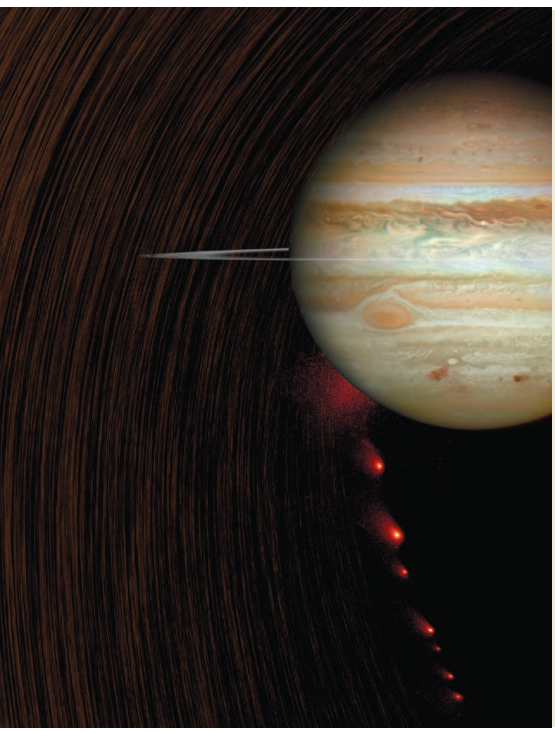


<< Ring-Tilting Events

Both Saturn's C ring and the rings of Jupiter show unexpected patterns of vertical corrugations (see the Perspective by **Salo**). **Hedman *et al.*** (p. 708, published online 31 March) show that in the case of Saturn, the patterns observed by the Cassini spacecraft in August 2009 were likely generated by an event in 1983 that caused part of the ring to tilt out of Saturn's equator plane. **Showalter *et al.*** (p. 711, published online 31 March) show that the features in Jupiter's rings observed in 1996 and 2000 by the Galileo spacecraft, and again in 2007 by the New Horizon spacecraft, are kinematically identical to those of Saturn's C ring. Jupiter's ring-tilting event occurred in 1994 and can be attributed to the impact of comet Shoemaker-Levy 9. Although the main fragments of the comet did not cross the ring, the associated dust debris may have caused the ring tilt.

CREDITS (TOP TO BOTTOM): SHOWALTER *ET AL.*; KNIGHT *ET AL.*

Building on Scaffold Proteins

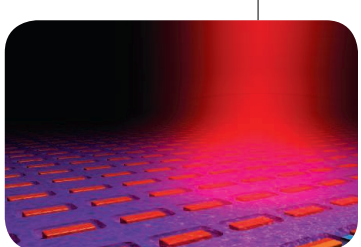
One of the most fundamental insights into the mechanisms of cell signaling has been the recognition of the importance of scaffold proteins. These proteins hold in proximity components that function together. Such tethering of interacting molecules can have large effects on specificity and efficiency of signaling mechanisms. But as **Good *et al.*** (p. 680) explain in their review, scaffold proteins can have other effects on the behavior of bound proteins, which influence the sensitivity or time course of a signaling response. Scaffolds have thus allowed the evolution of complex regulatory mechanisms, and efforts are now under way to design molecules to produce therapeutically useful scaffold regulators.

Mass and Flow

Measurement of multiple parameters on individual cells in conventional flow cytometry is limited because of spectral overlap of the fluorophore markers that are detected. **Bendall *et al.*** (p. 687; see the Perspective by **Benoist and Hacohen**) describe a technique in which more than 30 measurements can be made through the use of distinct elemental isotopes detected by mass spectrometry. This technique allows the analysis of hundreds of cells per second. Each cell is vaporized at 5500 degrees kelvin, and the markers are monitored by inductively coupled plasma–mass spectrometry (ICP-MS). The technique was used to analyze the signaling properties of various cell types in the human hematopoietic system but should also be applicable to many other systems.

Nanoantenna Photodiode

Antennas are designed to collect electromagnetic radiation and focus it to a point where the signal can be read. Shrinking the size of the antenna to the nanometer-scale allows optical wavelengths to be collected and focused. Surface plasmons, which are collective electronic excitations that propagate near to the surface of a metal, allow the light to be converted to an electrical signal. **Knight *et al.*** (p. 702; see the Perspective by **Moskovits**) fabricated arrays of gold nanoantennas directly on a silicon surface, which then form a potential barrier between the nanoantenna and the semiconductor. If the assembly is subjected to polarization-sensitive photon absorption, electrons are injected across the antenna-semiconductor barrier into the semiconductor to create a photocurrent. Combining light-harvesting and "hot" electron injection in the same nanoscale device provides a mechanism for spectral and photon detection at energies below the semiconductor band gap.



