# EVOLUTION OF THE PROTEIN IMPORT MACHINERY IN MITOCHONDRIA.

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Mitochondria evolved from an endosymbiotic proteobacterium in a process that required the transfer of genes from the bacterium to the host cell nucleus and the translocation of proteins thereby made in the host cell cytosol into the internal compartments of the organelle. Models for this evolution had suggested two highly improbable events were required to occur simultaneously: creation of a protein translocation machinery to import proteins back into the endosymbiont and creation of targeting sequences on the protein substrates themselves. We now know that at least 5% of proteins in proteobacteria are predisposed for targeting to mitochondria, leading us to propose that mitochondrial targeting information was pre-existing for many proteins of the endosymbiont. Still, the development of a primitive translocation channels in the membranes of the endosymbiont was a significant hurdle to initiate the evolution of mitochondria. Recent comparative sequence analysis and functional studies suggest that some of the pre-existing protein translocation apparatus of the endosymbiont was commandeered, including molecular chaperones, the signal peptidase and some components of the protein targeting machinery. However, the core translocases that drive protein import across the outer and inner membranes of mitochondria have no obvious counterparts in bacteria, making it likely that these machines were created de novo. The presence of similar translocase subunits in all eukaryotic genomes sequenced to date suggests that all eukaryotes can be considered descendants of a single ancestor species that carried an ancestral “protomitochondria”.