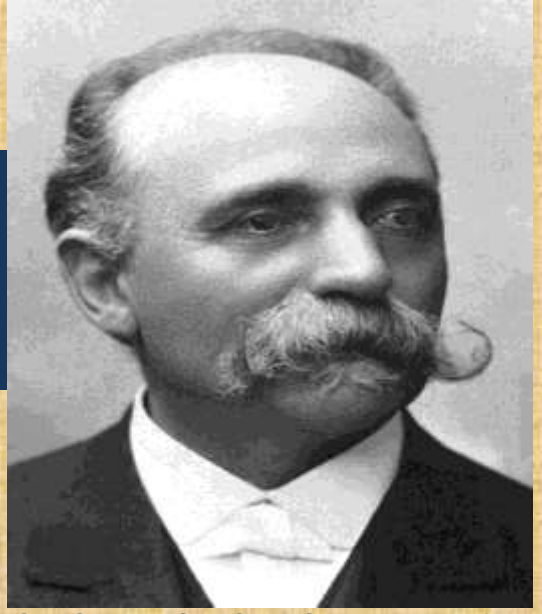



GOLGI COMPLEX




DISCOVERY



- The Golgi apparatus is noticeable with both light and electron microscope
- First discovered by an Italian physician **Camillo Golgi** in 1898 during an investigation of the nerve cells of the barn owl.
- Electron microscopic structure was described by **Dalton** and **Felix** in 1954

ORIGIN

Sources of new Golgi bodies are:

- (1) Vesicles dispatched from the endoplasmic reticulum,
- (2) Vesicles dispatched from the outer membrane of the nuclear envelope,
- (3) Vesicles formed by invaginations of the plasma membrane, and
- (4) Division of Golgi bodies already present in the cell.

The most widely accepted view is that golgi bodies are formed from vesicles dispatched from the ER. These vesicles are called **transition vesicles**

Aggregations of transition vesicles occur in areas of the cytoplasm referred to as zones of exclusion, which are free of ribosomes. These zones are often surrounded by membranes of the endoplasmic reticulum or the nuclear envelope. Small Golgi bodies, which are presumed to represent early stages in the development of the organelle, are found in the zones of exclusion

