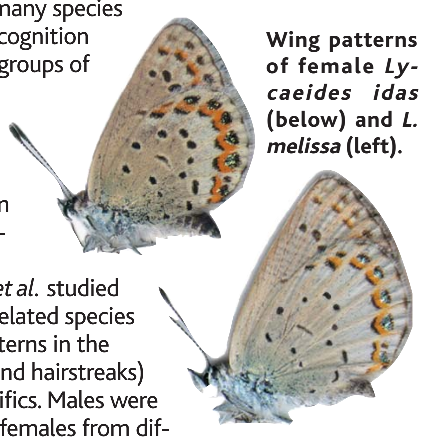
EDITORS' CHOICE

edited by Stella Hurtley

ECOLOGY/EVOLUTION

Butterfly Mate Recognition

In butterflies, the elaborate and colorful wing patterns have a number of functions, including warning signals to predators, camouflage, and thermoregulation. In many species they also serve as mate recognition signals. However, in some groups of butterflies the differences in wing pattern between species, or between populations within a species, are slight and subtle, and in such cases a mate recognition function has been thought unlikely. Fordyce *et al.* studied the ability of two closely related species with very similar wing patterns in the family Lycaenidae (blues and hairstreaks) to recognize their conspecifics. Males were presented with choices of females from different populations, including accurate computer-generated paper models of females to exclude the possibility of other cues such as pheromones. They preferred to initiate courtship with females or models having the conspecific wing pattern, indicating that even slight differences are distinguishable. Manipulation of the computer-generated models has the potential to suggest which elements of the wing pattern are most significant in mate recognition. — AMS



Wing patterns of female *Lycaeides idas* (below) and *L. melissa* (left).

J. Evol. Biol. **15**, 871 (2002).

DEVELOPMENT

Getting Your Left Right

Left-right asymmetry—whereby, for example, the heart is on the left side of the body with functionally distinct left and right chambers—is established very early in development. In the African toad *Xenopus*, and in chick embryos, Levin *et al.* now show that the H^+ and K^+ ATPase transporter is required in the formation of embryos with a normal left-right body axis. In fertilized *Xenopus* eggs, maternal transporter messenger RNA is symmetrically expressed; however, during the first two cell divisions of development it becomes localized. In chick embryos the transporter mRNAs are again symmetrically localized, but a difference in membrane potential is generated either side of the primitive streak. In both systems, interfering with transporter activity caused randomization of the expression pattern of asymmetrically expressed genes, resulting in opposite handedness in the organs and tissues produced later in development—including the heart, the gut, and the gall bladder. Thus, very early in development, differential ion fluxes generated by the H^+/K^+ ATPase are key to determining future left-right asymmetry. — SMH

Cell **111**, 77 (2002).

APPLIED PHYSICS

A New Low for Photonic Crystal Lasers

The development of integrated optical technology places strict demands on its components, including the ability to guide, modulate, and detect light efficiently. The ideal device would also have small volume and be compatible with current semiconductor technology processing. Photonic crystals, which contain arrays of periodically varying dielectric contrast that can be tuned to transmit particular wavelengths, are promising materials for meeting all of the above criteria. As a demonstration of their potential, Loncar *et al.* describe the fabrication and operation at room temperature of a high–quality factor, low-threshold photonic crystal laser etched into a slab of InGaAsP. With a spot size of just 3.9 square micrometers, lasing from the structure begins at just 220 microwatts of input light power, a threshold power significantly lower than other quantum well–based lasers. — ISO

Appl. Phys. Lett. **81**, 2680 (2002).

ATMOSPHERIC SCIENCE

Certainly Warmer

How much global warming occurs as a result of human additions of radiatively active agents like greenhouse gases and sulfate aerosols depends on how sensitive climate is to these species. "Climate sensitivity" is a measure of how much global average surface temperature can be expected to change in response to an increase in radiative forcing equivalent to that which would be produced by doubling the concentration of atmospheric CO_2 from pre-industrial levels (280 ppm). The best estimates of climate sensitivity suggest that its value lies between 1.5° and 4.5°C, but they do not generally include any information about how certain those bounds are. Gregory *et al.* use a model that includes observations of temperature changes in the ocean and the atmosphere to evaluate the probable lower bound of climate sensitivity, and find that there is a 95% chance that it is at least 1.6°C. Thus, unless greenhouse gas emissions are abated, substantial climate change will occur in response to warming during the next century. The large uncertainty in the amount of radiative forcing prevents the determination of an upper bound for climate sensitivity. — HJS

J. Clim. **15**, 3117 (2002).

GENETICS

RNAi and Fragile X

Fragile X syndrome is the most common form of inherited mental retardation and is generally caused by mutations in the fragile X mental retardation gene (FMR1). The FMR1 protein is thought to negatively regulate the translation of specific genes. Caudy *et al.* and Ishizuka *et al.* have now demonstrated that the homologous protein in *Drosophila*, dFMRP, is associated with a vital component of the RNA interference (RNAi) machinery, the RNA-induced silencing complex (RISC), as well as with ribosomal proteins and VIG (Vasa intronic gene). These results suggest that RISC might provide a link between RNAi-based and FMRP-based modes of post-transcriptional gene control or, more provocatively, that FMRP may play a role in RNAi, thereby implicating defects in RNAi in human disease. — GR

Genes Dev. **16**, 2491; 2497 (2002).

