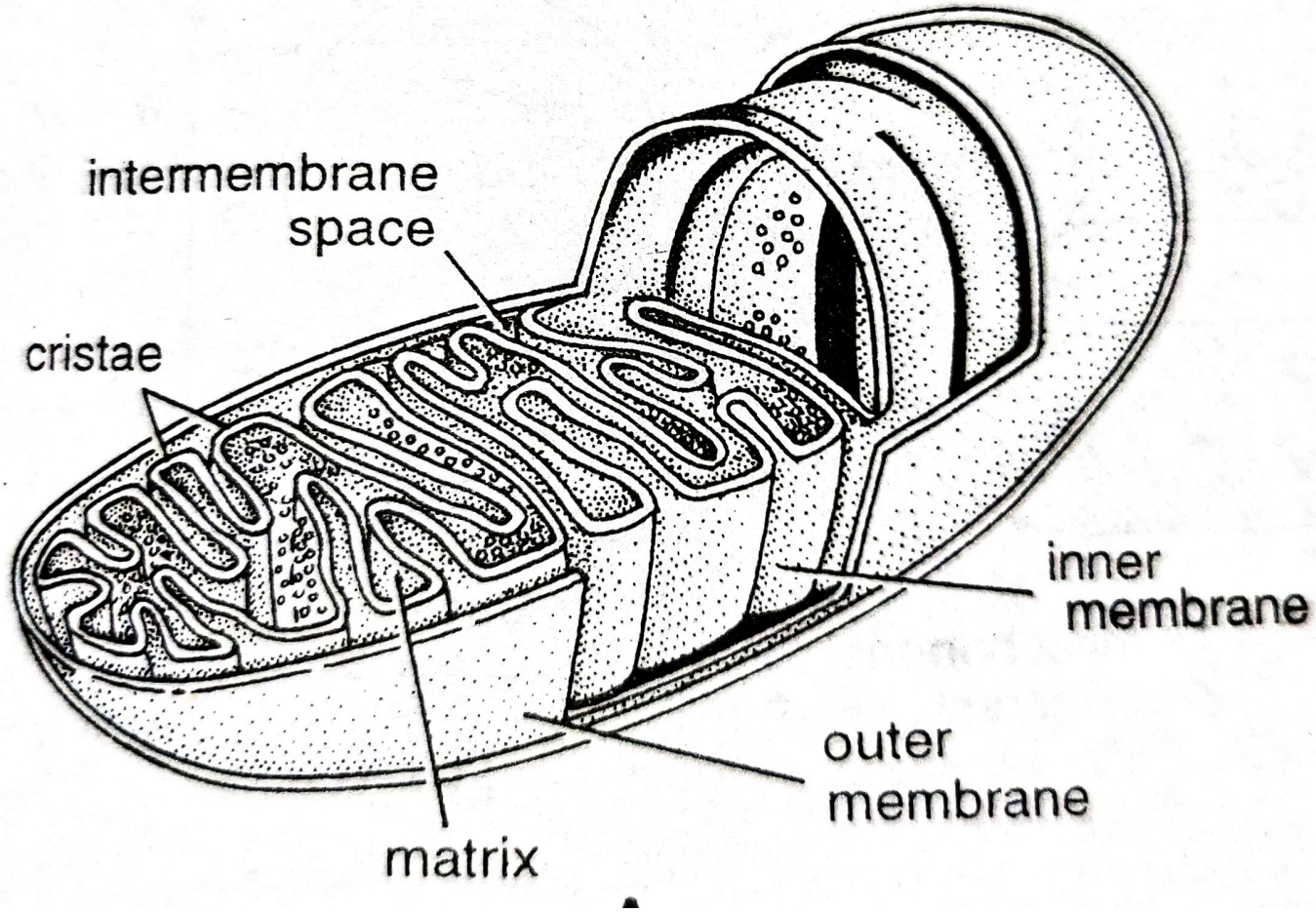
Mitochondria: Structure and Function

[I] History

Kolliker (1880) was the first to observe mitochondria dissected from the muscle cells of insects. **Flemming** (1882) called them '**fila**' while **Altmann** (1894) gave the name '**bioblast**' to these organelles. The term **mitochondria** which



is the most accepted one, was given by **Benda** (1897). **F. Meves** (1904) discovered the presence of mitochondria in *Nymphaea*, a plant. **Warburg** (1913) observed that respiratory enzymes were associated with these cytoplasmic particles. Finally, **Hogeboom, Schneider** and **Palade** (1948) confirmed **mitochondria as the site of cellular respiration**.