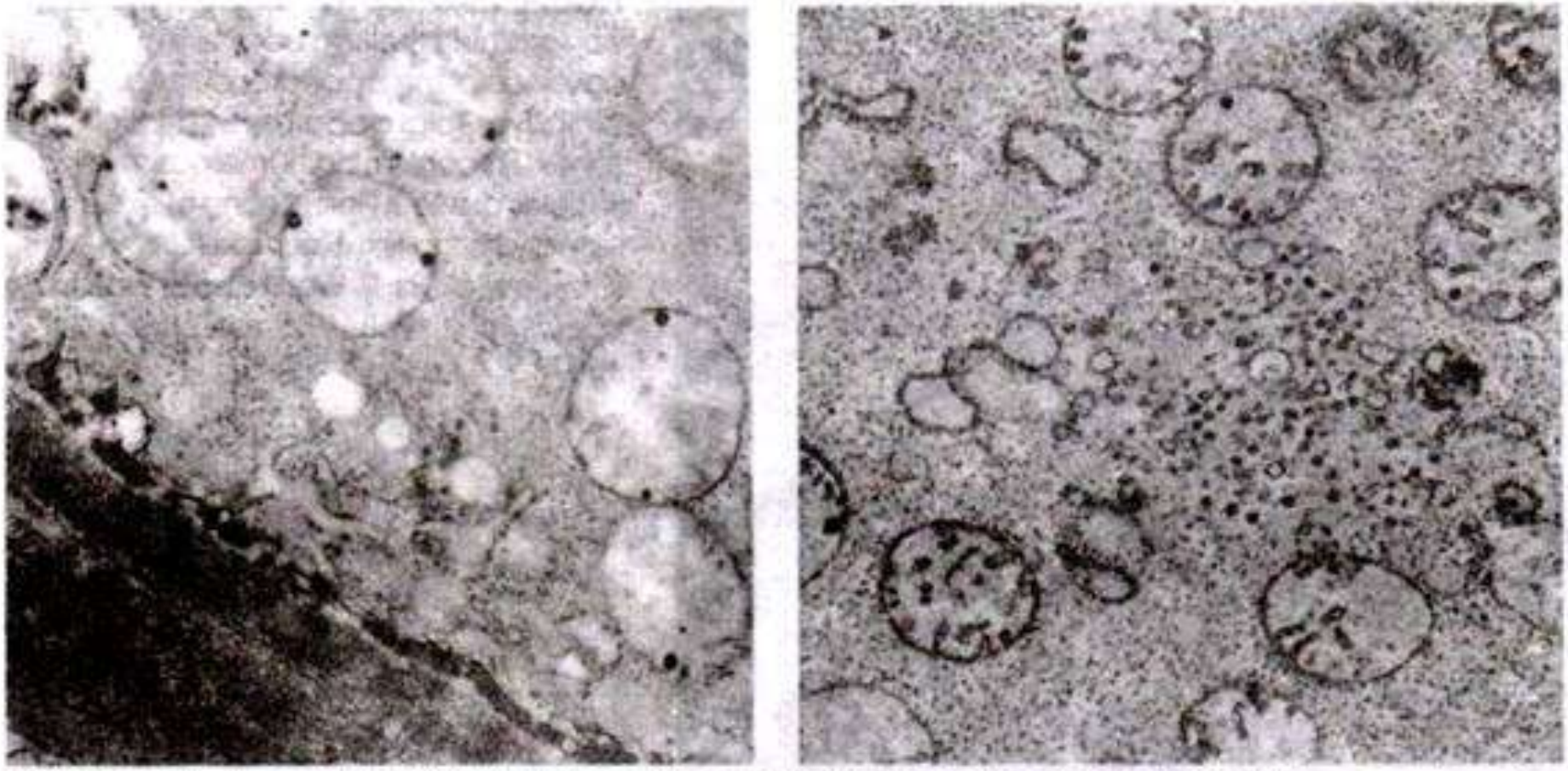
