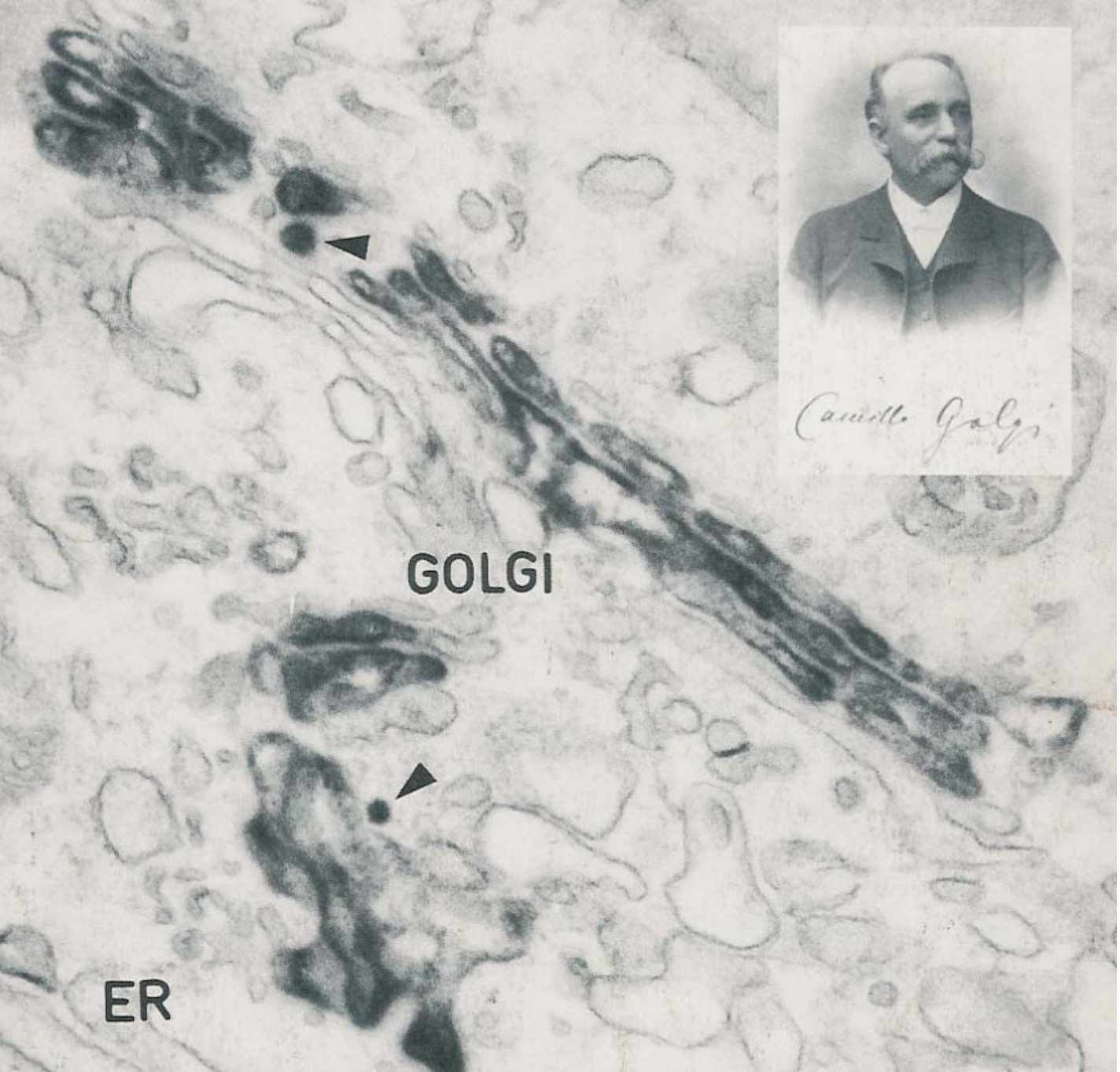


Camillo Golgi

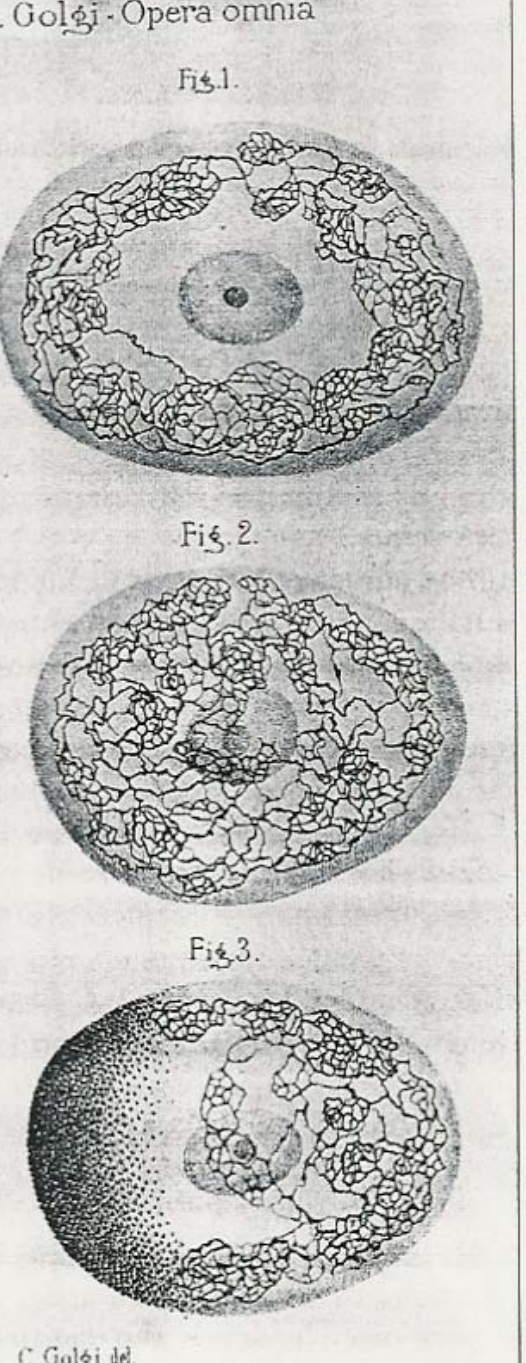
born. 7. juli 1843

in Corteno

Worked in Pavia, Italy

Discovered ***apparato reticolare interno*** (the Golgi apparatus)

in 1898



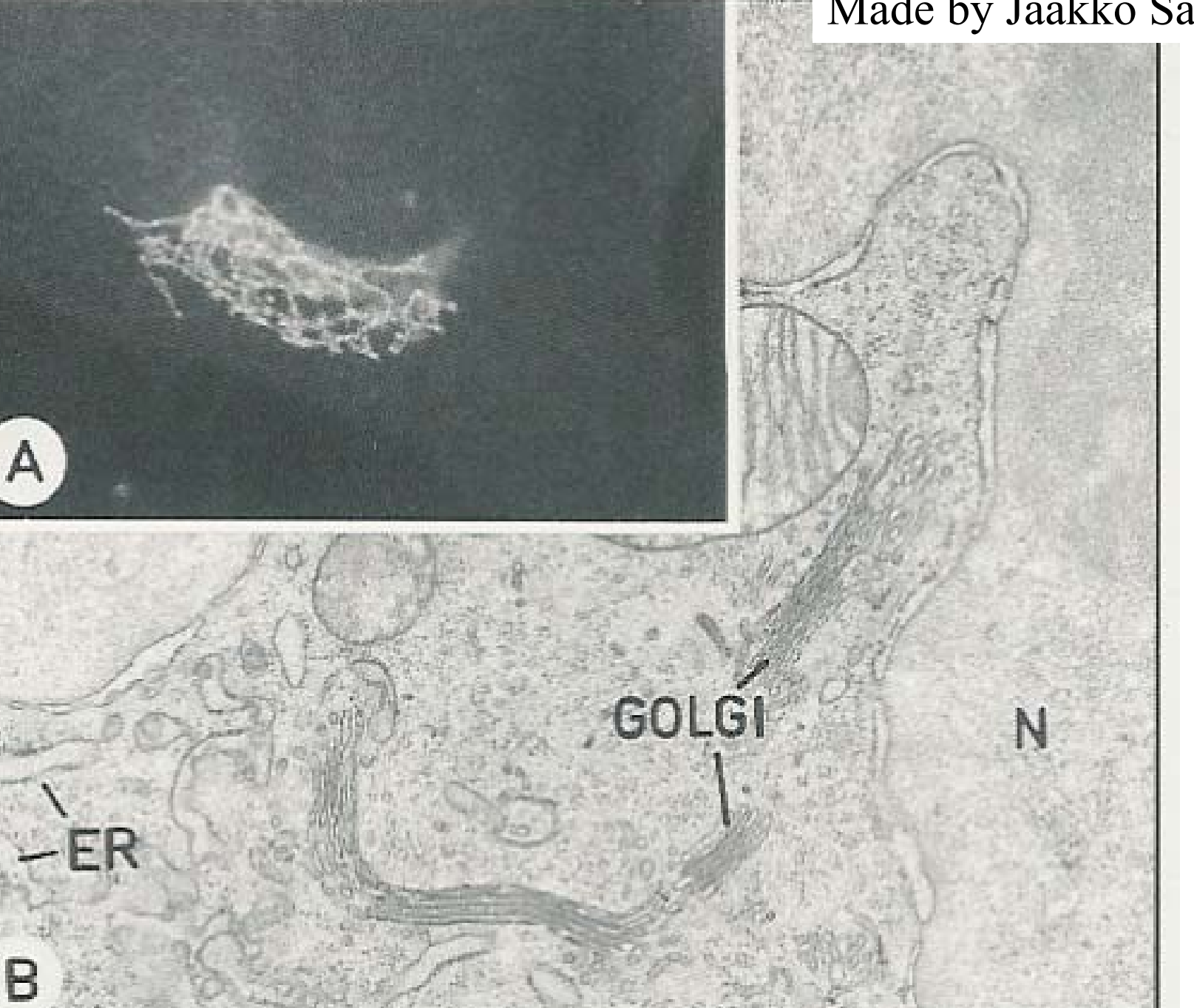
WHAT DID GOLGI ACTUALLY SEE?

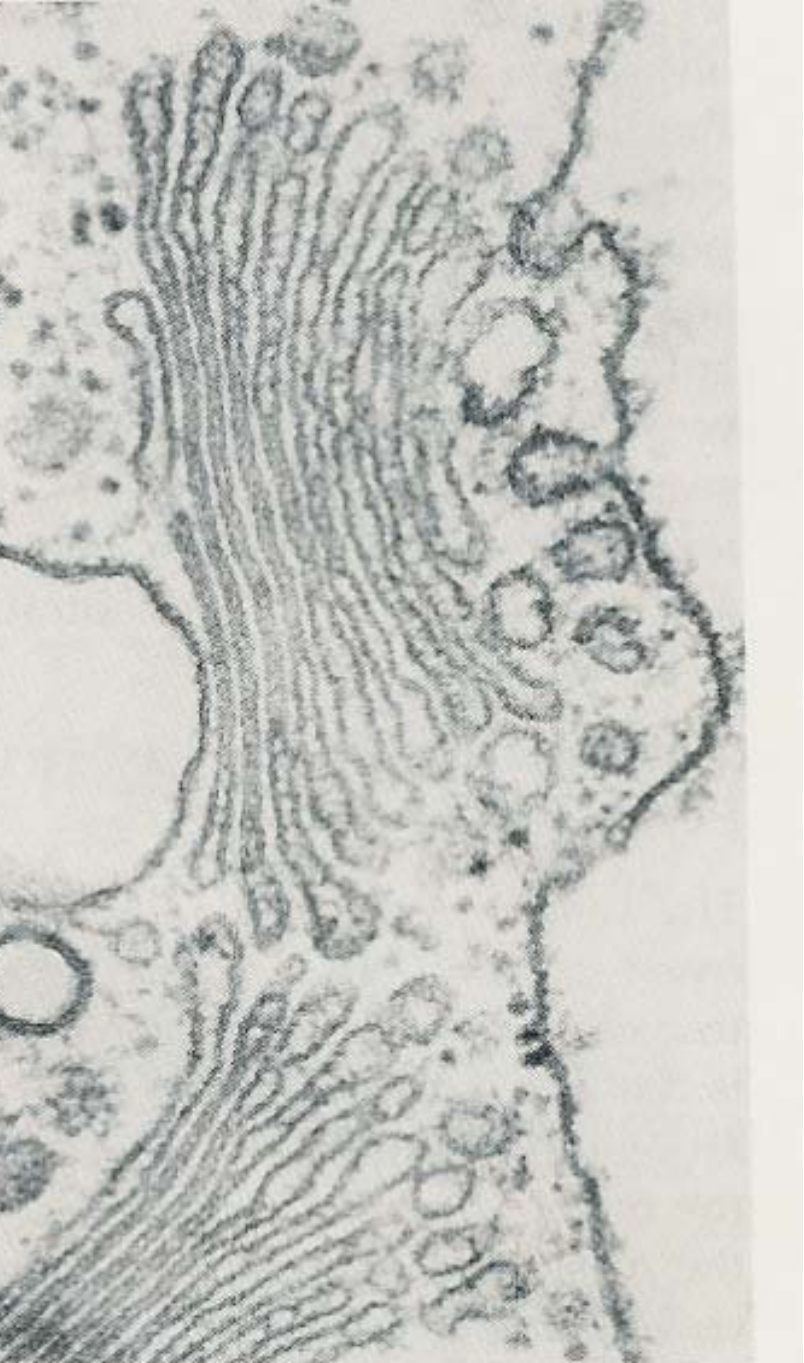
More than just the Golgi apparatus?

Others probably saw – or think they saw the same structures as Golgi.

No names mentioned.

