

Physiology of Respiration

Dr. Mahesha H B

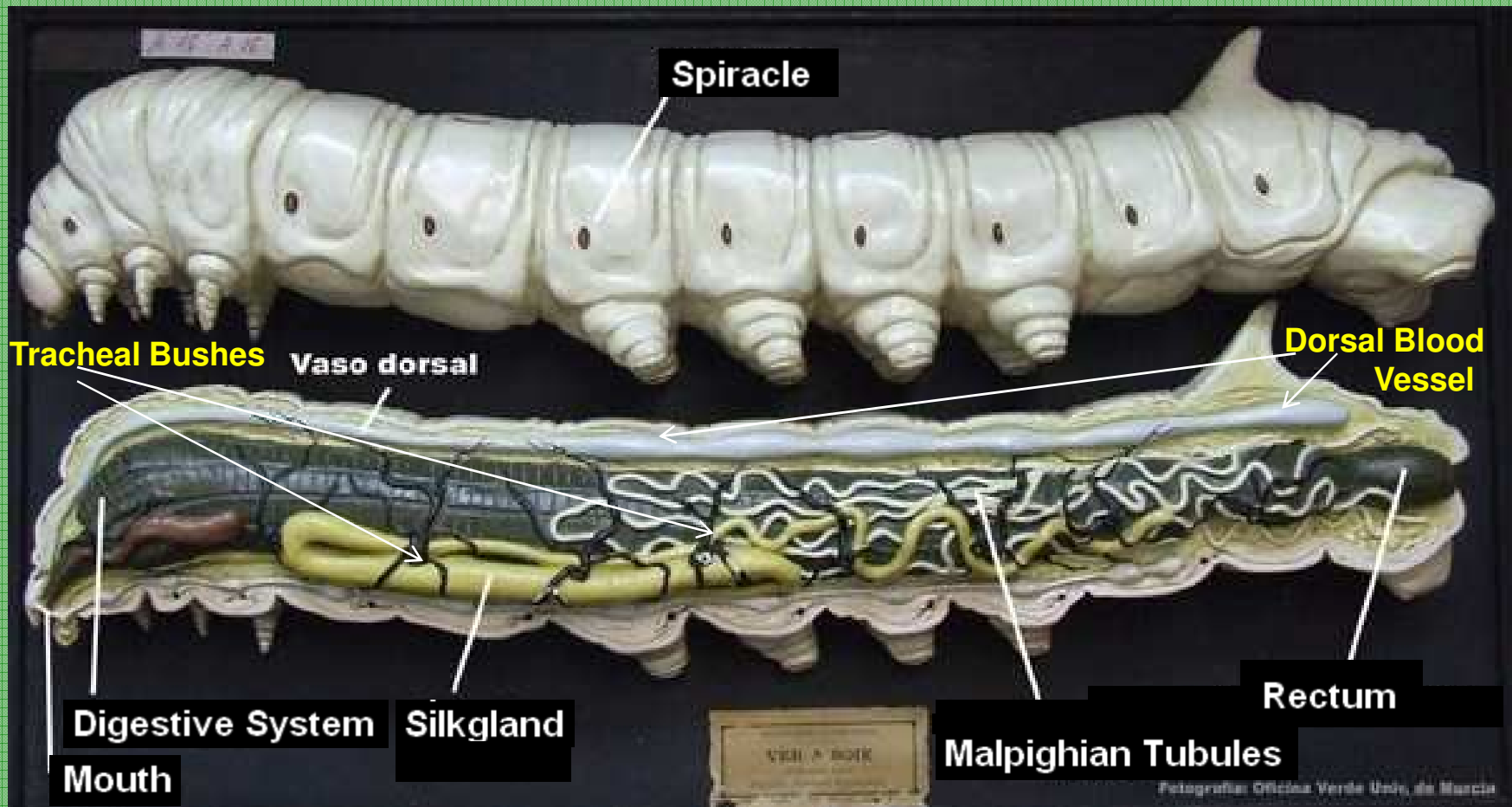
Professor and Head

Department of Sericulture

Yuvaraja's College

University of Mysore, Mysuru, India

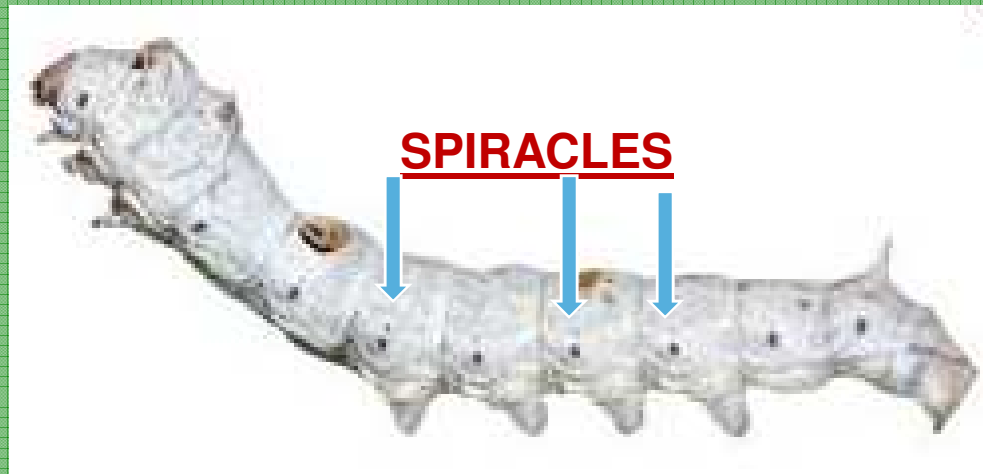
Overall Morphology and Anatomy of Silkworm Larva



In insects the intake of air for oxygen and distribution of air within the body is performed by a fine network of tubules called **tracheal** system.

The tracheae are invaginations of the cuticle, which branch everywhere, among the tissues which convey the O₂ directly to the site of utilization and the haemolymph is not concerned with gas transport.

