# STRUCTURE OF PLASMA MEMBRANE

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- Major components of biological membrane are lipids and proteins.
- Several membrane models have been proposed to explain the properties of the plasma membrane.
- Some of the earlier concepts are of historical importance but need to be discussed here because all these studies laid the foundation to explain the organisation of the membrane.

I- The isolation of cell membrane was done much later. But the indirect evidences suggested the structure of the membrane.

(i) Thin layer of lipid - given by Overton (1902). His observation was based on the fact that substances soluble in lipid could selectively pass through the membrane.

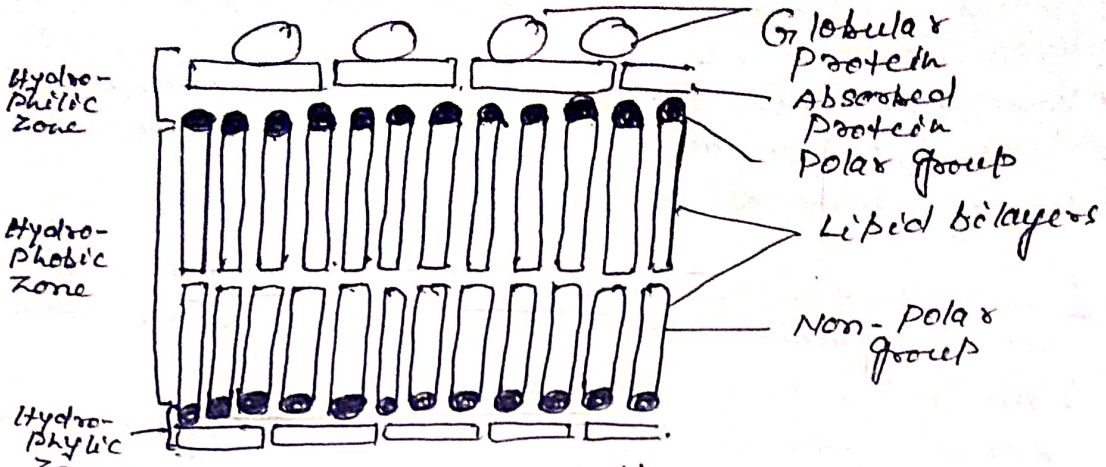
(ii) The double layer of Lipid - given by Gorter and Grendel (1926). They suggested that plasma membrane is composed of double layer of lipid molecules, because they found that the lipid extracted from erythrocyte memembrane was twice the amount expected.

II - Protein - Lipid bilayer - Protein model by Hugh Davson and James Danielli in 1935. It is popularly known as "trilamellar Sandwich model".

- The model describes a phospholipid bilayer that lies between two layers of globular proteins.
- Davson - Danielli model was the first attempt to describe membrane structure in terms of molecules and to relate the structure to biological and chemical properties.

The model was based on the physical properties of the plasma membrane, such as preferential permeability to lipid soluble substance, occurrence of low surface tension and high electrical resistance. Preferential permeability and high electrical resistance are characteristics of lipids and low surface tension a property of proteins. Danielli also suggested that the polar end of bilayer lipid molecules are turned outwards and attached to the charged groups of proteins. He also suggested the presence of pores in the membrane, though a direct evidence of their presence was lacking. However, a cell can regulate passive transport by mechanically sieving the particles as they attempt to diffuse through the membrane.

small ions and molecules pass through more easily than large ions and molecules. Sieving implies the existence of pores of different diameters through which the particles may pass.

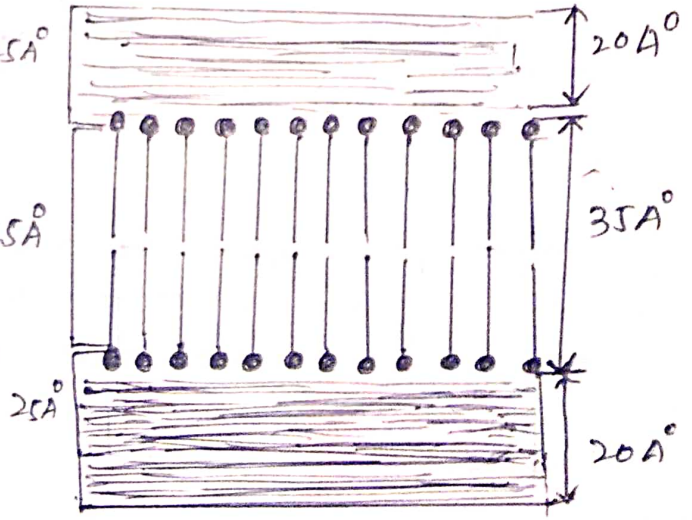



The Davson-Danielli model

III - The Unit membrane model - by J. David Robertson (1959).

- Robertson proposed the structure of plasma membrane which was evolved with the help of electron microscope, x-ray diffraction and chemical studies.
- According to him, the membrane has a central core bimolecular leaflet of lipid, flanked on either side by a single layered fully stretched out hydrophilic protein or non-lipid material. He called it the "Unit membrane"
- With the help of Electron microscope, he could be able to provide the thickness of plasma membrane, which was 75 °A, and the plasma membrane of two adjacent cells were separated by a space of 1-15 mm wide.
- He also observed that each dense band of protein was of 20A° and the polar group of lipids 5 A°, and thus a thickness of 25 A°.

