EDITORS' CHOICE

edited by Gilbert Chin

DEVELOPMENT

Counting Counts

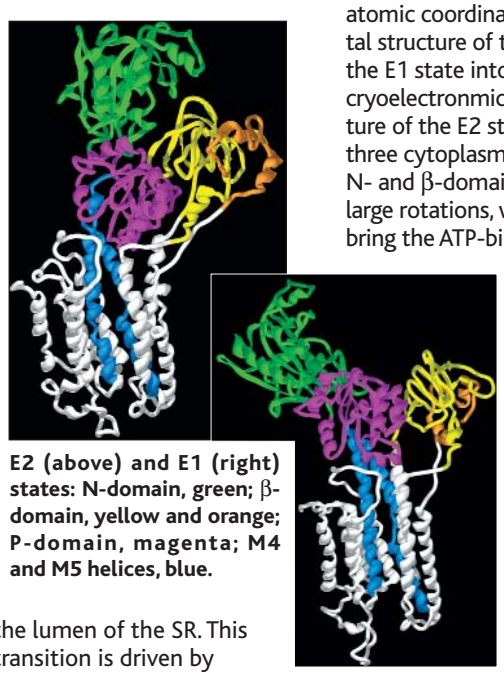
The size and number of cells forming an individual organ or organism are tightly regulated. Tang *et al*. examined the formation of discrete-sized aggregates of the slime mold *Dictyostelium discoideum* under starvation conditions. In times of plenty, *Dictyostelium* cells live as single amoeboid cells in solution; however, starvation causes cells to club together into streams before forming fruiting bodies. When streaming, the cells secrete a complex of polypeptides known as counting factor (CF). High levels of CF indicate high cell densities and signal the cellular aggregation stream to break up into clumps of cells. By modeling cellular behavior in response to CF levels, the authors predicted that CF could either decrease cell-cell adhesion or increase cell motility. Direct analysis of cellular behavior confirmed that CF indeed affects both cellular characteristics. In particular, CF increases cell motility via effects on actin polymerization and myosin distribution. — SMH

Proc. Natl. Acad. Sci. U.S.A. **99**, 1371 (2002).

BIOCHEMISTRY

Controlled Access

Maintaining secure boundaries that interdict passage of small molecules is especially challenging because cells need to pump ions across these boundaries in an energetically uphill direction. For a family of enzymes known as the P-type ATPases, exemplified by the sarcoplasmic reticulum (SR) Ca^{2+}-ATPase, the energy is supplied by the hydrolysis of ATP, and ion transport is effected by sequential changes in access and affinity. The ion binding site switches between two states: In E1, it offers a high-affinity calcium binding site to the cytoplasm (where calcium concentrations are low); in E2, the same binding site has low affinity for calcium and is accessible only from the lumen of the SR. This transition is driven by transfer of the high-energy phosphate, first from ATP to an aspartate (E1 to E1-P) and then from the aspartate to water (E2-P to E2).



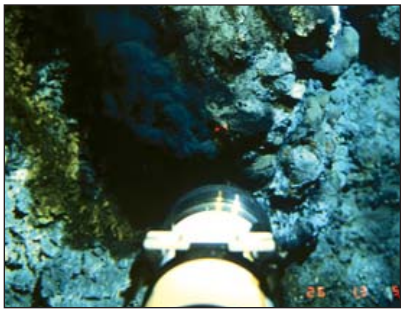
E2 (above) and E1 (right) states: N-domain, green; β-domain, yellow and orange; P-domain, magenta; M4 and M5 helices, blue.

Xu *et al*. have fitted the atomic coordinates of the crystal structure of the Ca pump in the E1 state into a 6-angstrom cryoelectronmicroscopy structure of the E2 state. Two of the three cytoplasmic domains (the N- and β-domains) undergo large rotations, which serve to bring the ATP-binding site close to the all-important aspartate. The membrane-proximal P-domain appears to function as a fulcrum, enabling two-way transmission of the rotational changes in the cytoplasmic domains to changes in the angular orientation of the transmembrane helices M4 and M5, which appear to move like an inexpert pair of chopsticks. — GJC

J. Mol. Biol. **316**, 201 (2002).

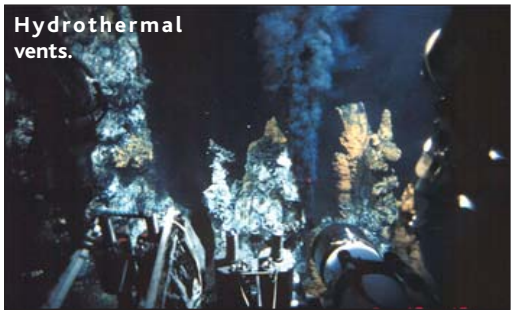
OCEANOGRAPHY

Lights, Camera, No Action



Deep sea hydrothermal vents are crawling with creatures too strange to appear in a Steven Spielberg movie. Submersible-based research has documented the lifestyles of many of these organisms, which live in the dark and extract energy from chemosynthetic rather than photosynthetic processes. Nonetheless, there are glimmers of light produced by thermal radiation at the vents (about 350°C), and many have wondered whether there are enough photons to feed the sluggish sealife at the bottom of the ocean.

