

# Preface

*The Golgi Apparatus: The First 100 Years* traces the first 100 years of Golgi apparatus discovery from the first published accounts from Pavia, Italy in 1898 to the Centenary Celebration in Pavia, Italy in 1998 and into the decade beyond. It is not intended, however, to be a comprehensive survey but rather to present the perspectives of the authors to summarize their contributions over the past 50 years in parallel with the modern era of Golgi apparatus discovery initiated in 1954 and made possible by the advent of the electron microscope. Included are methods of cell fractionation and biochemical analysis leading up to the present where efforts focus heavily on molecular biology.

Topics where the authors and their colleagues have made substantial and/or pioneering contributions are emphasized including Golgi apparatus morphology and structural organization and function (especially in plants), the existence and importance of cisternal tubules, development of methods of plant and animal Golgi apparatus isolation and subfractionation, biochemical analyses of highly purified plant and animal Golgi apparatus fractions in comparison to equally highly purified reference fractions. The use of such fractions in cell-free system analyses of membrane trafficking, the concept of Golgi apparatus function as part of an integrated system of internal endomembranes (the Endomembrane System), evidence for differentiation of membranes across the stacks of Golgi apparatus cisternae, and flux of membrane constituents along the polarity gradient defined by membrane differentiation all culminating in the membrane maturation or flow-differentiation model of Golgi apparatus function. More recent contributions to Golgi apparatus in cell growth (enlargement) and to cancer are summarized in the final chapters.

The authors' view of the dynamic working of the Golgi apparatus were based initially on static electron micrographs of the maize root tip generated by Hilton Mollenhauer in the Cell Research laboratory of the University of Texas in Austin, then under the direction of the late W. Gordon Whaley. Subsequent quantitative studies in the laboratory of D. James Morré at Purdue University suggested that massive amounts of membrane were moved to the plasma membrane at the cell surface in the discharge of secretory products in the outer cap cells of the maize root. The logical source of this membrane was the endoplasmic reticulum. The concept was further fueled by observations of Stanley Grove, then a graduate student in the laboratory of Charles Bracker at Purdue University. Grove's investigations with the Golgi apparatus of a fungus clearly demonstrated

a gradient of membrane morphology across the stacked cisternae from endoplasmic reticulum-like on one face to plasma membrane-like on the opposite face. A membrane composition of Golgi apparatus intermediate between that of the endoplasmic reticulum and the plasma membrane was determined using isolated cell fractions from both rat liver and mammary gland in collaboration with Thomas W. Keenan also from Purdue University. The actual concept of the dynamic passage of membrane material from the endoplasmic reticulum to the plasma membrane (i.e., membrane flow) was first tested experimentally in the laboratory of Werner Franke in the Department of Peter Sitte at the University of Freiburg. With the assistance of Barbara Deumling, Ernst Jarash, Jürgen Kartenbeck, Ronald Cheetham, and Hans-Walter Zentgraf, rats were pulse-labeled with  $^{14}\text{C}$ -leucine, the livers were excised, purified fractions of endoplasmic reticulum, Golgi apparatus, and plasma membrane were isolated and stripped to remove extrinsic and secretory proteins, and the residual intrinsic membrane proteins were analyzed for specific radioactivity. The pulse-chase kinetics were consistent with passage of membrane proteins from the endoplasmic reticulum to the plasma membrane via the Golgi apparatus. The membrane flow concept seemed secure. Unfortunately, alternative views based on recycling models soon prevailed and dominated the literature for more than two decades nearly up until the centenary year of Golgi apparatus discovery in 1998. That year marked a renewed appreciation for the dynamic, cisternal maturation model of Golgi apparatus function. The new resurgence of interest in the potential for membrane flux or flow across the stacked cisternae of the Golgi apparatus has provided the impetus to complete this monograph on the Golgi apparatus with emphasis on the dynamic aspects of Golgi apparatus underrepresented in all but the most recent Golgi apparatus literature.

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D. James Morré  
Hilton H. Mollenhauer



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The Golgi Apparatus

The First 100 Years

Morré, J.; Mollenhauer, H.H.

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