EDITORS' CHOICE

edited by Gilbert Chin

APPLIED PHYSICS

High-Speed Light Modulation

Photonics is competing directly with microelectronics in systems where speed is important, and more advanced optical systems will require the further development of many types of devices, including waveguides, light switches, filters, polarizers, and modulators. Ideally, these active devices should be fast.

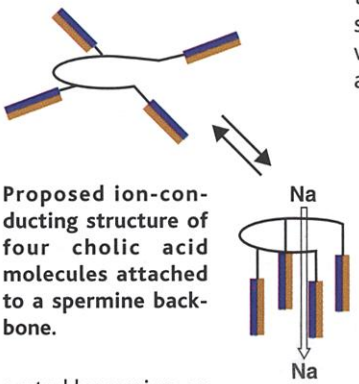
Harada *et al.* describe results on a fast light modulator that they developed based on an electro-optic polymer. The complex refractive index change induced by a relatively small applied electric field (141 volts) across the polymer gives rise to a large modulation efficiency (>30%) of the transmitted light through the polymer. They suggest that the fast operation of the device, in excess of 25 megahertz, makes the material a promising candidate in applications such as optical image processing and optical computing. — ISO

Appl. Phys. Lett. **77**, 3683 (2000).

BIOCHEMISTRY

A Bilious Ionophore

One of the fundamental characteristics of cells is the control of the permeability barrier between them and the outside world. Constituents that are meant to stay inside, such as macromolecules and phosphorylated metabolites, are insoluble in and retained by the membrane bilayer of hydrophobic lipids, whilst nutrient and waste products are transported by carriers or channels inserted into the membrane. The process of transport remains an outstanding problem, and simpler systems may be a productive route of study.



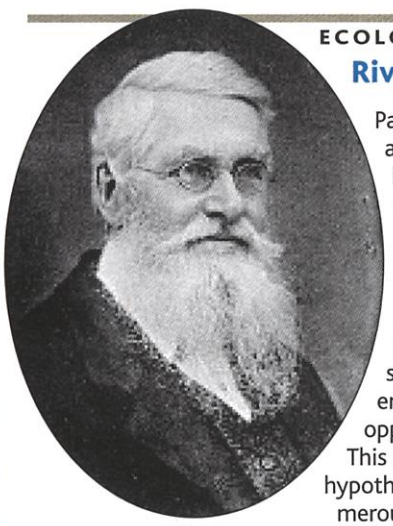
Proposed ion-conducting structure of four cholic acid molecules attached to a spermine backbone.

Otto *et al.* describe the one-step synthesis, from spermine and cholic acid, of a sodium ionophore. The activity of this adduct is highly sensitive to the length of the lipid acyl chains, and they interpret its sodium-carrying capacity as due to a dimeric structure in which the amphiphilic sterol moieties align perpendicularly to the plane of the membrane with their hydroxyl groups offering a hydrophilic interior channel for the passage of sodium ions. — GJC

J. Am. Chem. Soc., in press.

ECOLOGY/EVOLUTION

Riverine Barriers



Alfred Russel Wallace

Patterns of species distribution and diversity are influenced heavily by geographical barriers. In his accounts of Amazonian biogeography, Alfred Russel Wallace observed that the ranges of closely related primates would sometimes abut at large rivers; nearer the source of a river, the differences between the faunas of opposite banks would diminish. This observation gave rise to the hypothesis that the presence of numerous large rivers was a factor that significantly limited gene flow and contributed to the high levels of general species diversity seen in lowland Amazonia.

More recent primate studies have largely vindicated Wallace's idea. For marsupials and amphibians—and perhaps for diversity in general—the story might be different. Gascon *et al.* compare species assemblages of these animal groups on opposite banks of the Juruá river in Brazil. If Wallace's hypothesis were to hold, there should have been greater similarity between the faunas of the seasonally flooded forests on opposite banks than between those of the terra firme forests above the flood zone. However, they found no such relationship at any point along the river, suggesting that riverine barriers do not account for the patterns of diversity in marsupials and amphibians, and that other, more cryptic, geomorphological features might have played a significant role. — AMS

Proc. Natl. Acad. Sci. U.S.A. **97**, 13672 (2000).

CELL BIOLOGY

Cell Fate and Endocytosis

The *Drosophila* protein Numb helps to determine cell fate during development because it is asymmetrically distributed during cell division. Numb is known to interact with Notch, a receptor that also is involved in specification of cell fate.

Santolini *et al.* examined whether Numb may play a general role in cells and discovered that it appears to be important in enabling endocytosis at the cell surface. In mammalian cells, Numb protein was associated with endosomes and trafficked together with internalized proteins such as the transferrin receptor. It co-localized with the clathrin adaptor protein α adaptin as well as with another endocytic marker protein, Eps15. When cells were engineered to express fragments of Numb, clathrin-mediated endocytosis was inhibited. Further analysis will be required to define how Numb inhibits endocytosis, and to determine if its role in cell fate specification and its interaction with Notch are linked to its participation in endocytosis. — SMH

J. Cell Biol. **151**, 1345 (2000).

GEOPHYSICS

Dry and Stable

Water in a rock can affect many of its properties—for example, water can lower the melting temperature and reduce the viscosity of the rock so it deforms more easily. One way to infer water content at depth is by measuring electrical conductivity, which can be enhanced by the presence of water or another highly conductive mineral, such as graphite. Most measurements of electrical conductivity have been of continental or oceanic crust, but a few measurements have been made across long arrays of the underlying mantle and can be used to address the variability of the water content of the upper mantle.