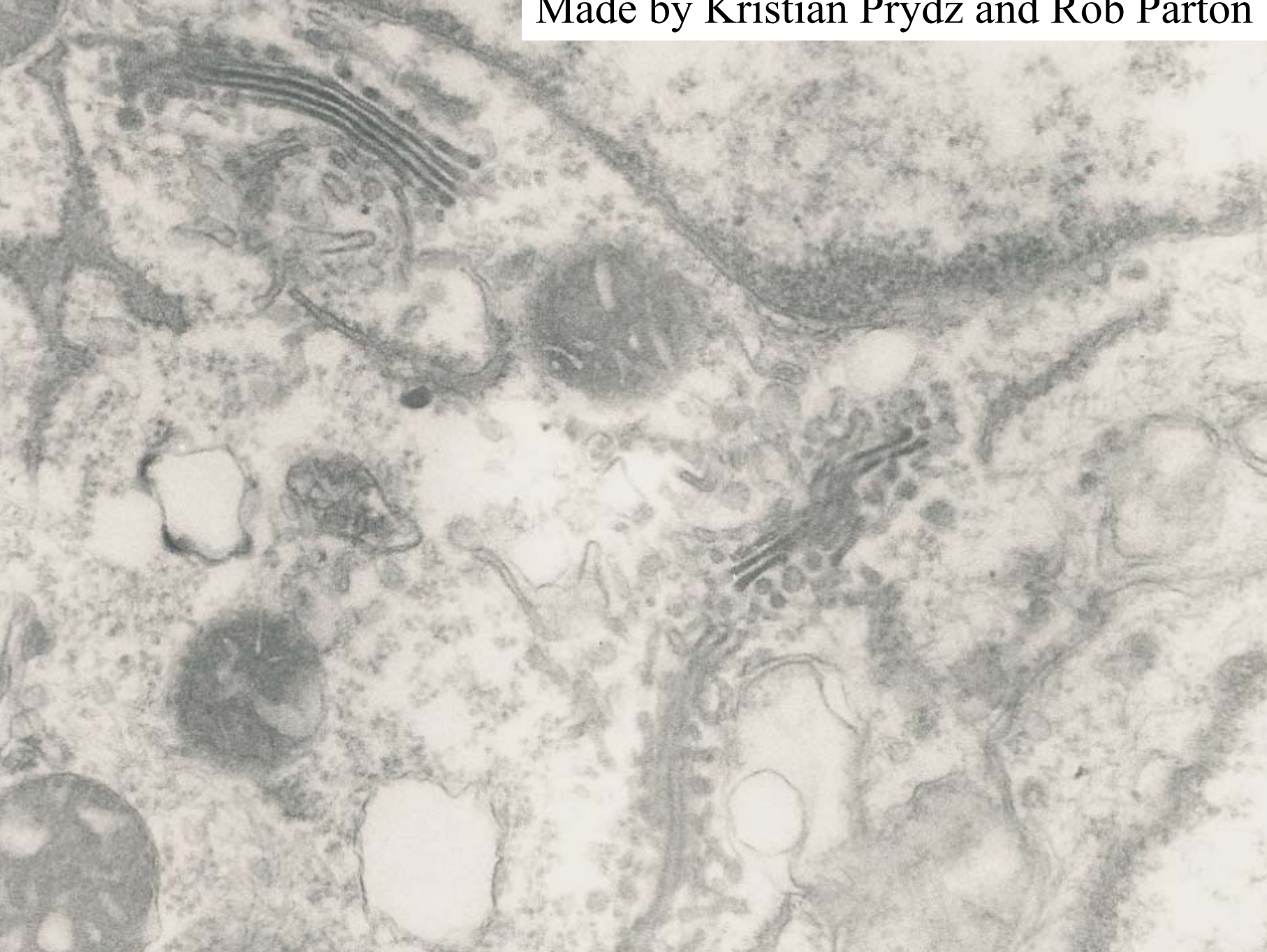
Made by Jaakko Saraste

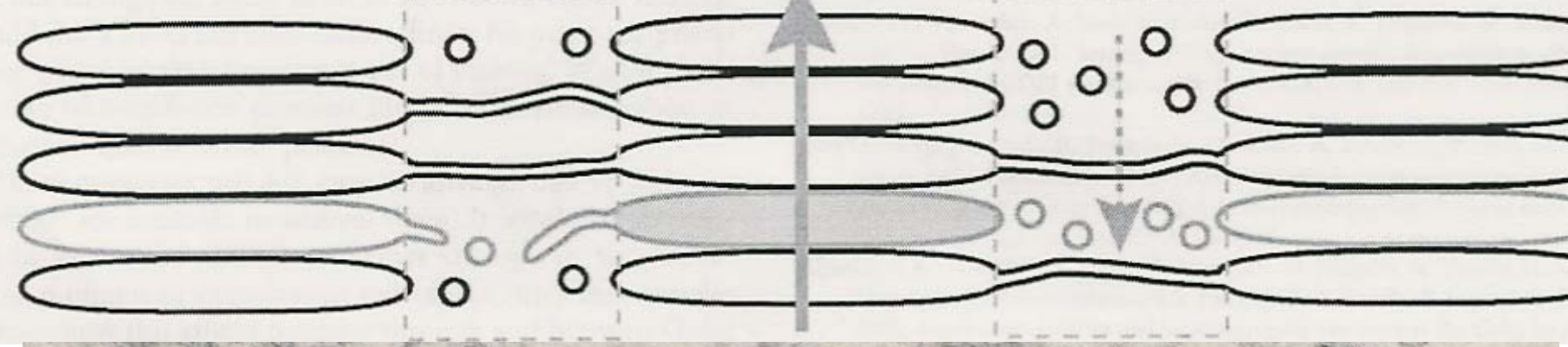


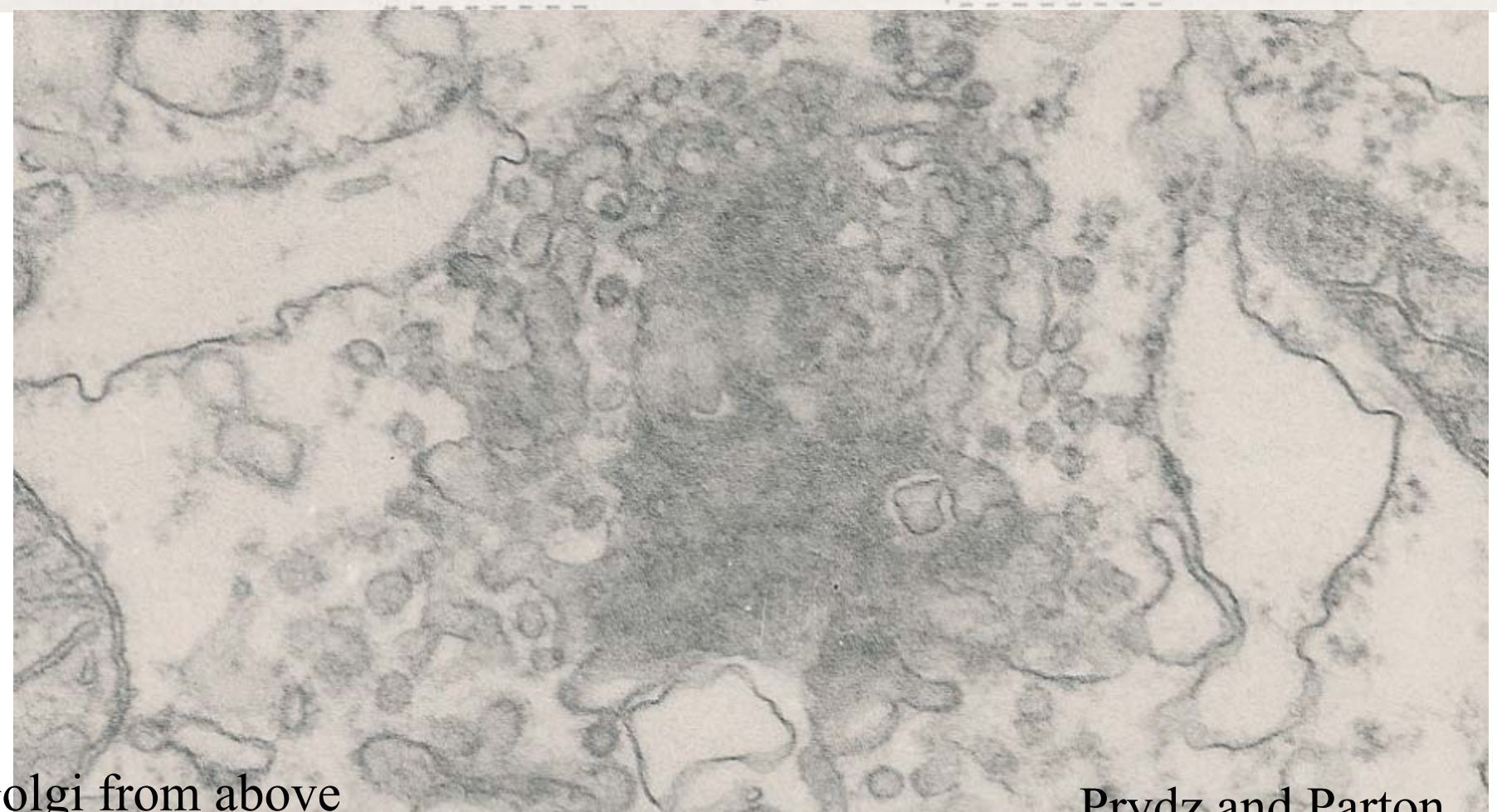


The Golgi apparatus in plants often has more cisternea than that of animal cells. It is reason to believe that this is because more carbohydrate has to be polymerised to polysaccharides

It is possible to observe vesicles of different sizes and possible fenestrations along the cisternea in the Golgi apparatus on the picture.