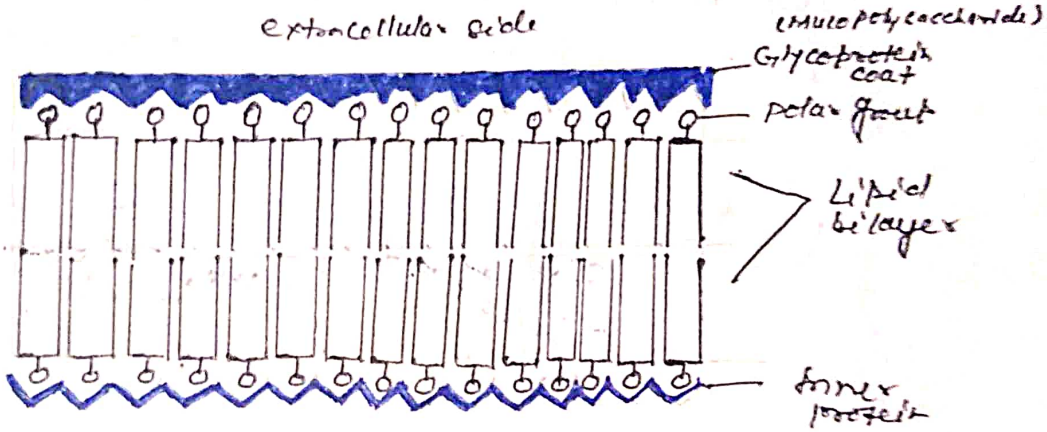
The clear zone was 25 A° thick and consisted of bimolecular lipid layer without polar groups.



Thus the unit membrane is 75 Å thick with 35 Å lipid layer between two protein layers, each of 20 Å.

- In later studies, Robertson observed that the outer and inner protein layers of plasma membrane differ in chemical reaction. This led him to amend the concept of universality of unit membrane. In such asymmetrical plasma membranes he suggested that the layer on one side of the lipid core consisted of protein and the other side of carbohydrate, perhaps in the form of mucopolysaccharides (outer side)

In this way the concept of Robertson differs from that of Davson - Danielli model. Further, Robertson's model was rigid and did not explain the permeability property, whereas as Danielli suggested the existence of polar pores lined by protein molecules.




Modified Robertson's model

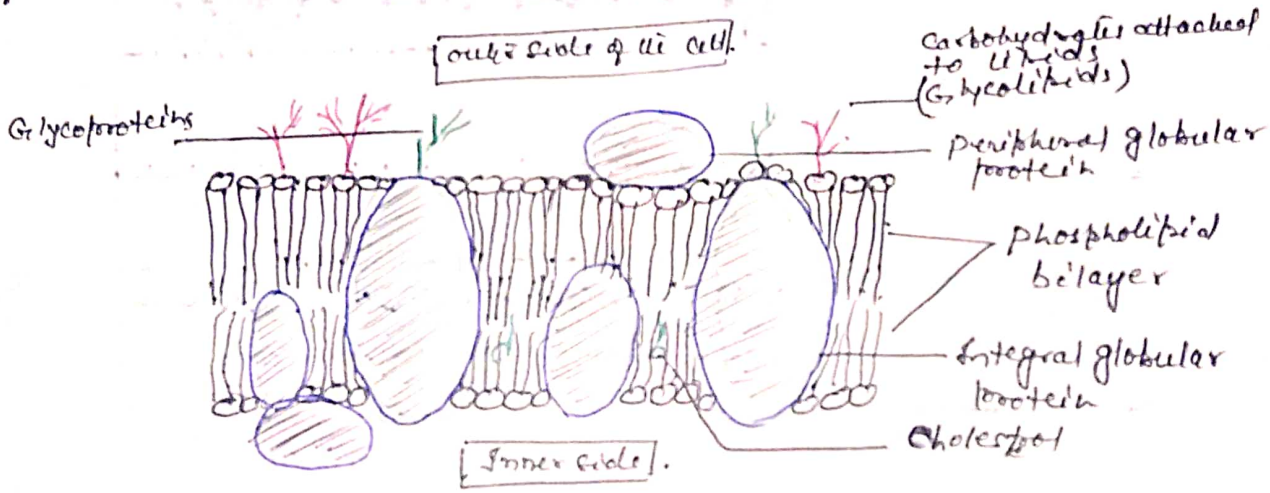
- Both the Davson - Danielli model and Robertson's unit membrane model are based on the structure of myelin which is a non-typical membrane. It is, thus, now believed that the arrangement of lipids and proteins may vary in different membranes.

## IV. Fluid-Mosaic Model – Proposed by S.J. Singer and Garth L. Nicolson in 1972.

- They gave the most convincing model of the membrane which revolutionised the entire concept of plasma membrane.
- According to this model, lipids are in the form of fluid bilayer and the globular proteins are partially or wholly embedded in the continuous lipid bilayer. Thus proteins do not form a sandwich covering of hydrophilic lipid layers.
- The lipids are mostly phospholipids or glycolipids
- The proteins have been compared to icebergs floating in a sea of the phospholipid bilayer.

The biological membrane are thus considered to be quasi fluid structure in which lipids and integral proteins are arranged in a mosaic manner.

- The Danielli-Davson model assumes hydrophilic bonding between lipids and proteins, whereas the Singer-Nicolson model considers hydrophobic association between lipids and proteins. The fluidity of the membrane is the result of this hydrophobic interaction.




- The globular proteins of the membrane are considered to be of two different types, extrinsic (peripheral) and intrinsic (integral) proteins.

The peripheral proteins are superficially located and many of them function as enzymes. They are entirely outside the lipid layer and readily dissociate from the membrane. The integral proteins, associated with lipids, penetrate into the interior of the membrane along with fatty acid side chains. They are tightly bound to the lipids and constitute functional proteins which are not easily separable. All membrane bound enzymes and carriers are included in this category.