Hirth *et al.* analyze recent measurements of the mantle beneath Archean cratons. These structures represent the oldest continental crust on Earth, and many cratons still appear to be related to their underlying mantle. The data imply that between depths of 150 and

CONTINUED ON PAGE 2215

SOURCE: (LEFT) DR. CHARLES H. SMITH/ WESTERN KENTUCKY UNIVERSITY; (RIGHT) OTTO *ET AL., J. AM. CHEM. SOC.*, IN PRESS.

250 kilometers, the mantle beneath the cratons is anomalously dry compared to the oceanic mantle, but that below about 250 km, the water content of the mantle is more uniform. The stability of Archean mantle may derive from this relative lack of water.—BH

Geochem. Geophys. Geosys. **1**, 2000GC000048 (2000).

CHEMISTRY

Fine Golden Rings

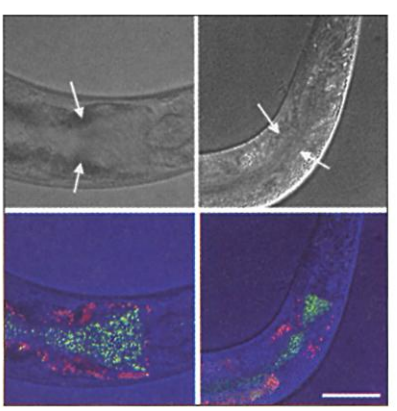
Catenanes are interlinked molecular rings. They are usually fully or mostly organic, and sophisticated versions may have future applications in molecular electronics. Gold-based catenanes have been reported, but in those structures the gold atoms were linked with organic bridges; direct gold-gold interactions were not significant. Wiseman *et al.* have synthesized unusual catenanes that have fully inorganic rings made of alternating gold and sulfur atoms, a ten-membered ring in one case and twelve in another. A large organic ligand is attached to each of the sulfur atoms. Weak gold-gold interactions, both between atoms in the same ring and between atoms in different rings, contribute to stabilization of the catenanes. — JU

J. Am. Chem. Soc., in press.

MICROBIOLOGY

Expanding the Host Range of Bacteria

Bacterial pathogens can exhibit extraordinary abilities to manipulate their target hosts, for instance by injecting molecules that promote greater binding and uptake of the bacterial invader. The hosts, on the other hand, are equally capable of developing resistance mechanisms that can diminish the virulence or infectivity. Understanding this arms race and exploiting it therapeutically would be accelerated if both organisms were amenable to genetic approaches, which could lead to the identification of mutants and molecules that mediate attack and defense.



Nematodes infected with fluorescently-tagged (blue) S. typhimurium (left) or P. aeruginosa (right); the intestine is marked with arrows.

Aballay *et al.* have extended their earlier work in establishing the nematode *Caenorhabditis elegans* as a host for bacterial infection. Previously, they had shown that a strain of *Pseudomonas aeruginosa*, which is a human pathogen, could infect *C. elegans* fatally; now they describe results showing that several strains of *Salmonella typhimurium* can also infect the nematode. Furthermore, *S. typhimurium* mutants deficient in a signal transduction pathway regulating virulence in vertebrates displayed significantly less potency in killing *C. elegans*, hinting at the potential for using the nematode, whose genome and developmental cell lineage are completely known, to dissect virulence mechanisms. Labrousse *et al.* have confirmed that *S. typhimurium* can infect *C. elegans*. They go on to show that mutations that reduce the ability of the bacterium to resist the acid pH of the gut, as expected, attenuate killing efficiency, supporting the proposal that *C. elegans* can serve as a genetically tractable model host for important human pathogens. — GJC

Curr. Biol. **10**, 1539 (2000); *Curr. Biol.* **10**, 1543 (2000).

GEOCHEMISTRY

Cultured Carbonate

Dolomite, $CaMg(CO_3)_2$, is found in much greater abundance in ancient rocks than in modern ones, but why this is true has been one of geology's enduring mysteries. Part of this uncertainty has stemmed from the inability until recently to precipitate dolomite in the laboratory at the low temperatures that must have prevailed at ancient sites of dolomite formation. Fortunately, dolomite does form in some modern environments and, taking clues from them, researchers have discovered that sulfate-reducing bacteria may be the missing ingredient.

Warthmann *et al.* have cultured a single strain of sulfate-reducing bacteria and shown that when they are grown in conditions like those in which they are found naturally, with sufficient amounts of Ca, Mg and carbonate, dolomite formation occurs within 30 days at a temperature of 30°C. Anaerobic bacteria such as these could have played an important role in dolomitization in Earth's early history, when a more reducing atmosphere existed. — HJS

Geology **28**, 1091 (2000).

CREDITS: ABALLAY *ET AL.*, *CURR. BIOL.* 10, 1539 (2000).

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