EDITORS' CHOICE

edited by Gilbert Chin

CHEMISTRY

A Leaner, Cleaner Substrate

Many antibiotics function by inhibiting the enzymes that synthesize the peptidoglycan layers that surround bacterial cell membranes. The bacterial transglycosylases are of special interest as targets because these enzymes are located on the outside surface of the cell, where they polymerize a cell wall constituent called Lipid II. One difficulty in studying transglycosylases is handling the substrate, which is hard to prepare in sufficient quantity and purity and which contains an undecaprenyl chain (55 carbon atoms) that aggregates. Ye *et al.* now report that they have identified a Lipid II analog with a shorter lipid chain (35 carbon atoms) that is a much better substrate for monitoring transglycosylase activity. This analog makes it possible to dispense with detergents in the in vitro reaction and should facilitate studies of these enzymes. — PDS

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

EVOLUTION

The Strength of Selection

Natural selection is the pervasive force shaping the evolution of living organisms. Selection can take several forms—directional, stabilizing, disruptive, indirect—and can act in different ways on different organismal traits.

In recent decades much research has been devoted to measuring the strength of the various types of selection on phenotypes and quantitative traits both in the wild and in the laboratory. Kingsolver *et al.* analyze this literature and uncover some unexpected patterns. In both vertebrates and plants, the strength of selection on morphological traits was twice as great as on life-history traits; strength of selection on some components of fitness such as fecundity or mating success was greater than on others such as survival; the strength and frequency of stabilizing selection, which keeps a trait constant, was no greater than that of disruptive selection. This synthesis provides a fresh view of the complexities of the evolutionary landscape and of the statistical hurdles that need to be cleared. — AMS

Am. Nat. **157**, 245 (2001).

GEOLOGY

A Lost Plate Turns Up

Reconstructing the position of Earth's continents beyond about 120 million years ago is difficult because most of the oceanic crust of this age or older has been subducted back into Earth's mantle. Oceanic crust covers most of the Earth, but many of the pieces of the plate tectonic puzzle, and even entire plates, have not yet been located.

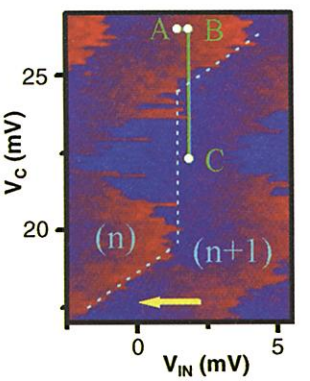
Sutherland and Hollis report the discovery of an old piece of seafloor northwest of New Zealand. They dated fossils deposited on top of the seafloor to 130 to 145 million years ago, making this the oldest seafloor in the South Pacific (the oldest ocean floor is early Jurassic in age and located in the West Pacific). Paleomagnetic data imply that this crust originated at high southerly latitudes and then moved north by more than 2000 kilometers to its present position. This new piece of the puzzle requires the presence of a new plate—named the Moa plate—and spreading ridge in the South Pacific during the Early Cretaceous, and also requires a large strike-slip fault along the margin of Antarctica. — BH

Geology **29**, 279 (2001).

APPLIED PHYSICS

Latching onto Cellular Automata

In devices known as quantum-dot cellular automata (QCA), the logic levels are represented by the spatial configuration of electrons, and coding of information in the device is controlled and manipulated by the position of a single electron. A clocked cell modulates the barrier between two quantum dots and allows the charge of the electron to be stored, or latched, into position, and thus provides a signal for the next cycle.



Operational space for the latched QCA device.

Using a device consisting of three quantum dots connected in series by tunnel junctions, Orlov *et al.* demonstrate a clocked QCA device in which the middle dot acts as a "latch" by forming a tunable barrier between the input and output dots controlled by clock pulses. The characteristics of the device are described by phase diagrams that illustrate the parameter space for device operation. Starting off in the null state (point A), when the clock signal applied to the middle dot is "low," the device remains in the

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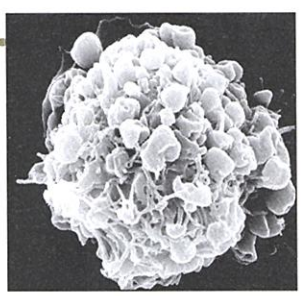
CELL BIOLOGY

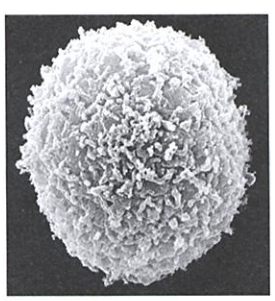
How to Make a Bleb

Apoptosis (programmed cell death) is used to remodel tissues and organs during development. Apoptotic cells undergo a characteristic series of morphological changes, including contraction of the whole cell and formation of blebs in the surface membrane.



Scanning electron micrographs of cells undergoing apoptosis with active (top) and inhibited (bottom) ROCK1.

