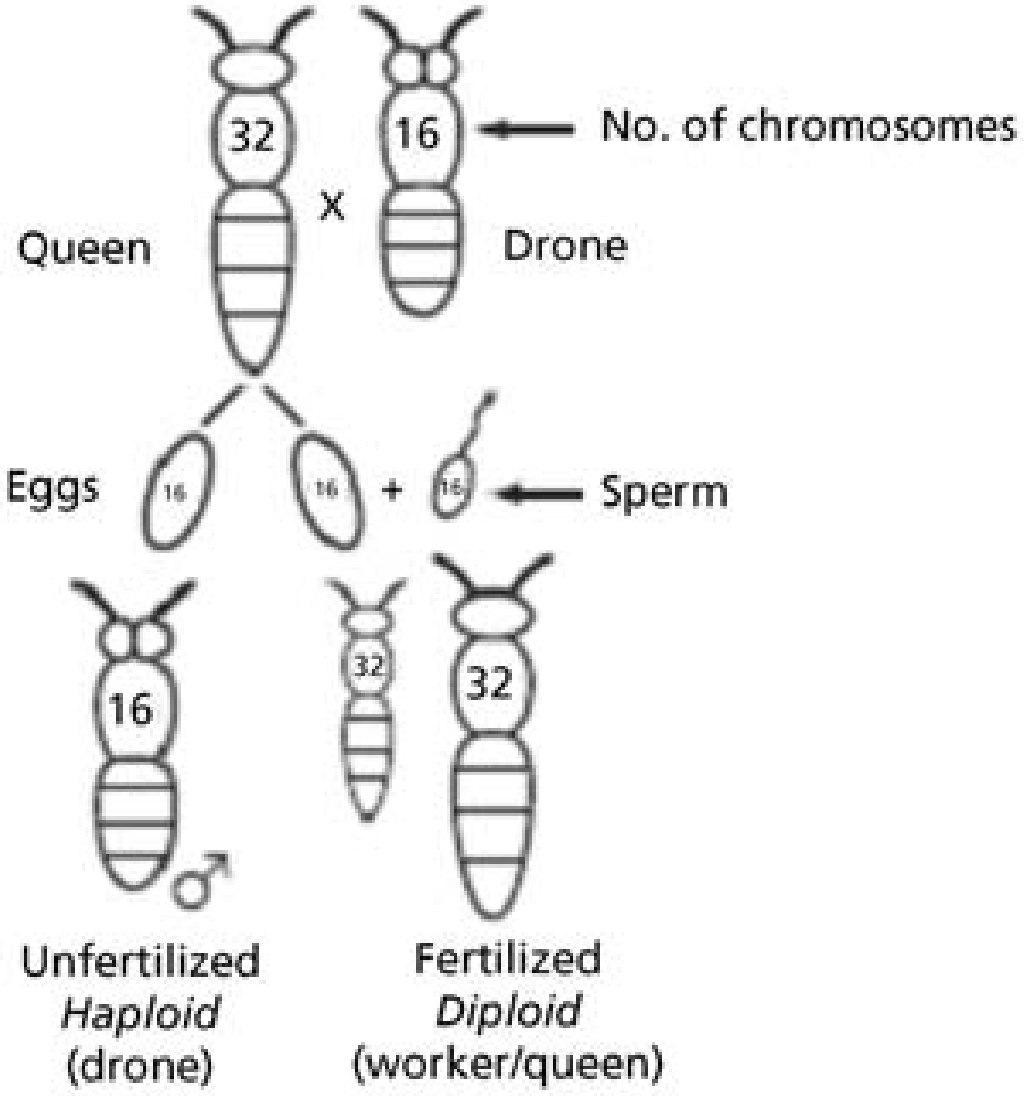
[1] Citations are not listed; consult Gary (*1974*).

TABLE 2.—*Worker bee pheromones*

Producing gland or source	Chemical compound	Behavior reaction in colony	Citations [1]
Nassanoff or scent	Geraniol	Fanning attractant	Boch (*1963*).
Do	Nerolic acid	-----do	Boch (*1964*).
	Geranic acid	-----do	
Do	Citral	-----do	Shearer (*1966*).
Do	All compounds of scent gland.	Swarm attraction and stabilization.	Morse (*1971*).
Sting	Iso-pentyl acetate	Colony alarm	Boch (*1962*).
Mandibular	2-heptanone	Alarm communications	Boch (*1965*).

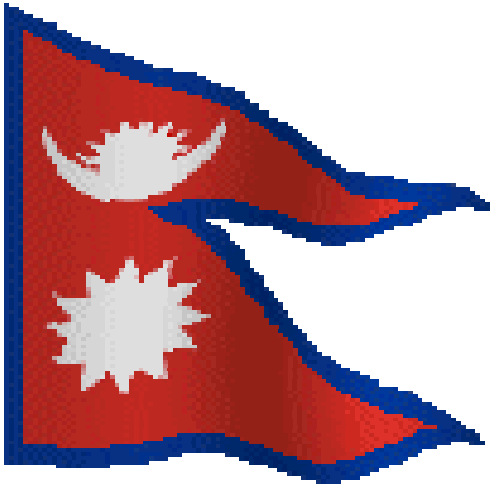
[1] Citations are not listed; consult Gary (*1974*).

The number of chromosomes in bees



Fact

- In 1609, Charles Butler in England produced his book on bees called *The Feminine Monarchie (see Figure 5), in which he recognized that the king* was in fact a female and so should be called a queen.
- Royal jelly has up to 10 times more pantothenic acid and 18 times more biopterin than food fed to worker larvae, but quantity is also important, and queen larvae must consume far more food than workers.
- If the queen suddenly dies or is removed, there will be no eggs in queen cups to develop into queens. The workers will then choose young larvae under three days old in worker cells that already exist, draw out the cells, feed them as for queens and so produce emergency queens.



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