Made by Kristian Prydz and Rob Parton



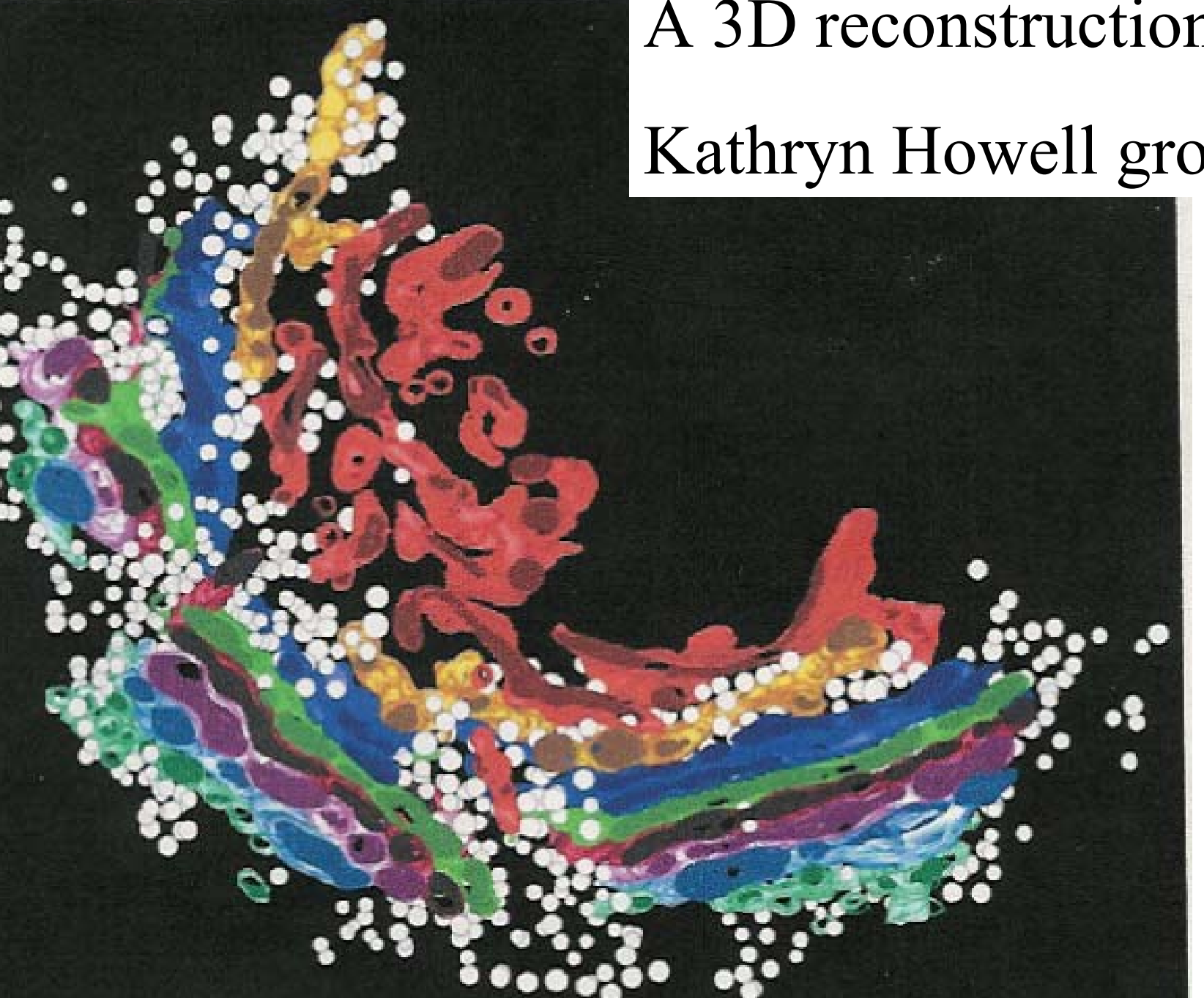


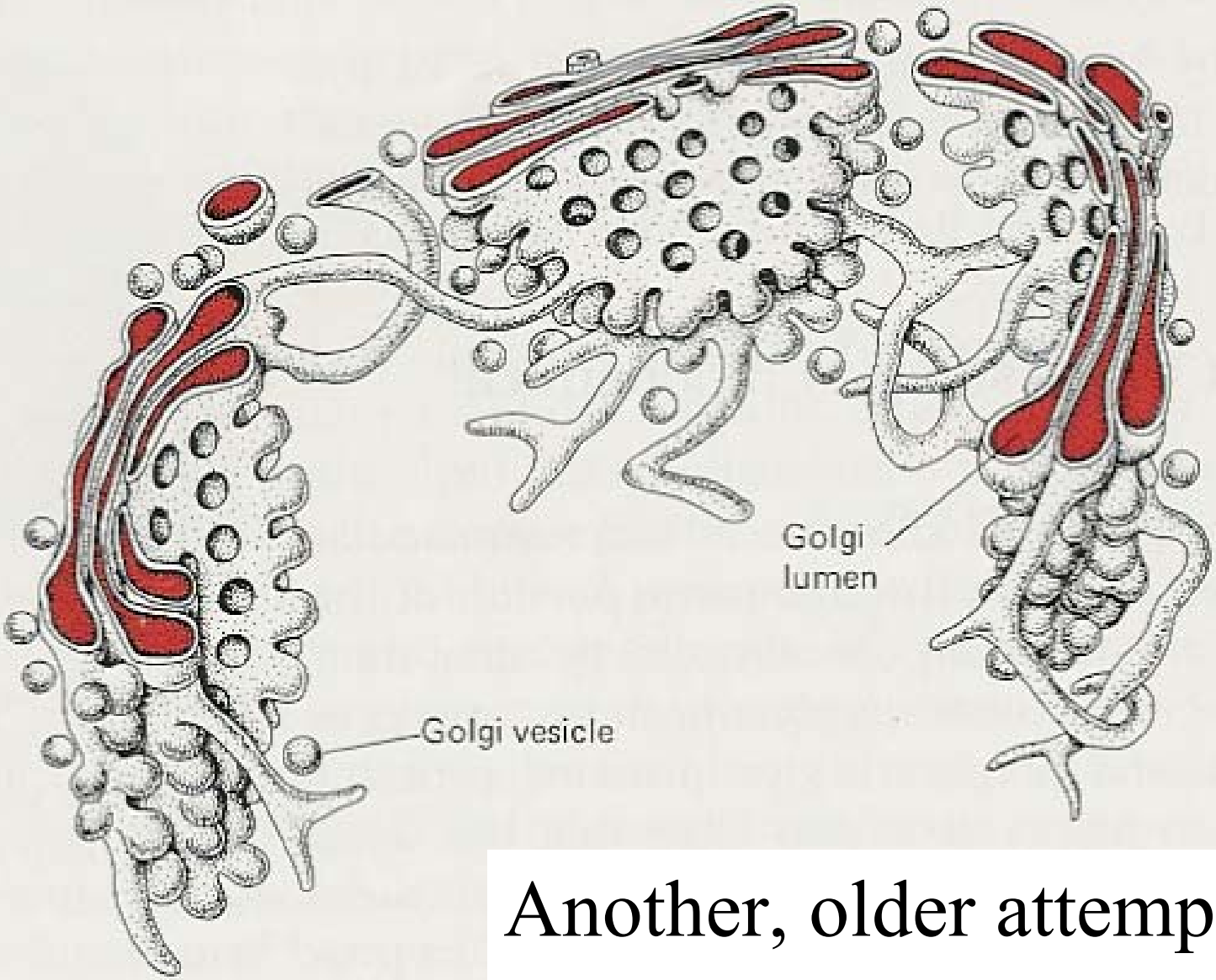
Golgi from above

Prydz and Parton

A 3D reconstruction

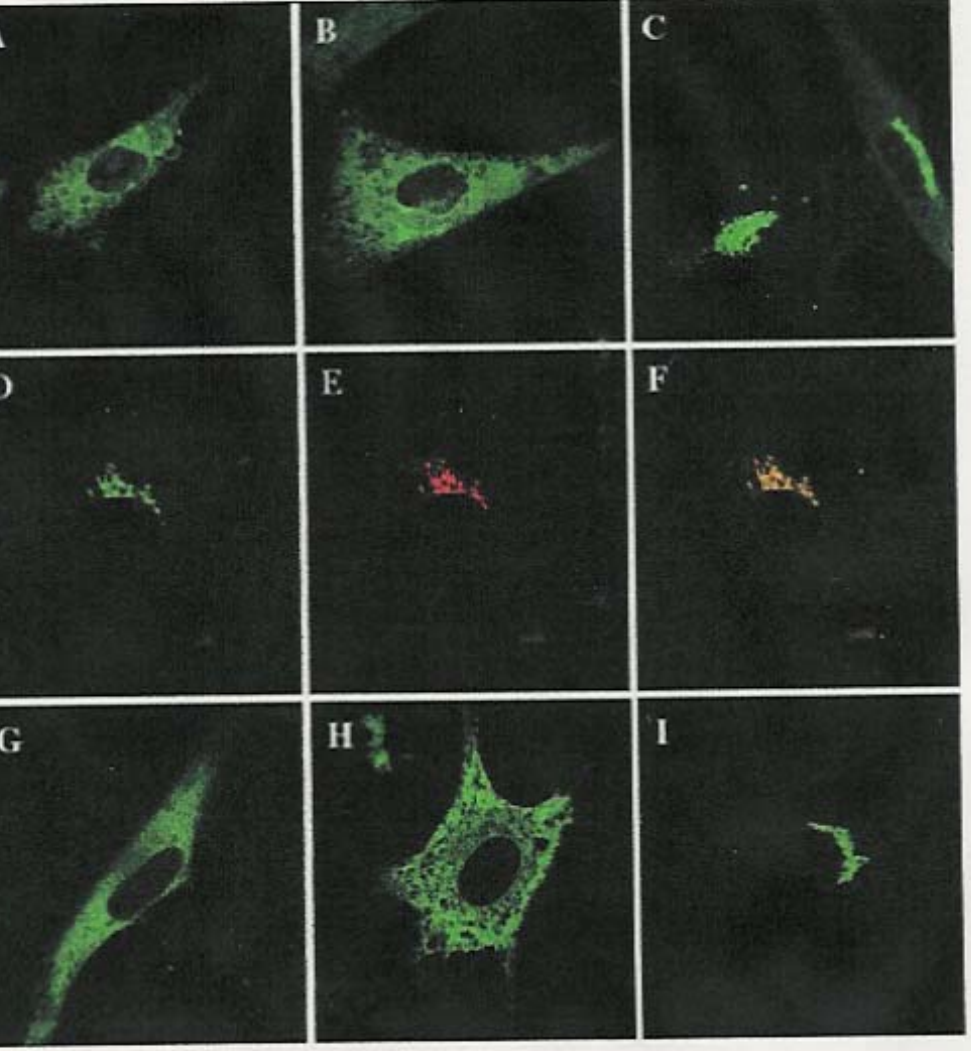
Kathryn Howell group



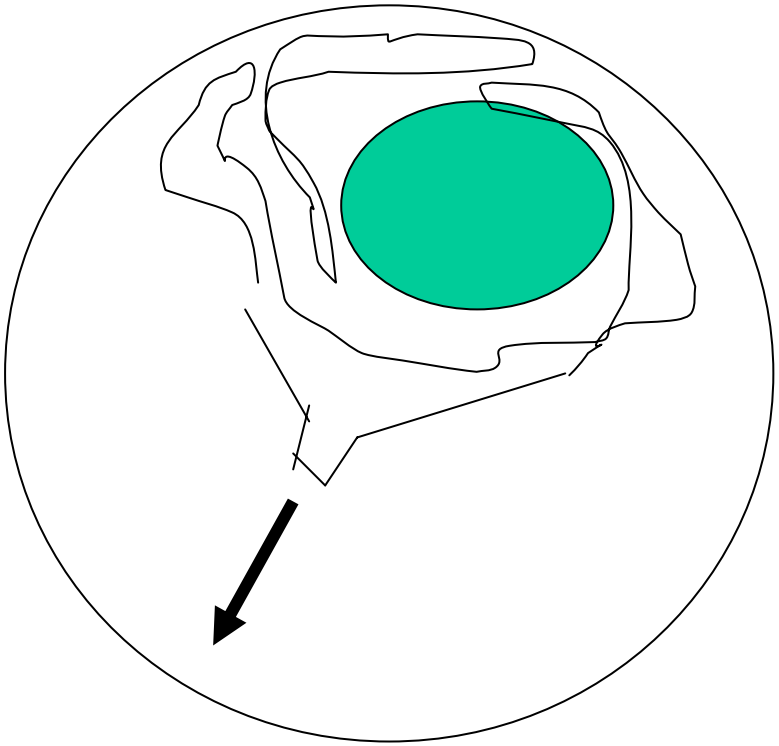


Another, older attempt

Alain Rambourg



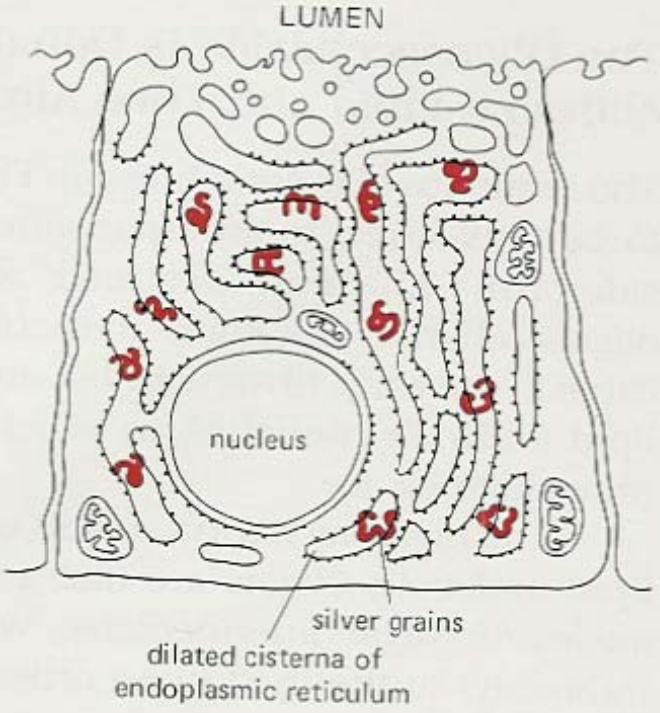
g. 2. EXT1 and EXT2 comigrate to the Golgi apparatus. Monolayers of BHK lls were transfected with EXT1-GFP (*A*), mEXT2-GFP (*B*), or both (*C*). When ansfected into the same cell, EXT1-GFP and EXT2-GFP relocated to the Golgi), while the Golgi apparatus was immunolabeled with an anti-Golgi 58K onoclonal antibody and a Texas red-conjugated secondary antibody (*E*). hen overlaid, they show excellent colocalization (yellow) (*F*). GFP fusion onstructs of the EXT homologs EXTL2 (*G*) and EXTL3 (*H*) were also localized, s well as the murine N-deacetylase/N-sulfotransferase (NDST2), a key enzyme

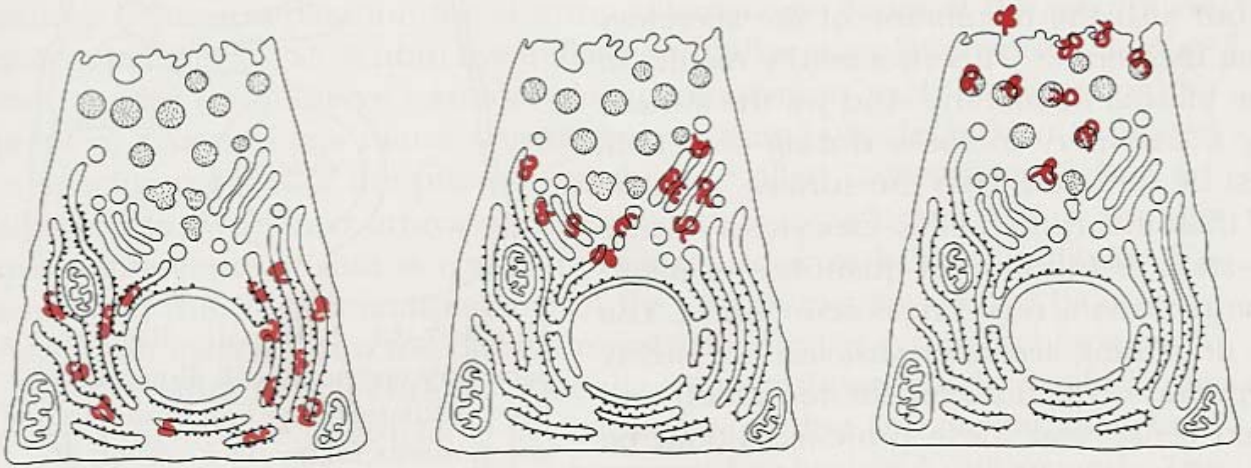


Concentration of secretory proteins from a relatively large volume (ER) to a relatively small volume (Golgi), before further

The first proof of Golgi involvement in secretion ~ 1971

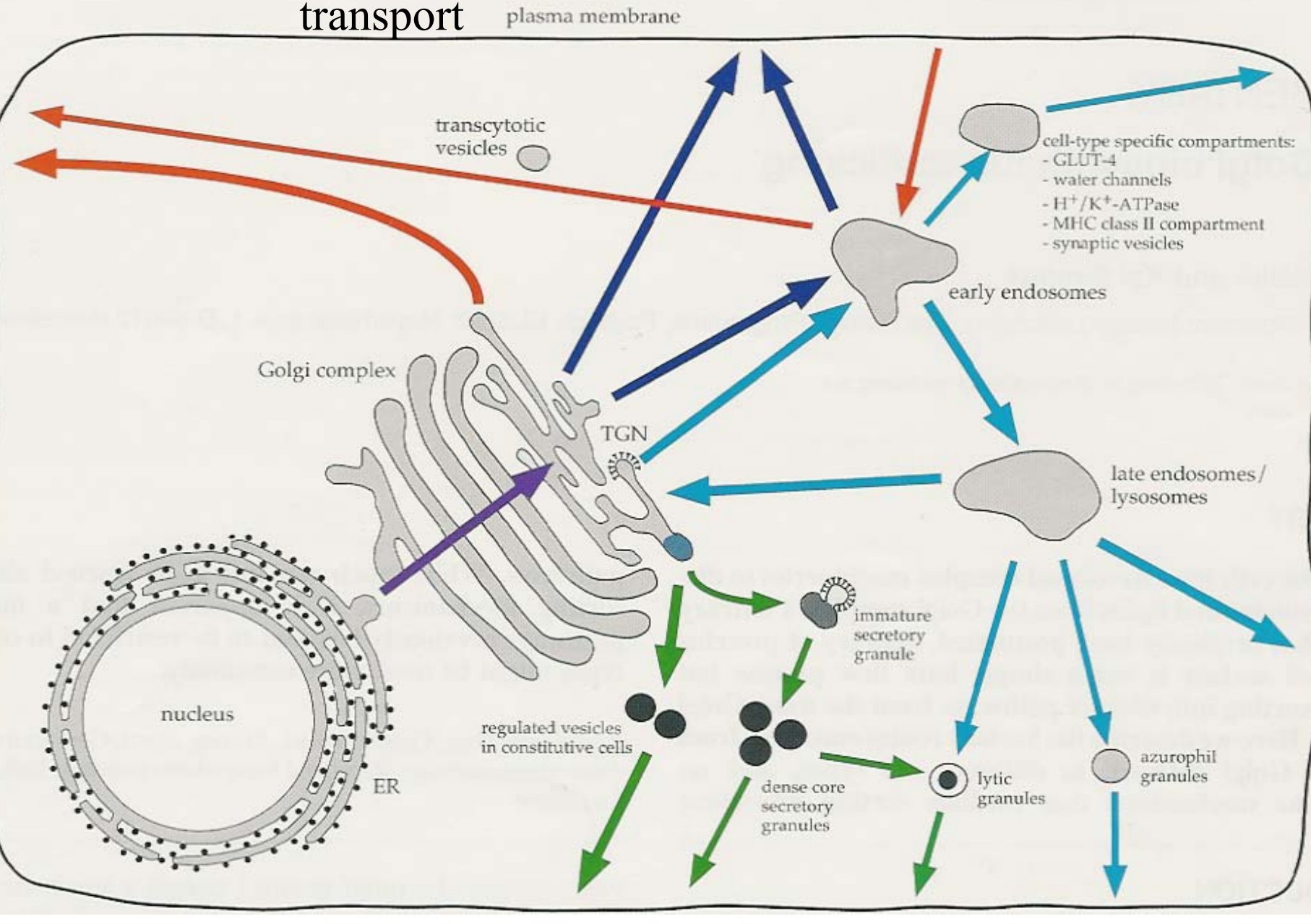
Figure 7–34 Schematic diagram of thyroglobulin synthesis in a thyroid cell incubated with [^{3}H]mannose. By using the techniques shown in the preceding figures, silver grains are localized over the rough ER, demonstrating that the [^{3}H]mannose is incorporated into thyroglobulin there. However, the resolution of the technique (~140 nm) is insufficient to localize the product to the cisternal space, even though such a localization is indicated in this diagram.

