EDITORS' CHOICE

edited by Gilbert Chin

COMPUTATIONAL BIOLOGY

Simulating a Bacteriophage

Progress in determining the genome sequences of complex organisms has reinforced the idea that much will become clear (although there still will be much biology to be studied). An idea of what will become possible can be gleaned from studies of the bacteriophage T7, which is known to contain 39,937 bp of DNA, encoding 59 proteins that together serve to hijack *Escherichia coli* into making more T7 particles.

Endy *et al.* constructed a simulation of the life cycle of T7 and used this model to compute the synthetic rates of T7 proteins and the overall growth rate (virus.molsci.org/t7). These compared reasonably well with the observed values for wild-type phage and for some, but not all, mutants in which the gene for T7 RNA polymerase had been repositioned. They then randomly permuted the T7 genome and found that less than 5% of these simulated phages displayed a computational growth rate faster than that of the wild type, revealing that this descendant of a laboratory isolate from half a century ago is quite fit indeed. — GJC

Proc. Natl. Acad. Sci. U.S.A. **97**, 5379 (2000).

APPLIED PHYSICS

New Jobs for Nitrides

Thin films of GaN and related nitride semiconductors have found use in light-emitting and laser diodes, and other applications for these materials are being pursued. For example, Schottky-barrier photodetectors based on AlGaN films grown on sapphire show promise as detectors of harmful solar ultraviolet radiation. The growth of these films on silicon substrates would offer several advantages, including lower cost and easier device integration, but devices grown on Si have had slower response times and unwanted sensitivity to visible light, in part because of interdiffusion.

Pau *et al.* used plasma-assisted molecular beam epitaxy to grow Si-doped AlGaN films on Si(111) surfaces with intermediate layers of Al and AlN. These devices show comparable performance to those grown on sapphire. The InGaAsN family of materials has applications in long-wavelength lasers and solar cells. Chang *et al.* show that the lower band gap of this material makes it an excellent candidate for low-power P-n-p heterojunction bipolar transistors (HBTs) with AlGaAs. The transistors exhibit a peak current gain of 23 and have a turn-on voltage of 0.77 volts, a quarter volt lower than comparable AlGaAs/GaAs HBTs. — PDS

Appl. Phys. Lett. **76**, 2785 (2000); *Appl. Phys. Lett.* **76**, 2788 (2000).

OCEANS

A Conveyor Belt for Carbon

Dissolved organic carbon (DOC) represents a vast reservoir of carbon in the ocean and is believed to be produced in the surface waters and then transported from there to the deep ocean, where it is utilized at very low rates by free-living bacteria. Measurements of the carbon isotope composition of water from the North Atlantic and the North Pacific previously showed that DOC is quite old compared to dissolved inorganic carbon, and that DOC in the North Atlantic is younger and more abundant than in the North Pacific. On the basis of these results, it was hypothesized that the deep ocean DOC is transported via a "conveyor belt" from the North Atlantic to the North Pacific.

Druffel and Bauer have measured the carbon isotope composition of water from the Southern Ocean and find that the age of the Southern Ocean DOC is closer to that in the North Pacific, but that the DOC concentration there is almost the same as in the North Atlantic. The results support the conveyor belt movement of DOC, but also indicate an extra source of young DOC in the North Atlantic or a small microbial sink in the Southern Ocean as possible explanations for the quantitative deviations. — JU

Geophys. Res. Lett. (2000).

GEOLOGY

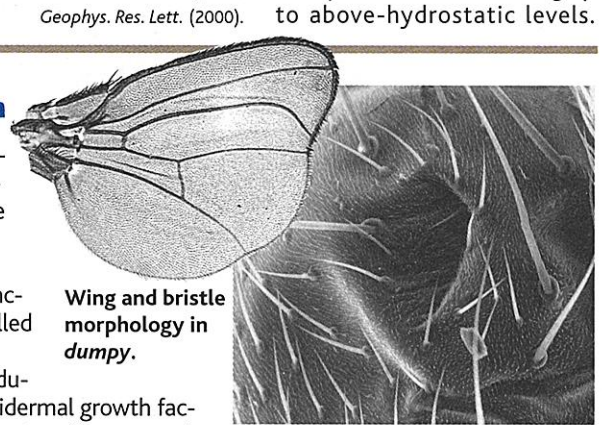
Strengthening the Crust by Breaking It

An active fault seems the archetypal expression of upper-crustal weakness, but could such weak structures actually contribute to the overall strength of the crust? Townend and Zoback suggest that, in intraplate settings, faults actually may help keep the crust strong.

Reviewing bulk-permeability data from a variety of sources, they note that permeability measured from core samples invariably is three to four orders of magnitude lower than larger-scale crustal permeability measured in situ through borehole studies, induced seismicity, and other techniques. This scale-dependent permeability difference is best explained by networks of hydraulically conductive faults; moreover, a large suite of data from high-resolution borehole logs suggests that only critically stressed faults (fractures at or near the point of Coulomb frictional failure) are hydraulically conductive. The relatively high permeability of the crust facilitated by these conductive faults prevents subsurface pore fluid pressures from building up to above-hydrostatic levels.

