EDITORS' CHOICE

edited by Stella Hurtley

MICROBIOLOGY

Biomineralization of Gold

Ions of precious metals such as gold, silver, and platinum, as well as mercury, have high electrochemical potentials and are easily reduced and tend to precipitate on the surfaces of and within thiol-rich bacterial cells. For metal bioremediation purposes, planktonic bacteria are not ideal for concentrating metals.

Karthikeyan and Beveridge have looked at the potential of *Pseudomonas aeruginosa* biofilms for gold recovery. The pillar and pore architecture of these biofilms allows a high fluid flow and strong redox gradients to form, thus promoting the concentration and deposition of metal colloids in the biofilm matrix. Moreover, the biofilm helps to protect the bacteria against the toxic properties of the gold salts, much as it protects them against the effects of antibiotics. — CA

Environ. Microbiol. **4**, 667 (2002).

GEOLOGY

Beneath Gibraltar

In 1755, a magnitude 8.5 earthquake ripped through the area west of Gibraltar; the event, and its related tsunami and fires, killed tens of thousands in Lisbon, the Gulf of Cadiz area in southwest Spain, and Morocco, and provided key raw material for Voltaire's *Candide*. Pinning the quake on a particular source has been difficult, however, largely owing to the complex, diffuse tectonics of the African-Eurasian plate boundary in the Gibraltar region.

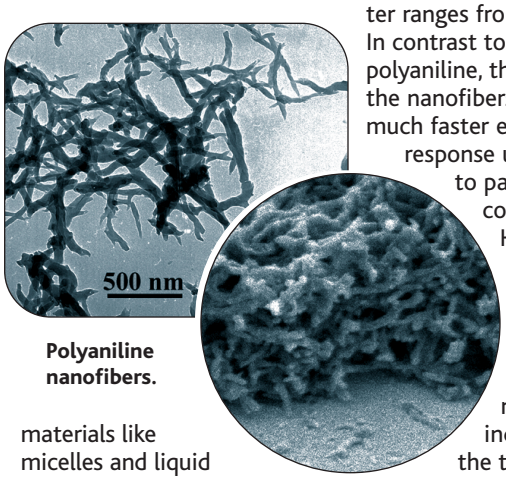
Gutscher *et al*. offer new insights in a study of Gibraltar tectonics. Using reflection seismology, they show that a large, chaotic submarine deposit in the Gulf of Cadiz, commonly interpreted as a gravity slide, is more likely to be an accretionary wedge associated with active compressional tectonics. And a tomographic cross section generated from seismic travel times shows a steeply east-dipping body of cold, dense material, stretching from beneath the Gulf of Cadiz, west of Gibraltar, to beneath the Alboran Sea, east of Gibraltar, that they interpret as subducting Mesozoic lithosphere. The Alboran Sea thus is likely to be a back-arc extensional basin related to rollback of the subducting slab, and active subduction in the Gulf of Cadiz to the west constitutes a possible source for the Great Lisbon Earthquake. — SW

Geology **30**, 1071 (2002).

CHEMISTRY

Synthesizing at the Interface

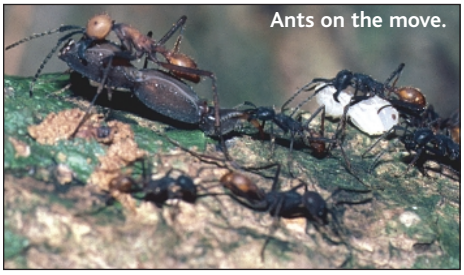
Polyaniline is useful in electronic and optical applications in part because its properties can be controlled easily by simple and reversible acid-base doping and de-doping. Synthesis of nanometer diameter fibers has only been possible via templated synthesis, using either hard templates like anodized alumina, or soft materials like micelles and liquid crystals to guide the polymerization.



Polyaniline nanofibers.

Now Huang *et al*. have used a well-known chemical synthesis route to make polyaniline without a template. Instead of operating in a uniform aqueous solution, they ran the reaction in an immiscible aqueous-organic biphasic system so that the by-products of the reaction would naturally separate. After dialysis, the polyaniline was recovered in the form of interconnected nanofiber networks, where the fiber diameter ranges from 30 to 50 nm. In contrast to a thin film of polyaniline, the film made of the nanofibers showed a much faster electrical response upon exposure to parts-per-million concentrations of HCl and subsequent exposure of the fully doped films to NH_3. The response of the nanofibers was independent of the thickness of the film made, due to their high porosity which allowed for rapid gas diffusion. — MSL

J. Am. Chem. Soc. 10.1021/ja028371y (2002).


Ants on the move.

ECOLOGY/EVOLUTION

Avoiding Gridlock

Many ant and termite species set out from the nest in columns, to scour the neighborhood for food. Like commuters in the rush hour, these crowded columns face the problem of congestion, and in some species form distinct traffic lanes. Foraging army ants in the Panamanian tropical rain forest traverse the forest floor in huge, high-speed columns of tens of thousands of workers and often form a three-lane structure in which outward-bound ants occupy two outer columns while the homeward-bound ants occupy the center.