Probing the Cuprate Surface

Changing the positively charged carrier density of layered copper oxide materials transforms them from insulators into high-temperature superconductors. To discover what is happening within the bulk material, **Sakurai *et al.*** (p. 698) adopted an inelastic x-ray scattering technique to observe how the copper and oxygen orbitals shift with changes in the chemical environment. In a complementary study, **Scagnoli *et al.*** (p. 696, published online 7 April) used resonant x-ray scattering to image orbital currents in a copper oxide plaquette. Gaining a better understanding of how changes in the chemical environment affect the electronic behavior of the bulk material, combined with observations of (previously only theoretically predicted) loop currents, may be key to unlocking the mechanism of high-temperature superconductivity.

Dinosaurs in the Dark

Conventional wisdom has long held that physiological limitations meant that dinosaurs and pterosaurs were only active during the day, leaving the night to small, primitive mammals. Using characteristics of eye structure in extant species with known activity patterns, **Schmitz and Motani** (p. 705, published online 14 April; see the cover), suggest that these archosaurs were in fact active both day and night. Many similarities were observed between extant and extinct groups; flying animals are largely diurnal, carnivores largely nocturnal, and herbivores cathemeral (or active in bouts throughout a 24-hour cycle), indicating that paleozoic archosaurs, like mammals and birds, adopted daily activity patterns shaped by ecology.

Eat or Be Eaten—Alone

It is possible now to sequence the genomes of single cells, and of course anything else that might be on or within that cell. **Yoon *et al.*** (p. 714) shotgun-sequenced single cells of recently discovered picobiliphyte marine algae obtained directly from a wild environment, which

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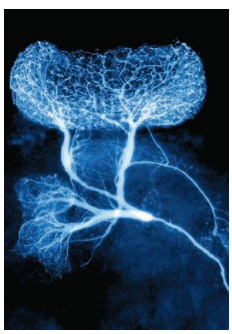
provides a fascinating glimpse of possible virus infections and putative bacterial meals, with each cell displaying a different complement of genomes. Furthermore, this assumed photosynthetic genus apparently does not possess a complete plastid, and is thus more likely to be heterotrophic.

Priming the Intracellular Armory

The immune cytokine interferon gamma is capable of eliciting nearly 2000 host genes, including several families of guanosine triphosphatases such as the interferon-inducible, 65-kilodalton guanylate-binding proteins (Gbps). **Kim *et al.*** (p. 717) systematically assessed the effects of inactivating each member of the mouse family of Gbps and found that several were important in soliciting the machinery to combat intracellular bacterial infections by oxidative killing, phagocytosis, and autophagy.

Intriguing Insect Interneuron Normalization



In the mushroom bodies that extend from of the brain of the locust, dense input signals from the antennal lobe are transformed into sparse representations in the intrinsic neurons of the mushroom bodies (the Kenyon cells). **Papadopoulou *et al.*** (p. 721) addressed the challenge of the distribution of sparse encoding in this system by applying a normalization function in which the network inhibits itself proportionally to the amplitude of the average input. In the locust, normalization is done by a single giant GABAergic neuron in each mushroom body, which receives input from virtually all the Kenyon cells and thereby acts to increase the dynamic range and overall encoding capacity of the system. This work has implications for understanding mechanisms underlying sensory representation in the mammalian brain.

Timing Infectiousness

Foot-and-mouth disease virus (FMDV) is a source of major economic loss for the livestock industry, not to mention the major logistical and animal welfare issues that accompany infection control. **Charleston *et al.*** (p. 726) have undertaken experiments in cattle to ascertain what the criteria should be for detecting infectiousness and thus how much leeway there is for modifying infection-control policies to limit cost and maximize animal welfare. They found that even if virus can be detected in a blood sample, it does not mean an animal is infectious. For successful transmission, certain symptoms also have to be apparent, and FMDV virus has to be excreted in mucus. But infectiousness is short-lived—1.7 days—because immune responses kick in and limit virus replication. The priority now is to develop rapid and accurate diagnostic tests as a precursor to reassessing infection-control policy.

Infectious Behavior

In the nematode worm *Caenorhabditis elegans*, three sensory neurons regulate resistance to pathogen infections by controlling the activation of a signaling pathway and promoting behavioral avoidance of certain pathogens. The neurons integrate behavioral responses to environmental oxygen, bacteria, and other animals within a neural circuit, and consequently their individual role in the control of immune responses has been difficult to assess. Now, **Sun *et al.*** (p. 729, published online 7 April; see the Perspective by **Tracey**) show that two of these neurons, which are located in chemosensory organs exposed to the environment, sense molecules related to disease or inflammation and regulate innate immunity via a pathway known as the unfolded protein response.

Remodeling Responses

The ability to measure responses of cellular signaling systems in single cells allows investigators to characterize the ways each cell optimizes responses to external cues. In studies on mitogen-activated protein kinase (MAPK) signaling in yeast cells, **Pelet *et al.*** (p. 732) discovered there was a linear relation between an osmotic stimulus and the amount of activated MAPK (in this case, Hog1) translocated to the nucleus and its retention time in the nucleus. Hog1 causes transcription of stress-response genes, but unlike the expected response of the kinase, gene activation was bimodal and varied even within the same cell. Further experiments and mathematical modeling showed that this variation corresponded to chromatin remodeling.

CREDIT: PAPADOPOULOU *ET AL.*

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