

The electron transport chain or cytochrome system

The hydrogen ions and electrons generated from, the dehydrogenation of respiratory intermediates during glycolysis, pyruvic acid oxidation, and kreb's cycle do not react directly with oxygen. These are produced in the mitochondrial matrix. From mitochondrial Matrix these are carried to a system of electron acceptor and transfer protein molecules located in the inner mitochondrial membrane. **These together form the electron transport chain or electron transfer system or mitochondria respiratory chain.** In the matrix the released hydrogen ions are picked up by two hydrogen acceptor molecules or coenzymes.

a. NAD

b. FAD

These two enzymes are reduced to $\text{NAD}^+ + \text{H}$ and FADH_2 respectively, after picking up hydrogen ions and by transferring them to electron transport chain, return back to the original state.

Components of electron transport chain: Electron transport chain consists of a series of co enzymes and cytochromes located in the inner mitochondrial membrane. These act as electron Carriers. These are of following four types.

Flavoproteins

Cytochromes

Ubiquinone

Iron sulphur protein

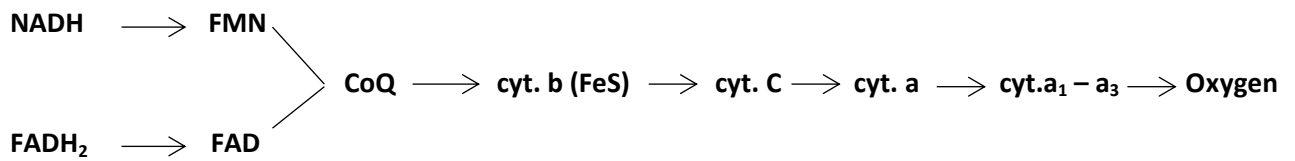
Except for ubiquinone, in all others the electron acceptor and donating centres are prosthetic group of coenzyme.

Flavoproteins : Flavoproteins are the proteins with prosthetic group derived from vitamin B₂, (riboflavin). These are Flavin mononucleotide (FMN) and Flavin dinucleotide (FAD).

Cytochromes: These are proteins with haeme groups these are of five different types' a, a₃, b, c and c₁. c₁ is located in complex II. Haeme group have iron sulphur centres (FeS) and accept electrons.

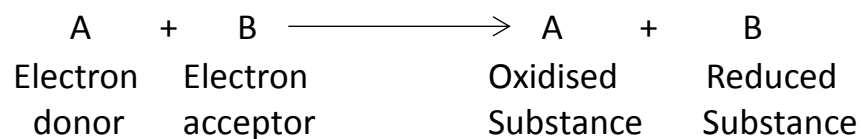
Ubiquinone or coenzyme Q: It is a lipid soluble mobile electron carrier. It is able to accept and donate two electrons and two protons.

Pathway of electron flow through electron transport chain: the electrons flow along the electron transport chain is as follows.



At various stages of glycolysis and kreb's cycle the enzyme of the electron transport chain receives hydrogen and electron from NADH and FADH₂. The electrons are now transported in stages from enzyme to enzyme, down a descending sequence of energy yielding reactions. At the end of the chain the electrons and the hydrogen ions combine with oxygen to form water. Thus oxygen is the terminal electron acceptor of the mitochondrial respiratory chain.

Transfer of electrons over the ETS is a series of oxidation reduction reaction or redox reactions. Oxidation and reduction are complementary to each other because electrons cannot float around on their own. They are passed on from one compound to another. Thus for every oxidation there is a corresponding reduction. The electron donor an electron acceptor forms the redox pair.