GEOPHYSICS

Dynamic Disappointment

Near-surface horizontal tectonics have shaped much of Earth's topography; many sedimentary basins, for instance, apparently stemmed from horizontal stretching of the lithosphere, followed by cooling, subsidence, and sedimentary infilling. However, some theoretical models have concluded

CONTINUED ON PAGE 499

CREDITS: FORDYCE *ET AL.*, *J. EVOL. BIOL.* **15**, 871 (2002)

CONTINUED FROM 497

that a substantial part of Earth's surface topography might be tied to density-driven flow in the mantle. For example, the subduction of cool, dense slabs in the mantle, viscously coupled to the overlying lithosphere, could "pull down" Earth's surface—by as much as 1 to 2 km. The possibility of such dynamic topography has profound implications for how we understand basin formation, but determining subsidence contribution in real sedimentary basins has been difficult.

Wheeler and White analyzed age, depth, and sedimentary thickness data from wells, seismic reflection profiles, and other sources over a wide area of Southeast Asia, where models have predicted some of the largest amplitudes of dynamic topography on Earth. The maximum basin depth that could potentially be explained by dynamic topography amounts to around 300 m, far less than the 1 to 2 km predicted by numerical models. — SW

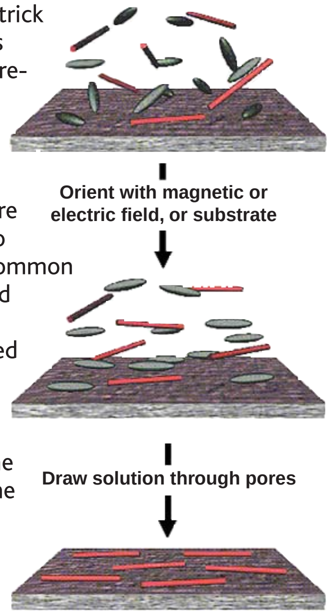
Tectonics 10.1029/2001TC900023 (2002).

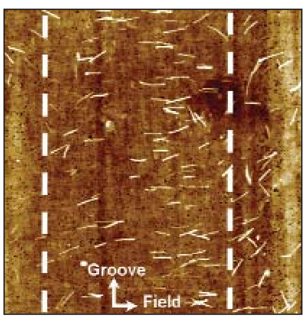
MATERIALS SCIENCE

Nanotubes in the Groove

Molecules in liquid crystalline materials can be aligned either by pretreatment of a substrate surface or by the subsequent application of an electric or magnetic field. Lynch and Patrick exploited this property to create well-oriented carbon nanotube (CNT) films. The CNTs were dissolved into one of two common nematic liquid crystals and then deposited onto prescratched polycarbonate membrane substrates. The liquid crystal molecules tended to align parallel to the grooves in the substrate, forcing the CNT to follow suit. By applying a mild vacuum, the liquid crystal was drawn out through the holes in the membrane, leaving behind either single or multilayered films as desired. Applying an electric field to part of the substrate could locally reorient some of the CNTs perpendicular to the direction of the grooves. This technique should make it easier to engineer nanotube-based devices or reinforcing layers without the need to grow oriented CNT in situ. — MSL

Nano Lett. 10.1021/nl025694j (2002).





Experimental setup (top) and resulting electric field alignment of the carbon nanotubes (bottom).

HIGHLIGHTED IN *SCIENCE*'S SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT

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Modeling Fine-Tuned Affinity

Using a combination of experimental analysis and mathematical modeling, Coombs *et al.* have investigated the fundamental molecular interactions by which the immune system reacts to peptide antigens. The critical interaction is that of peptide bound to major histocompatibility complex (pMHC) on the surface of antigen-presenting cells, which binds to T cell receptors (TCRs) on T lymphocytes. However, T cell activation requires that the affinity of this interaction be just right. If the TCR does not remain bound to pMHC long enough, activation is not completed. However, too high an affinity is not optimal because the system must respond to exceedingly small amounts of pathogen-derived molecules. pMHC molecules are thought to be amplified by serial interaction with multiple TCRs; thus, weaker binding can be advantageous to signaling. Modeling of pMHC-TCR interactions supports the concept of an ideal range of affinities for activation. Internalization of TCRs appears to require recognition of TCRs that have interacted with pMHC but have since dissociated, presumably producing biochemical changes in the TCR. Also, differences in cross-reactivity of naïve and mature T cells may be mediated by changes in amounts of intracellular signaling molecules that are available to interact with the TCR. — LBR

Nature Immunol. **3**, 926 (2002).

CREDITS: LYNCH & PATRICK *NANO LETT.* 10.1021/NL025694J (2002)

Science

Modeling Fine-Tuned Affinity

L. Bryan Ray

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