Respiration in Arthropoda.

The respiration involves the exchange of gases between the body and the environment. The oxygen from the surrounding medium enters within the body and carbon dioxide comes out of the body to the environment. Either entire surface or at least some parts of the body act as respiratory surface. If the animal is terrestrial then the surface of exchange must remain moist. Usually the circulatory system carries oxygen from the respiratory surface to the different tissues and again returns carbon dioxide from the tissues to the respiratory surface for removal.

Respiratory organs in Arthropods :-

Among the arthropods - Branchiopoda, cirripedia, chironomous larvae and minute Arachnids respire through the generally surface of the skin. In these forms exchange take place by the physical process of diffusion. But most arthropods have specialised structures for aquatic and aerial respiration.

Aquatic respiration :-

1. Gills :-

The gills are the respiratory organs of aquatic arthropods. These are best developed in crustaceans. In other aquatic arthropods, special types of gills are often encountered.

i) Origin of Gills in crustacea :-

Gills originate as outpushing of the body wall. In Amphipoda, the gills are outgrowths of the thoracic limbs and in Isopods the endopodites of second and fifth pleopods are modified as gills.

ii) Shape of gills in Crustacea :-

A typical gill is crescent-shaped. It consists of a rod, on each side of which are arranged blade-like gill filaments. One end of each filaments remains connected with rod and blood vessels enter into it through this region.

iii) Types of gills in Crustacea :-

According to mode of attachment the gills may be of three types :-

a) Podobranchia — attached with the exopodite of the thoracic appendage.

b) Arthrobranch — attached with the Arthroidal membrane.

c) Pleurobranch — attached with the lateral wall of thorax.

Fig - Podobranchiate gill of crustacea.

iv) Modification of gills in Arthropoda :-

The gills are variously modified in Crustaceans and other Arthropods -

In phyllocarida — broad epipodites of the thoracic appendages work as gills.

Similar gills are seen in Cumacea. Gills are platelike in Amphipoda and flattened in a Decapod, palinurus as

In phyllopoda — the leaf like pleopods work as gills.

Fig - Pleurobranchial gill

2. Tracheal gills :-

i) To obtain oxygen dissolved in water nymphs and larvae of many aquatic insects posses special adaptations.

ii) Trachial gills are one such adaptation which develope as leaf-like or filiform outgrowths covered by very thin cuticle with a networks of tracheoles.

iii) They are located various parts of body, frequently abdomen, less frequently thorax and rarely head.

iv) For instance, most zygopteron larvae have filamentous abdominal gills, while larval plecoptera have tracheal gill. Larval Anisoptera have gills in the anterior part of rectum, which in known as branchial chamber.

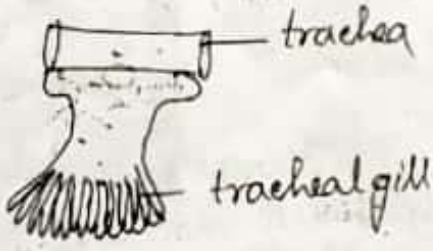

Fig - Tracheal gill.

3. Blood gill :-

Some aquatic insects such as trichopterus and tipulid larvae posses gills devoid of tracheae but containing blood. These are termed as Blood gill.

4. Rectal gill :-

In the nymphs of several insects the inner surface of rectum bears gills. These gill are called Rectal gill.

is in the form of a valve to prevent undue loss of water and to regulate the in and out flow of air.

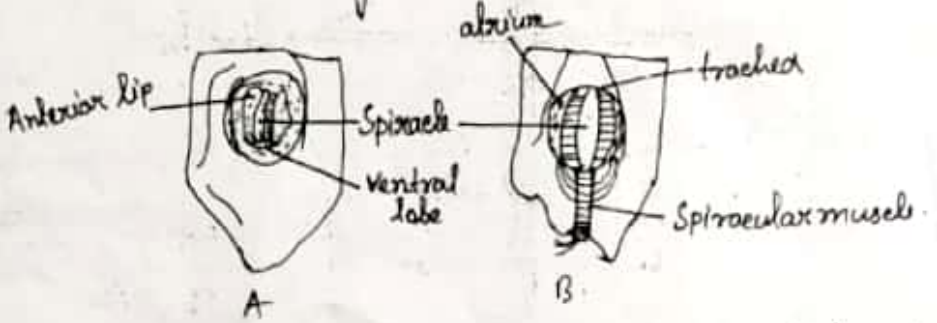

Fig – Spiracles of an Insect – A. Outer view
B. Inner view.