Couzin and Franks have developed a mathematical model of ant behavior to investigate this pattern, which takes into account factors such as the ability of individual ants to follow pheromone trails and to detect each other's presence and avoid collisions. This individual-based model shows that local interactions and individual movements, especially asymmetry in turning rate between two interacting ants, can generate the observed three-lane structure. This self-organizing system appears to minimize the potential for congestion, allowing the ants to return to the nest by nightfall with the maximum quantity of prey. The model does not require that the individual ants attempt to minimize their journey time, which may have a cost to others. By contrast, individual humans tend to behave selfishly in traffic, with a rather different outcome. — AMS

Proc. R. Soc. Lond. B 10.1098/rspb.2002.2210 (2002).

IMMUNOLOGY

T Cell Memory Takes Shape

Following an immune response, small numbers of memory lymphocytes persist, providing a rapid-reaction

CONTINUED ON PAGE 21

force to protect against further infection. This is the basis for vaccination, and understanding how memory cells work will be key to developing more effective vaccines in the future.

Using mice carrying a viral-specific transgenic T cell receptor, Kaech *et al*. performed a genome-wide profile of $CD8^+$ T cells and correlated this with function and phenotype of these cells, before and after viral infection. Predictably, genes controlling migration, cytokine expression, and cytotoxicity were active during infection. In contrast, transcription of other genes increased only in memory cells that persisted several weeks after viral clearance. Among these were genes associated with cell cycle regulation, response to homeostatic cytokines, and receptor-mediated signals. Thus, precursors for $CD8^+$ memory T cells emerge during the height of a viral immune response, but only later become fully equipped to self-maintain and to respond rapidly to subsequent infection. —SJS

Cell **111**, 837 (2002).

CHEMISTRY

Parallel Processing

Recipes for the preparation of nanoparticles of various shapes and sizes abound, but, when it comes to making nanoparticles with a narrow distribution of sizes and shapes in large amounts, most methods fail because the precise control of temperature and homogeneous mixing are especially difficult to achieve in rapid reactions.

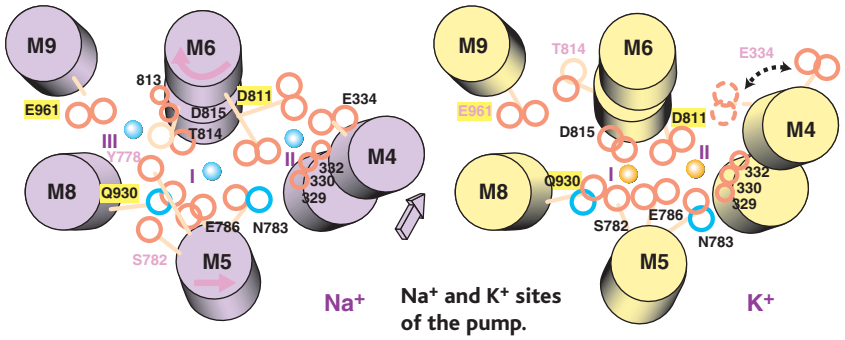
Nakamura *et al*. use a micro-reactor to overcome these hurdles in preparing CdSe nanocrystals, which can be used as fluorescent tags and in tunable light-emitting diodes. Using a previously reported method involving precipitation from a surfactant, they demonstrate that their process can generate CdSe nanoparticles continuously and reproducibly, with the capacity to tune the effects of temperature on particle size distributions and fluorescence properties. Parallel operation of these micro-reactors may permit industrial-scale preparation of CdSe and other nanoparticles. — JFU

Chem. Comm. **2002**, 2844 (2002).

BIOCHEMISTRY

An Uneven Exchange

The sodium pump (Na^+,K^+-ATPase) was one of the first active transport proteins identified almost half a century ago. Nevertheless, the structural basis for the recognition of three sodium ions in the outward half of the pumping cycle and of two potassium ions in the inward half is still largely mysterious. Ogawa and Toyoshima have built on their



Na^+ and K^+ sites of the pump.

crystallographic analysis of Ca^{2+}-ATPase, a related transport enzyme, by modeling the sodium pump amino acid sequence into the transmembrane domain (containing 10 helices) by homology. They find that the two sites that are known to bind Ca^{2+} (0.99 Å ionic radius) in the calcium pump are responsible for carrying two (I, II) of the Na^+ ions (0.95 Å) and, after slight movements of the helices, both of the K^+ ions (1.33 Å). In both cases, the coordinating ligands are either main chain carbonyl oxygens or side chains carboxylates and amides. The third Na^+ ion (III) is nearby, and the tilting of helix M5 and the rotation of helix M6 combine to render this site inhospitable to K^+. — GJC

Proc. Natl. Acad. Sci. U.S.A. **99**, 15977 (2002).

SOURCE: OGAWA AND TOYOSHIMA, *PROC. NATL. ACAD. SCI. U.S.A.* **99**, 15977 (2002)

Avoiding Gridlock

Science **299** (5603), 19.
DOI: 10.1126/science.299.5603.19b