EDITORS' CHOICE

edited by Gilbert Chin

MICROBIOLOGY

Bacterial Promiscuity

An important factor in the evolution of bacteria is the ability to exchange DNA between different species by a variety of mechanisms, which holds profound implications for the development of antibiotic resistance. Majewski *et al.* have found that the ease of genetic exchange between individuals of the human pathogen *Streptococcus pneumoniae* and other strains and species depends on the relatedness, as measured by sequence divergence, of the DNA donor and the recipient. If the DNA strands attempting to recombine differ in sequence, two factors appear to act to hinder recombination: the bacterial DNA editing machinery—the mismatch repair system, which will remove an entire donor strand—plus a reluctance to form DNA heteroduplexes because of a scarcity of regions of sequence identity between the donor and recipient strands. Hence, sexual isolation and speciation can still be achieved in bacteria despite their promiscuity.

But worryingly, the mismatch repair system of *S. pneumoniae* appears to become overwhelmed by multiply mismatched DNA sequence. Related species could thus become important donors in the evolution of the *S. pneumoniae* genome and may pose a problem when the targets of drugs or vaccines are exposed to strong selective pressure, as summarized by Calverys *et al.* — CA

J. Bacteriol. **182**, 1016 (2000); *Mol. Microbiol.* **35**, 251 (2000).

MATERIALS SCIENCE

Polymer Parachutes and Necklaces

Surfactant vesicles can be used as nanoreactors for polymerization reactions and can serve as templates that direct the morphology of the polymer formed. This approach has been used to make closed spherical polymer structures as well as so-called "parachute-like" morphologies. One might expect that these morphologies would depend on the relative solubility of the monomers and polymers versus the surfactant, which would influence phase separation.

Jung *et al.* performed a systematic study of the factors that determine the final vesicle-polymer morphology using a wide variety of polymers and surfactants. Nanoscopic phase separation occurred for all common surfactant-polymer combinations, which suggests that phase separation occurs during polymerization. The final morphology did, however, depend on the chemical nature of the two components, and so guidelines for the synthesis of vesicle-polymer hybrid architectures can be developed. Novel architectures seen include "wrapped parachutes," in which a second vesicle surrounds an inner parachute-like structure, and necklace architectures, in which numerous polymer beads decorate the vesicle surface. — JU

Adv. Mater. **12**, 210 (2000).

GEOPHYSICS

Olivine Strains, Anisotropy Gains

Beneath the seemingly solid crust of Earth are complex flow patterns of rock in the mantle that can be observed by indirect seismic measurements of travel times and paths. Seismic anisotropy may occur when seismic waves propagate faster along paths that are parallel to the direction of a flow structure than along perpendicular paths. The most abundant magnesium- and iron-rich silicates in the mantle, such as olivine and its high-pressure polymorphs, flow by dislocation diffusion or creep over long time scales and under large strain rates.

Zhang *et al.* have conducted a series of laboratory experiments to determine how simple shear deformation of fine grained, polycrystalline olivine samples may alter assumptions about seismic anisotropy. At 1573 K and strains greater than 0.6, the olivine grains deformed by strain softening and dynamic recrystallization along one dominant slip direction. Along the slip direction, they measured a bimodal distribution of orientations for the recrystallized grains. About half were oriented parallel to the shear direction and half were oriented perpendicular to the maximum principal stress. The shear-directed grains would lead typically to faster seismic velocities along the flow direction, but the stress-directed grains would lead to faster seismic velocities at oblique angles to the flow direction. Indirect imaging of mantle structure may require a more complex correlation between seismic anisotropy and grain orientations and could lead to different images of large-scale flow in the mantle. — LR

Tectonophysics **316**, 133 (2000).

GEOCHEMISTRY

The Natural Lowdown on pH

Measurements of pH usually lie in the range of 0 to 14, and this scale normally covers variability in the laboratory and the natural world, where neutral pH is considered to fall in the middle of this scale. Solutions with negative pH are possible theoretically but beyond the range of most sensors and buffers.

Nordstrom *et al.* developed a pH sensor that operates under extremely acidic conditions and used it to identify water in the environment with a pH as low as –3.6. These low pH ground waters occur at Iron Mountain, California, in an abandoned mine that is now a Superfund site. The authors suggest that the interaction of ground water with pyrite (FeS_2) produces sulfuric acid and that evaporation in the hot mine environment further concentrates hydrogen ion. Such acidic waters have extremely high levels of dissolved metals and sulfate. — BH

Ultraacidic water at Iron Mountain

SOURCE: D.NORDSTROM, C. ALPERS, C. PTACEK, D. BLOWERS

Environ. Sci. Technol. **34**, 254 (2000).