b) Tracheae :-

Tracheal system is an invagination of the cuticle. It is represented by an extensive network of branching and anastomosing tubules. The general plan varies in different species and orders of insects, but there is usually a pair or more of longitudinal trunks with cross-connections. The wall of each trachea is formed of three layers, an inner chitinous layer or intima with a spiral thread like thickening or taenidia. Taenidia prevents the collaps of the trachea if the pressure with gets reduced. Intima consists of outer epicuticle with a protein-chitin layer below it. In the middle of the cellular layer of epithelium and an outer delicate supporting layer or basement membrane.

c) Tracheales :-

At various points along their length, and especially distally, the tracheae gives rise to finer tubes called tracheoles. There is no sharp distinction between tracheae and tracheoles but the latter are always intracellular and retain their circular lining at moulting, which is not usually true with tracheae.

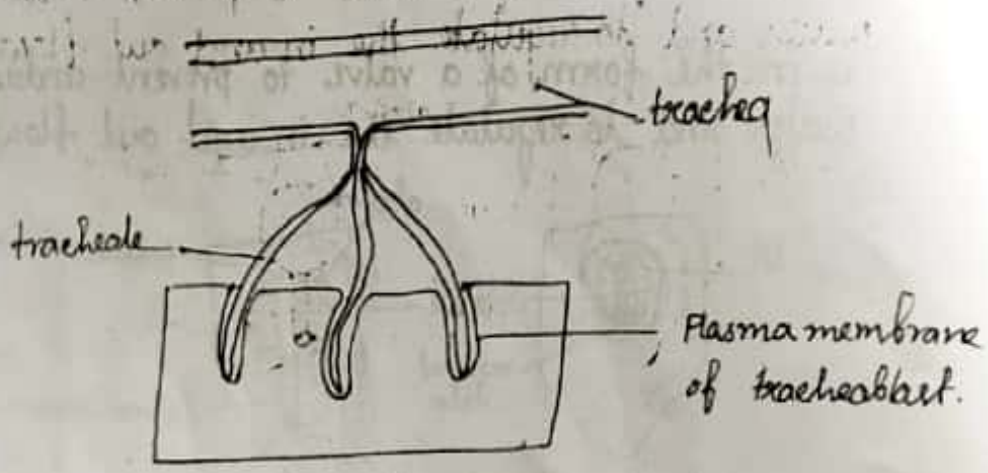

Fig- An intracellular tracheole.

d) Air sacs :-

In grasshoppers, butterfly, bees, cicadas etc, the tracheae dilates into air sacs of different sizes. These may be found in places where muscle movement will fill and empty them. Scarabaeid beetles also have smaller air sacs along the tracheae of the elytra. These chambers are innervated and invested with the tracheal coverings but in reverse order, with the cuticle outside. The air sacs lack the spiral thickening, allow an increased supply of oxygen and afforded a greater breathing capacity to the insect.

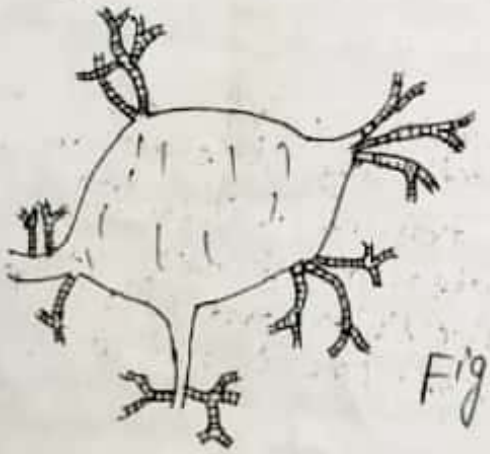

Fig- An air sac

Types of tracheal systems :-

Tracheal system can be classified on the basis on number and distribution of functional spiracles out of total numer of ten pairs.

a) Holopneustic :-

when all the spiracles remain open e.g. most adults and many larval insect.

b) Hemipneustic :-

when one or pair of spiracles remain closed e.g. — Some flies, beetles, butterflies etc.

c) Apneustic :-

when the spiracles are altogether lacking e.g. endoparasitic and aquatic larval insects. In such cases the gaseous exchange takes place either through the body surface or through its out growths, called gills.

other devices of aerial respiration

1. Lungs :- In the crustacea, Birgus sp. the upper part of the gill chamber is separated from the rest and forms a closed chamber within which vascular tufts project.

2) Book lung :-

The book lungs are best seen in Scorpionids. There are blind sacs which originate from the evaginations of Ophisthaoma. These are regarded as