edited by Stella Hurtley and Phil Szuromi

Slow Shaky Ice

Seismic instruments are calibrated to record sudden tectonic earthquakes and may miss slower events. Using a new method to search for events with durations of 35 to 100 seconds, **Ekström *et al.*** (p. 622; see the Perspective by **Fahnesock**) have found thousands of slow earthquakes. About 40 of these slow events are associated with glaciers and represent a previously unrecognized type of earthquake in which stick-slip motion along the base of the glacier produces the slow earthquake. The recognition and continued study of these glacial earthquakes will improve our understanding of glacial dynamics and of a different regime in earthquake physics, where the movements and material properties along the fault boundaries are distinct from typical tectonic events.

Green Mineral, Red Planet

Olivine is a common igneous rock-forming mineral (usually greenish in color) on Earth, particularly in basaltic rocks formed by volcanism, and under warm and wet terrestrial conditions weathers to serpentine. **Hoefen *et al.*** (p. 627) report outcrops of olivine-rich rocks in the Nili Fossae region of Mars that are associated with the Isidis impact event. If the olivine has been exposed to the surface since the impact event about 3.6 billion years ago, then either no water has flowed through this region since then, or terrestrial weathering rates may not apply to Mars. Alternatively, the olivine may have been exposed to the surface in the past few thousand years and would not have weathered under current martian conditions.

Vesicles via Clay

Clay and other minerals could have catalyzed the synthesis and growth or organic molecules, including RNA, in the prebiotic era. Once formed, however, a means for encapsulating and protecting these early molecules was needed. **Hanczyc *et al.*** (p. 618; see the Perspective by **Russell**) show that clay minerals can also catalyze the formation of vesicles from fatty acids; in turn, the clay minerals and any other molecules on their surface often become trapped in these vesicles. Pressing growing vesicles through small pores allows them to divide. This system represents one possible model for the emergence of cells.

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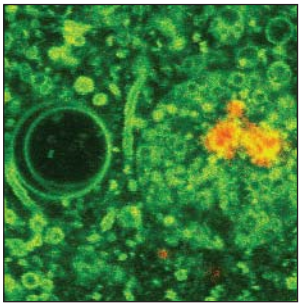
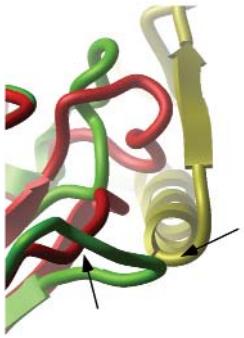


Structure of Trafficking Complex Revealed

Rab guanosine triphosphatases (GTPases) play central roles in intracellular membrane traffic. The Rab GDP-dissociation inhibitor (RabGDI) regulates RabGTPase by delivering and retrieving geranylgeranylated, GDP-bound forms of Rab to and from cell membranes. **Rak *et al.*** (p. 646) have solved the structure of a monogeranylgeranylated RabGTPase complexed with RabGDI at 1.5 angstrom resolution. The lipid is bound in a cavity that is not present in the unbound form of RabGDI. The structure shows why RabGDI has a higher affinity for the GDP-bound form of Rab GTPases and also explains why a specific mutation in RabGDI causes mental retardation in humans.

646



CREDITS: (TOP TO BOTTOM) HANCZYC *ET AL.*; RAK *ET AL.*

Creating Skeletal Diversity

Combinatorial synthesis of chemical libraries tends to create molecules with different appendages on the same central core, and methods that increase skeletal diversity (for example, that change the number and size of ring structures) are still needed. **Burke *et al.*** (p. 613) present a strategy based on the chemistry of furans (five-membered aromatic rings containing an oxygen atom) in which substituent groups guide different outcomes of the ring chemistry. They use this approach to create a library of >1000 compounds that increases the skeletal diversity compared with the reactant pool.

Lighter Fuel, Better Air

The expected impacts of a global hydrogen-fuel economy on air quality and climate, based on results from a three dimensional atmospheric chemistry model, are presented by **Schultz *et al.*** (p. 624; see the Perspective by **Prather**). They project that the replacement of 50% of modern fossil fuel use by hydrogen burning would cause a 5 to 6% decrease in the global OH concentration, as well as significantly lower concentrations of tropospheric ozone and other air pollutants. The greatest climate impacts are expected from the reduction of CO_2 emissions and the decrease in tropospheric ozone.

Cooperative Breeding Improves Fitness

Explaining cooperative breeding in mammals and birds remains one of the greatest problems for evolutionary biology. Recently, there has been controversy over the extent to which cooperative breeding can be explained by kin selection, when individuals gain fitness through the reproduction of relatives. In a meta-analysis of data on cooperatively breeding species, **Griffin and West** (p. 634) found that preferential helping of relatives is more common in species where benefits of helping are greater, thus providing support for the kin selection theory.