BIOCHEMISTRY

Strength Through Repetition



Wing and bristle morphology in *dumpy*.

SOURCE: WILKIN ET AL., *CURR. BIOL.* **10**, 559 (2000).

Many invertebrates secrete a protective external cuticle that is composed of extracellular matrix and that forms strong adhesive connections with the underlying epithelia. Wilkin *et al.* have characterized an unusual component of the cuticle-epithelial cell junction in the fruit fly *Drosophila*, a protein called Dumpy. Gigantic in size (2.5 megadalton), Dumpy represents an extreme form of modular protein construction, containing 308 epidermal growth factor (EGF) modules interspersed with 185 copies of a new module (DPY), along with a cross-linking domain and a membrane-anchoring domain. The structural properties of the EGF-DPY-EGF triad predict that Dumpy forms a fiber that is nearly one micrometer in length. Insertion and cross-linking of the fiber within the cuticle may provide a strong anchor for underlying tissue, allowing it to support mechanical tension at sites under stress. — PAK

Curr. Biol. **10**, 559 (2000).

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That, in turn, keeps the intraplate crust relatively strong, as high pore fluid pressures at depth tend to reduce the effective failure strength of rock. — SW

Geology **28**, 399 (2000).

CELL BIOLOGY

Endocytosis and the Nucleus

The protein epsin is known to bind to components of the clathrin coat that surrounds portions of the plasma membrane destined to be pinched off during endocytosis. The central and C-terminal domains of epsin contain the clathrin and clathrin adaptor binding sites, while the N-terminal domain had been shown to have an essential, albeit unknown, function on the basis of genetic studies. Hyman *et al.* find that the structure of the epsin N-terminal domain is similar to portions of proteins that are translocated from the cytoplasm to the nucleus. Following up this clue, they went on to demonstrate an interaction between epsin and a transcription factor, and observed regulated import of epsin into the nucleus. Thus, epsin may serve to convey signals from the endocytic pathway to the transcription machinery. — SMH

J. Cell Biol. **149**, 537 (2000).

ENVIRONMENT

In Dollars and Sense

Many researchers and policymakers have argued that the environment is markedly undervalued in economic and political deliberations. How, then, should value be assigned to environmental resources and ecosystem services in order to make economic and risk assessments and to set prices? For example, how should society charge for pollution or for release of greenhouse gases, and how should priorities among different development or abatement plans be set?

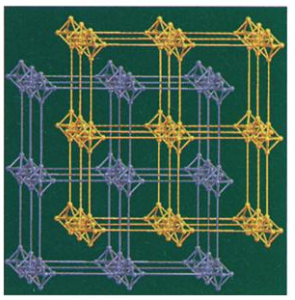
Recent work has developed several approaches to these questions, which lie at the crossroads between economics and the environmental sciences, and a special section of *Environmental Science & Technology* provides reviews from several leading researchers and discussion of the problems and challenges in addressing environmental and health issues in both the industrialized and developing worlds. For instance, one study by Poulos and Whittington concludes that approaches that work well for developed countries may fare poorly in less-developed countries and thus complicate global comparisons. — BH

Environ. Sci. Technol. **34**, 1381–1461 (2000).

CHEMISTRY

Achieving an Open Weave

If an inorganic or metal-organic framework has a sufficiently large lattice, interpenetrating networks can form in which the atoms and bonds of one lattice are woven through the other in a regular fashion. When such structures form, there typically is little space remaining.



Spacious molecular networking.

Reineke *et al.* report that the condensation of Tb(III) ions with a long dicarboxylate linker in the presence of dimethylsulfoxide (DMSO) yields an interpenetrating network with a large free volume (71%) that is occupied by unincorporated and exchangeable DMSO guest molecules. The authors suggest that this porosity arises from the ratio of the length of the linkers to the size of the complexes that link them together; in fact, these compounds just miss forming a triple interpenetrating network. — PDS

J. Am. Chem. Soc., **122**, 4843–4844 (2000).

HIGHLIGHTED IN *SCIENCE*'S SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT

Science's stke www.stke.org

Apoptotic Signals at the Golgi

Caspases are proteases that mediate a sequence of events leading to apoptosis or programmed cell death. Mancini *et al.* show that caspase-2 localizes primarily to the cytoplasmic face of the Golgi complex (which disintegrates during apoptosis) and cleaves golgin-160, a Golgi membrane protein implicated in maintaining Golgi integrity and membrane trafficking. When a caspase-resistant form of golgin-160 was overexpressed in cultured cells, Golgi disintegration was delayed in response to apoptosis-inducing agents. These data support the notion that specific caspases may localize to distinct intracellular sites in the course of transducing apoptotic signals. — LC

J. Cell Biol. **149**, 603 (2000).

CREDIT: REINEKE *ET AL.*, *J. AM. CHEM. SOC.* **122**, 4843–4844 (2000).