GENETICS

Origins of Sparrow Speciation

Homoploid hybrid speciation is the result of hybridization between two parental species without a change in chromosome number. Such speciation is relatively rare, however, because it requires the rapid establishment of reproductive isolation of the new species from that of its parents. Trier *et al*. examine the origins of the Italian sparrow, which originated as a result of hybridization between the house and Spanish sparrows. Transcriptome analysis of the parental sparrows identified 86 species-specific SNPs. This allowed tracing of the genetic ancestry within the Italian sparrow and identified some ongoing, but limited, gene flow between the parental species and the Italian sparrows. Mosaic ancestry of the Italian sparrow sex chromosomes was evidenced by a cline analysis framework. This identified ancestry of both house and Spanish sparrow sex chromosome–linked loci that exhibited allele frequency shifts. Mitochondrial and nuclear encoded mitochondrial genes exhibited similar divergences. These results suggest that mito–nuclear interactions may also be a factor in isolating the Italian sparrows from their parental species and that reproductive isolation may be evolving as a result of mito–sex chromosome interactions. — LMZ

PLOS Genet. **10**, e1004075 (2014).

BIOMEDICINE

Orchestrating an Attack

Urinary tract infections (UTIs) persist if the innate immune system fails to clear the bacteria. Immune defense against UTIs requires neutrophils, macrophages, and the cytokines they secrete; however, how they all work together is unclear. Using a murine model of UTI, Schiwon *et al*. found that neutrophils are the key antibacterial effectors in UTI but that neutrophil migration was regulated by two functionally distinct macrophage subsets: sentinel macrophages resident in the bladder and helper macrophages that need to be recruited from the circulation. The sentinel macrophages sensed the infection and produced chemokines to recruit neutrophils and helper macrophages. Helper macrophages did not directly combat bacteria like neutrophils, but did produce the cytokine tumor necrosis factor as a "helper signal," which allowed the sentinel macrophages to produce the chemokine CXCL2. CXCL2 in turn induced the secretion of matrix metalloproteinase-9, which allowed neutrophils to enter the uroepithelium to combat the bacteria. Thus, the antibacterial phagocyte response is not simply a disorganized tissue invasion of neutrophils and macrophages that clear the bacteria by eating them, but instead a highly coordinated process involving the exchange of information between three phagocyte subsets with distinct immunological tasks. — SMH

Cell **156**, 456 (2014).

BIOMATERIALS

The Heart of the Matter

A common problem after a serious wound or injury is the formation of scar tissue that prevents the full restoration of functionality. Scarring can occur rapidly, so there is a need for a quick and easy way to deliver protective materials to damaged tissues. After myocardial infarction (MI), otherwise known as a heart attack, there is an expansion of the infarct site in the left ventricle (LV) that is caused by the healing process. A key component of this adverse LV remodeling is the family of extracellular proteases known as the matrix metalloproteinases (MMPs), which are regulated by the presence of tissue inhibitors of MMPs (TIMPs). In an effort to modulate the balance of MMPs and TIMPs to prevent LV expansion after MI, Eckhouse *et al*. developed an injectable degradable hydrogel based on hyaluronic acid that was loaded with recombinant TIMP-3. Using a porcine model, which has a similar coronary anatomy to humans, the hydrogel was locally injected into the heart after MI. After 7 days, TIMP-3 was specifically localized to the injection sites. More importantly, in comparison to the control animals, the gel-injected pigs showed a reduction in the infarct size, improved remodeling of the LV, and increased cardiac function. — MSL

Sci. Transl. Med. **6**, 223ra21 (2014).

ENGINEERING

Spore Work Pays Off

The presence or absence of water on a surface or surrounding a cell can have a strong influence on its mechanical properties. This response to water gradients is useful in applications such as microfluidics or for transpiration in plants, but in principle can also generate work that might be harvested as electrical power. Chen *et al.* show

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that dormant spores of *Bacillus subtilis* and *Bacillus thuringiensis* are actually much more effective at converting energy from water gradients—in this case, changes in relative humidity—than are synthetic materials designed for this purpose. Furthermore, a mutation in *B. subtilis* causing a loss of most of its coating layers also confers an increase in energy density. Monolayers of assembled spores induced large deformations as a response to water potential on microcantilevers and latex sheets, and even when integrated into an energy-harvesting device. — NW

Nat. Nanotechnol. **9**, 137 (2014).

PLANT SCIENCE

Sneaky Smut

When the fungus *Ustilago maydis* colonizes a maize plant, causing corn smut, its hyphae wind their way through to the vascular tissue, which is rich in resources that sustain fungal growth. The fungus also secretes an effector protein called Tin2, which causes the plant to produce

anthocyanins, flavonoid pigments that lend a reddish color. Tanaka *et al.* now show that Tin2 contributes to the virulence of *U. maydis* and also induces the expression of genes that encode the plant's anthocyanin biosynthetic pathway. This results in more anthocyanin. Not so coincidentally, it also results in less lignin, the complex polymer that lends sturdiness to cell walls. This is because the biosynthetic pathways for anthocyanins and lignins share a common precursor. Plants with reduced lignin content were overly susceptible to fungal infection, which suggests that Tin2 promotes anthocyanin production at the expense of lignin production, reducing the plant's barriers to fungal growth. — PJH

eLife **3**, e01355 (2014).

CHEMISTRY

Waves of NO

Diffraction is perhaps the best evidence that light acts as a wave. The peaks and valleys in overlapping beams can either reinforce or suppress each other, leading to visible intensity oscillations on a detection screen. Quantum mechanics dictates that atoms manifest this type of behavior also, although the experimental conditions necessary to observe it can be as challenging to achieve as the mental agility needed to reconcile it with human-scale experience. von Zastrow *et al.* have detected remarkably clear interference fringes in the distribution of nitric oxide (NO) scattering angles from inelastic collisions with noble gas atoms. Close agreement between the experimental results and quantum-mechanical calculations confirmed a type of matter diffraction as the underlying cause of the striking oscillatory pattern in the angular distribution. — JSY

Nat. Chem. 10.1038/nchem.1860 (2014).

MATERIALS SCIENCE

A Coat To Fit Many

Applying a coating is a useful way to change the surface properties of a material. Common examples include antiglare coatings on lenses or anticorrosion coating on metals. Flat surfaces can be uniformly coated relatively easily, but uniformly coating a complex, porous three-dimensional (3D) shape can be much more challenging. Nguyen *et al.* develop a method to coat such structures conformally by using membrane precursors dissolved in a mixed solvent that includes a component that will selectively swell the object that needs to be coated. Initial experiments used polydimethylsiloxane (PDMS) as the membrane precursor and poly(lactic acid) (PLA) fibers as the material to be coated in and explored the role of solvent composition, precursor concentration, and exposure time on the thickness of the coating that formed. The precursor infiltrates the thin swollen surface region of the PLA fibers, becomes trapped there upon unswelling, and can be cured into a solid conformal coating on heating. The PLA can be removed through selective vaporization, leaving behind the PDMS membrane that retains the geometry of the original PLA fiber or more complicated initial shapes generated using 3D printing. This technique works for a wide range of precursor materials, including acrylic, epoxy, and polyurethane. — MSL

ACS Appl. Mater. Interfaces 10.1021/am4053943 (2014).

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