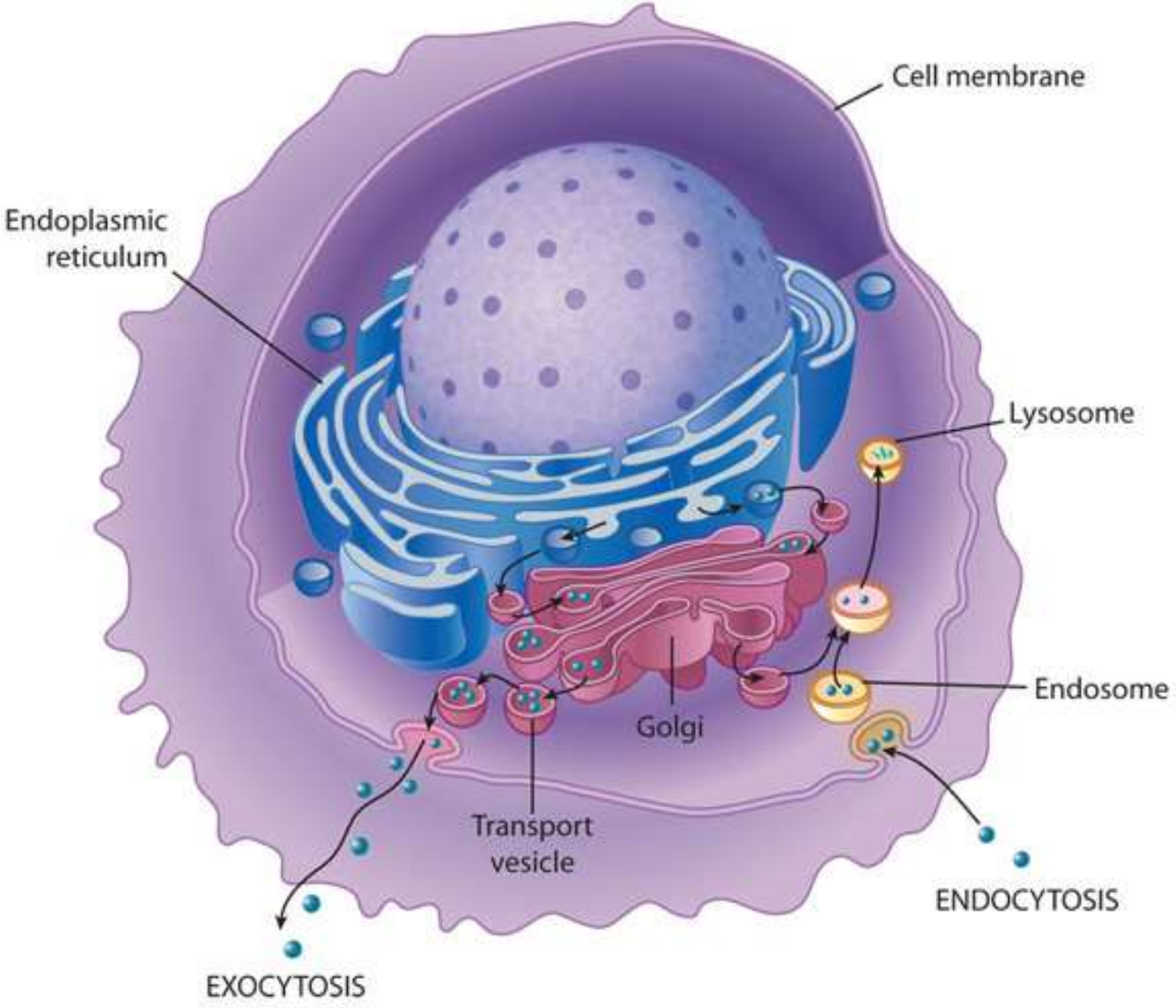


