EDITORS' CHOICE

edited by Gilbert Chin

A nest box for *Parus major* in *Malus domestica*.

ECOLOGY/EVOLUTION

Beneficial Birds and Bees

Agricultural intensification, urban sprawl, and deforestation are all examples of processes that are likely to lead to loss of ecosystem services: the material benefits that natural or seminatural landscapes provide for the human population. Yet the effects of these processes—and hence the economic values of the lost benefits—are often hard to quantify.

An example of such a service is the pollination of crop plants by native bees, leading to the production of fruit. Kremen *et al*. compared the efficacy of bee pollination of watermelon in intensive and organic farms in California, which varied in their proximity to bee habitat (woodland and chaparral). Only in the organic farms close to native habitat were full pollination services (in terms of maximized fruit production) achieved by native bees; in organic farms far from native habitat, and in all intensive farms, supplementary pollination by managed, introduced honeybees was necessary to improve fruit yields. Fruit production can also be enhanced by the presence of vertebrate predators of pest species. Mols and Visser found that simply constructing nest boxes for great tits in Netherlands apple orchards significantly increased fruit yield per tree. These results add to the evidence that conservation or promotion of natural biological diversity in an agricultural landscape can be economically advantageous. — AMS

Proc. Natl. Acad. Sci. U.S.A. 10.1073/pnas.262413599 (2002); *J. Appl. Ecol.* **39**, 888 (2002).

DEVELOPMENTAL BIOLOGY

Moving Laterally

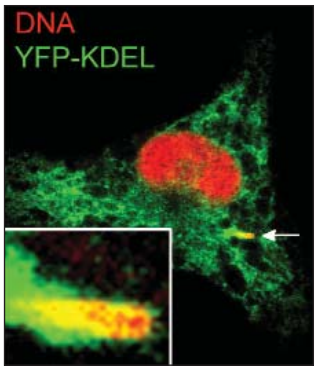
The lateral line of fishes is a sensory organ composed of neuromasts spread along the side of the fish; via the lateral line, the fish sense nearby movements and thus can detect predator and prey. The neuromasts originate from placodes in the head, from which precursors migrate in stereotypical patterns across the surface of the fish. David *et al.*, studying lateral line formation in the zebrafish, find that the path of travel is dictated by interactions between CXCR4b and SDF1a, homologs, respectively, of a receptor and ligand that are involved in lymphocyte migration. An SDF1a-demarcated pathway is laid down for the migrating lateral line primordium, whose successful navigation depends on expression of the receptor, CXCR4b. The growth cones of sensory neuron axons journey along with the migrating primordium and eventually form the nerve for the lateral line. Although SDF1a expression defines the path of migration, the direction of migration is likely defined by other factors. — PJH

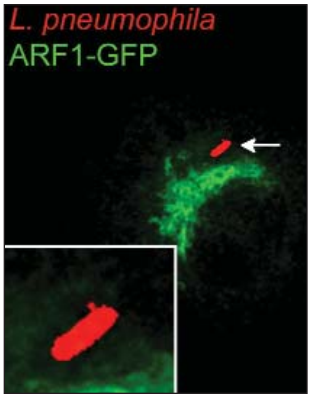
Proc. Natl. Acad. Sci. U.S.A. **99**, 16297 (2002).

MICROBIOLOGY

Detouring Membrane Traffic

The pathogen *Legionella pneumophila* invades macrophages and replicates intracellularly within specialized phagosomes: membrane-enclosed vacuoles. Usually, an entering phagosome would be directed to fuse with lysosomes, and its contents would be degraded by lysosomal digestive enzymes. How does internalized *Legionella* avoid this fate?





L. pneumophila **(arrows, red) become surrounded by ER-derived markers (left, green) but not by Golgi markers (right, green).**

Kagan and Roy examined membrane trafficking after internalization of *L. pneumophila* and found that, soon after their formation, the phagosomes intercept and fuse with early secretory vesicles and recruit proteins that were originally destined for the endoplasmic reticulum (ER). This sets up a privileged membrane compartment resistant to fusion with lysosomes and permits the development of an organelle for bacterial multiplication. — SMH

Nature Cell Biol. **4**, 945 (2002).

GEOPHYSICS

A Saltatory Itinerary

Plate tectonics drives the major plates (including the continents) over Earth at rates of several centimeters per year (or hundreds of kilometers per tens of millions of years). Reconstructions of these paths are based on inferring spreading across ocean basins and using paleomagnetic data to estimate the paleolatitudes of continents (because the inclination of Earth's predominantly polar magnetic field varies with latitude). Extensive and precisely dated magnetic records in continents allow for the compilation of an apparent polar wander path, which describes the motion of a plate or continent over time (essentially, the drift of the continent) over Earth. Such paths help in reconstructing continental geometry and in evaluating the assembly of continents; biologic evolution in response to geologic events; climate change; and, if many paths change abruptly, major changes in mantle dynamics.