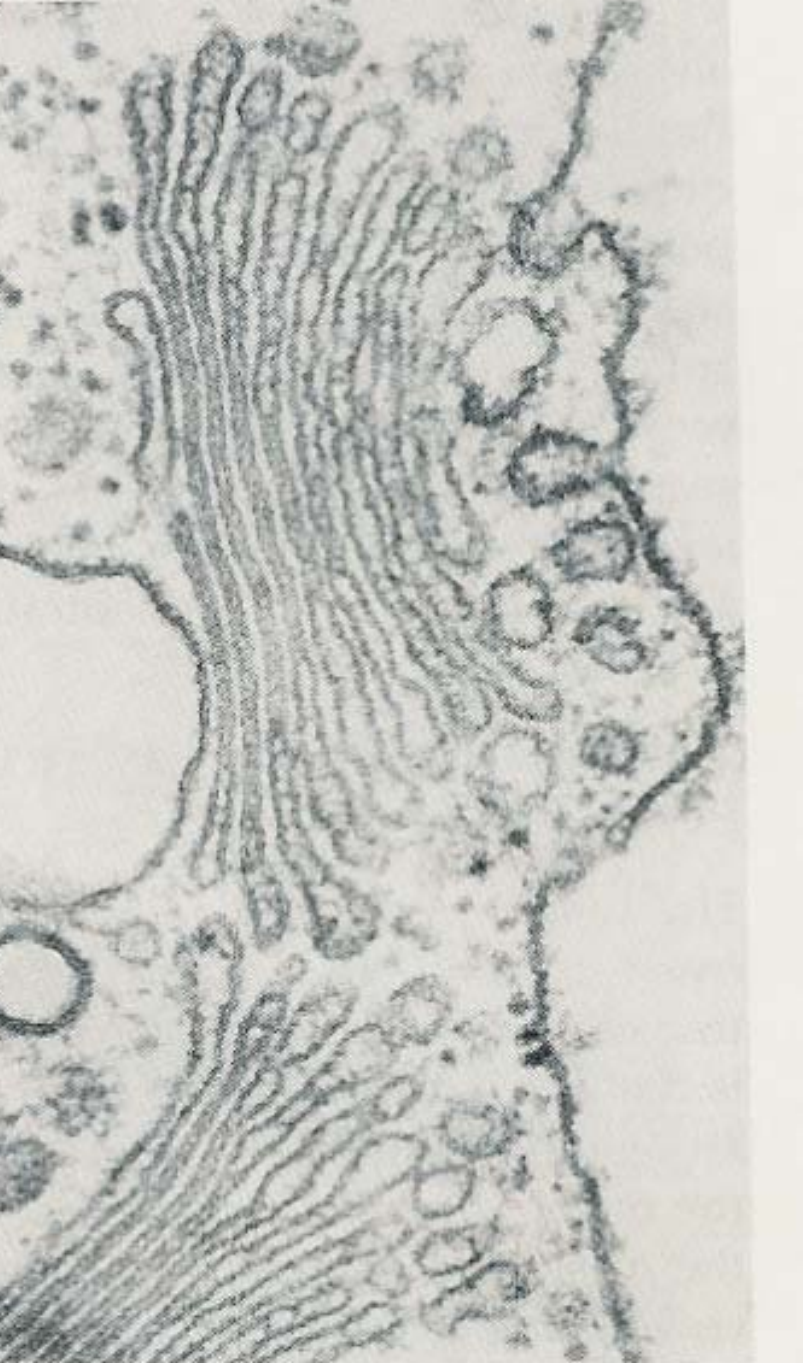




Keller and K. Simons

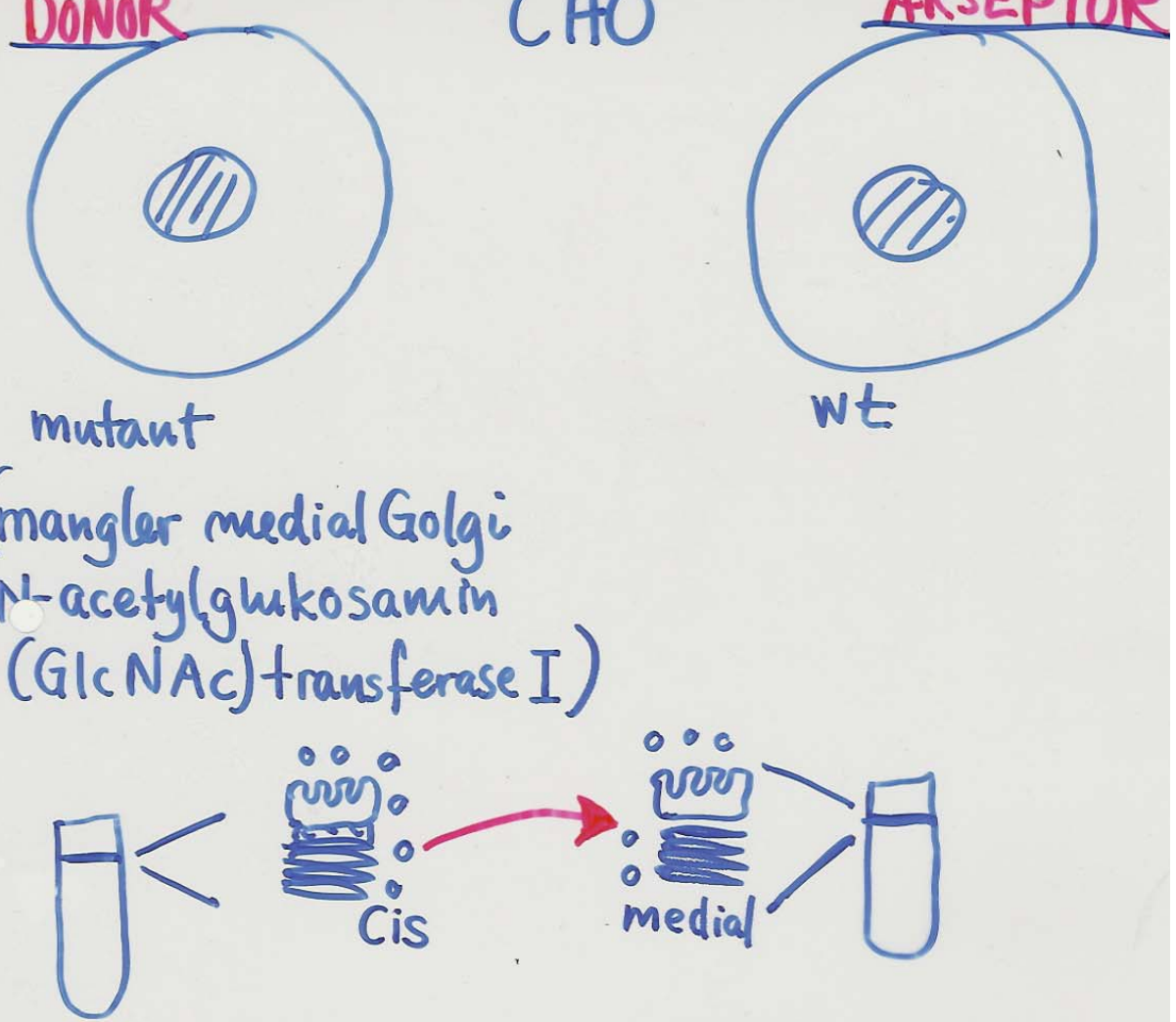
A large number of factors is needed for membrane transport





Many algae/plant cells produce molecules in their Golgi apparatus that are larger than the diameter of a normal transport vesicle.

A model implying gradual cisternal maturation was proposed in the 1950-ies.

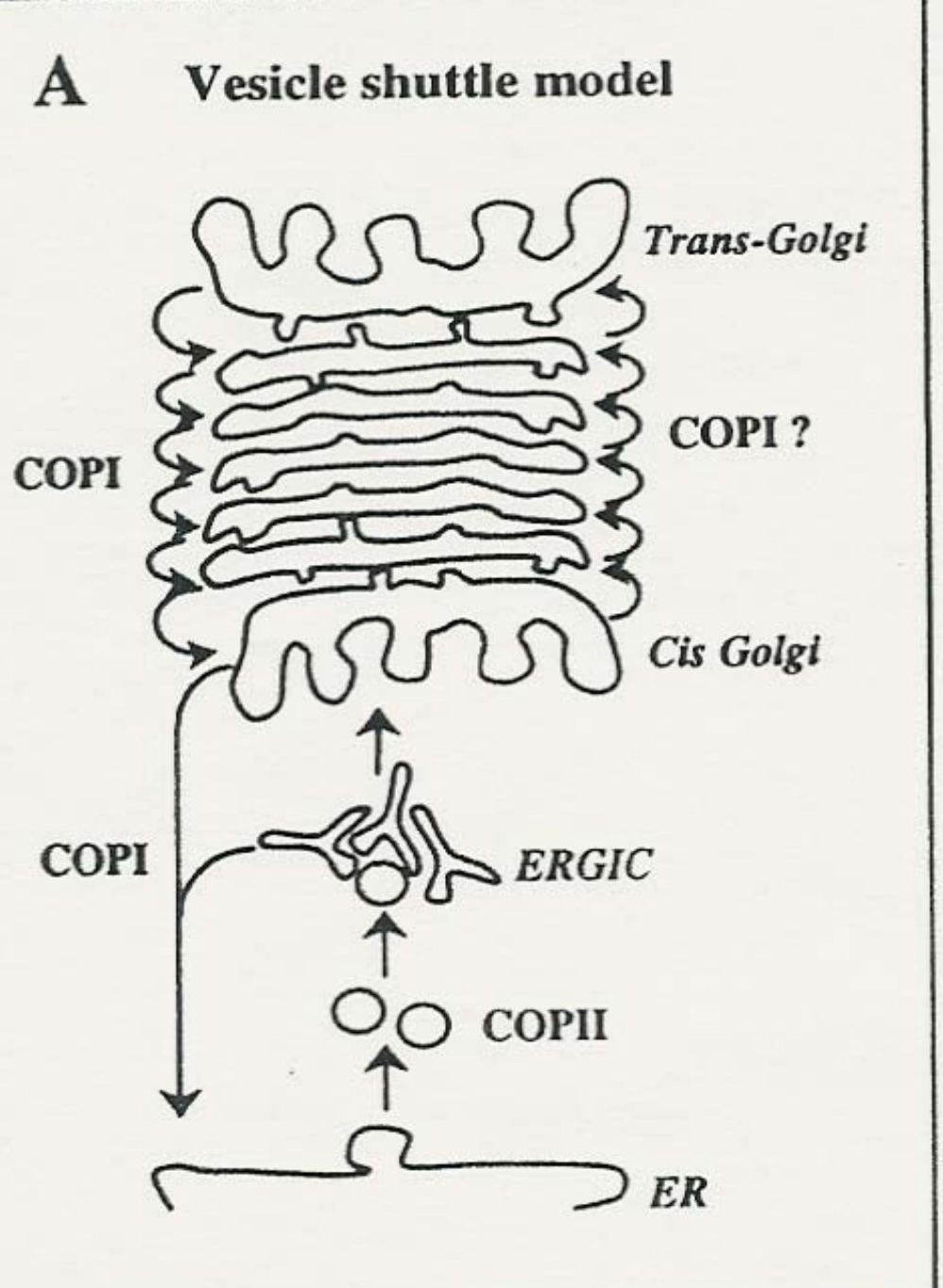


Budding, transport og fusjon:

Membraner, ATP, cytosoliske og membran-assosierte proteiner.

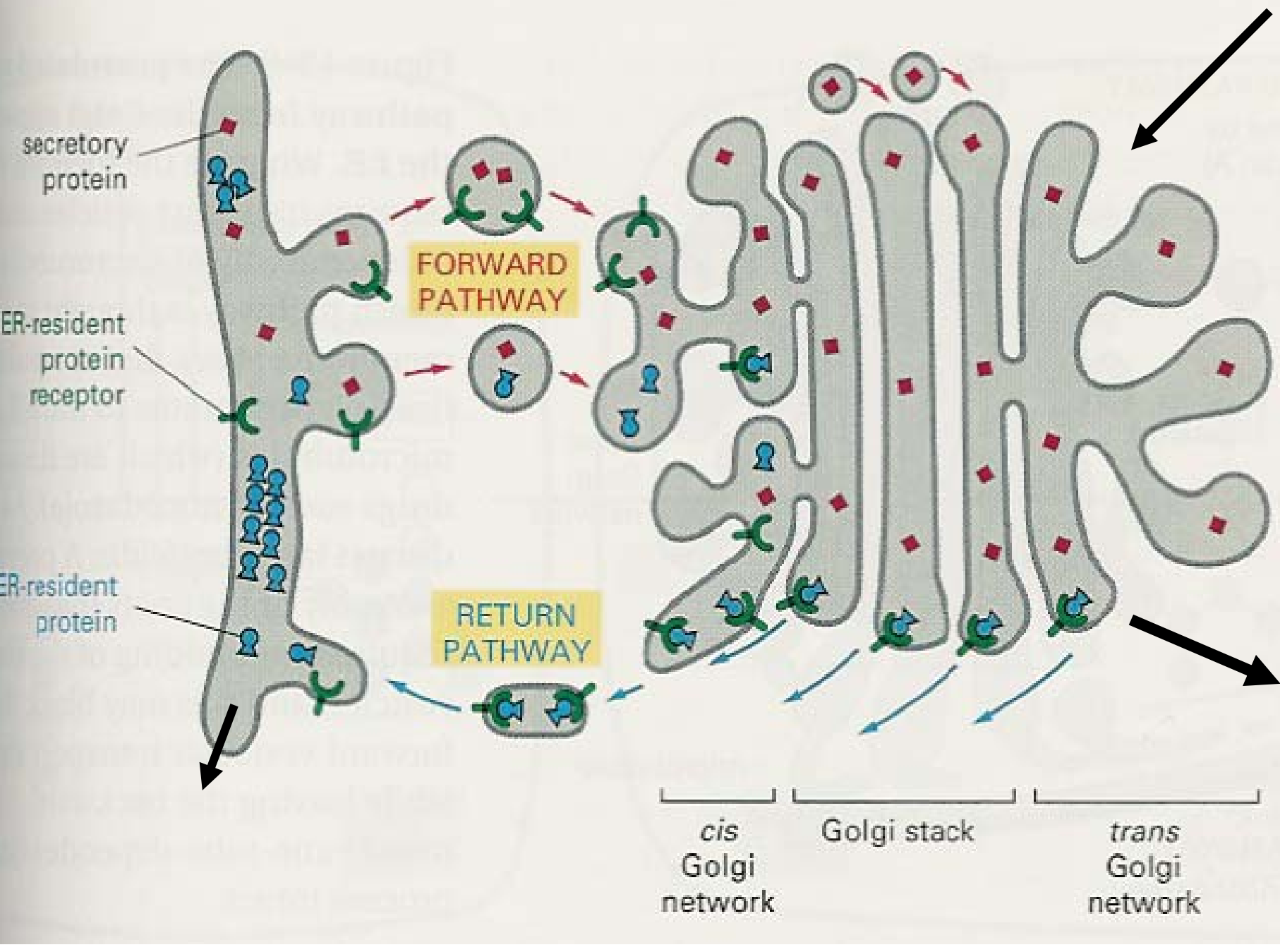
NSF, SNAP, osv

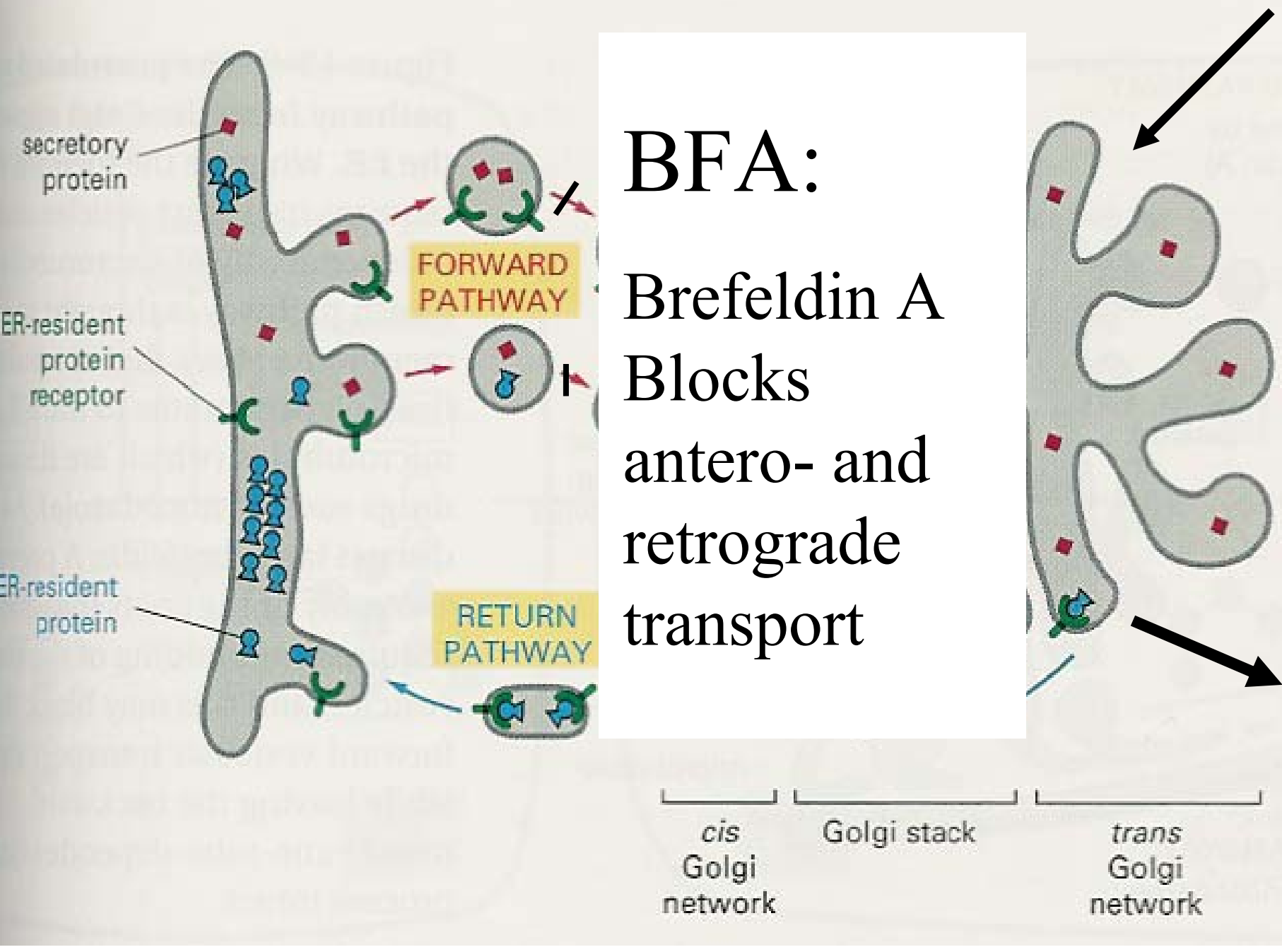
Donor cells were infected with VSV leading to expression of the VSV G (glyco) protein at high levels. The protein is not terminally modified by N-acetyl-glucosamine, because the donor cells do not express the needed transferase. When a donor Golgi fraction is mixed with a wild type acceptor Golgi fraction containing this enzyme ^{3}H-glucosamine is incorporated.



The results of Rothman and co-workers formed the basis for a model implying forward (anterograde) vesicular transport in the Golgi apparatus. They also observed vesicles by EM (in collaboration with Orci).