FIGURE 18–7 Zones of exclusion (clusters of tiny vesicles) believed to give rise to Golgi bodies. (Courtesy of Drs. H. H. Mollenhauer and J. Morre, in *Origin and Continuity of Cell Organelles*, J. Reinert and H. Ursprung, Eds.; copyright © 1971, Springer-Verlag.)

LOCATION

- Found in all eukaryotic cell
- Absent in prokaryotic cells
- It is absent in a few cell types such as mammalian RBC.
- In secretory and absorptive cells, it usually lies between the nucleus
- The invertebrates and plant cells usually have several small golgi complexes called Dictyosomes, scattered throughout the cytoplasm


Cell membrane
Endoplasmic reticulum
Lysosome
Endosome
Golgi
Transport vesicle
ENDOCYTOSIS
EXOCYTOSIS

WHAT IS GOLGI APPARATUS?

- Also known as Golgi complex, Golgi body or Golgi
- Sac-like membrane bound organelles
- Responsible for transporting, modifying and packaging proteins and lipids into vesicles

CHEMICAL COMPOSITION

- Membrane of golgi complex contain 60% lipids and 40% proteins
- Proteins are similar to those found in ER
- They have more of phosphatidic acids and phosphatidyl glycerol
- Plant golgi membranes contain glucose, mannose, fucose, galactose, arabinose, glucosamines and other sugars
- NAD dependent enzymes like cyt.c oxidase and cyt.b reductase. Other enzymes- glycosyl transferase, glucose-6-phosphatase, phospholipase A, casein phosphokinases, thiamine pyrophosphatase

STRUCTURE

CISTERNAE

- Flattened, parallel sacs
- Composed of stacks of membrane-bound structures known as cisternae.
- A mammalian cell typically contain 40-100 stacks
- Each cisternae comprises of a flat, membrane enclosed disc that includes special golgi enzymes which helps to modify cargo proteins
- Cisternae also carry structural proteins important for their maintenance as flattened membranes
- Found near to RER
- The cisternae are held together by matrix proteins, and the whole of the golgi complex is supported by cytoplasmic microtubules.

