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2008 : September 2008 - Fast Moving Fronts : Wolfgang Baumeister

FAST MOVING FRONTS - 2008

September 2008


Wolfgang Baumeister talks with *ScienceWatch.com* and answers a few questions about this month's Fast Moving Front in the field of Microbiology.



Article: Macromolecular architecture in eukaryotic cells visualized by cryoelectron tomography

Authors: Medalia, O;Weber, I;Frangakis, AS;Nicastro, D;Gerisch, G; Baumeister, W

Journal: SCIENCE, 298 (5596): 1209-1213 NOV 8 2002

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Max Planck Inst Biochem, D-82152 Martinsried, Germany.

SW: Why do you think your paper is highly cited?

I think it became immediately clear that this paper marked a breakthrough in demonstrating for the first time that cryoelectron (cryo-ET) tomography—an emerging imaging technique with unique potential for molecular cell biology—was capable of visualizing molecular structures in intact cells under close-to-life conditions.

It became clear that this method had the unique potential to bridge the existing divide between cellular and molecular structural studies. This was also recognized by the editors of *Science*, who selected it as one of the breakthroughs of the year across all fields of science.

SW: Does it describe a new discovery, methodology, or synthesis of knowledge?

It described the first application of a technique we had developed in previous years to a eukaryotic cell grown on an electron microscopy (EM) grid.

SW: Would you summarize the significance of your paper in layman's terms?

The methods traditionally used in biological electron microscopy of cells and tissues are prone to artifacts. The artifacts resulting from chemical fixation, dehydration, and contrasting agents are completely eliminated in cryopreparations.

Cryo-ET tomography combines the close-to-life preservation of biological samples with the power of three-dimensional imaging. It allows studying the structural organization of cells in a non-invasive manner at molecular resolution (2-4 nm). Tomograms of this kind contain a wealth of information about supramolecular architecture and molecular interaction networks. The challenge ahead of us is to mine

this imposing amount of information.

SW: How did you become involved in this research and were there any particular problems encountered along the way?

We began to develop cryo-ET tomography already in the late '80s—in the face of strong skepticism. Many in the field regarded it as simply not feasible to obtain high-resolution tomograms of biological material embedded in vitreous ice, given the radiation sensitivity of such samples. Major technical developments were necessary to make it possible, in particular the development of smart software for the automated recording of tomograms in a low-dose regime.

SW: Where do you see your research leading in the future?

With the improvements in resolution which we can realistically expect will come along in the next few years, and with more powerful computational tools for the interpretation of the tomograms, it will become possible to map the molecular landscape inside cells in a comprehensive manner. This will enable us to study molecular machines and their functional environment in action and also to reveal molecular interaction networks—the molecular sociology of the cell. Visual proteomics will therefore play a major role in cell biology in the years to come.

"I think it became immediately clear that this paper marked a breakthrough in demonstrating for the first time that cryoelectron (cryo-ET) tomography..."

Prof. Dr. Wolfgang Baumeister
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Keywords: cryoelectron tomography, biological electron microscopy cells tissues, artifacts, chemical fixation, dehydration, contrasting agents, cryopreparations, close-to-life preservation biological samples, three-dimensional imaging, tomograms, supramolecular architecture, molecular interaction networks, molecular landscape, molecular machines, visual proteomics.

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