EDITED BY STELLA HURTLEY

Oil Is Bad for the Heart

Crude oil, which commonly makes up the largest proportion of spilled oil, is cardiotoxic to fish embryos. To better understand the processes involved, **Brette *et al.*** (p. 772) exposed captive young tuna to oil samples collected from the Deep Water Horizon spill site to determine the mode of cardiotoxicity. Crude oil prolonged the action potential of cardiomyocytes and disrupted the excitation-contraction coupling in these cells, functionally disrupting cellular excitability and creating the potential for cardiac arrhythmias. Such cardiac impacts may be more broadly distributed in vertebrates exposed to crude oil.

The in-Laws Through History

Admixture, the result of previously distant populations meeting and breeding, leaves a genetic signal within the descendants' genomes. However, over time the signal decays and can be hard to trace. **Hellenthal *et al.*** (p. 747) describe a method, using a technique called chromosome painting, to follow the genetic traces of admixture back to the nearest extant population. The approach revealed details of worldwide human admixture history over the past 4000 years.

Losses and Gains

In order to better understand the process by which de novo genes originate, **Zhao *et al.*** (p. 769, published online 23 January) examined testis-based gene expression among *Drosophila melanogaster* strains and identified both fixed and polymorphic de novo genes. The results suggest that spontaneous activation of previously noncoding DNA may be an important factor in generating genetic novelty.

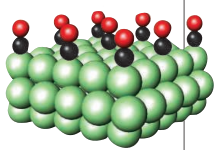
On the Fast Track

Membranes based on graphene can simultaneously block the passage of very small molecules while allowing the rapid permeation of water. **Joshi *et al.*** (p. 752; see the Perspective by **Mi**) investigated the permeation of ions and neutral molecules through a graphene oxide (GO) membrane in an aqueous solution. Small ions, with hydrated radii smaller than 0.45 nanometers, permeated through the GO membrane several orders of magnitude faster than predicted, based on diffusion theory. Molecular dynamics simulations revealed that the GO membrane can attract a high concentration of small ions into the membrane, which may explain the fast ion transport.

Robot Rules

In the case of mound-building termites, colonies comprising thousands of independently behaving insects build intricate structures, orders of magnitude larger than themselves, using indirect communication methods. In this process, known as stigmergy, local cues in the structure itself help to direct the workers. **Werfel *et al.*** (p. 754; see the Perspective by **Korb**) wanted to construct complex predetermined structures using autonomous robots. A successful system was designed so that for a given final structure, the robots followed basic rules or "structpaths" in order to complete the task.

Speeding Up Surface Diffraction



Surface diffraction methods can determine the atomic structure of the topmost layer of a crystal and also subsurface structures. However, many surface diffraction methods either require ultrahigh vacuum conditions, which limits the reaction conditions that can be studied, or require long data acquisition times, which limits temporal resolution. Using high x-ray energies, **Gustafson *et al.*** (p. 758, published online 30 January; see the Perspective by **Nicklin**) were able to measure the intensities of surface-diffracted beams to follow the surface oxidation that accompanies the changes in a palladium surface during the catalytic oxidation of CO with O_2.

Rolling Under New Madrid

During 1811–1812, the New Madrid Seismic Zone experienced a sequence of three large intraplate earthquakes and at least one comparably sized aftershock. There have been no earthquakes of similar magnitudes since then. Using a combination of historical data dating back to the original large events and an epidemic-type aftershock sequence model, **Page and Hough** (p. 762, published online 23 January) found that the current low seismicity is not part of an aftershock sequence. Instead, despite low observable deformation rates, there is ongoing accumulation of strain, leaving the potential for large earthquakes in the region.

Keeping Alphaviruses Under Wraps

Viruses mutate to avoid detection, and the host responds in kind. For example, 2′-O methylation of the 5′ cap of viral RNA allows viruses to escape detection by the interferon-stimulated host defense protein, IFIT1. Alphaviruses, however, lack this modification but are able to remain undetected in the presence of IFIT1. How? Using a combination of viral mutants and biochemical analysis, **Hyde *et al.*** (p. 783, published online 30 January) found that alphaviruses contain secondary structural motifs in the 5′ untranslated region of their genomic RNA that allow them to avoid detection by IFIT1. When these regions were rendered nonfunctional, IFIT1 was able to keep the virus under control.