Retrograde transport in the Golgi apparatus had not yet been discovered.


secretory protein
ER-resident protein receptor
ER-resident protein
FORWARD PATHWAY
RETURN PATHWAY
cis Golgi network
Golgi stack
trans Golgi network



BFA:

Brefeldin A Blocks antero- and retrograde transport

Cell, Vol. 95, 993–1003, December 23, 1998, Copyright ©1998 by Cell Press

Procollagen Traverses the Golgi Stack without Leaving the Lumen of Cisternae: Evidence for Cisternal Maturation

Lidia Bonfanti,*†# Alexander A. Mironov, Jr.,*†#
José A. Martínez-Menárguez,§ Oliviano Martella,*†
Aurora Fusella,*† Massimiliano Baldassarre,*‡
Roberto Buccione,*‡ Hans J. Geuze,§
Alexander A. Mironov,*†‖ and Alberto Luini*‡‖
*Istituto di Ricerche Farmacologiche "Mario Negri"
Consorzio Mario Negri Sud
Department of Cell Biology and Oncology
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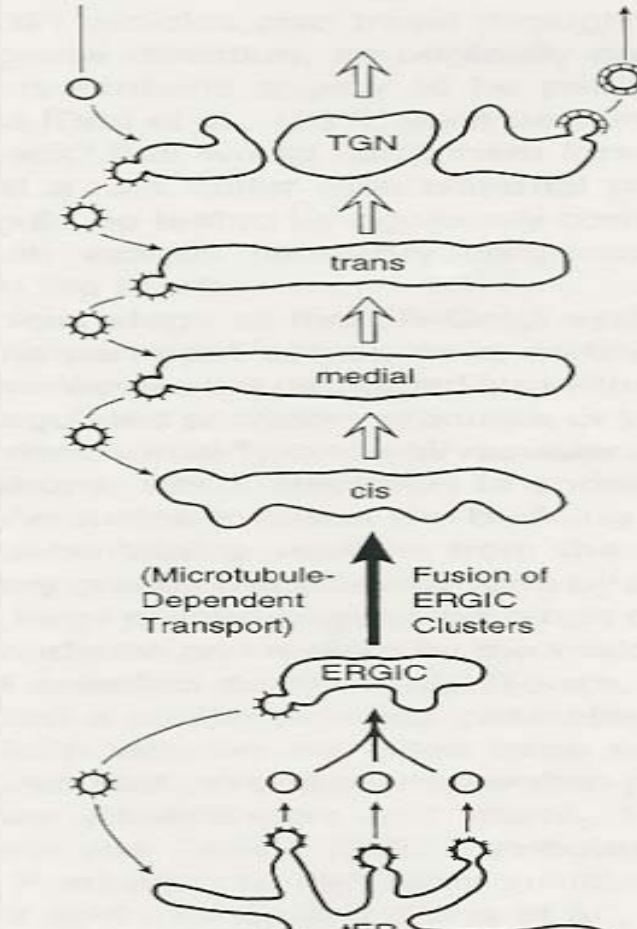
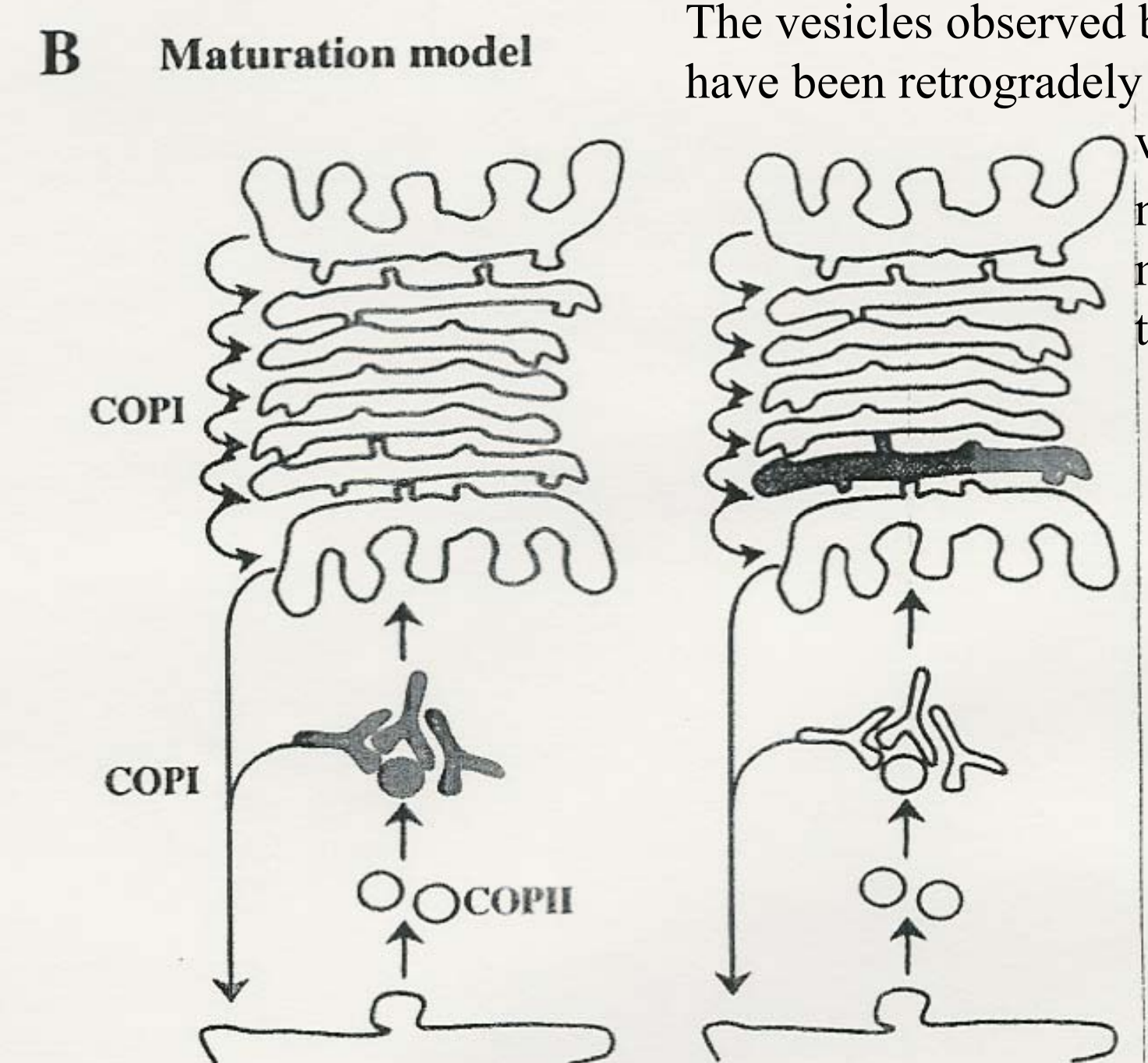
66030 S. Maria Imbaro (Chieti)
Italy
§Department of Cell Biology
Medical School and Institute of Biomembranes
Utrecht University
3584CX Utrecht
The Netherlands



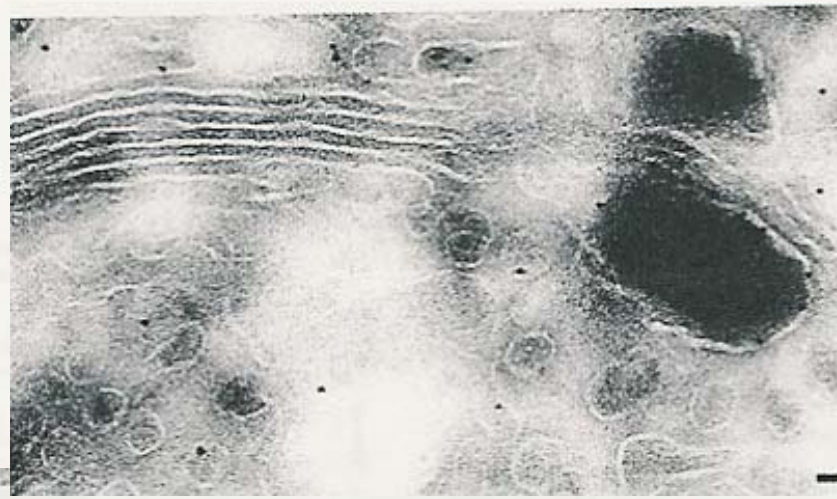


The vesicles observed by EM could have been retrogradely transported vesicles.

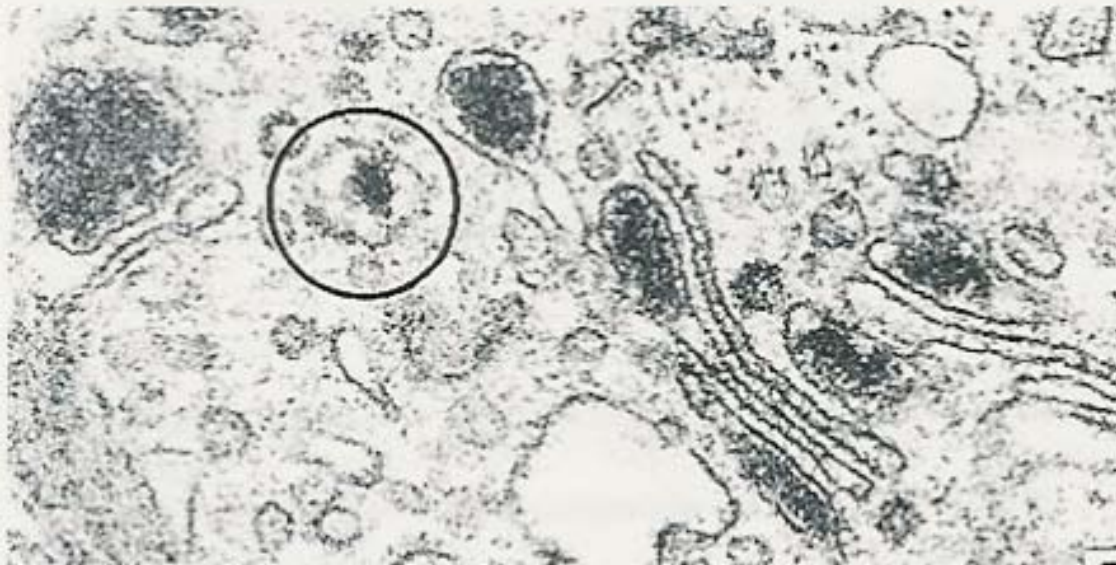
necessary for maintenance o the Golgi.

Cell, Vol. 102, 335–348, August 4, 2000, Copyright ©2000 by Cell Press

Megavesicles Implicated in the Rapid Transport of Intracisternal Aggregates across the Golgi Stack



Allen Volchuk,* Mylène Amherdt,† Mariella Ravazzola,†
Britta Brügger,* Victor M. Rivera,‡ Tim Clackson,‡
Alain Perrelet,† Thomas H. Söllner,*
James E. Rothman,*§ and Lelio Orci†
*Cellular Biochemistry & Biophysics Program
Memorial Sloan-Kettering Cancer Center
New York, New York 10021
†Department of Morphology
University of Geneva Medical School
1211 Geneva 4
Switzerland
‡ARIAD Pharmaceuticals, Inc.
Cambridge, Massachusetts 02139



Hugh Pelham

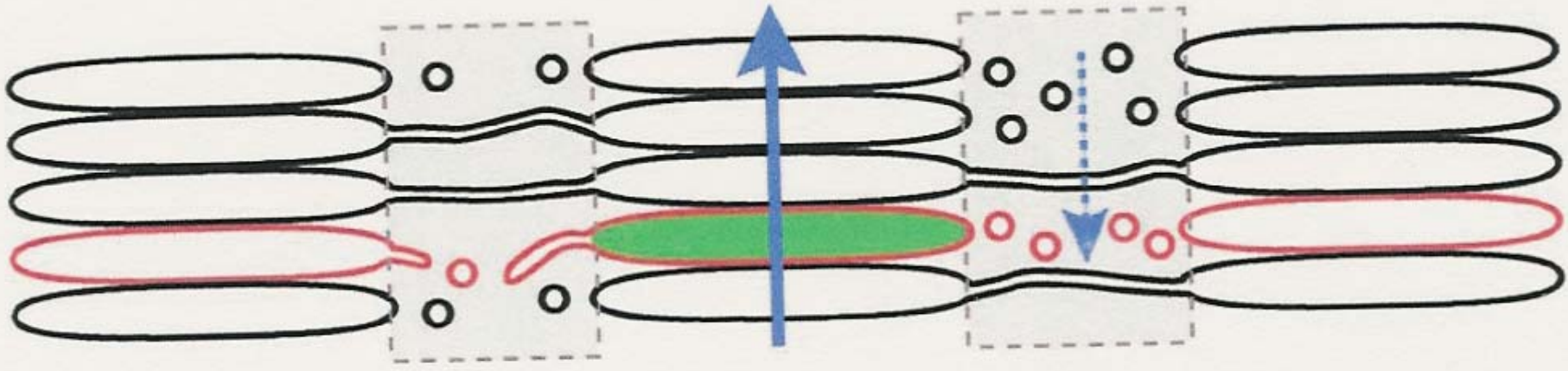
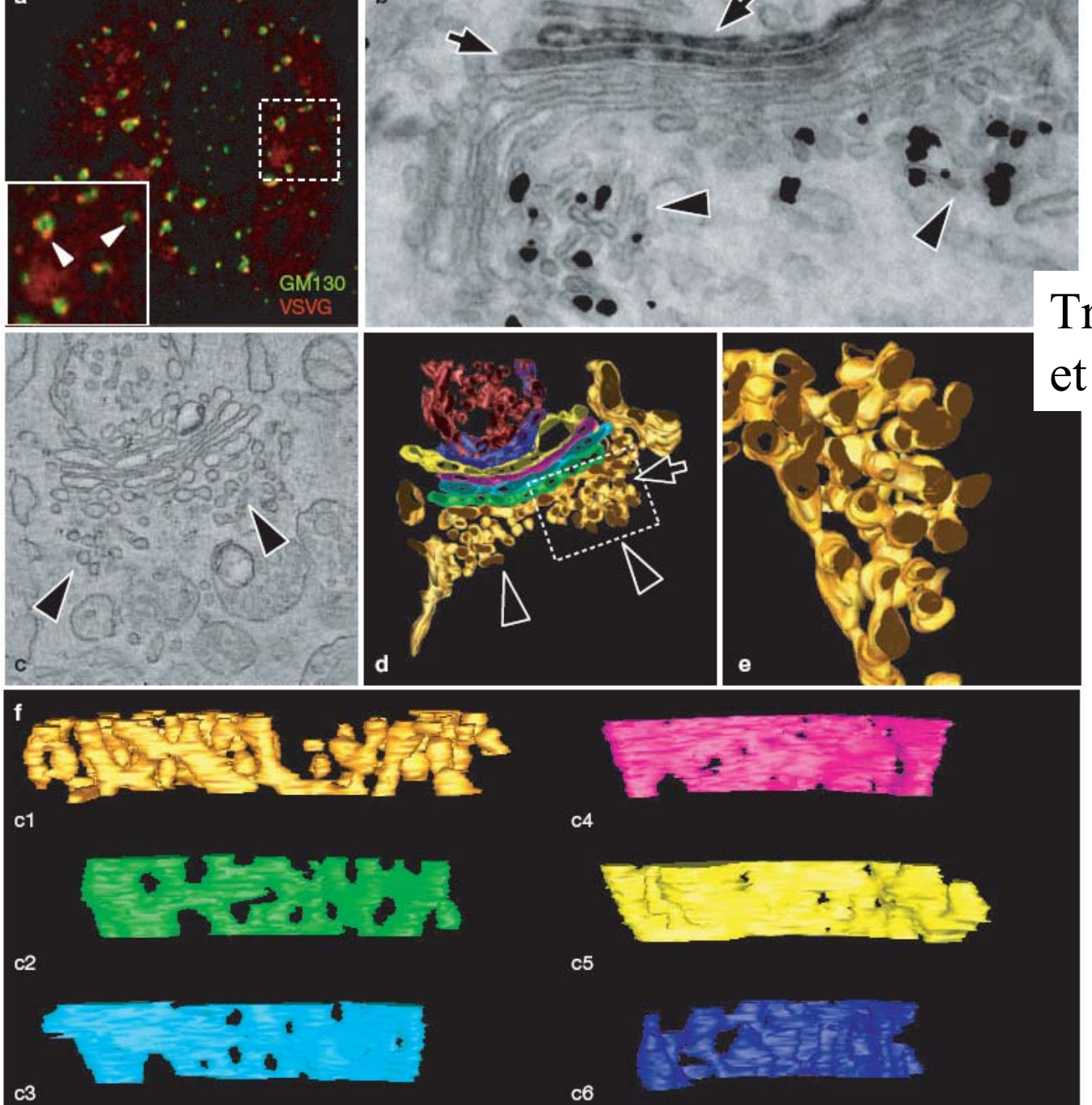


Figure 1. **Schematic structure of the Golgi.** The Golgi ribbon consists of cisternal stacks separated by tubulovesicular domains (gray boxes). Tubular connections between equivalent cisternae are well documented (Ladinsky et al., 1999); whether cisternae at different levels are also sometimes connected by tubules is less clear. Individual glycosyltransferases tend to be found at a characteristic level of the stack (red). They enter vesicles and seem to be able to move along the ribbon. When VSV G is delivered to the Golgi in a short pulse, it enters only a subset of the stacks (Mironov et al., 2001). Single cisternae containing VSV G (green) can then move through the stack; exclusion of VSV G from the tubulovesicular regions prevents its transfer both to adjacent cisternae in the same stack and to other stacks in the ribbon. Blue arrows indicate forward movement of cisternae and presumed net retrograde movement in the tubulovesicular regions.

