Chapter 4: Conclusion

Mycoplasma pneumoniae and *Ostreococcus tauri* are model minimal cells, genomically and spatially, respectively. Whole cell electron cryotomography was used to identify and characterize the large protein motor inside of *M. pneumoniae*'s attachment organelle (Chapter 2) and show the organization of a eukaryotic cell throughout the cell cycle (Chapter 3). This work contributed to the development of techniques to prepare whole cells in a frozen hydrated state (Appendix).

The discovery of *M. pneumoniae*'s motor will drive future studies to identify the proteins that form the motor, and ultimately lead to an understanding of how the motor functions. This could lead to targeted drug therapy for *M. pneumoniae* infections. The identification of a new macromolecular motor will also add to a new tool for nanotechnology. Besides the flagellar motor, other large macromolecular motors have not been well characterized. A significant advantage of *M. pneumoniae*'s motor is that it has already been shown to function independent of the cell body (Hasselbring and Krause, 2007).

O. tauri showed many fundamental surprises that will lead to future work to completely understand their ramifications. 1) *O. tauri* has a simplified mechanism for mitosis. Chromosome segregation is unlikely to rely on a mitotic spindle and chromosome condensation. 2) The nuclear envelope has large gaps in it throughout much of the cell cycle. Despite this, the cell maintains a distinct nucleo-plasma and retains nuclear pore complexes. 3) The chloroplast creates its own internal division plane and segregates its granules and genome. 4) Without multiple copies of the mitochondria, one must expect controlled segregation of the mitochondrion genome. 5) *O. tauri*'s extremely simplified organelle structure, with one copy of each major organelle, showed that the division and segregation of

its organelles were never left to chance. One may speculate that the tight regulation of organelles is probably not unique to *O. tauri*. *O. tauri*'s simple structure makes obvious a phenomenon probably present in most eukaryotes. Together, these three papers have demonstrated how electron cryotomography will continue to dramatically alter the way we think about how cells are organized.

Reference

Hasselbring, B.M., and Krause, D.C. (2007) Cytoskeletal protein P41 is required to anchor the terminal organelle of the wall-less prokaryote Mycoplasma pneumoniae. *Mol Microbiol* **63**: 44-53.