TUBULES

- Small round tubules arise from the periphery of the cisternae. Some of these enlarge at their ends to form vesicles
- Irregular branching element

VESICLES

- Oval, rounded, vacuole-like
- Lies near the ends and concave surface of the golgi complex
- Types of vesicles

Exocytotic vesicles

Secretory vesicles

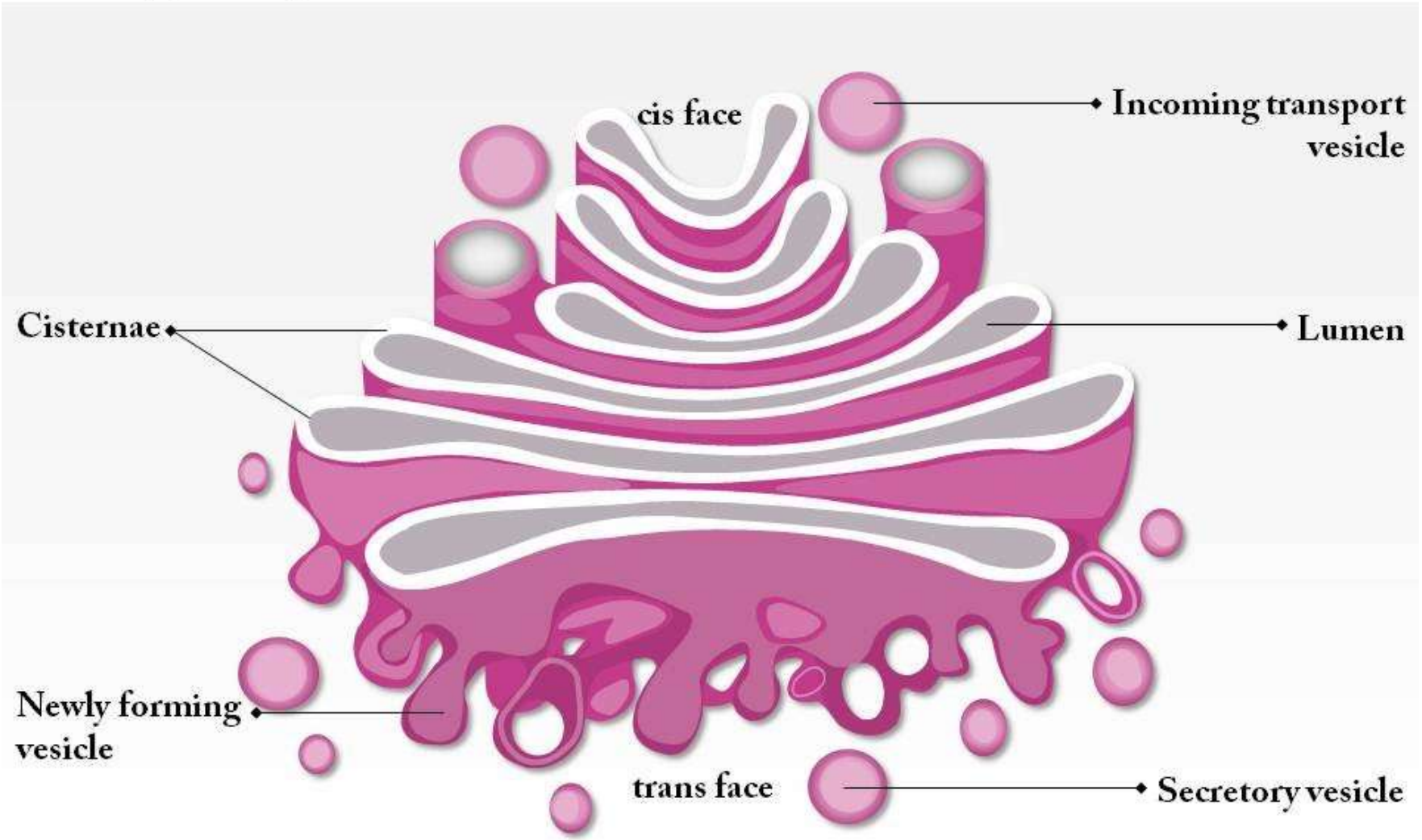
Lysosomal vesicles

- The cisternae stacks has four functional regions:

1. Cis-face – composed of interconnected network of tubules called CGN(cis Golgi network). CGN is a sorting station that distinguishes proteins to be sent back to ER and to those that proceed to the next Golgi station.
2. Endo-face
3. Medial-face
4. Trans-face- contain network of tubules and vesicles called trans Golgi network(TGN). Sorting station where proteins are segregated into diff types of vesicles heading either to PM or other intracellular destinations.

- Each different areas of golgi cisternae contains different types of enzymes

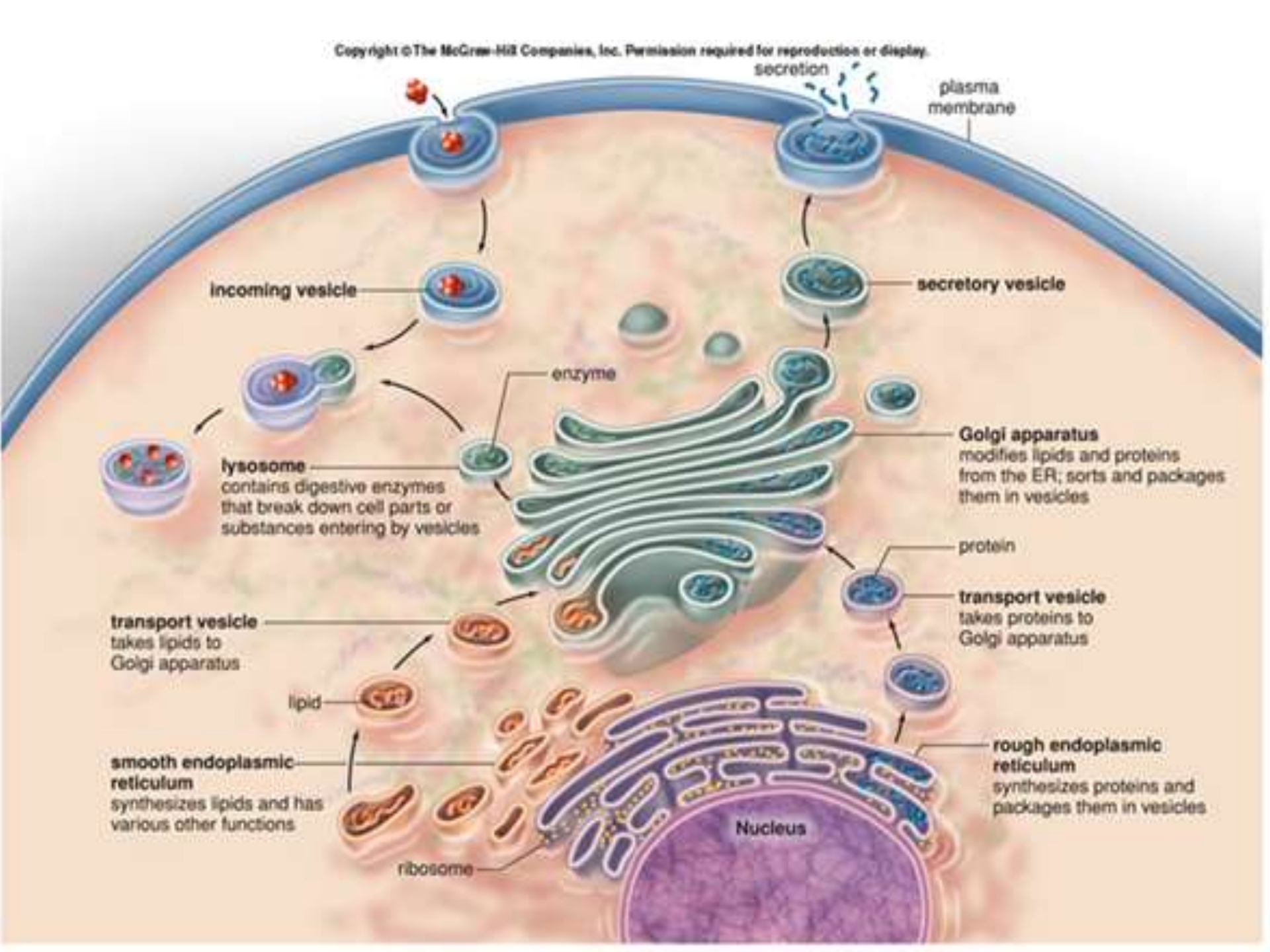
Golgi body


cis face
Incoming transport vesicle
Cisternae
Lumen
Newly forming vesicle
trans face
Secretory vesicle

- The cis-golgi is the section nearest to ER and it is where the golgi apparatus first receives the cargo vesicles containing the newly synthesised proteins
- These fuse with the golgi membrane and empty their contents into the lumen
- Inside the lumen, the molecules are modified
- The modification takes place through the endo-golgi and medial-golgi sections
- Eventually, they end up at the trans-golgi, where the finished product is packaged for transportation to the rest of the cells

GERL CONCEPT

- Proposed by Novikoff et al
- GERL stands for Golgi apparatus-Endoplasmic Reticulum-Lysosome
- These organelles form a system to carry out the following cellular processes:
- endocytosis
- exocytosis of internal substances