Limb Regeneration

Flatworms possess pluripotent stem cells that can regenerate any cell type in the body, whereas vertebrates mobilize committed progenitor cells whose fate is predetermined. Investigating limb regeneration in a crustacean, **Konstantinides and Averof** (p. 788, published online 2 January) found that arthropods use committed progenitor cells to regenerate missing tissues, including satellite-like cells to regenerate muscle. The study reveals similarities between arthropod and vertebrate muscle regeneration, pointing to a common basis for muscle regeneration that may date back to the common ancestors of all bilaterian animals.

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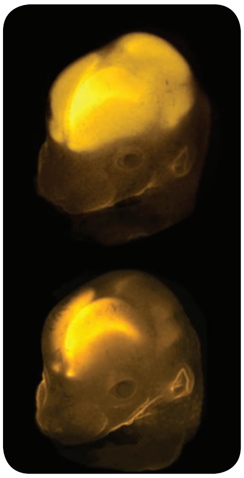
Additional summaries

Toddler Welcome

It has been assumed that most, if not all, major signals that control vertebrate embryogenesis have been identified. Using genomics, **Pauli *et al.*** (p. 746, published online 9 January) have now identified several new candidate signals expressed during early zebrafish development. One of these signals, Toddler, is a short, conserved, and secreted peptide that promotes the movement of cells during zebrafish gastrulation. Toddler signals through G protein–coupled receptors to drive internalization of the Apelin receptor, and activation of Apelin signaling can rescue *toddler* mutants.

Fine-Tuning Brain Gyrations

A handful of patients who suffer from seizures and mild intellectual disability have now led the way to insights about how one piece of regulatory DNA controls development of a section of the human cortex. Imaging the brains of these patients, **Bae *et al.*** (p. 764; see the Perspective by **Rash and Rakic**) observed malformations on the surface folds in a brain region that includes "Broca's area," the main region underlying language. The three affected families shared a 15–base pair deletion in the regulatory region of a gene, *GPR56*, which encodes a G protein–coupled receptor required for normal cortical development that is expressed in cortical progenitor cells.



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Developmental Complexity

Although related, the plants *Arabidopsis thaliana* and *Cardamine hirsuta* have different sorts of leaves—one, a rather plain oval and the other, a complicated multipart construction. Comparing the development of the two leaf types, **Vlad *et al.*** (p. 780) uncovered a gene that regulates developmental growth. The *C. hirsuta* gene encoding the REDUCED COMPLEXITY (RCO) homeodomain protein arose through gene duplication and neofunctionalization, but was lost in the *A. thaliana* lineage. In *C. hirsuta*, RCO suppresses growth in domains around the perimeter of the developing leaf, yielding complex-shaped leaves. *A. thaliana*, lacking RCO, produces simple leaves. When RCO was expressed in *A. thaliana*, the leaves became more complex. Thus, the capacity to produce complex leaves remains, despite loss of the initiator.

Introducing MARS-Seq

Immune cells are typically differentiated by surface markers; however, this designation is somewhat crude and does not allow for fine distinctions that might be characterized by their RNA transcripts. **Jaitin *et al.*** (p. 776) used massively parallel single-cell RNA-sequencing (MARS-Seq) analysis to explore cellular heterogeneity within the immune system by assembling an automated experimental platform that enables RNA profiling of cells sorted from tissues using flow cytometry. More than 1000 cells could be sequenced, and unsupervised clustering analysis of the RNA profiles revealed distinct cellular groupings that corresponded to B cells, macrophages, and dendritic cells. This approach provides the ability to perform a bottom-up characterization of in vivo cell-type landscapes independent of cell markers or prior knowledge.

Cell-Cell Interactions in Development

In vertebrate embryos, the number, size, and positional identity of mesodermal segments (somites) located bilaterally along the anterior-posterior axis is widely believed to be controlled by a molecular clock of oscillating gene expression interacting with a traveling wave of signals to determine how many cells make up a somite. **Dias *et al.*** (p. 791, published online 9 January; see the Perspective by **Kondo**) reveal that it is possible to generate somites of normal size, shape, and identity without either a clock or a wavefront. Instead, the findings suggest that somite size and shape are regulated by local cell-cell interactions.

Folding When Wet

Most globular proteins release water as they fold to form a dry hydrophobic core. In contrast, **Sun *et al.*** (p. 795; see the Perspective by **Sharp**) report a high-resolution structure showing that the antifreeze protein Maxi retains about 400 water molecules in its core. Maxi is a dimer in which two helical monomers each bend in the middle to form a four-helix bundle. The helices are spaced slightly apart to accommodate two intersecting polypentagonal monolayers of water. The pentagons form cages around inward pointing side chains to stabilize the structure. The ordered waters extend to the protein surface where they are likely to be involved in ice binding.

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