Besse and Courtillot provide an update on the polar wander paths of many plates over the past 200 million years. Their analysis describes periods when mantle dynamics were relatively stable, and some episodes, such as during the Cretaceous,

CONTINUED ON PAGE 2287

when mantle flow became reorganized with respect to Earth's spin. However, they do not see evidence of episodes of rapid reorganization that have been proposed in some previous studies. — BH

J. Geophys. Res. **107**, 2300 (2002).

MOLECULAR BIOLOGY

A Tail of Two Cids

The discovery of how small RNA molecules (about 22 to 28 nucleotides in length) regulate gene expression (see Breakthrough of the Year, p. 2296) portends a renaissance of interest in this class of biopolymers. Genetic information encoded in DNA is first extracted by transcription into pre-messenger RNA (pre-mRNA), then exons are spliced together to produce a mature mRNA, which is exported from the nucleus into the cytoplasm. All of these processes are tightly regulated, yet recent results indicate that the cytoplasmic mRNA may be subject to another round of regulation that determines when that genetic information is finally converted into usable proteins.

Juge *et al.* show that *Drosophila* contain a single poly(A) polymerase, the enzyme responsible for polyadenylating mRNAs and rendering them competent for export and translation, that is present and active in both the nucleus and cytoplasm. A cytoplasmic surplus of this enzyme results in excessively long poly(A) tails and embryonic lethality, hinting at regulatory control of adenylation during development. Additional evidence for the connection between poly(A) tails and germline and embryonic development comes from Wang *et al.*, who find that the *Caenorhabditis* protein GLD-2 is the catalytic portion of a cytoplasmic poly(A) polymerase. They propose that its activity may be directed by interaction with RNA-binding recruiter proteins.

Fission yeast refrain from dividing until DNA replication is complete; hydroxyurea, a cancer therapeutic which inhibits synthesis of deoxyribonucleotides, activates the replication checkpoint. Saitoh *et al.* and Read *et al.* have identified cytoplasmic poly(A) polymerases (Cid1 and Cid13) as components of the cellular response that overcomes arrest at this checkpoint, suggesting a general involvement of these enzymes in eukaryotic processes. — GJC

EMBO J. **21**, 6603 (2002); *Nature* **419**, 312 (2002); *Cell* **109**, 563 (2002); *Proc. Natl. Acad. Sci. U.S.A.* **99**, 12079 (2002).

PHYSICS

Coupling Superconductivity and Magnetism

Superconductivity and the Kondo effect are two well-known and fairly well-understood examples of many-body systems. Both involve the interaction of electron spin, and the competition of their different coupling mechanisms has led to theoretical proposals for coupling superconductivity and magnetism. The superconductor provides a natural source of entangled electron pairs, and the repulsive interaction of localized spin in the Kondo effect spatially separates the pairs while keeping them entangled.

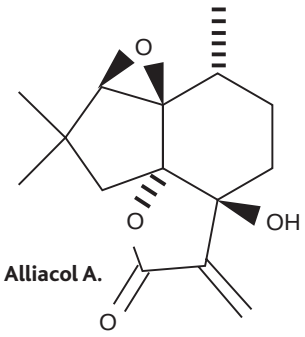
Buitelaar *et al.* connected a quantum dot to superconducting leads and show that changing the number of electrons on the dot from odd (Kondo regime) to even (non-Kondo regime) strongly affects the transport of the superconducting pairs through the dot. In particular, they show that relative strength between the Kondo correlation and the pairing strength of the superconducting pairs will be an important consideration if a source of nonlocal spin-entangled pairs is to be realized. — ISO

Phys. Rev. Lett. **89**, 256801 (2002).

CHEMISTRY

Switching Preferences

In designing organic reaction routes, synthetic chemists assess whether the groups on carbons atoms are nucleophilic (preferring to react at positively charged sites) or electrophilic (seeking out negative charge). In the closing of internal rings in molecules, a bond might be formed most conveniently between two carbon atoms that, inconveniently, bear groups with similar nucleophilicity. Mihelcic and Moeller use anodic electrochemisty to turn this liability into an asset by performing an umpolung reaction—a trick, used by some enzymes, that switches the polarity at a particular carbon atom. In their synthesis of the tricyclic alliacol A, the formation of a radical cation during the oxidation of an silylenol ether allowed its normally nucleophilic β-carbon atom to attack an electron-rich furan ring to form a six-membered ring in high yield (88%). The final ring was created via Friedel-Crafts alkylation. Unlike other electrochemical approaches, anodic oxidation could be executed with only a vitreous carbon anode and a 6-volt lantern battery. — PDS



Alliacol A.

CREDIT: MIHELCIC AND MOELLER, *J. AM. CHEM. SOC.* 10.1021/JA029064V

J. Am. Chem. Soc. 10.1021/ja029064v.

Moving Laterally

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