White *et al*. used a low-light, charge-coupled device camera to measure the spatial and spectral emissions from two hydrothermal vent fields in the Pacific. The photon flux in the wavelength range of 400 to 600 nm was greater than the calculated photon flux of the thermal radiation. They attribute the excess light to vapor bubble luminescence, chemiluminescence (mixing of sulfides with vent fluids), crystalloluminescence (crystallization of minerals escaping from the vent), and triboluminescence (crystal fracturing). The photon flux between 600 to 900 nm was orders of magnitude too low for photosynthetic activity; the photon flux at 900 to 1000 nm was greater, but still below the minimum flux required even by organisms adapted to low light conditions. — LR



Hydrothermal vents.

J. Geophys. Res. **107**, 10.1029/2000JB000015 (2002).

BIOCHEMISTRY

Hold the MSG

The assembly-line production of proteins takes place in the factory known as the ribosome. The amino acids (attached to their corresponding transfer RNAs) are recruited in a precise order that is specified by the order of the triplet-nucleotide codons in the messenger RNA (mRNA) instruction guide. Termination codons signal a halt to production; the factory is then disassembled and recycled for use at the beginning of another mRNA.

Several recent crystal structures of release and recycling factors (eRF1, RF2, and RRF) have suggested that they mimic the overall shape of transfer RNA, and a critical three–amino acid motif (GGQ) in the release

CONTINUED ON PAGE 1429

factors has been shown to mediate recognition of the termination codons. Nakahigashi *et al.* and Heurgué-Hamard *et al.* now identify HemK as the enzyme that methylates the glutamine (Q), yielding *N*-5-methylglutamine. Mutations in *hemK* result in severe growth defects as well as termination inefficiency. What makes this particularly unexpected is the history of the *hemK* gene: first as a suppressor discovered in a screen for heme biosynthetic enzymes (hence its name) and later as a sequenced gene exhibiting similarity to a family of adenine-specific DNA methyltransferases. — GJC

Proc. Natl. Acad. Sci. U.S.A. **99**, 1473 (2002); *EMBO J.*, **21**, 769 (2002).

BIOMEDICINE

Aorta Not to Happen

In response to stresses such as high blood pressure and myocyte death, cardiac muscle cells can become hypertrophic (enlarged). Under continued stress, however, the ventricular wall can dilate and contract less strongly, leading to congestive heart disease. Several factors are likely to contribute to this progression, although the key mechanisms have yet to be established.

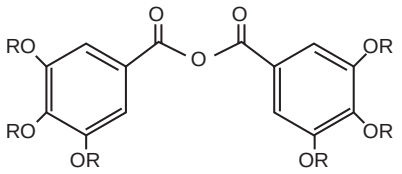
Hara *et al.* tested whether mast cells, which are associated with heart tissue, could influence the transition from compensatory hypertrophy to heart failure. In a model in which stress was applied by artificial constriction of the aorta, mast cell–deficient W/W^v mice were resistant to chronic systolic overload. Compared to wild-type mice, W/W^v animals exhibited less heart enlargement and perivascular fibrosis. Decreased cardiac pathophysiology also was observed after administration of the mast cell degranulation inhibitor tranilast to normal mice subject to aortic constriction. The authors suggest that mast cells could contribute to heart failure by releasing molecules such as histamine and chymase, which can promote apoptosis of myocytes and structural changes in components of cardiac tissue. — SJS

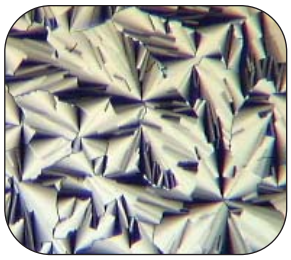
J. Exp. Med. **195**, 375 (2002).

CHEMISTRY

Interdigitated Liquid Crystals

Many liquid crystals are based on rodlike molecules, but disclike molecules can also form mesophases with columnar structures. The component molecules can even be half-discs, but in these cases the molecules are still stacked one on top of the other like coins in a jar, and the stacking is stabilized by either strong metallic or hydrogen-bond interactions. Kishikawa *et al.* synthesized a series of half-disc molecules that contained a strong central dipole linkage. Although the molecules stacked into columns, they did so in an antiparallel fashion with minimal overlap between them, thus creating an interdigitated structure. Increasing the length of the side groups (R) strengthened the intermolecular interactions of the core, which is consistent with observations from other discotic systems. When a chiral alkane was used for the side group, the interdigitated columns adopted a helical structure with a slow periodic rotation of the half-discs about the columnar axis. — MSL





A half-disc molecule (above) and liquid crystal texture (below).

J. Am. Chem. Soc. 10.1021/ja012156k (2002).

CLIMATOLOGY

No Change in Variability

An increase in the solar forcing of Earth's climate system, caused primarily by the addition of anthropogenic greenhouse gases to the atmosphere, is thought to be responsible for much of the rise in global average temperature that has been observed during the past century. It is thought that warming might contribute secondarily to variation in components of climate such as heat waves, storminess, drought, Asian monsoon, El Niño, and patterns of rainfall, all of which could produce dramatically negative effects on agriculture, water availability, and human settlement.

In order to assess whether such increases in climate variability already have begun, Vinnikov and Robock present a technique to analyze climate trends based on determining the statistical distributions of climatic indices. They analyze historic observations of sea level, annual precipitation, drought severity, monsoonal rainfall, and the Southern Oscillation, and find that none of these quantities display significant trends in their variabilities during the past 100 years. — HJS

Geophys. Res. Lett. **29**, 10.1029/2001GL014025 (2002).

CREDITS: KISHIKAWA *ET AL., J. AM. CHEM. SOC.* 10.1021/JA012156K (2002)

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