The Golgi apparatus was visualized in animal and plant cells by an enzyme cytochemical procedure free of the artifacts associated with the metallic methods of Camillo Golgi. This was the first cytochemical demonstration of the Golgi apparatus, an organelle that has received much attention from biologists. [The SC7 indicates that this paper has been cited in over 695 publications since 1961.]

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My first papers in histochemistry were published while I was at the University of Vermont where I was doing research in biochemistry. Three publications demonstrated that the staining of nuclei and salivary chromosome bands (after the Gomori-Takamatsu procedure) was an artifact.1-3 I studied the effects of different fixatives and metallic ions upon cytoplasmic particles isolated from rat liver homogenates and in tissue sections, publishing the results in 1953.4 Most biochemists at the time held the opinion that enzymes could not be demonstrated cytochemically. But in fact, as we and others showed, the activities could be demonstrated in situ. In 1955, when I came to the Albert Einstein College of Medicine, I vigorously pursued this histochemical controversy. It was the subject of prolonged, often sharp controversy.5-9 Not only was the enzyme cytochemical method reproducible, it also provided the first information about the enzymatic properties of this ubiquitous and complex organelle.

Combined staining for lysosomal acid phosphatase (β-glycerophosphate or cytidine monophosphate as substrate) and Golgi nucleoside diphosphatase demonstrated a topographical and, presumably, a functional association between the Golgi apparatus and lysosomes. Subsequent studies revealed that lysosomes probably originated from a region of smooth endoplasmic reticulum situated in the cellular processing apparatus of the Golgi apparatus. This region I termed GERL.9 The role of GERL in processing lysosomal enzymes is currently under investigation in my laboratory.

We utilized nucleoside diphosphatase to distinguish the trans aspect of the Golgi apparatus (Daniel Friend made me aware of this distinction)10 and the endoplasmic reticulum in some cells; NADH-tetrazolium reductase to visualize the mitochondria; cathepsins to localize the peroxisomes and mitroperoxisomes; and acid phosphatase to reveal the lysosomes and GERL.11,12 We are currently using immunocytochemistry to visualize other enzymes in the Golgi apparatus and in lysosomes.

The development of the GERL concept evolved slowly from the earlier studies on the Golgi apparatus. We view this organelle as part of a unique cellular processing system.