Coleman *et al.* and Sebbagh *et al.* have examined some of the mechanisms involved in bleb formation and find that the activities of an effector kinase of Rho (a GTPase), called ROCK1, are necessary and sufficient. This kinase is cleaved by the protease caspase-3 to produce a truncated molecule with constitutive activity, which then phosphorylates the light chain of the motor protein myosin, which favors contractile interactions with actin and bleb formation. The significance of the blebbing process in the intact organism for efficient clearance of dead cells is unclear, but it is known that inhibition of blebbing itself does not cancel the other consequences of triggering the apoptotic pathway. — SMH



Nature Cell Biol. **3**, 339; 346 (2001).

SOURCE: (LEFT) COLEMAN *ET AL.*, *NATURE CELL BIOL.* **3**, 339; 346 (2001); (RIGHT) ORLOV *ET AL.*, *APPL. PHYS. LETT.* **78**, 1625 (2001).

null (neutral) state, irrespective of the input signal (within operational limits). With a "high" clock signal, the device becomes active and switches to the logic 1 (point C) or logic 0 state (point B), and remains in this state when the input signal is set to zero or even reversed. With appropriately applied clock and input signals, the device can be programmed through a whole cycle of null-active-locked-active-null states. — ISO

Appl. Phys. Lett. **78**, 1625 (2001).

CLIMATOLOGY

Alkenones as a Proxy

In a group of papers the use of alkenones as a proxy for paleo–sea surface temperatures (SSTs) and paleoatmospheric CO_2 concentrations is assessed. Although several other widely used paleo-proxies already exist, each of them has drawbacks that prevent it from serving as an unequivocal standard. The alkenone undersaturation ratio is not a perfect proxy, but after more than a decade of use, the results have been encouraging. Furthermore, the carbon-isotopic composition of organismal alkenones is a function of the concentration of atmospheric CO_2, and thus has been used to infer pCO_2. This set of reviews examines different facets of the use of alkenones in order to establish a better physiological understanding of their biosynthesis as well as their practical value as thermometers and CO_2 barometers. — HJS

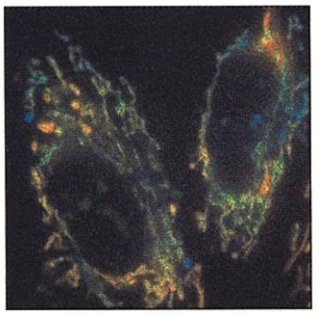
Geochem. Geophys. Geosys. **2**, 2000GC000057; 2000GC000050; 2000GC000052; 2000GC000055 (2001).

BIOCHEMISTRY

Variations on a Theme

A change in fluorescence offers a sensitive signal that usually can be measured without compromising cellular integrity. Application of this approach to intact cells has enabled temporal and spatial observation of changes in ion concentrations and in macromolecular association (via fluorescent resonance energy transfer). An early indicator, the jellyfish protein aequorin, has largely been supplanted by small molecules, which have been refined to discriminate between Mg^{2+} and Ca^{2+}, for instance; more recently, green fluorescent protein (GFP) has emerged as a tunable indicator with the advantage of genetically based targeting.

Nagai *et al.* have developed a new generation of circularly permuted GFP variants incorporating calmodulin. Among the constructs are flash-pericam, a single-wavelength indicator with a K_d of 0.7 μM for Ca^{2+}; inverse-pericam, whose fluorescence decreases with Ca^{2+}; and ratiometric-pericam, whose excitation wavelength is calcium-dependent. This last indicator could be targeted intracellularly either by tacking on a nuclear localization signal or by using the signal sequence from cytochrome c oxidase, a mitochondrial protein. — GJC



Measuring calcium concentrations in mitochondria (red, high; blue, low).

CREDITS: NAGAI *ET AL.*, *PROC. NATL. ACAD. SCI. U.S.A.* **98**, 3197 (2001).

Proc. Natl. Acad. Sci. U.S.A. **98**, 3197 (2001).

HIGHLIGHTED IN *SCIENCE*'S SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT

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Sprouty Blocks Branching

Sprouty (Spry) proteins restrict branching of the developing trachael systems in *Drosophila* and mouse, likely through inhibition of fibroblast growth factor (FGF) signaling. Both Lee *et al.* and Impagnatiello *et al.* report that mammalian Spry proteins antagonize growth factor signaling pathways that regulate the branching of blood vessels in vertebrates. When overexpressed in the endothelium and extra-embryonic vasculature of mouse embryos, Spry caused poor branching of blood vessels and inhibited angiogenesis; overexpression of Spry proteins in cultured endothelial cells blocked growth factor–induced differentiation into a netlike structure. Spry expression also blocked the proliferative effects of FGF, epidermal growth factor (EGF), and vascular endothelial cell growth factor (VEGF), possibly because of increased expression of the cell-cycle inhibitor p21. Impagnatiello *et al.* also show that mouse Spry proteins are palmitoylated and associated with caveolin, although not in lipid rafts. Thus, this family of membrane-bound proteins appears to influence morphogenesis through regulation of several receptor tyrosine kinase pathways. — LDC

J. Biol. Chem. **276**, 4128 (2001); *J. Cell Biol.* **152**, 1087 (2001).