Silkworm External Morphology showing SPIRACLES

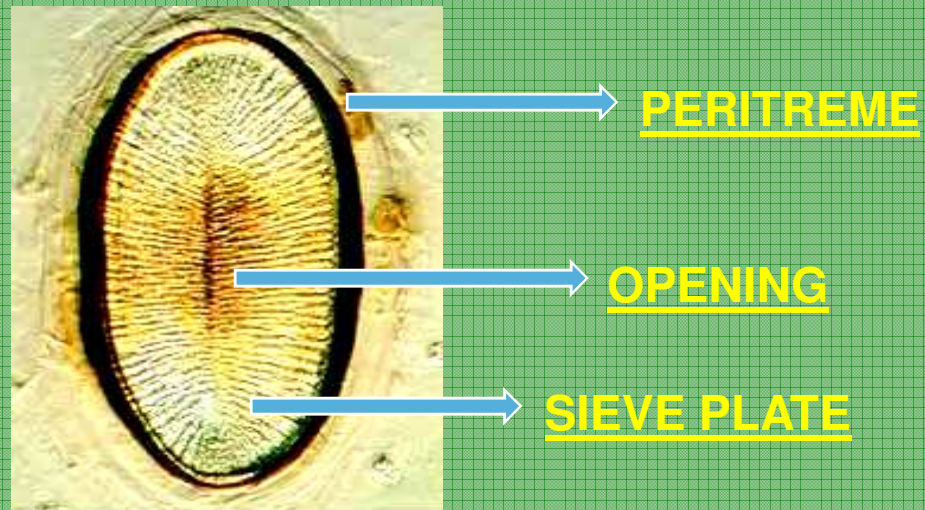


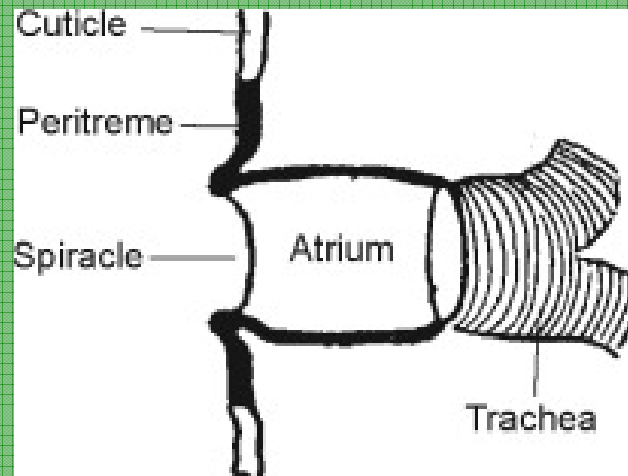
There are nine pairs of spiracles, one on each side of the pro-thorax from the first to the eighth abdominal segments.

Spiracle

- **Is the external opening through which air enters into the trachea.**
- **Respiratory function is carried out through the spiracles by the movements of the body wall.**
- **There are 9 pairs of spiracles, one on each side of the pro-thorax & from the 1st to 8th abdominal segments.**
- **It has a chamber or atrium with a opening and closing mechanism called Atrial valve.**
- **Spiracle is surrounded by a Sclerite called Peritreme.**
- **Closing and opening of spiracle is regulated by atrial valve.**
- **Peristigmatic glands present around the spiracle that prevents the wetting of organs.**

SPIRACLE ENLARGED A spiracle consists of peritreme, sieve plate and a atrium.





