CLIMATE SCIENCE

Lining up the Ducks

Redistributing mass alters rotational speed.

Tide gauge and satellite measurements indicate that global mean sea level has increased by 1.5 to 2.0 mm/year during the 20th century. A significant fraction of this increase is ascribed to glacial melting caused by warming, with the remainder due to thermal expansion of the oceans. Because glacial melting redistributes Earth's mass from high latitudes, where water is stored as ice, to lower latitudes, any appreciable melting should change the planet's rate of rotation, as when a spinning figure skater extends her arms, and the orientation of the rotational vector, which should move as mass shifts. However, the simultaneous agreement in the movement of the rotational pole, the historical observations of ancient eclipses (which allow trends in the length of day to be computed), and space-based gravity measurements (which reflect mass redistributions) has seemingly precluded any major amount of ice melting during the past hundred years.

Mitrovica *et al.* challenge that view with a new theory of rotational stability that involves reformulating how the shape of Earth has responded to glacial melting. In this way, they show how the full suite of Earth rotation and geodetic observations can be reconciled with those of glacial melting and associated sea level rise. — HJS

Earth Planet. Sci. Lett. **243**, 390 (2006).

ECOLOGY/EVOLUTION

The Origin of Natural Selection

The initial stimulus for Darwin's insight into natural selection as the engine of speciation and evolution is often believed to be the radiation of the Galapagos finch. In fact, his thoughts were triggered by the mockingbirds of the endemic genus *Nesomimus*, which exhibit a variety of allopatric forms on the islands of the same archipelago.

Nesomimus parvulus.

Although the finches have been studied intensely by generations of evolutionary biologists, the mockingbirds have suffered a benign neglect. Darwin's view was that the Galapagos mockingbirds, which were recognized as three species on the basis of the *Beagle* specimens (a fourth being added after his death), had descended from a single colonization event perpetuated by wayfarers from Chile or Argentina.

Arbogast *et al.* have tested this view by analyzing mitochondrial DNA sequences. The molecular phylogeny indicates that the Galapagos mockingbirds are indeed monophyletic, but that their closest relatives in the genus *Mimus* are now found in North and Central America, rather than the nearest part of the mainland (Ecuador), and that *Nesomimus* appears to belong within the ancestral genus. Their analysis also illuminates the finer-grained relationships amongst the Galapagos mockingbirds, revealing the wind-aided routes by which they diversified and how their history compares to that of the finches. — AMS

Evolution **60**, 370 (2006).

GEOPHYSICS

Not the Fault of Compaction

Deltas represent a huge accumulation of sediment; large ones are often the sites of major cities, such as New Orleans. Several processes—compaction of the sediment, withdrawal of ground water and oil (which accelerates compaction), and sea level rise—lead to subsidence and inundation of the deltas and to associated problems for their cities. These are compounded when the supply of new sediment is interrupted, as is commonly the case.

On the other hand, subsidence can also be related to faulting induced within the huge sediment pile. By analyzing a large number of leveling benchmarks tied to modern Global Positioning System data, Dokka shows that subsidence over the past 50 years around New Orleans has been dominated by such a fault and not by sediment compaction driven by groundwater pumping as has been presumed. The fault has downthrown a 200-km-wide block extending north of New Orleans out into the Gulf of Mexico. The size of the fault block has made it difficult to recognize in local benchmark surveys, which thus could not reveal the absolute rates. Subsidence attributed to faulting may have reached about 17 mm/year around 1970 and several millimeters per year recently, which is comparable to the presumed compaction rate. — BH

Geology **34**, 281 (2006).

MATERIALS SCIENCE

Crayfish Crystals

A number of studies have shown that biomineralization can occur through the sudden transformation of amorphous calcium carbonate (ACC) into its crystalline forms. In crayfish, for example, the exoskeleton consists primarily of a composite of chitin and protein microfibrils and calcium carbonate. Sugawara *et al.* examine the role of a recently isolated crayfish peptide, known as CAP-1, on the formation of calcium carbonate crystals. Chitin was spun-coated onto glass, where it formed a layer of fibrils and was then covered with a supersaturated solution of calcium carbonate and a small amount of CAP-1. The authors observed the growth of micrometer-sized crystals that were composed of assemblies of nanocrystals and were all found to have the same *c*-axis orientation. The crystals were connected to the chitin through CAP-1 and formed a nanocomposite. Crystallization occurred within the first 5 min after mixing, indicating that a sudden transformation of ACC occurs in the presence of CAP-1. By removing the lone phosphoserine residue of the peptide, the authors observed oriented crystal growth but

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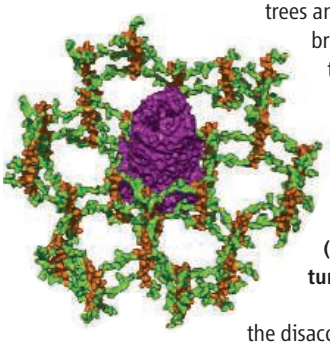
with larger crystals, indicating that the phosphate group may play a role in limiting crystal growth through the stabilization of the ACC. — MSL

Angew. Chem. Int. Ed. **45**, 10.1002/anie.200503800 (2006).

BIOCHEMISTRY

A NAG-NAM Network

Any mention of biological polymers often serves as shorthand for proteins or nucleic acids. Sugar-based macromolecules come to mind less readily even though they constitute some of the most abundant and visible manifestations: cellulose in trees and chitin in invertebrate exoskeletons. A third and equally important member of this group is the disaccharide building block (NAG-NAM) of the bacterial cell wall, whose essential contribution to survival is amply illustrated by the use of lysozyme in the laboratory and penicillin (and its descendants) in the clinic.



An angled view of the peptide (green), glycan (orange), and TolC turret (purple).

Meroueh *et al.* describe the NMR structure of a synthesized fragment incorporating two of these disaacharides and their two pendant peptides, which cross-link the glycan strands in vivo. Modeling this fragment into an average-length glycan (10 saccharide units) yields a helix with the pentapeptides emerging at 120° to each other. Factoring in the critical assumption that these strands run perpendicularly to the membrane surface makes it feasible to situate these helices within a honeycomb structure with pores of diameter 70 Å, which snugly accommodate the TolC efflux channel that bridges the periplasm and outer membrane. — GJC

Proc. Natl. Acad. Sci. U.S.A. **103**, 4404 (2006).

DEVELOPMENT

Trading Accuracy for Speed

Genetic damage is potentially very dangerous to cells, so when it does occur, repair usually follows right away. During cell division, DNA replication forks grind to a halt at sites of damage, activating a "checkpoint" that delays cell-cycle progression until repair is complete. But for some developmental processes, cell-cycle timing is itself critical, as in the asynchronous cell divisions that occur in the two-cell *Caenorhabditis elegans* embryo. How do developing nematodes keep to schedule when confronted by a checkpoint?

Holway *et al.* show that during early *C. elegans* embryonic development, checkpoint activation by damaged DNA is prevented by the genes *rad2* and *gei-17* but remains responsive to developmental inputs that regulate timing. *gei-17* suppresses the repair checkpoint by facilitating replication through damaged DNA. Although the normal replication machinery cannot cope with damaged DNA, the so-called translesion DNA polymerase *polh-1* enables the *C. elegans* embryo to overcome genomic damage and avoid a fatal delay in cell division. But this is a tradeoff: Translesion polymerases are error-prone, and embryos opt for survival at the cost of an increase in mutations. — GR

J. Cell Biol. **172**, 999 (2006).

CREDIT: MEROUEH *ET AL., PROC. NATL. ACAD. SCI. U.S.A.* **103**, 4404 (2006)