MOVEMENT OF MATERIALS

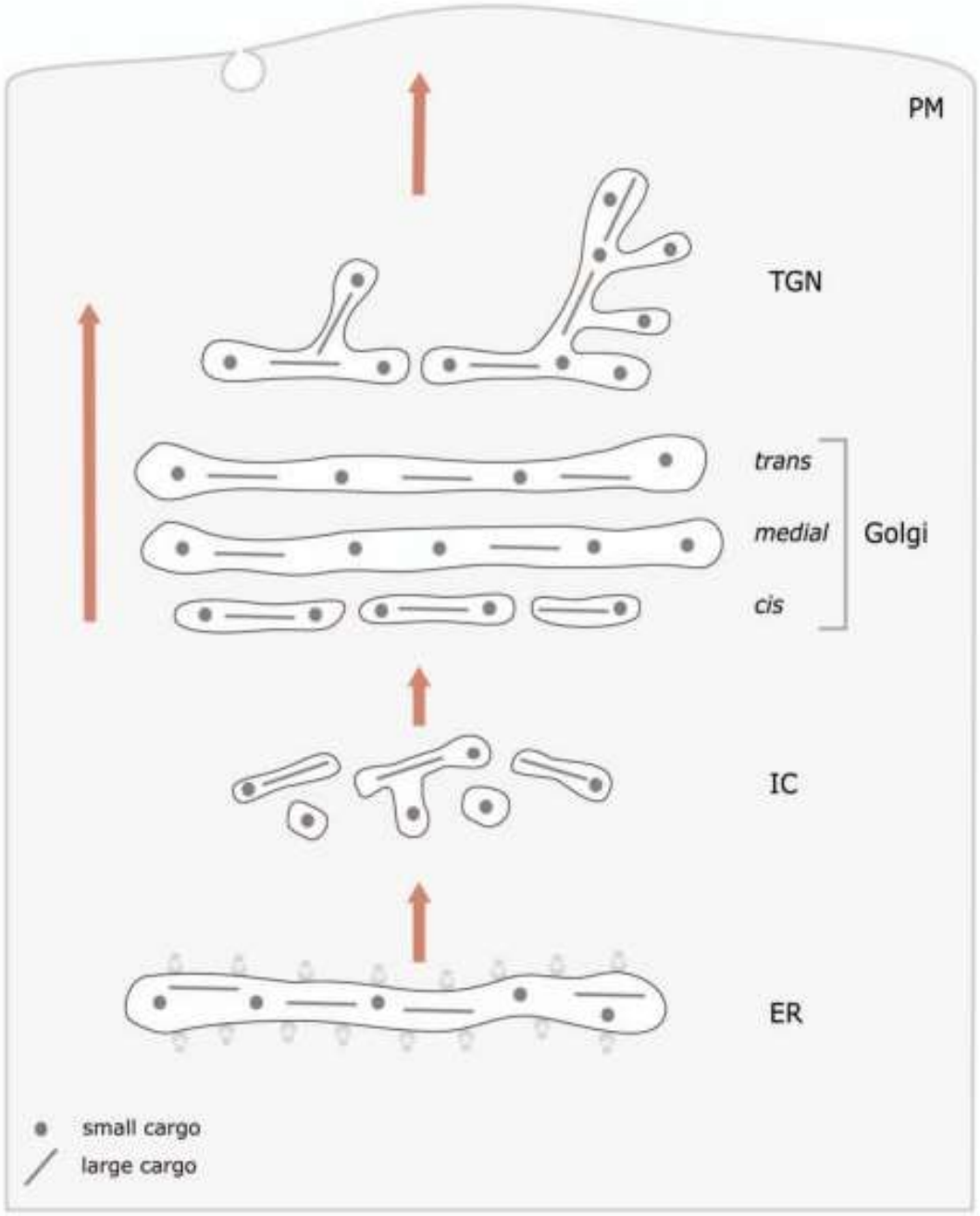
- 2 models

1. Cisternal maturation model
2. Vesicular transport model

Cisternal maturation model

- The cisternal progression-maturation concept has a relatively old precursor, called the progression model, according to which the transport of cargo proteins through the Golgi complex occurs by the progression of cisternae from the cis face to the trans face of the Golgi stack.
- This scheme envisions that the Golgi complex turns over constantly in a process that carries a steady flow of membranes from the endoplasmic reticulum to and through the Golgi complex, and thence to the plasma membrane.
- The membrane flow begins with the exit from the endoplasmic reticulum of membranous carriers containing cargo proteins, and it continues with the movement of these membranes to the cis face of the Golgi complex, where they coalesce into a new cis cisterna.

- This process repeats itself, and at the same time, the trans-most Golgi cisternae disassemble into transport carriers that are directed towards the plasma membrane.
- As a result, each cisterna changes its position in the stack—repeatedly—until it reaches the trans face.
- Thus, the cisternae themselves act as carriers in this intra-Golgi trafficking segment.
- This model is simple and elegant, and it accommodated many morphological observations from the early decades of electron microscopy (EM).
- Retrograde movement-backward movt.