How Legumes Let in Bacterial Symbionts

The complex interplay between bacterium and plant that results in nodulation of legumes—and thus the facility for the symbiosis to fix nitrogen—depends on the Nod factors, lipo-chitooligosaccharides of a variety of distinctive specificities. **Limpens *et al.*** (p. 630; see the Perspective by **Cullimore and Dénarié**) have now identified two genes of the legume *Medicago trunculata* that encode putative receptors for the Nod factors. In *M. trunculata*, the receptors that regulate bacterial entry into the plant root-hair cells seem to be more

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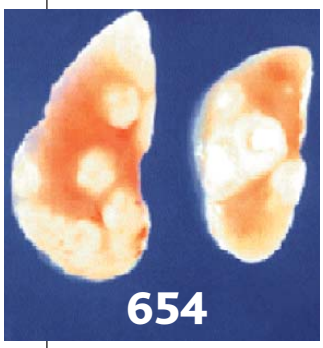
selective than the receptors that regulate the earlier responses of root-hair curling. The *LYK* genes identified here function in the process of bacterial entry and subsequent growth of the infection thread.

Risk Factors in Breast and Ovarian Cancer

Mutations in *Breast Cancer Gene 1* (*BRCA1*) are a major cause of familial breast cancer. The BRCA1 protein functions in cellular responses to DNA damage, but its precise molecular actions are not fully understood. Two different approaches now show that the carboxyl-terminal (BRCT) domain of BRCA1 (which is also found in other proteins that function in control of DNA damage) specifically binds to target sequences when serine or threonine residues in the target domain are phosphorylated. **Yu *et al.*** (p. 639; see the Perspective by **Caldecott**) demonstrate the phosphorylation-dependent interaction of BRCA1 with BRCA1-Associated carboxyl-terminal helicase and show that this interaction is required for a proper cellular response to DNA damage. **Manke *et al.*** (p. 636) used a proteomic strategy to identify BRCT domains in a screen for modules that would bind sequences preferentially phosphorylated by the phosphoinositide-like kinases ATM and ATR, which are activated in response to DNA damage. Determining the environmental and genetic contributions to cancer risk is a high priority. In a collaboration among 12 cancer centers and hospitals in the New York City area, **King *et al.*** (p. 643, see Perspective by **Levy-Lehad**) studied 1021 breast cancer patients and their families (who were not selected on the basis of family history of breast cancer) to evaluate genetic or environmental factors that may modify the risks of breast and ovarian cancer to women with *BRCA1* or *BRCA2* mutations. Mutations were associated with high cancer risk, but nongenetic factors, specifically physical exercise during adolescence and a healthy weight early in life, were protective against breast cancer.

Moving Bridges in RNA Polymerase

A new class of bacterial RNA polymerase inhibitor is described that provides a lead for drug design as well as insight into how the enzyme works. **Artsimovich *et al.*** (p. 650) show that the inhibitor binds outside the active site and acts allosterically to inhibit catalysis, but does not inhibit backtracking (reverse translocation of RNA polymerase that is uncoupled from catalysis). Previous studies have proposed that movement of a helix known as the bridge helix is involved in nucleotide binding or translocation. This study suggests that the inhibitor probably interferes with the bridge helix movement that is required for catalysis.



Destroyed in Transit

Despite the huge global rise in tuberculosis, protective immunity to the causative pathogen, *Mycobacterium tuberculosis* (Mtb), is measurable in most infected individuals. Critical in mediating this is the cytokine interferon-γ (IFN-γ), which activates a variety of immune-response genes, of which nitric oxide synthase 2 (NOS2) is considered pivotal. **MacMicking *et al.*** (p. 654) identified a protein, LRG-47, that can mediate protection from Mtb infection independently of NOS2. Macrophages from mice lacking LRG-47 produced bacteria-laden phagosomes that could not fuse with lysosomes and thus impeded the normal cellular pathway for destroying intracellular bacteria.

A Gut Feeling for Left and Right

Many vertebrate organs develop morphological asymmetries during embryogenesis. A dramatic example is the digestive system, where the liver and pancreas occupy asymmetric positions and the intestine bends in complex patterns for packing into the abdominal cavity. Using zebrafish as a model, **Horne-Badovinac *et al.*** (p. 662) investigated how the embryo translates left-right asymmetries in gene expression into morphologic asymmetry in the gut. Gut looping appears to be driven by asymmetric migration of a tissue called the "lateral plate mesoderm," which displaces the developing intestine to the left.

CREDIT: MACMICKING *ET AL.*