As the tracheal system is continuously exposed to the atmospheric air, there is every chances of moisture loss from the tracheal system. But to prevent this desiccation or moisture loss insects developed a **perispiracular glands**. These perispiracular glands are distributed on the inner surface of the tracheal system. These are **unicellular glands**, secretes a **hydrophobic oily substance** all over the inner surface of the tracheal system, which keeps the surface oily and moist.

•Tracheae

•The tracheae are lined with a thin layer of cuticle which is thickened to form spiral rings that give them rigidity.

•They are lined by cuticle continuous with that of the body wall.

•Thread like ridges run spirally around the inner circumference and form the so called spiral thread. The spiral thickening is known as taenidia.

•Taenidia prevents the collapse of the trachea. When filled with air they present a silvery appearance.

•Tracheoles

•The smallest branches of the tracheae are the tracheoles.

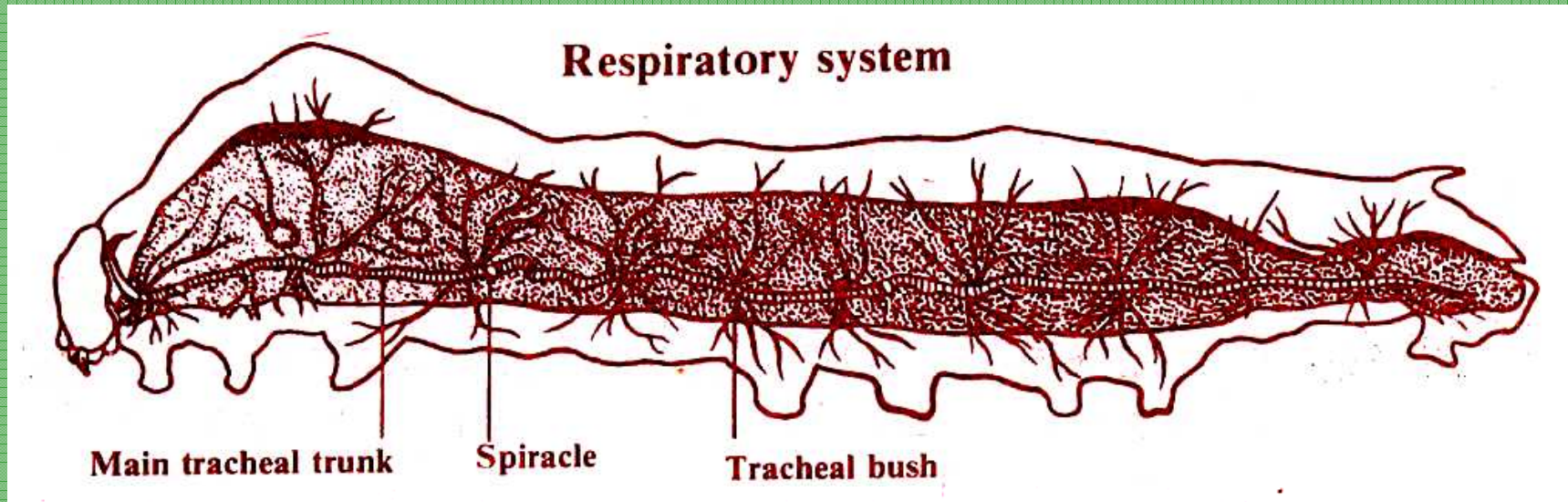
•Tracheoles are less than 1 micron in diameter; they end blindly and closely contact the respiring tissues.