[II] Distribution

Mitochondria are present in the living eukaryotic cells and absent from prokaryotic cells like bacteria and blue green algae. These are lost secondarily in some highly specialised eukaryotic cells like mammalian RBC.

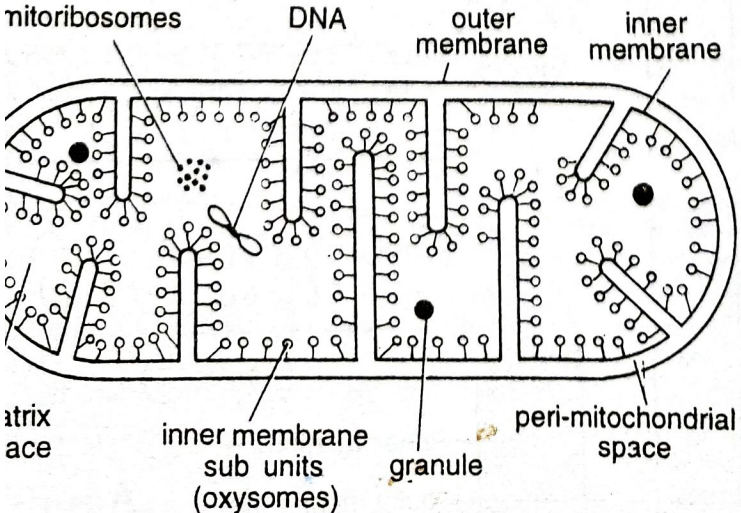
[III] Form, size and number

Mitochondria are either filamentous or granular. They can change their shape. Their diameter varies from 0.5 to 2.0 μ. The number of mitochondria varies from one per cell in *Micrasterias* to 3,00,000 per oocyte. There are fewer mitochondria in green plant cells than animal cells.

[IV] Structure

Mitochondria can be stained *in vivo* with **Janus Green B.** It has two parts —the outer **envelope** and a **central cavity** filled with **matrix** (Fig. 15A). The surrounding envelope is made of two unit membranes with a space in between. It is called **perimitochondrial space**. The outer membrane is smooth but the inner membrane has many infoldings which extend into the matrix. These infoldings are called **cristae** (the cristae, however, do not divide the mitochondrion into separate chambers; Fig 15 B).

The cristae provide an increased surface area within the mitochondrion for enzymatic activity. The inner surface of the inner membrane (i.e.; the one facing the matrix) is covered by small tennis racket-like particles with a head and a stalk (Fig 16 A, B). These particles have been variously named as **inner membrane sub-units**, **elementary particles** or **oxysomes**. **Parsons** (1963) called them **electron transport particles** (ETP). These particles are placed at a regular



distance of about 100Å. Each mitochondrion has approximately 10^4 to 10^5 such particles.

Each particle consists of a head called **F_1** sub-unit, appproximately 100Å in diameter and is attached to a base piece called **Fo** sub-unit. It is 35 – 50Å in length. F_1 sub-unit projects into the matrix. It is an integral protein of the inner membrane. The inner membrane has all the enzymes required for electron transport. The F_1 – F_o combination have special ATPase (ATP synthetase) for oxidative phosphorylation.

[V] Chemical composition

The major chemical constituents of mitochondria are shown in Table 10.

[VI] Hereditary independence

More than 70 enzymes are known to be present in mitochondria. 70 S type ribosomes, called **mitoribosomes** are also present. They are actively involved in protein synthesis. A circular DNA is present in the matrix. It is about 5μ long and resembles bacterial DNA. It has a capacity to replicate. Hence, like chloroplasts, mitochondria also are **genetically autonomous** or can be called '**a cell within a cell**' or '**intracellular prokaryotic parasites**'.