Virus Invasion

West Nile virus is spread through mosquitoes to birds, wildlife, and humans and has established itself at an astonishingly rapid rate since it was introduced to North America in 1999. How did the West Nile virus establish itself so successfully to the detriment of human and wildlife populations? **Kilpatrick** (p. 323) reviews the scenarios and dynamics that point to the key bird hosts and the relative predilections of the associated mosquito vectors to feed on a variety of animals, including humans.

Making Waves

Patterns of ocean chlorophyll variability from satellite observations have been attributed to oceanic Rossby waves—slow-moving features with wavelengths of hundreds of kilometers but with sea surface heights of only centimeters—that take months or years to cross ocean basins from the west to the east. **Chelton *et al.*** (p. 328, published online 15 September; see the Perspective by **McGillicuddy**) report that the cause of these chlorophyll anomalies has been misidentified. Analysis of 10 years of remotely observed sea surface height fields and concurrent observations of upper-ocean chlorophyll concentrations suggests that the dominant mechanism controlling the development of these anomalies is the horizontal advection of chlorophyll-rich surface water caused by the rotational motions of eddies.

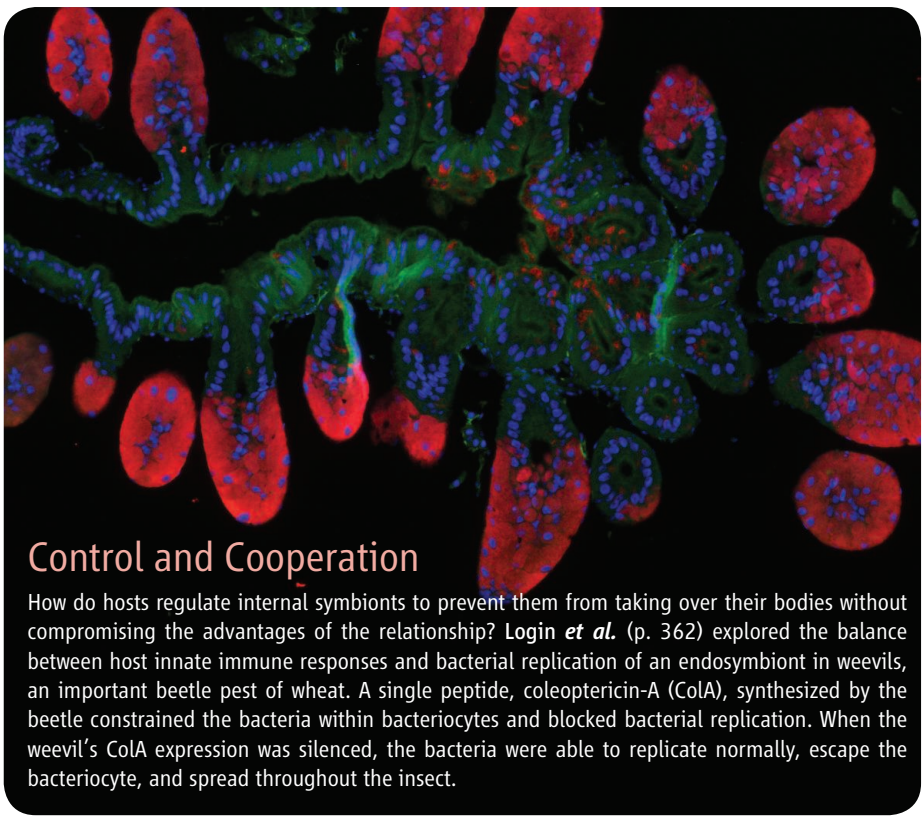
Nano-Heterojunction Self-Assembly

Nanoscale materials can now be synthesized by a wide range of methods, including self-assembly techniques. The junction regions between dissimilar materials often have unusual and desirable properties. **Zhang *et al.*** (p. 340) were able to extend the self-assembly toolbox to make heterojunctions of semiconducting nanotubular segments. The conjoined segments could transport electrical charge and also increase the lifetime of photogenerated charge carriers.

CREDITS (TOP TO BOTTOM): A. HEDDI AND S. BALMAND/BF2I LABORATORY; ZHANG *ET AL.*

Controlling Light

The behavior of light as it propagates through a material and from one material to another is very well understood in terms of classical optics. **Yu *et al.*** (p. 333, published online 1 September; see the cover; see the Perspective by **Engheta**) now demonstrate a powerful new method to control light propagation, based on introducing abrupt phase shifts along the optical path. These phase discontinuities are constructed using plasmonic interfaces that consist of an optically thin two-dimensional matrix of optical antennas with subwavelength separation. The flexibility of the technique should prove useful for developing a wide variety of small-footprint planar optical components.



Control and Cooperation

How do hosts regulate internal symbionts to prevent them from taking over their bodies without compromising the advantages of the relationship? **Login *et al.*** (p. 362) explored the balance between host innate immune responses and bacterial replication of an endosymbiont in weevils, an important beetle pest of wheat. A single peptide, coleoptericin-A (ColA), synthesized by the beetle constrained the bacteria within bacteriocytes and blocked bacterial replication. When the weevil's ColA expression was silenced, the bacteria were able to replicate normally, escape the bacteriocyte, and spread throughout the insect.

Whence the Water Vapor?