PM
TGN
trans
medial
cis
Golgi
IC
ER
small cargo
large cargo

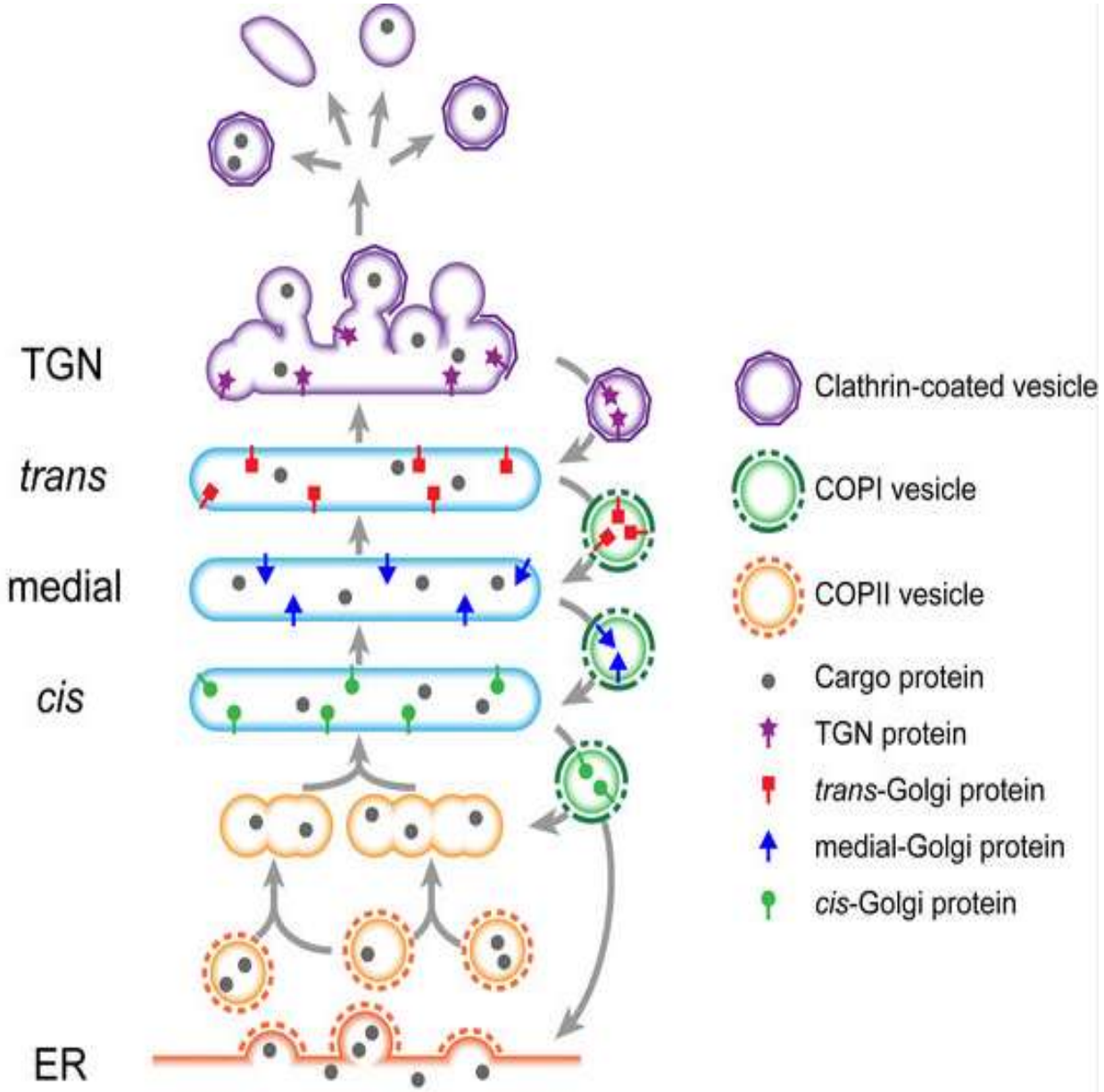
DRAWBACKS

- Golgi cisternae are not similar to each other- movt from cis to trans
- The progression model could not explain how these enzymes remain in their cisternae while cargo proteins are swept forward

Vesicular transport model

- Retrograde movt.
- The first step in vesicular transport is the formation of a vesicle by budding from the membrane.
- The cytoplasmic surfaces of transport vesicles are coated with proteins.
- Three kinds of coated vesicles, which appear to function in different types of vesicular transport, have been characterized.

1. **clathrin-coated vesicles**, which are responsible for the uptake of extracellular molecules from the plasma membrane by endocytosis as well as the transport of molecules from the *trans* Golgi network to lysosomes.
2. **COP-coated vesicles** (COP stands for coat protein). One class of these vesicles (**COPII-coated vesicles**) bud from the ER and carry their cargo forward along the secretory pathway, to the Golgi apparatus.
3. **COPI-coated vesicles** bud from the ER-Golgi intermediate compartment or the Golgi apparatus and function in the retrieval pathways that serve to retain resident proteins in the Golgi and ER



Cisternal maturation model

Golgi Apparatus

Amoeba Sisters #AmoebaGIFs