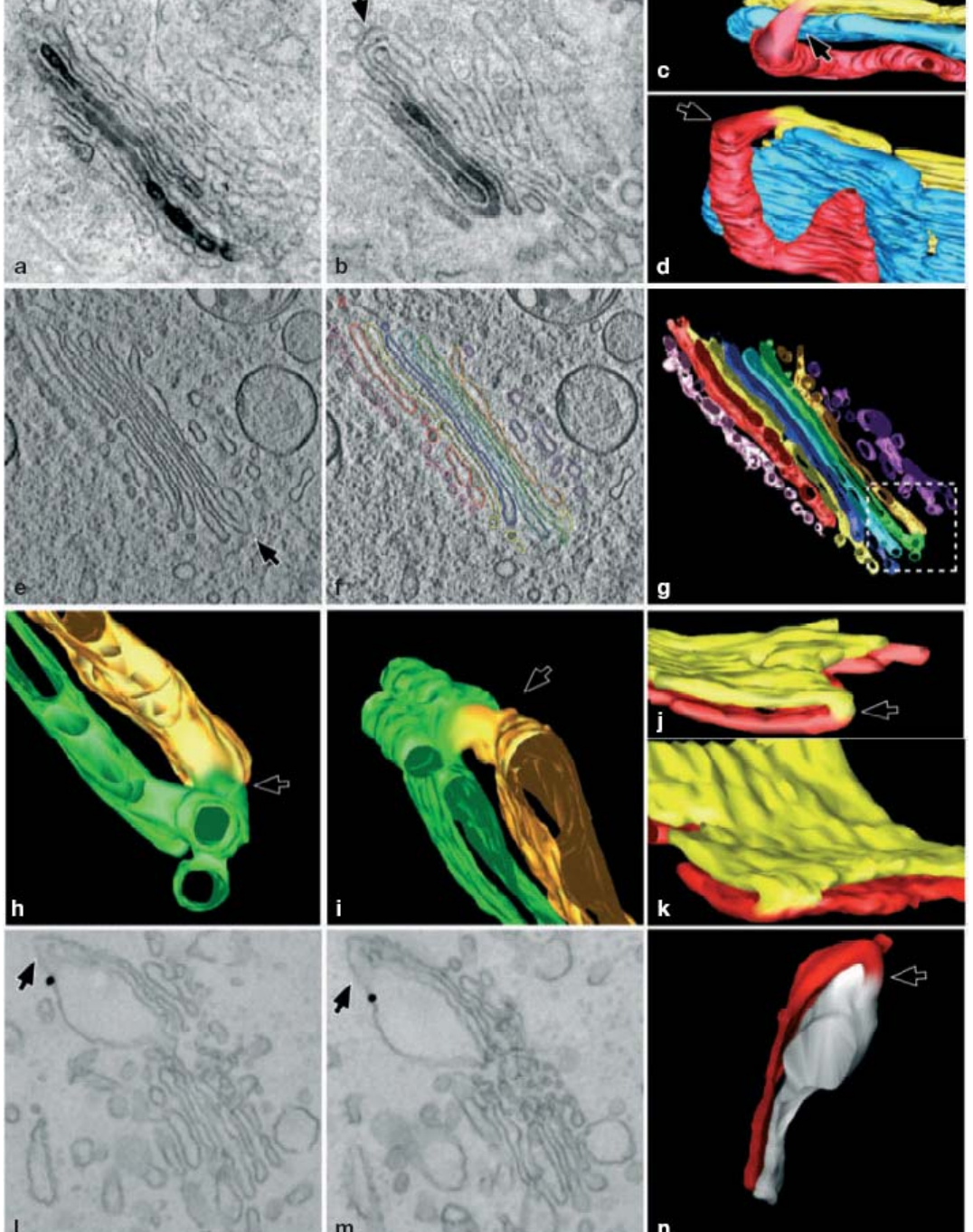
A resident Golgi protein is excluded from peri-Golg vesicles in NRK cells

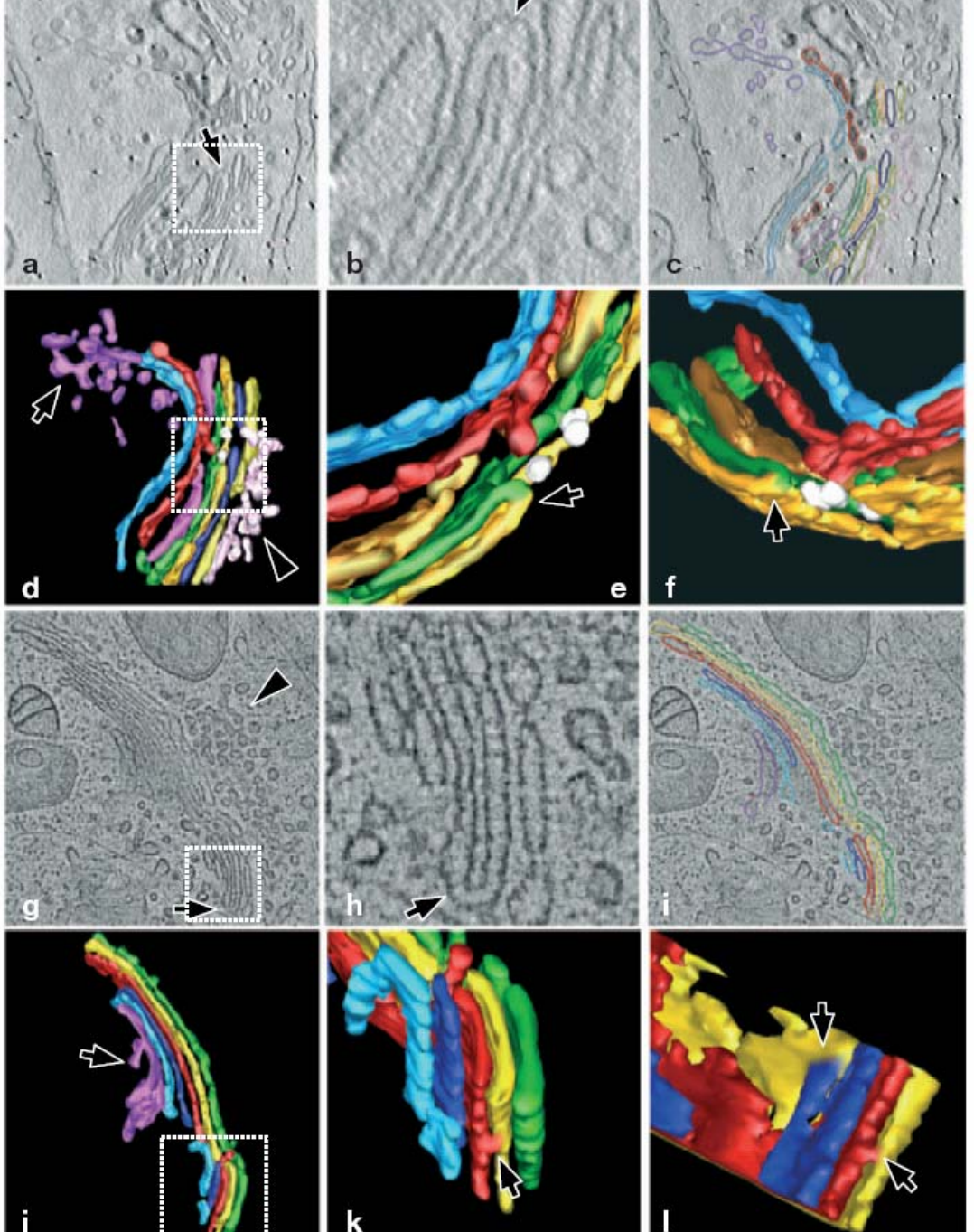
Pierre Cosson*, Mylène Amherdt*, James E. Rothman†, and Lelio Orci*‡

*Department of Morphology, University of Geneva Medical School, 1211 Geneva 4, Switzerland; and †Cellular Biochemistry and Biophysics Program, Memorial Sloan–Kettering Cancer Center, New York, NY 10021



Trucco, A et al. 2004


a
b
c
d
e
f
g
h
i
j
k
l
m
n


a
b
c
d
e
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g
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k
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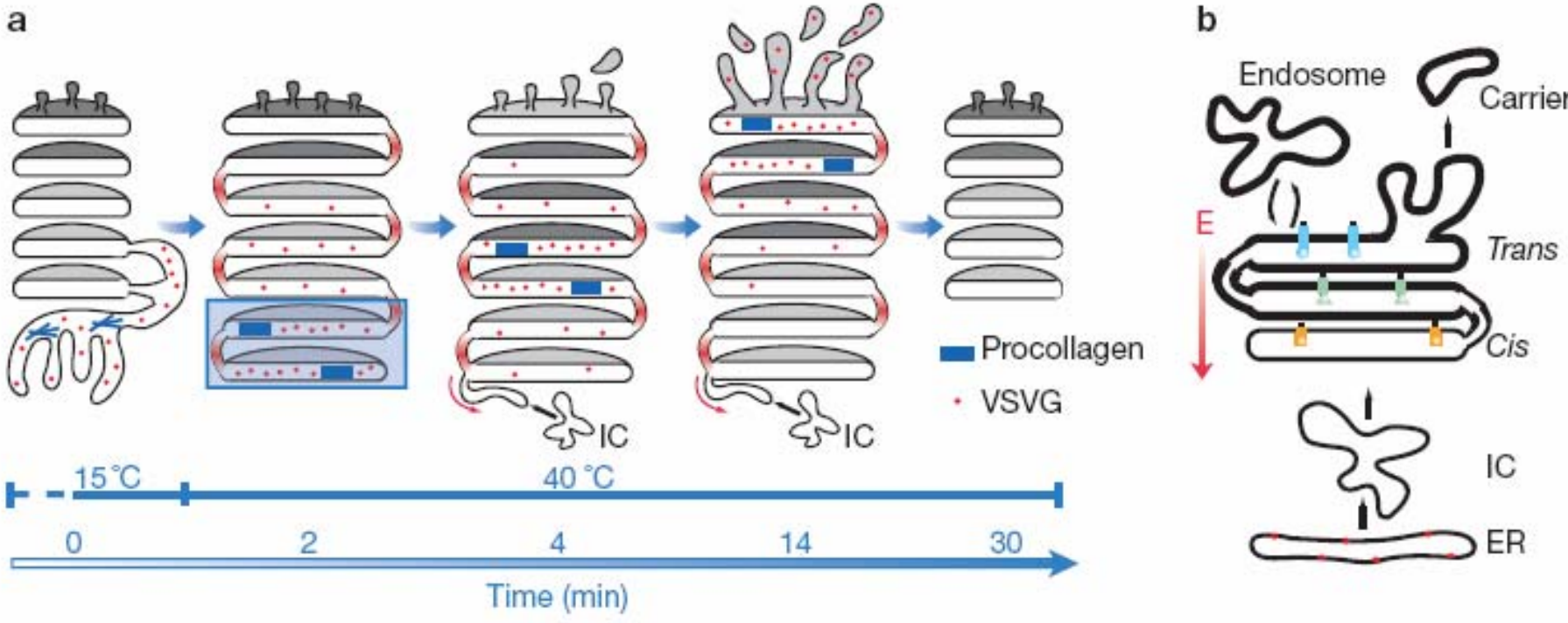

a
Procollagen
VSVG
IC
IC
15 °C
40 °C
0
2
4
14
30
Time (min)
b
Endosome
Carrier
E
Trans
Cis
IC
ER

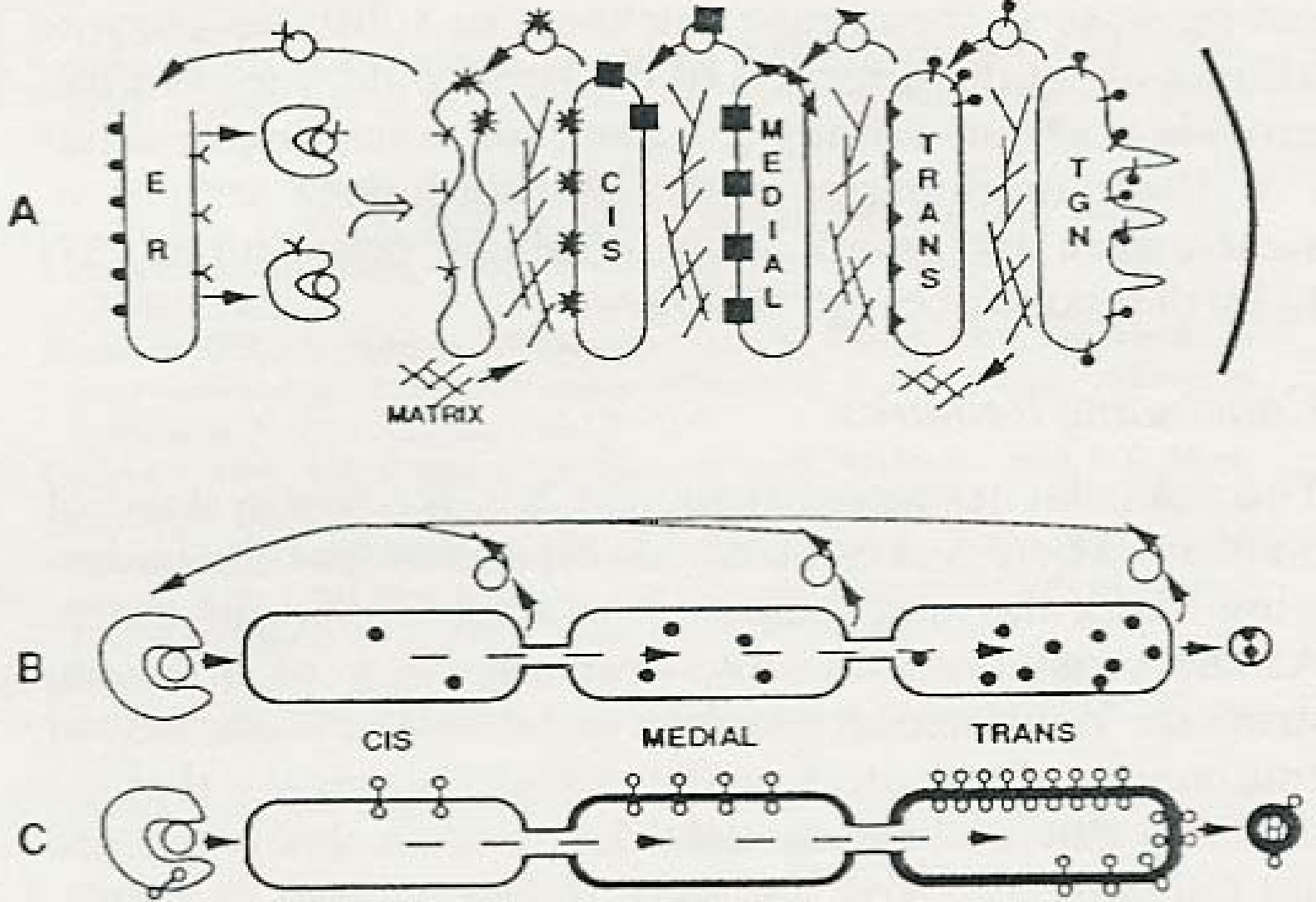
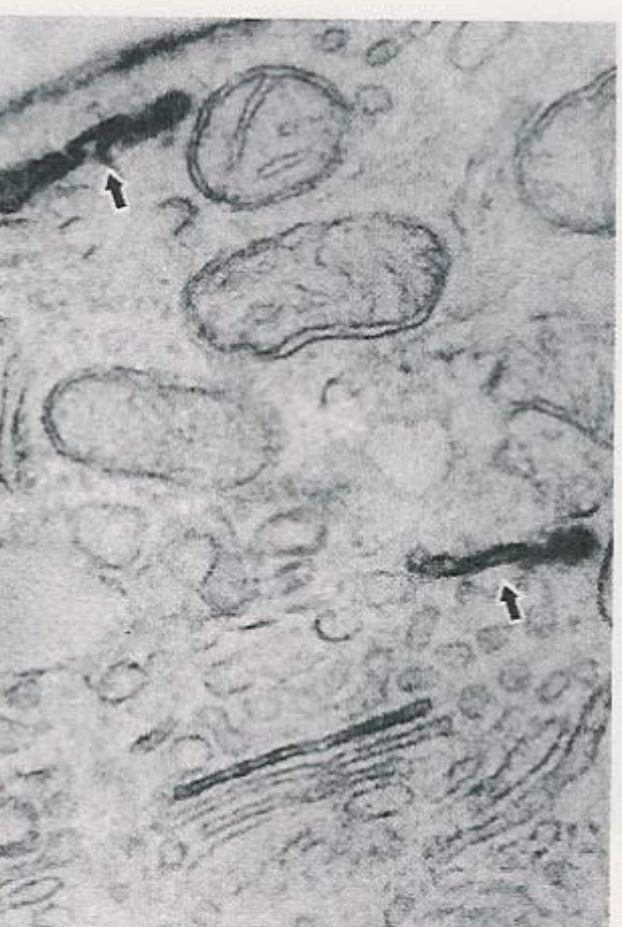