Transport of electrons and protons through different complexes: Electrons enter the electron transport chain in mitochondria through two ways.

a. Through FMN

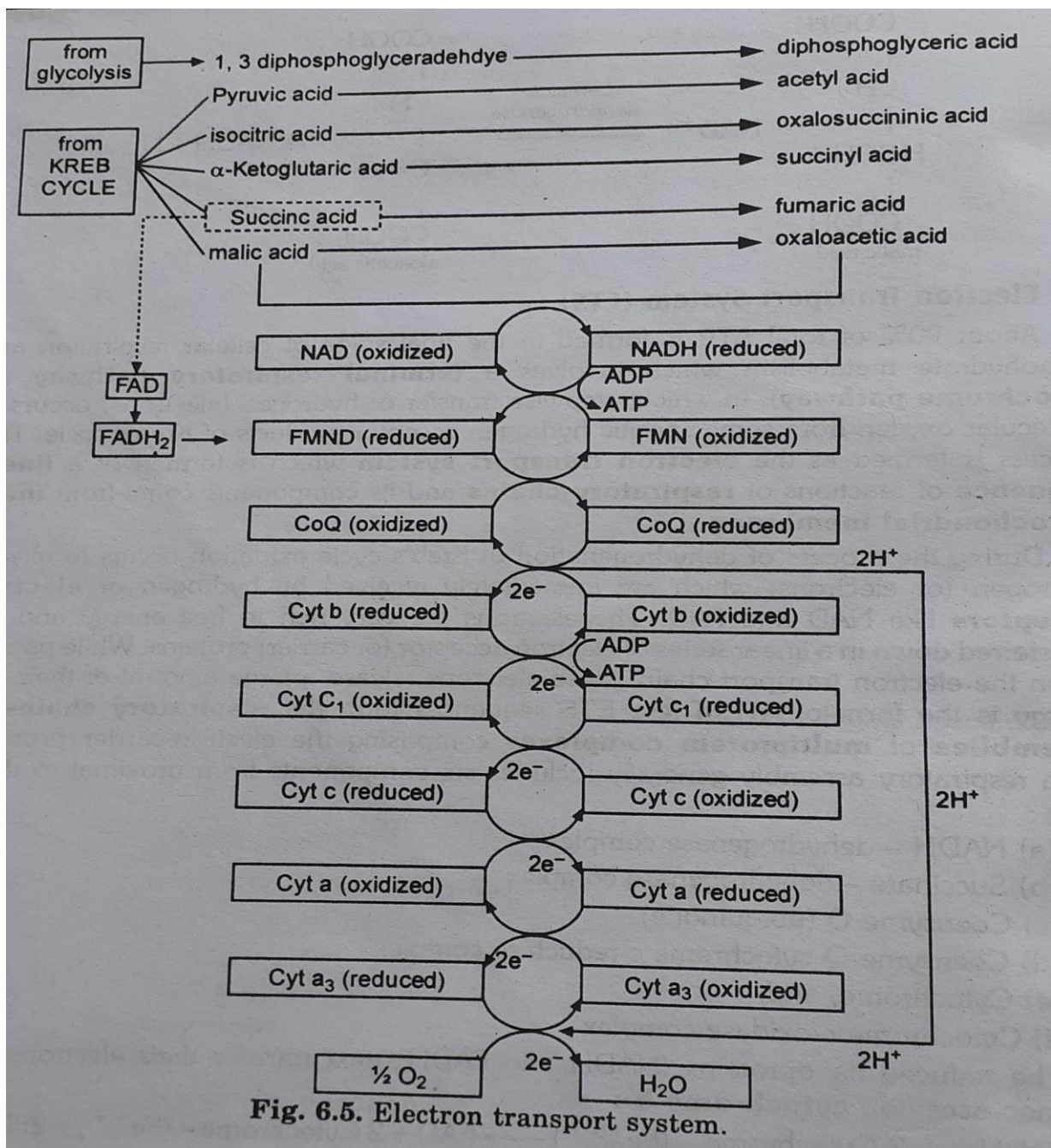
b. Through FAD

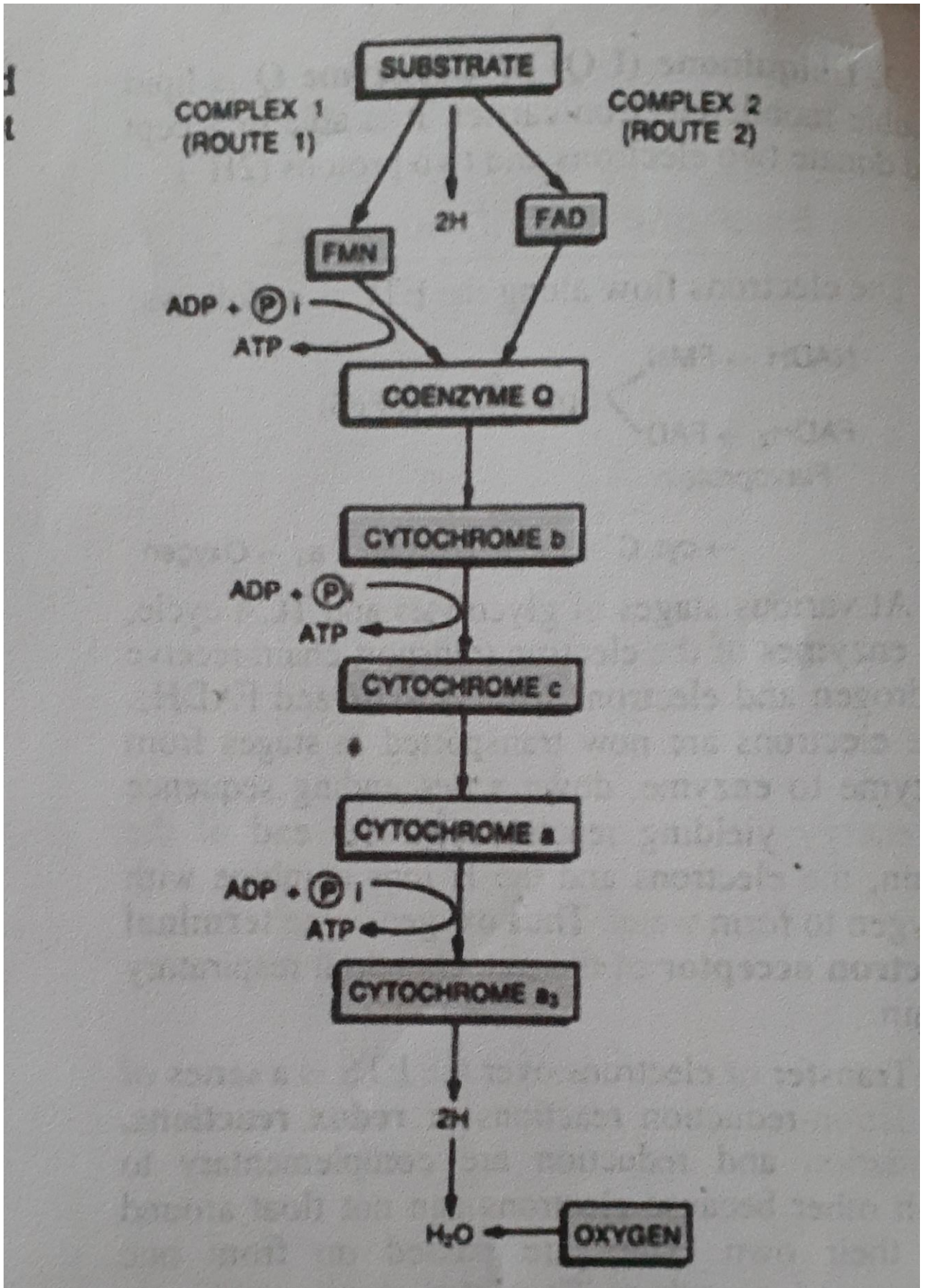
Both the routes converge at coenzyme Q, level where the electrons coming from the two routes collect. NADH + H⁺ formed in pyruvic acid oxidation and in kreb's cycle reaction transfer its electron and hydrogen ion to FMN, the first electron carrier in route 1 of electron transport chain.