•It is intracellular in nature, but enclosed only in the cytoplasm of tracheal and cell called tracheoblast.

•Gaseous exchange occurs here. Provide for a tremendous amount of surface area.

•Through such a network of tracheae and tracheoles oxygen is carried to the various parts, tissues and cells of the body and carbon dioxide is removed, through the same channels.

RESPIRATORY SYSTEM SHOWING THE TRACHEAL DISTRIBUTION

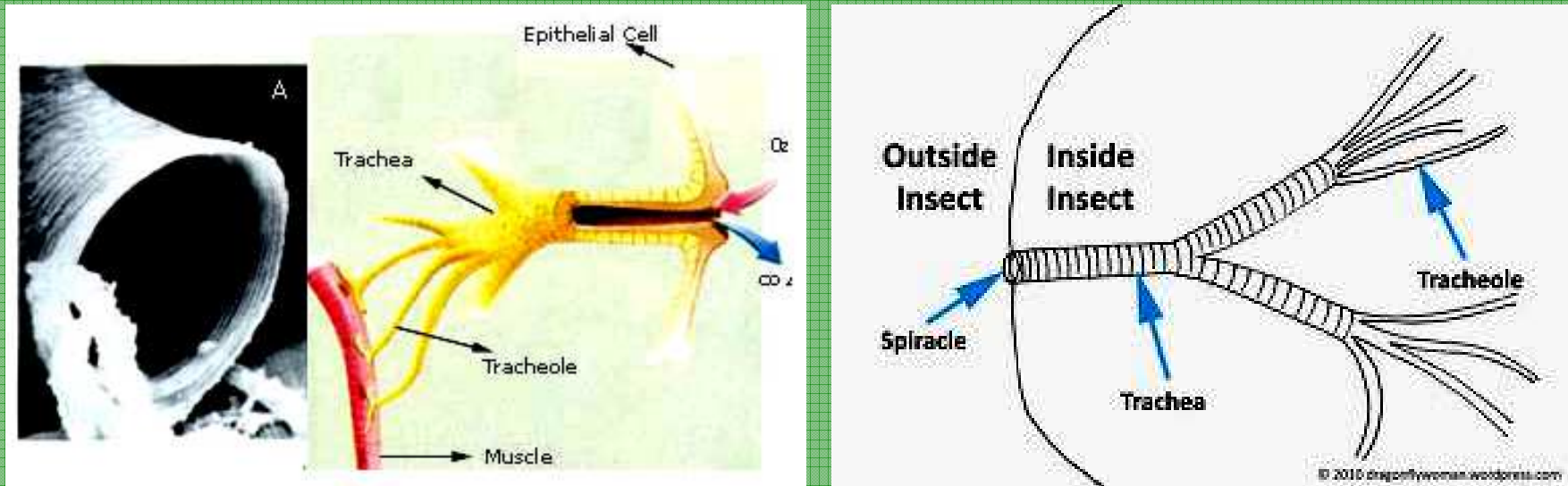


The number of tracheal branches start radially from the spiracular cavity next to the atrium and looks like bushes called tracheal bushes.