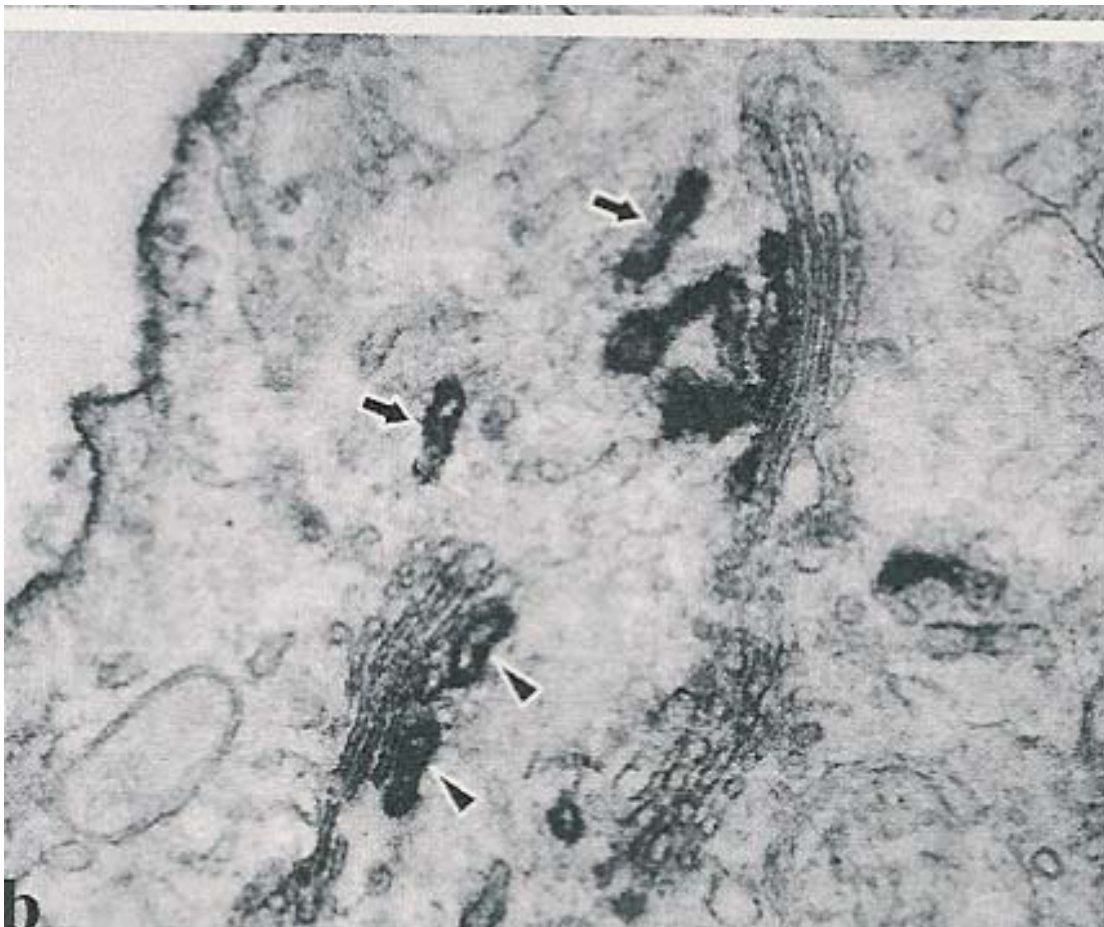
Figure 1. (*A*) Cisternal maturation–progression. According to an alternative view, the TGN consists of tubules emanating from the *trans*-compartment (16). (*B* and *C*) Possible mechanisms of vec-

Correlative Light-Electron Microscopy Reveals the Tubular-Saccular Ultrastructure of Carriers Operating between Golgi Apparatus and Plasma Membrane

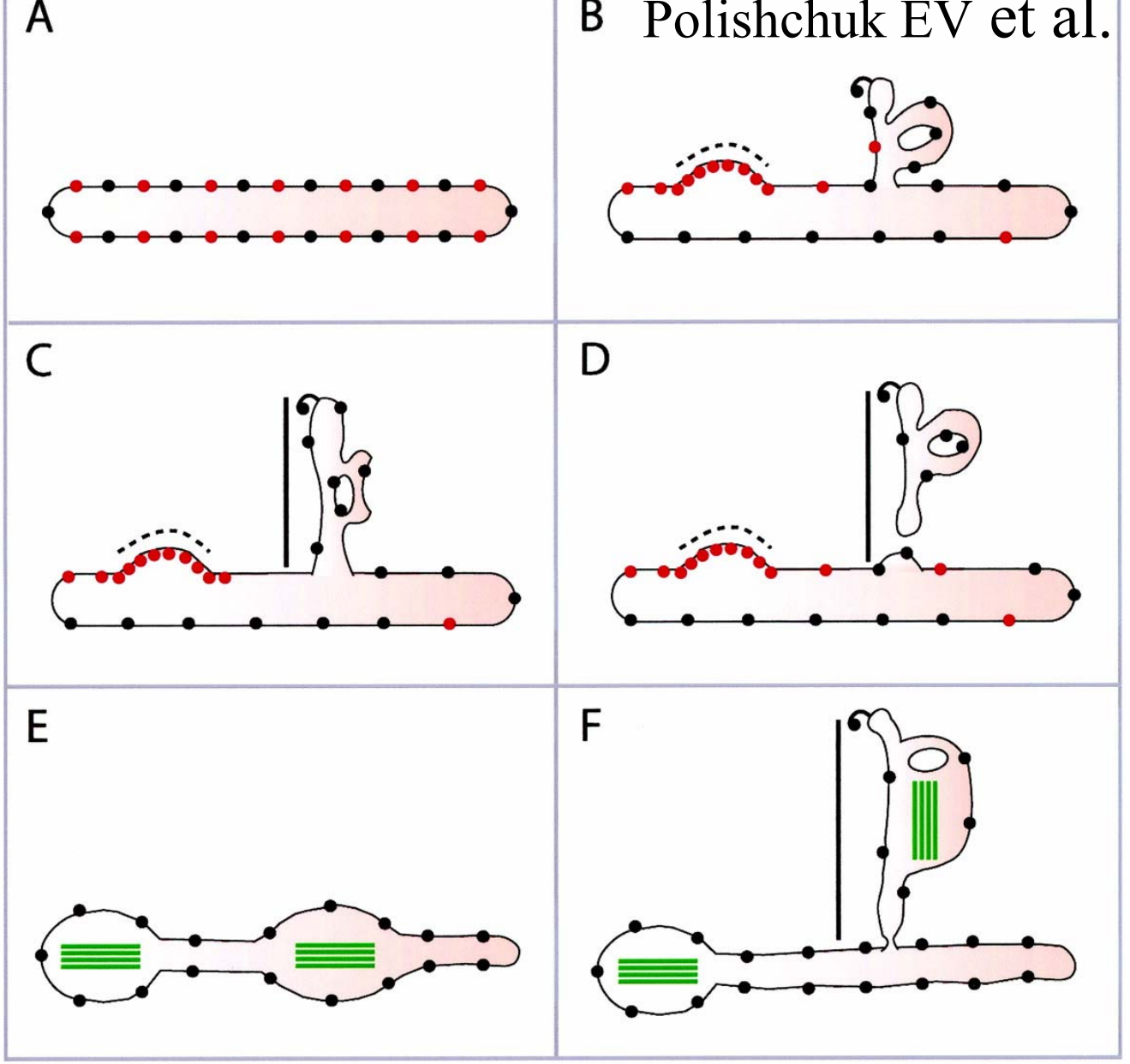
Roman S. Polishchuk, Elena V. Polishchuk, Pierfrancesco Marra, Saverio Alberti, Roberto Buccione, Alberto Luini, and Alexander A. Mironov

Department of Cell Biology and Oncology, Istituto di Ricerche Farmacologiche "Mario Negri," Consorzio Mario Negri Sud 66030 S. Maria Imbaro (Chieti), Italy





Polishchuk EV et al. 2003



COP I COP II Exocyst

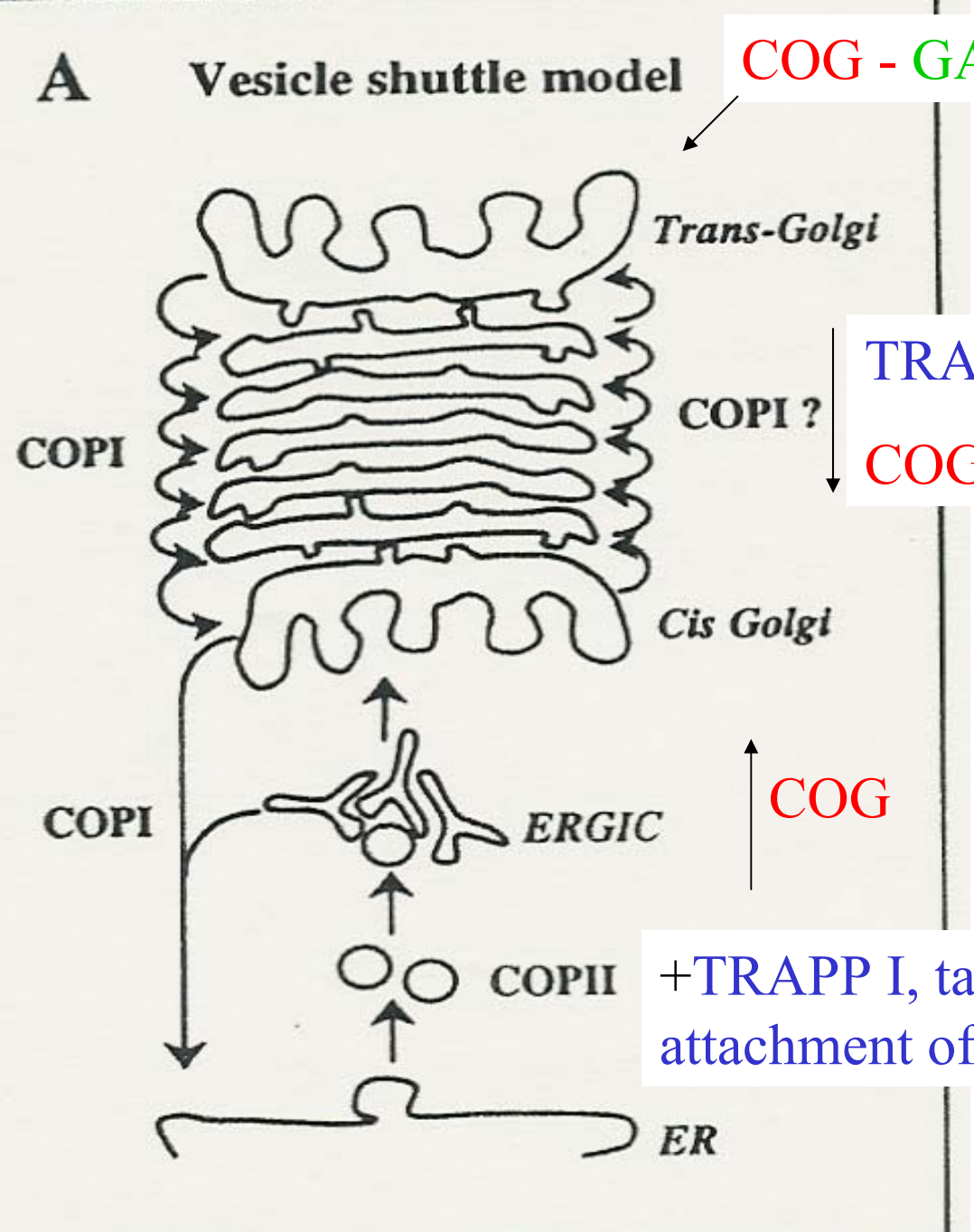
TRAPP I (7) TRAPP II (10)

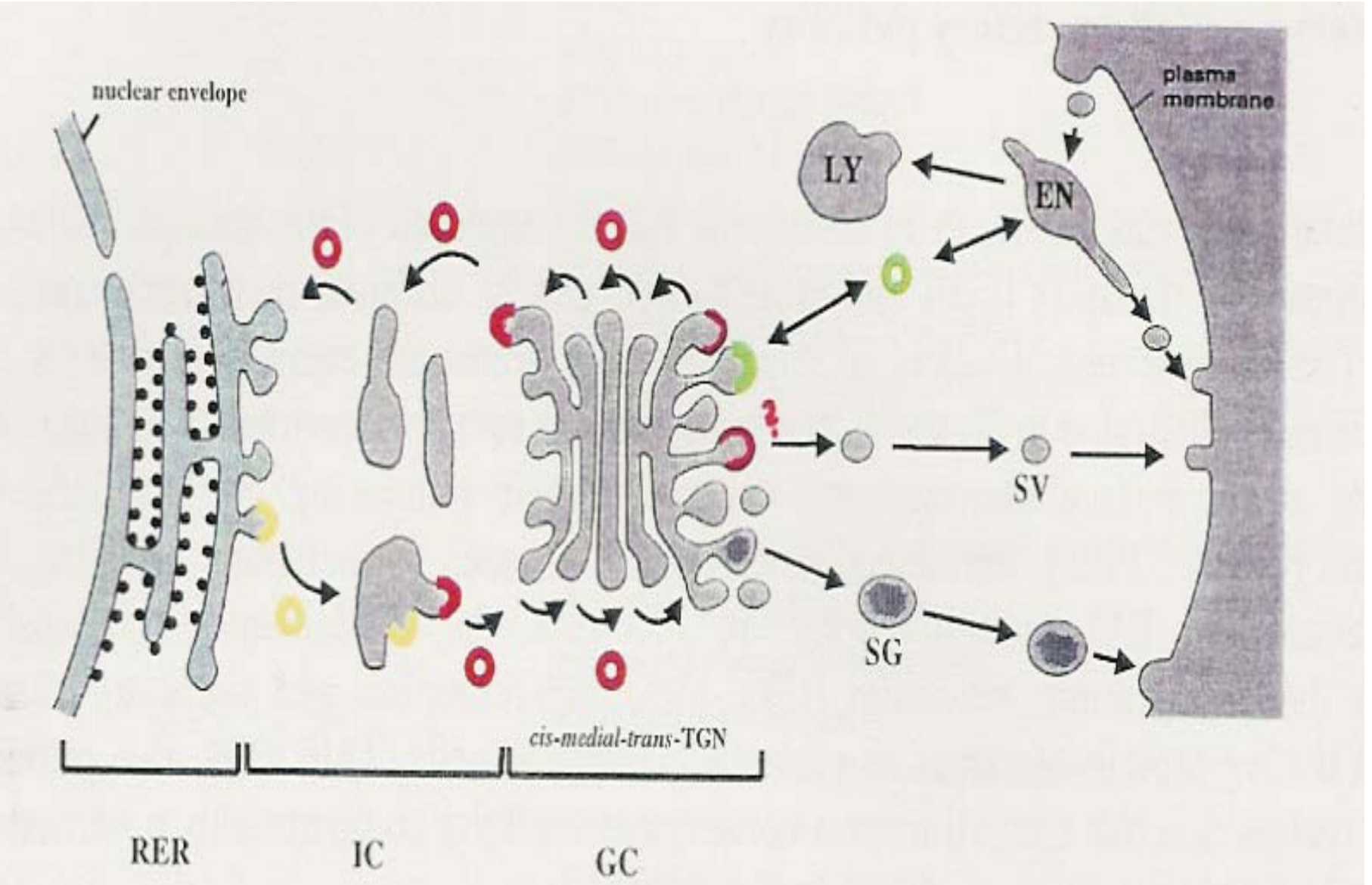
Transport protein particle

COG (8 subunits, COG-1 to COG-8)