In this transfer, NADH is oxidized and FMN is reduced to FMNH². NAD is again used in the reaction of pyruvate oxidation and TCA cycle. Electrons from succinic acid are picked up by FAD, the first electron carrier in route 2 of

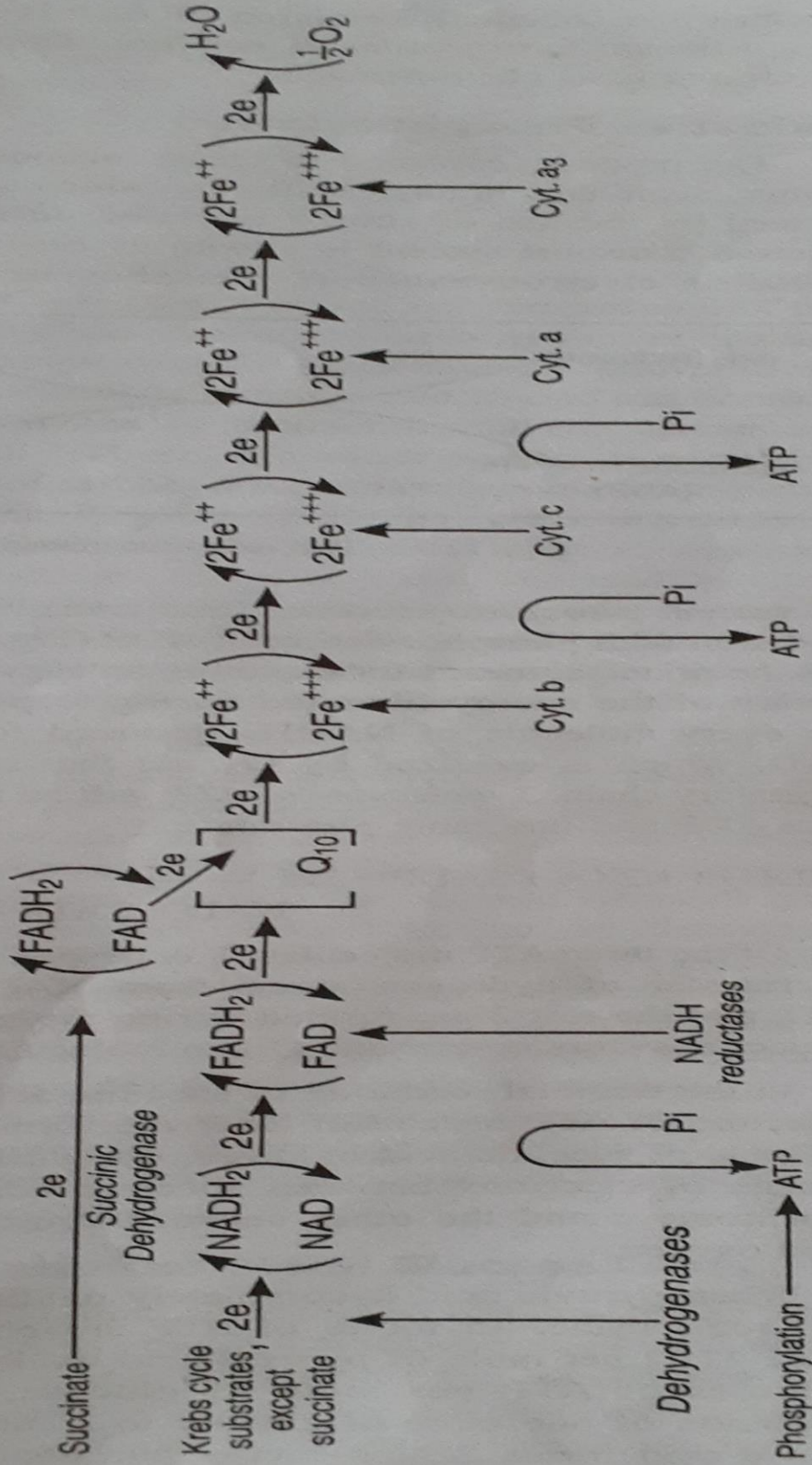
electron transport chain. **The electron transferring reactions are Redox reaction.**

Proton Gradient – Electron transport at each step takes place because the acceptor has higher electron affinity than the donor. Energy from such electron transport is utilised in transporting H^+ FROM THE matrix to the outer side of the inner membrane. This develops a higher proton concentration outside the inner membrane in the matrix. This difference in proton concentration across the inner membrane is called the proton gradient.





ETC of Mitochondria



Sequence of events in ETC
