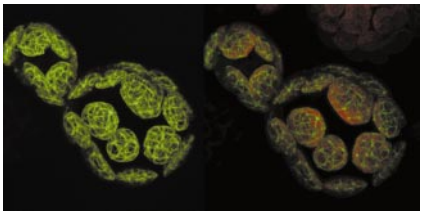
An FtsZ Plastoskeleton

On page 945, Kiessling et al. observe that FtsZ protein from the moss *Physcomitrella patens* can form a cytoskeleton-like network in chloroplasts. As McFadden discusses on page F19, FtsZ is well known in bacteria as a protein that transiently polymerizes into a ring at the division site. It has also been implicated in chloroplast division, but this is the first time that any protein has been linked to such a permanent plastoskeleton. *Physcomitrella* was recently chosen as a model organism, thanks to properties such as homologous recombination rates of up to 90% and tissues that are a single cell in thickness. The latter characteristic made it easier for Kiessling et al. to detect fusions between FtsZ and green fluorescent protein, and may explain why the plastoskeleton has been characterized first in this moss.

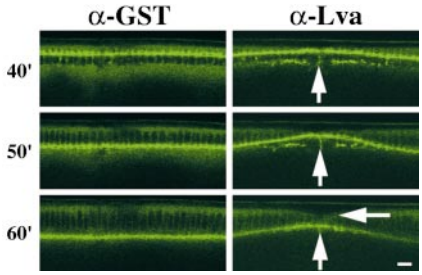


Chloroplasts are thought to be the descendants of engulfed bacterial symbionts. Intracellular life led to an increased need for communication and a decreased need for the tough cell wall that blocked that communication. But some structure may be necessary for chloroplasts to keep their shape. As the eukaryotic cytoplasm developed a tubulin cytoskeleton from the FtsZ template (the two proteins share structural features and GTP-dependent filament assembly), FtsZ-interacting eukaryotic proteins may have added to FtsZ's capabilities. The resulting filaments, visualized by Kiessling et al., can span entire chloroplasts and may give chloroplasts structure.

Membrane Addition during Cellularization

Tübingen gave us Krüppel and staufen; now Santa Cruz gives us … Lava Lamp.

On page 905, Sisson et al. assure us that the movements of the Golgi apparatus during *Drosophila* cellularization "resemble the motion of droplets in a lava lamp." The newly described Lava Lamp (Lva) protein moves in a similar pattern, hence the name.



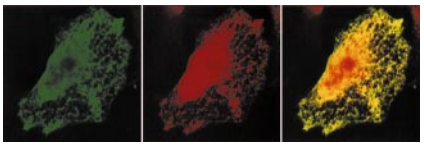
Sisson et al. find that these Golgi movements are vital for adding membrane to the advancing furrow during fly cellularization. When antibodies to Lva are injected into fly embryos, or Brefeldin A is used to inhibit membrane trafficking, aspects of the Golgi motion fail, as does cellularization. Thus cellularization, and probably the related process of cytokinesis, require membrane secretion in addition to actomyosin-based contraction. Lecuit and Wieschaus came to a similar conclusion in the August 21 issue, as discussed by Krämer on page F15.

Lva emerged from a screen for proteins that interact with both actin microfilaments and microtubules. Some of the Lva in fly embryos is located on the Golgi apparatus, which moves apically just before cellularization, and then basally with the furrow front, before again moving rapidly apical. Early treatment with antimicrotubule drugs eliminates both the initial apical movement of the Golgi and furrow progression.

The function of Lva is unknown, but its cofractionation and coimmunoprecipitation with spectrins suggest a structural role in maintaining either the Golgi's integrity or its secretion ability. Lva's interaction with CLIP190 suggests it may also provide a link to dynein-based microtubule transport.

Presenilins and Ubiquilins

Familial, early-onset Alzheimer's disease has been associated with mutations in genes encoding three proteins: amyloid precursor protein (APP), presenilin 1 (PS1), and presenilin 2 (PS2). PS1 and PS2 help determine, either directly or indirectly, the rate of cleavage of APP. Now on page 847, Mah et al. describe ubiquilin, a ubiquitin-related protein that interacts with the presenilins and increases their rate of synthesis.



