Prokaryotic cell biology by electron cryotomography

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The prospect of understanding simple cells in complete molecular detail is truly exciting. Electron cryotomography (ECT) is a powerful technique that enables 3D visualisation of intact cells at macromolecular resolution, essentially bridging the so-called 'resolution gap' between light microscopy and data derived from high-resolution imaging techniques (e.g., X-ray crystallography, single particle electron cryomicroscopy).

Recent technological advances in ECT hardware development, sample preparation, and automated data collection have proven particularly useful in studying prokaryotic organisms. Until recently bacterial and archaeal cells were perceived as bags of jumbled enzymes. However, unraveling prokaryotic cell architecture at the nanometre scale has yielded a much more intriguing picture of spatiotemporally organized entities.

Here, I briefly introduce the principles of ECT and discuss its advantages and limitations. I then report how ECT has been utilised to tackle outstanding questions regarding the mechanism of bacterial cell division and protein secretion.