All the nine tracheal bushes get connected laterally by the longitudinal lateral tracheal trunks. And the two tracheal bushes in the respective segments get connected by transverse ventral tracheal commissures.

Tracheae ramify repeatedly, forms tracheoles, diameter is one micron.

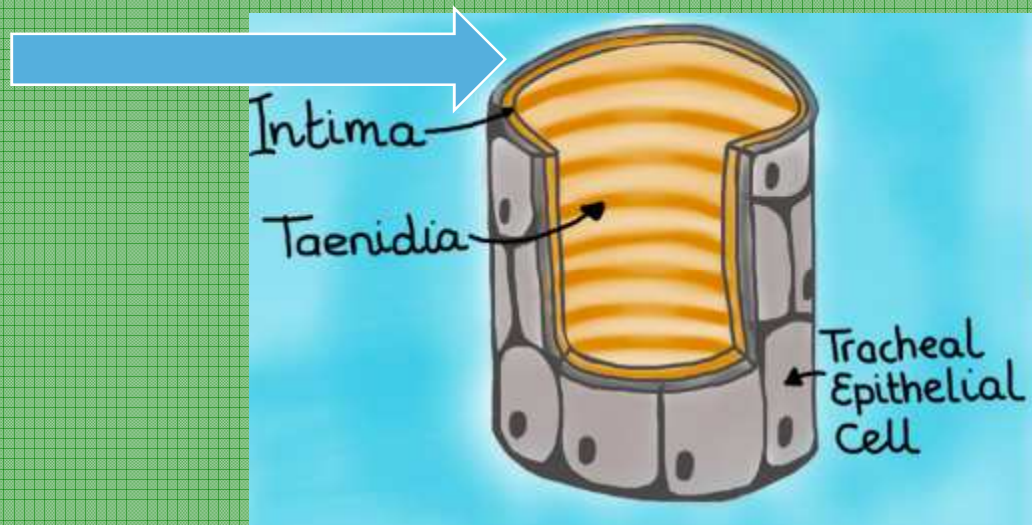
Diagram showing the distribution of trachea and movement of gas