Ubiquilin's COOH-terminal ubiquitin-associated domain is involved in binding the presenilins, as determined by two hybrid analysis, colocalization, coimmunoprecipitation, and cell fractionation studies. The NH_2-terminal ubiquitin domain is unlikely to be ligated to other proteins, as it lacks the necessary COOH-terminal glycine, but it may help ubiquilin to bind to the proteasome or another substrate.

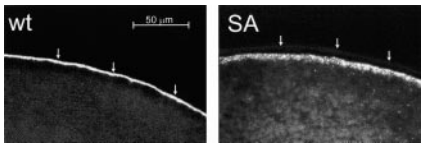
Mah et al. find that ubiquilin expression increases the levels of presenilins without altering the proteins' half lives. They suggest that ubiquilin may help to fold the presenilins. This would not necessarily be detected as an increase in half life, as many proteins are never completely synthesized if folding starts off badly. The folding theory is supported by recent detection of both a frog homologue of ubiquilin, which acts as a molecular chaperone to prevent cyclin A degradation, and a second human ubiquilin protein, which binds a possible molecular chaperone.

Ubiquilin is found in neurofibrillary tangles of Alzheimer's patients (as is ubiquitin) and the Lewy bodies characteristic of Parkinson's patients. Transgenic mouse experiments may help to determine whether ubiquilin accumulation is a cause or effect of these diseases.

Three Out of Four

Dehydration leads to vasopressin production, aquaporin-2 (AQP2) phosphorylation, and translocation of the

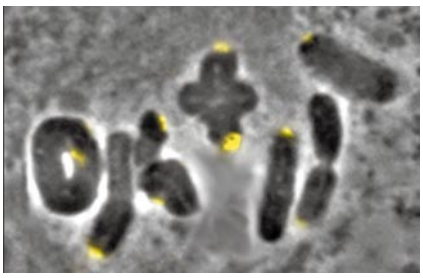
AQP2 channel to the plasma membrane, where it can help readsorb water that would otherwise be lost in urine. On page 919, Kamsteeg et al. report that three out of the four subunits of any AQP2 homotetramer must be phosphorylated to get translocation to the plasma membrane.



Kamsteeg et al. can make such a claim because they use *Xenopus laevis* oocytes as their model system. This allows the injection of exact amounts of RNAs encoding AQP2 mutants that either cannot be phosphorylated (a serine to alanine change) or resemble constitutively phosphorylated proteins (a serine to aspartate change). The AQP2–S256A is exclusively intracellular, whereas the AQP2–S256D is exclusively on the plasma membrane. After expression of different ratios of the two mutants (which form heterotetramers), Kamsteeg et al. use measurements of oocyte osmotic water permeability to calculate the proportion of the heterotetramers that is reaching the plasma membrane. Assuming that heterotetramer formation is random, these values fit with a model in which three out of the four subunits must be phosphorylated to get translocation. Future studies should determine whether this control is exerted at the level of exocytosis, endocytosis, or both.

Does Dynein Do Anything at Kinetochores?

The microtubule motor dynein is abundant at mammalian kinetochores in the early phases of mitosis and meiosis, but most dynein staining disappears as chromosomes align on the metaphase plate. On page 739, King et al. study this process in grasshopper spermatocytes. They show that microtubule attachment alone is sufficient to prevent accumulation of dynein at the kinetochore, or to promote its loss.



Less intense dynein staining at attached kinetochores could be explained if the resident dynein was either stretched out onto microtubules, or masked by microtubules or associated proteins. King et al. argue against both of these possibilities, as dynein staining does not increase immediately after kinetochores are detached from the spindle. An immediate increase would be expected if the spread-out dynein "snapped back" to the kinetochore or was revealed by microtubule loss.

Instead, dynein reaccumulation takes up to ten minutes. This timecourse makes it unlikely that kinetochore-localized dynein has a function in attachment. Antibody and mutant experiments have suggested that dynein is not absolutely necessary for kinetochore attachment or chromosome movement in mammalian cells. A role in fine-tuning attachment remains possible, but is less likely given that reattachments take one to two minutes, whereas dynein reaccumulation takes five to ten minutes.

Dynein's kinetochore localization may be an obtuse way for the protein to get to the centrosome, where it does have a proven role in focussing the spindle. But this walk towards the poles may have another function. If dynein pulls checkpoint proteins with it, away from the kinetochore, it could act as the microtubule-attachment detector that turns off the checkpoint and allows mitosis to proceed.

By William A. Wells, 1095 Market St. #516, San Francisco, CA 94103. E-mail: wells@biotext.com