

<< Pulling on Molecular Wires

Most studies of molecular conductivity examine molecules of fixed length. **Lafferentz *et al.*** (p. 1193) studied changes in conductivity that arise when they pulled a conducting polymer off a gold surface with the tip of a scanning tunneling microscope. They synthesized polyfluorene oligomer “wires” on the gold surface through a thermal reaction and pulled off chains as long as 20 nanometers. Superimposed on the expected exponential decay in current, which occurs as molecular length increases, is an oscillatory component that arises from stretching of the chain as monomer units successively detach from the surface.

Escaping Mendel

Paramutation is a non-Mendelian inheritance of traits caused by epigenetic modifications in the genome that can be passed on to the next generation. **Erhard *et al.*** (p. 1201) revealed that the RMR6 gene in maize, which is required for the maintenance and establishment of paramutation, is an RNA polymerase (Pol IV) that is also involved in epigenetic silencing in another plant, *Arabidopsis thaliana*. Unexpectedly, Pol IV did not synthesize RNA, but appeared to have a genome-wide effect, possibly mediated by competition with other polymerases.

Hothouse to Icehouse

About 34 million years ago, at the Eocene-Oligocene transition, Earth’s climate underwent a dramatic change and a permanent ice sheet began to form in Antarctica. **Liu *et al.*** (p. 1187; see the Perspective by **Kump**) present geochemical evidence for sea surface temperature changes at multiple locations. It appeared that high-latitude surface ocean waters cooled from about 20° to 15°C, and although lower latitudes experienced cooling, the effect was not as significant. Combining these results with oxygen isotopic data, which can be used to estimate ice volume, as well as temperature, indicated that the volume of continental ice varied only slightly, and that glaciation of the Northern Hemisphere did not occur.

Astrocytes in Alzheimer’s

Recently, multiphoton calcium-imaging in the living brain of Alzheimer’s disease model mice has become a technical possibility. During

investigations of calcium signaling in astrocytes in living mice, **Kuchibhotla *et al.*** (p. 1211) discovered a role for astrocytes in Alzheimer’s disease (AD). In AD model mice that developed cortical plaques, calcium waves were observed to propagate throughout the network of structurally interconnected astrocytes. These waves were not seen in mice without plaques. The data indicated that a long-range and coordinated signaling mechanism occurs during pathology that might be contributing to cortical dysfunction and memory loss. Thus, while plaques may affect neurons locally, they have a more global effect on the network of astrocytes, hinting to possibilities for therapeutic interventions.

Ancestral Footprints

Preserved footprints can provide important information about the anatomy and gait of ancestral humans, yet (as for human ancestors in general) the fossil record is very patchy. **Bennett *et al.*** (p. 1197; see the cover; see the Perspective by **Crompton and Pataky**) report the discovery of sedimentary layers preserving multiple hominin footprints that are over 1.5 million years old at Ileret, on the eastern shores of Lake Turkana, Kenya. The Ileret prints are distinct from the 3.75-million-year-old footprints discovered 30 years ago at Laetoli (Tanzania). The footprint surfaces were analyzed using laser scanning and geometric morphometric statistical techniques, and were found to resemble those of humans in having an arch, an adducted (in-line) big toe, and evidence of the transfer of weight to the “ball” of the foot

before the “toe off” movement that is unique to modern humans.

Inducing a Magnetic Monopole

Although the existence of a magnetic monopole is consistent with the fundamental laws of

physics, no matter how small you divide a magnet, it

always comes with a north and south pole.

Qi *et al.* (p. 1184, published online

29 January) show theoretically that a mag-

netic monopole can be induced

by placing a charge at the surface of a strong topological insulator. Manipulating Maxwell equations around these new quantum states of matter revealed how the magnetic monopole could be measured with a magnetic force microscope.

From Model to Marker

It is quite a leap from building genetic networks in a model organism to the identification of a clinically relevant marker for a human cancer. **Liu *et al.*** (p. 1218) combined transcription-factor DNA binding site mapping and expres-

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sion profiling data with literature mining and protein interaction data to build a network around the classical pair-rule genes in *Drosophila* that specify the segments during embryogenesis. Consequently, a gene was identified that encodes an E3 ubiquitin ligase adaptor, SPOP, that targets the Jun kinase pathway. The gene is conserved in humans, and expression is associated with the most common type of kidney cancer.

Distasteful Discussed

When I say in metaphorical terms that something left “a bad taste in taste in my mouth,” does this phrase have a biological basis? **Chapman *et al.*** (p. 1222; see the Perspective by **Rozin *et al.***) argue that it does, and provide behavioral and physiological evidence in support of their assertion. They found unpleasant tasting liquids activated the *levator labii* muscle (lifting the upper lip and contracting the nostrils), as did viewing facial expressions of disgust and receiving unfair treatment in a two-player game (the Ultimatum Game), suggesting a common basis in gustatory and moral feelings of disgust.

Red and Blue Motivations

Embodied or grounded cognition is a recent and vigorous rethinking of the basis of cognitive processes proposing that perceived bodily states support the conceptual manipulation of symbols. **Mehta and Zhu** (p. 1226, published online 5 February) showed how this rethinking helps explain the effects of color (red versus blue) on the performance of a wide variety of cognitive tasks, such as the solving of anagrams, the memorizing of word lists, and “blue-sky” imagining. They concluded that red activated risk-avoidance mechanisms and, by contrast, blue enhanced exploratory behaviors.

Tackling Tuberculosis

Emerging, extensively resistant strains of *Mycobacterium tuberculosis* present an urgent need for alternative drugs. The widely used β -lactam class of antibiotics, which includes penicillin, has been mainly ineffective against *M. tuberculosis* because the drugs are hydrolyzed by a bacterial β -lactamase (BlaC).

Hugonnet *et al.* (p. 1215) showed that because the β -lactam meropenem is a slow substrate of BlaC, a covalent intermediate can be trapped and crystallized. The structure of the covalent BlaC-meropenem complex provides a basis for designing improved *M. tuberculosis*-specific β -lactams. In addition, a combination of FDA-approved drugs, meropenem and the BlaC inhibitor, clavulanate, was found to be active in vitro not only against both laboratory strains that mimic the “persistent state,” but also against extensively drug-resistant strains.



Reconstructing the RNA World

The “RNA World” hypothesis for the origin of life on Earth posits that the path to DNA-based organisms included a stage where RNA acted both as an information storage molecule, like DNA, and as an effector molecule, like protein, and was capable of replicating itself. **Lincoln and Joyce** (p. 1229, published online 8 January) generated an in vitro RNA-based self-replicating system lacking any protein component. Each ribozyme is present as two halves, which are cross-ligated. Sequence variation in the “halves” showed that recombination is rife in the system. Consequently, competition experiments allowed the most efficient replicator combinations to emerge through selection and become dominant.

Putting Teeth into Development

The first morphological sign of tooth development in mammals is the formation of the dental lamina, a thickened band of oral epithelium from which all teeth subsequently grow. Now **Zhang *et al.*** (p. 1232) show that the mouse tooth morphogenetic field is also patterned by a spatial restriction of inductive signals in the developing tooth mesenchyme. Two transcription factors, *Msx1* and *Osr2*, act antagonistically to regulate the levels and spatial distribution of *Bmp4*, an essential odontogenic signal. Disrupting the balance between these factors may result in either missing teeth or extra teeth.

CREDIT: HUGONNET ET AL.

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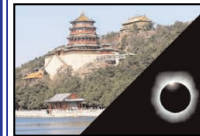
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