Water vapor has been detected in the inner regions of planet-forming disks—where terrestrial planets are created. Using the Heterodyne Instrument for the Far-Infrared on board the Herschel Space Observatory, **Hogerheijde *et al.*** (p. 338; see the Perspective by **Akeson**) now report the detection of water vapor over the full extent of the disk around the young star TW Hydrae. In the outer regions of this planet-forming disk, water vapor could only originate from icy grains. Thus, the result suggests the presence of a large reservoir of water ice in the region where comets and giant planets form.

When Cl and CH_4 Collide

The simplest class of two-body chemical reaction is the formation of a diatomic molecule. Two atoms come together and, generally speaking, the only variable is their relative velocity. Things get considerably more complicated if you add another atom to the mix and consider its reaction with a preformed diatomic. Now, there are relative spatial orientations, and the diatomic might be vibrating or rotating. Nonetheless, over the past half-century or so, chemists have developed a firm grasp of how these reactions work in detail. The next frontier will be to understand how an atom reacts with a polyatomic, which has many different ways of vibrating. **Czakó and Bowman** (p. 343) simulated the reactivity of methane with a chlorine atom, providing a theoretical basis for a multitude of pivotal experiments on this system.

Polar Connections

The climate records extracted from ice cores recovered from the Greenland Ice Sheet are detailed but relatively short in duration—around 120,000 years. Ice cores from Antarctica, on the other hand, have lower temporal resolution but extend back more than 800,000 years. In order to infer how Greenland's climate may have varied over a longer interval, **Barker *et al.*** (p. 347, published online 8 September) used the Antarctic temperature record, data from Chinese speleothems, and the concept of the bipolar seesaw to produce a well-dated reconstruction of inferred Greenland temperature variability. Abrupt shifts in Northern Hemisphere climate appear to have occurred throughout the Late Pleistocene, and glacial terminations may have been linked to oscillations of the bipolar seesaw.

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Hunting Mastodons

A mastodon skeleton containing an embedded projectile tip was discovered in the late 1970s near Manis, Washington. It was initially dated as about 14,000 years ago but the age, and whether the bone containing the projectile was directly associated with the rest of the skeleton, has been questioned. **Waters *et al.*** (p. 351) provide new dates on the fossils that confirm an age of about 14,000 years ago. The data, together with genetic analyses, show that the skeletal elements are related and also that the projectile was fashioned from a mastodon bone. This age predates the Clovis culture in North America and, along with other sites, shows early exploitation of megafauna.

Tumor Necrosis Factor Response

Engineers use information theory to analyze how noise influences information transfer, for example, in telephone systems. **Cheong *et al.*** (p. 354, published online 15 September; see the Perspective by **Thomas**) have now applied such analysis in biological experiments by monitoring the response of thousands of single mouse fibroblasts to stimulation with various doses of tumor necrosis factor (TNF). Signal transmission was surprisingly noisy, meaning that the cells could only really differentiate whether TNF was present or not. Such limitations of a single signaling pathway appear to be overcome by the cooperation of multiple signaling pathways in networks, or by groups of cells collectively averaging their response to the same signal.

Mitochondrial Division

Mitochondrial division regulates both the shape and the distribution of the mitochondrial network, which is important in maintaining cellular health. **Friedman *et al.*** (p. 358, published online 1 September; see the 14 October Perspective by **Rambold and Lippincott-Schwartz**) demonstrate that mitochondria in both yeast and mammalian cells are constricted and divide at positions where they form stable contact sites with the endoplasmic reticulum.

Not in the Genes

The mechanism, distribution, and function of DNA methylation in plant genomes have been characterized, but the stability of DNA methylation over multiple generations and the rate of change are less well understood. **Schmitz *et al.*** (p. 369, published online 15 September) determined the methylation status of several previously sequenced *Arabidopsis* lines, including three ancestral and five descendant lines separated by 30 generations. The frequency of DNA methylation changes was 5 orders of magnitude higher than genetic changes. Also, unlike genetic changes that were mostly random, DNA methylation changes occurred in hotspots.

Improving the Fit

Designing proteins for specific functions often relies on grafting functional groups onto existing protein scaffolds. Success has been limited because backbone remodeling, which might allow more complex grafting, has been computationally challenging. **Azoitei *et al.*** (p. 373) integrated computational design and directed evolution to enable the manipulation of protein backbone structure required for transplantation of the backbone and side chains of discontinous functional motifs. They grafted a two-segment HIV gp120 epitope that is targeted by the cross-neutralizing antibody b12, onto an unrelated scaffold. The final design showed high affinity and specificity for b12 and the complex structurally mimicked the gp120-b12 interaction.

Navigating with the Cerebellum

To navigate in space, animals use two strategies: landmark-assisted or map-navigation, which requires self-motion cues. Although the cerebellum is known to assist in the coordination of self-motion information, its role in spatial navigation is unclear. **Rochefort *et al.*** (p. 385) examined whether impairment of the cerebellum affects the spatial code in the hippocampus, using transgenic mice with a selective disruption of protein kinase C–dependent plasticity at parallel fiber–Purkinje cells synapses. Although landmark-assisted navigation was robust, when the mice had to rely on motion-generated cues—for example, in the dark—navigation suffered.

CREDIT: FRIEDMAN *ET AL.*