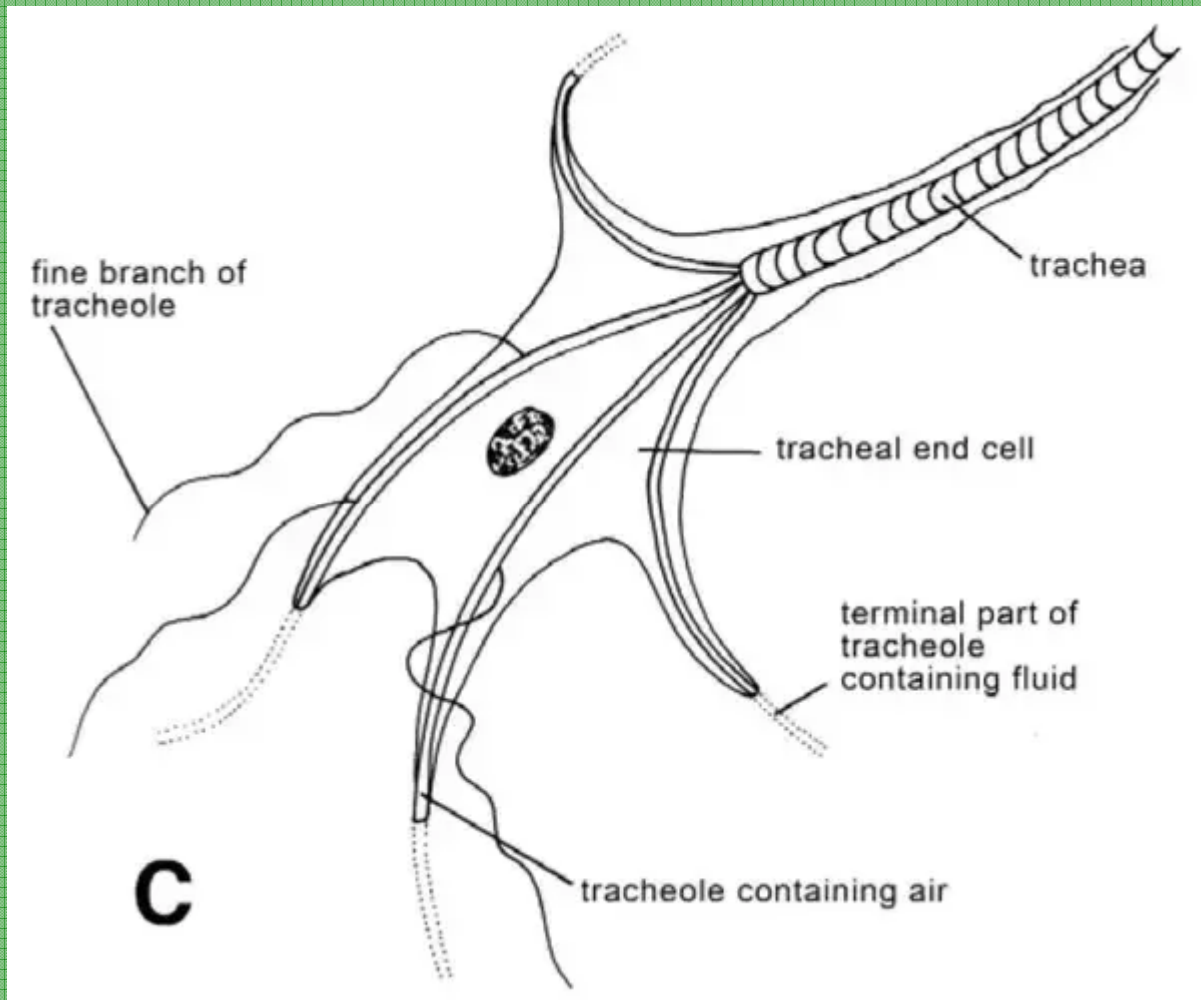
Trachea are lined by cuticle continuous with that of the body wall. It has a characteristic striated appearance due to thread like ridges which run helically around the inner circumference and form **taenidium**. It prevents from collapsing of trachea.

There is a membrane between the taenidia is called inter **taenedial membrane**, it is very thin and highly flexible. So trachea can stretch to double length without breaking them. So the taenedia and thin membrane provide the necessary rigidity and flexibility to the tracheal tracheal membrane is 0.01 to 0.02 micron thick.

Internal view of tracheal system



Epithelial cell layer
is covered with
acellular
basement membrane



When the tracheae has been reduced by repeated branching to a diameter of 2-5 micron it enters a large satellite cell, the tracheal end cell or transitional cell and there breaks up abruptly into a number of tracheal capillaries or tracheoles, which are less than one micron in thickness. These tracheoles are inter connected with each other and form a mat over tissues.

It is generally supposed that the passage of oxygen from tracheoles in to the tissue takes place by physical diffusion. But several authors have suggested that the tracheal epithelium, and particularly the tracheal end cells play a more active part.

Breathing occurs by the movement of body wall.

The tracheoles end in the tissues in various ways. In the gut and salivary gland they ramify and pass between the cells without penetrating them. In the fat body and rectal papillae, however they may enter the cells, while in the flight muscle there is a net work of intracellular tracheoles. A solitary exception is the fore part of the silk gland which has no tracheation.

Acknowledgements
to

- 1. Sericulture Manual II, FAO, Rome, 1987.**
- 2. The Principles of Insect Physiology by V B Wiggelesworth 1972.**
- 3. The silkworm – A Laboratory Tool by Y Tazima 1979.**
- 4. Internet.**