Conserved oligomeric Golgi – 800 kDa complex, interactions with ε-COP, SNARES, GTPases…

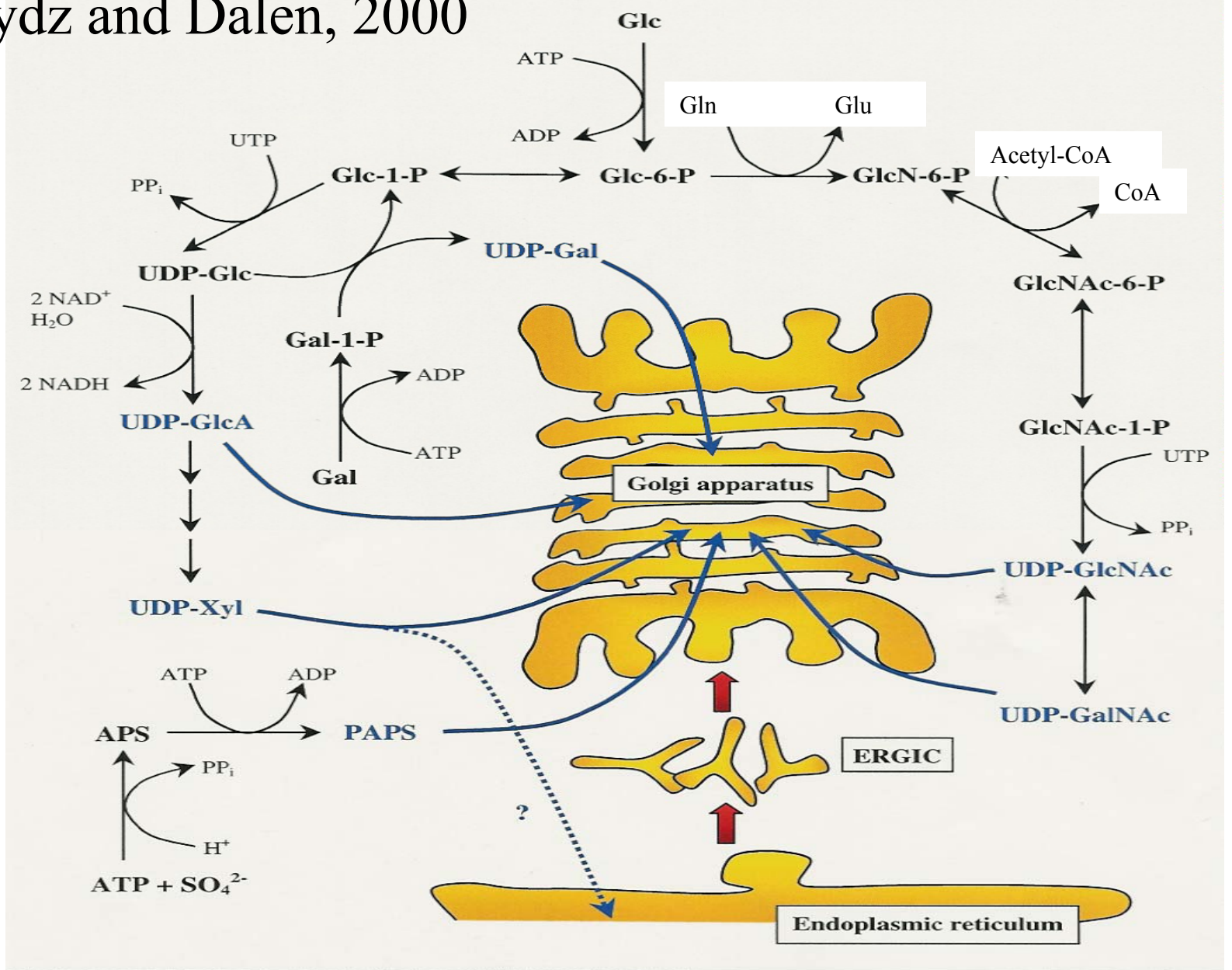
GARP/VFT (Golgi associated retrograde protein/ Vps fifty three – heterotetrameric rab effector)


A Vesicle shuttle model
COG - GARP/VFT
Trans-Golgi
TRAPP II
COPI ?
COPI
COG
Mutations give defects i
glycosylation
Cis Golgi
COPI
ERGIC
COG
COPII
+TRAPP I, targeting and/or
attachment of vesicles to Golgi?
ER



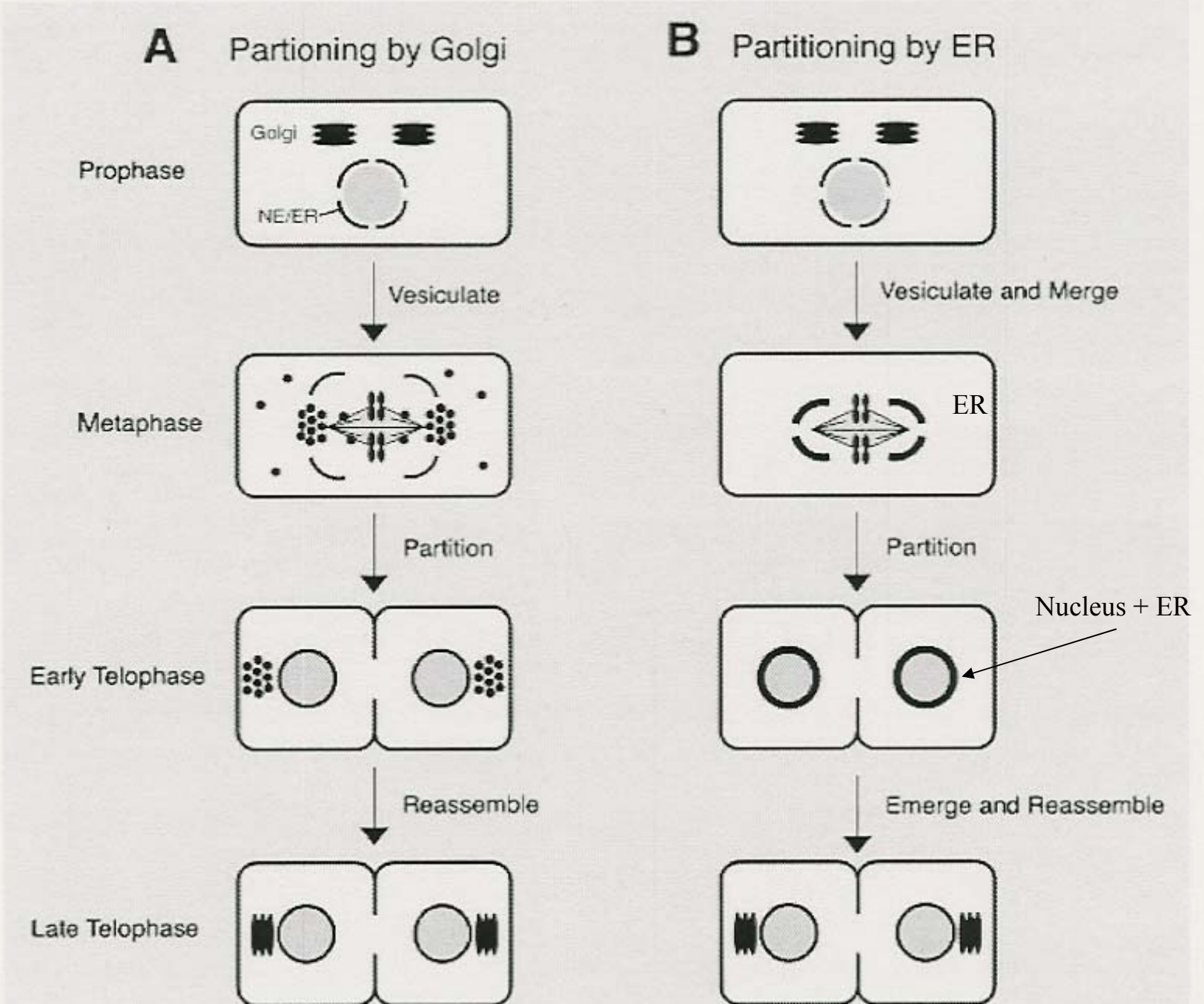
The main pathway of glycosylated proteins goes through the ER and Golgi apparatus

Prydz and Dalen, 2000



Abbreviations:

APS:	Adenisone-5'-phosphosulphate	GlcA:	Glucuronic acid
ERGIC:	ER-Golgi intermediate Compartment	GlcN:	N-Glucosamine
		GlcNAc:	N-acetyl-Glucosamine
		IdoA:	Iduronic acid


A
Partioning by Golgi
B
Partitioning by ER
Prophase
Golgi
NE/ER
Vesiculate
Vesiculate and Merge
Metaphase
ER
Partition
Partition
Nucleus + ER
Early Telophase
Reassemble
Emerge and Reassemble
Late Telophase

More than one way to replicate the Golgi apparatus

Sean Munr

he Golgi apparatus, in common with other cytoplasmic organelles, must be replicated during the cell ycle. Recent studies using green fluorescent protein (GFP) fusions, suggest that this process may occur by fferent mechanisms in different organisms. In this issue of *Nature Cell Biology*, striking new data shows n apparent *de novo* formation of the Golgi in the daughter cells of budding yeast.

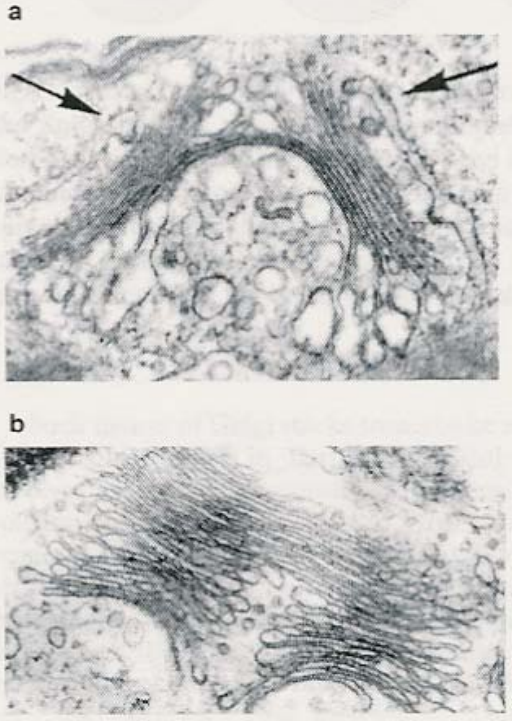


Figure 1 Golgi stacks from algae apparently replicating by binary fission. Electron micrographs of Golgi from *Oedogonium cardiacum* (a). Associated tER is shown (arrows). Golgi from *Tetraselmis striata* (b) are also shown. The stacks are apparently splitting from *cis* to *trans*, or *trans* to *cis* respectively[5,12]. Figures adapted from refs 5 and 12, © permission from Csiro publishing and the Company of Biologists, respectively.

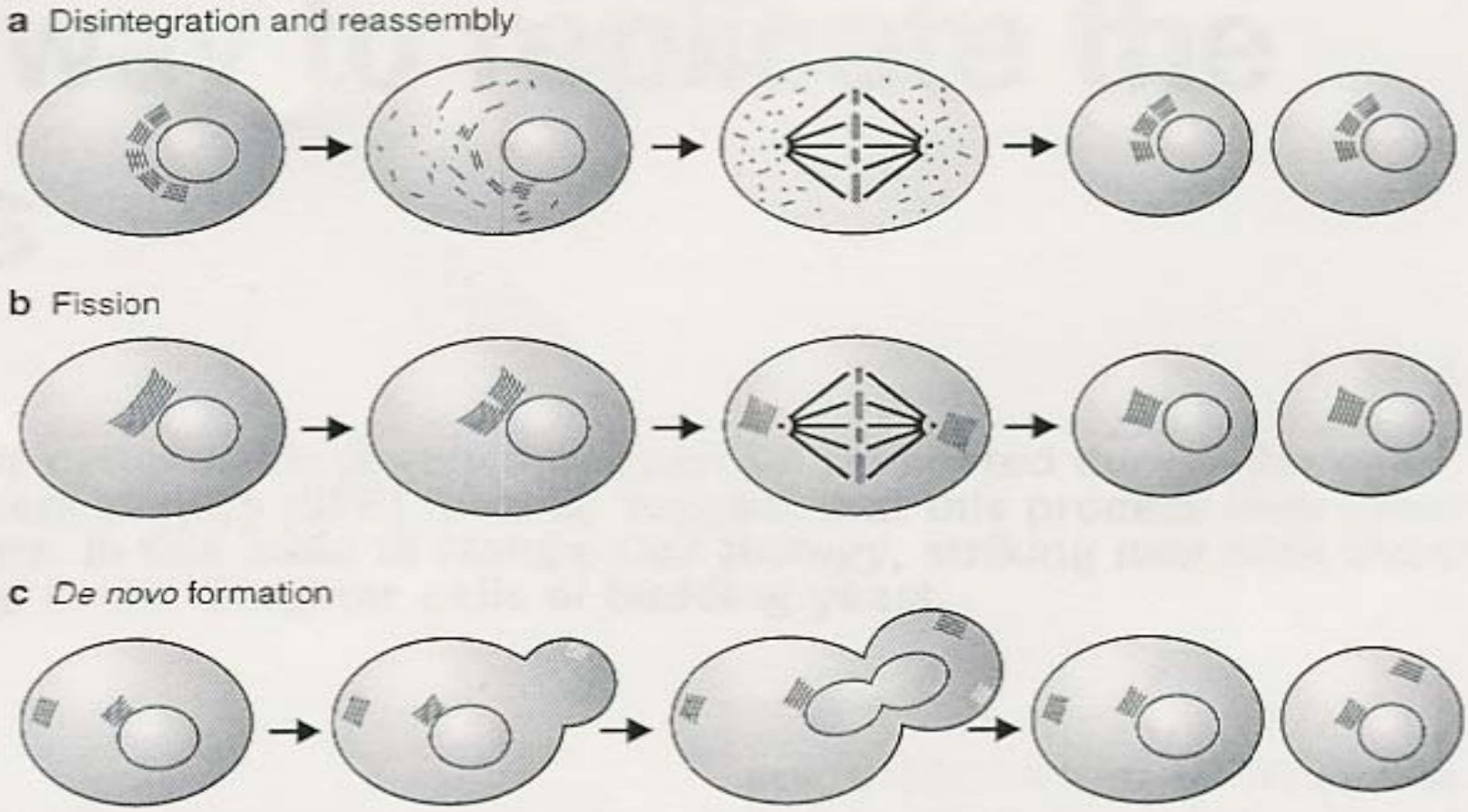


Figure 2 **Golgi replication schemes in different species.** a, **Breakdown and reassembly of the Golgi (red), as seen in many animal cells.** b, **Fission of the Golgi stack and segregation of each half. This mechanism is seen in many algae and protozoa. The starting number of stacks per cell can be one, two or more. In higher plants, the stacks also remain intact throughout the cell cycle and double in number, but it is not clear if they undergo fission or appear *de novo*[7].** c, ***De novo* formation of a new Golgi stack (yellow) at a distance from the existing stacks as described in *Pichia*.**

GIARDIA LAMBLIA