MEDICINE

Profiles in Cancer Diagnosis

Current methods of cancer diagnosis may not reveal distinct subtypes of disease that have disparate clinical outcomes. Molecular oncologists have speculated that by comparing the gene expression profiles of tumors in the same diagnostic category, it might be possible to detect and classify these subtypes in a clinically

CONTINUED ON PAGE 935

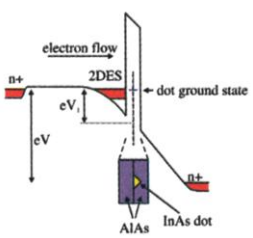
meaningful way. Work by Alizadeh *et al.* illustrates the power of this new diagnostic strategy and the utility of DNA microarray technology in cancer (www.ncbi.nlm.nih.gov/CGAP/). In a study of diffuse large B-cell lymphoma (DLBCL), these authors identified two disease subtypes that differed in their response to chemotherapy. Patients with DLBCL whose gene expression profile resembled that of germinal center B cells had a markedly better response than did those with a profile typical of activated B cells. These results bring the notion of "tailored" cancer therapy—treatment optimized for individual patients—a step closer to reality. — PAK

Nature **403**, 503 (2000).

PHYSICS

Tuning into Hidden Levels

Electrons confined to move in a plane form a two-dimensional electron system, or 2DES. Application of a magnetic field perpendicular to this plane causes the electrons to redistribute into degenerate quantized magnetic sublevels, or Landau levels (LLs), where they occupy a ladder of discrete energy levels. Those discrete levels below the Fermi level (E_F) are fully occupied, while those above the E_F are empty. It is the properties of these LLs—their width, separation and energy—that determine the electronic behavior of two-dimensional conductors. Most experiments, however, probe only those LLs that are made to pass through E_F and reveal little about the structure or dynamics of the levels below E_F. Main *et al.* show how to extract the properties of these hidden levels directly. They placed a quantum dot next to the 2DES and then tuned the energy level of the quantum dot so that resonant tunneling occurred with a "buried" LL. — ISO



Measuring Landau levels

Phys. Rev. Lett. **84**, 729 (2000).

ECOLOGY AND EVOLUTION

Pollination and Plant Populations

The highly specialized and coevolved relationships between flowers and their pollinators—morphological, physiological, and chemical—have fascinated biologists since Darwin. Most studies have concentrated on mechanisms of the interactions and the immediate selective benefits for the plant and animal partners; in the case of the plant, the currency measured generally has been pollen transferred or fruit and seed set.

Ultimately, as Herrera points out, the pollinator regime can only be regarded as selective if it affects progeny production under natural field conditions. To investigate this question, Herrera subjected a mediterranean dwarf shrub, *Lavandula latifolia*, to two experimental pollinator regimes, differing in the time of day that the flowers were exposed to pollinators. Different pollinators are prevalent at different times of day. Herrera found that flowers that were exposed to pollinators during the middle of the day had a significantly better chance of producing progeny that survived for three years than flowers exposed at the beginning and end of the day. These differences were mainly the result of a higher rate of seedling emergence from the former, which in turn resulted from the higher rate of outcrossing experienced by these flowers because they were visited by a higher proportion of bee and butterfly species. Differences in pollination regimes therefore had measurable demographic consequences. — AMS

Ecology **81**, 15 (2000).

Science's stke

Reciprocal Signaling Roles for STAT3 and SHP2

One subunit of the receptor for the cytokine interleukin-6 (IL-6) is gp130. Tyrosine phosphorylation of gp130 recruits both protein phosphatase 2 (SHP2) and signal transducer and activator 3 (STAT3). Ohtani *et al.* utilized knock-in technology to create mice deficient in only the gp130–mediated SHP2 pathway or the gp130–mediated STAT3 pathway to identify the functions of these two pathways. STAT3 signaling was required for embryonic development, whereas SHP2 signaling-deficient mice were viable and fertile. Reciprocal roles for signaling via STAT3 (positive) and SHP2 (negative) were found for cytokine production in T cells and immunoglobulin responses in B cells, consistent with the observation that eliminating the SHP2 pathway resulted in prolonged IL-6–induced STAT3 phosphorylation. — NG

Immunity **12**, 95 (2000).

CREDIT: P. MAIN, A. THORNTON, R. HILL, S. STODDART, T. IHN, L. EAVES, K. BENEDICT, M. HENINI.

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