A sophisticated, differentiated Golgi in the ancestor of eukaryotes

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The Golgi apparatus plays a central role in processing, sorting, and secreting proteins to fulfill many functions of eukaryotic cells. It typically comprises a series of compartments (cisternae), stacked in a characteristic morphology. Yet, the way in which this morphology is maintained is poorly understood. Also, although the last eukaryotic ancestor (LECA) likely possessed a stacked Golgi, the complexity of membrane trafficking and cisternal differentiation in this ancestor is unexplored. Several Golgi proteins have proposed roles in organizing this organelle, and the coiled-coil golgins are of particular relevance. We address Golgi evolution by analyzing and comparing genome sequences from organisms which have lost stacked cisternae, and those that have not. Using genomics and immunomicroscopy, we first identify Golgi in the anaerobic amoeba *Mastigamoeba balamuthi*. We then searched 87 genomes spanning eukaryotic diversity, for presence of the most prominent proteins implicated in Golgi structure, focusing on golgins. We show some candidates as animal-specific, and others as ancestral to eukaryotes. None of the proteins examined show a phyletic distribution that correlates with the morphology of stacked cisternae, suggesting the possibility of stacking as an emergent property. Strikingly, however, the combination of golgins conserved among diverse eukaryotes allow for the most detailed reconstruction of the organelle to date, showing a sophisticated Golgi with differentiated compartments and trafficking pathways in the LECA.