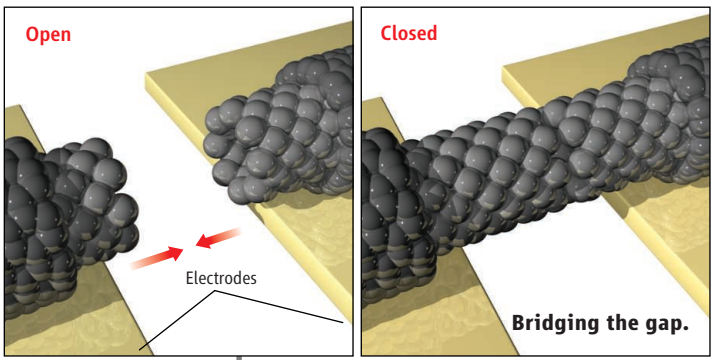


HIGHLIGHTS OF THE RECENT LITERATURE

MATERIALS SCIENCE

Tubular Switches

The mechanical strength and resilience of carbon nanotubes (CNTs) have prompted investigations of their use in applications ranging from fibers to molecular switches. A less commonly exploited property is the unusually low sliding friction characterizing the relative motion of the concentric hollow cylinders that make up double- or multiwalled CNTs—an action analogous to the extension or contraction of a collapsible spyglass.

Deshpande *et al*. have taken advantage of this property in fabricating nanotube-based voltage-gated switches. First, they mounted low-resistance (10 to 20 kilohms) CNTs on gold leads over a silicon gate region. Application of a 4.5-V bias across the leads cleaved the tubes in two, leaving an insulating gap of 5 to 20 nm in the middle and thereby creating an "off" state. Subsequent application of a higher bias (5 to 10 V) reestablished electrical contact, creating a conductive "on" state. The authors attributed this behavior to a charge-induced sliding of the inner tubes through the outer shells and across the gap, an explanation supported by the observation that the outer shells remained rigidly fixed to the leads. For double-walled CNTs, successive application of a 9-V bias across the leads and a 110-V gate potential cycled the device between on and off states. — PDS

Nano Lett. **6**, 10.1021/nl052513f (2006).

CELL BIOLOGY

Easing the Way Out

During animal development, proteins of the Wnt family act as morphogens, establishing gradients of molecules that control gene expression and cell fate. Many players in the Wnt signaling pathway have been identified in a variety of animal systems, including the morphogen itself and its cognate receptor, and also the many downstream components. Bänziger *et al.* and Bartscherer *et al*. have independently identified a new player in the pathway, respectively calling it *wntless* (*wls*) or *evenness interrupted* (*evi*). Wls/Evi is a conserved multipass transmembrane protein specifically found in Wnt-secreting cells, and it appears to promote the secretion of Wnt proteins in *Drosophila*, *C. elegans,* and humans. Wnt signaling relies on a functional interaction with Wls/Evi in the secretory pathway, which may involve the regulation of intracellular trafficking or covalent modification of Wnt. — SMH

Cell **125**, 509; 523 (2006).

APPLIED PHYSICS

A Liquid Mirror

Beyond the capacity to amuse carnival patrons, deformed mirrors can be highly useful in the field of adaptive optics. As light travels through the atmosphere, variations in temperature, density, and refractive index distort the optical wavefront. The cumulative effect of these distortions is a blurring of the image when, for example, the light is collected in the viewfinder of a telescope. If the extent of the wavefront distortion is measured, which can be done with the aid of an artificial guide star created using a laser beam, an adaptively deformable mirror can be tuned to iron out the distortions and restore the image clarity.

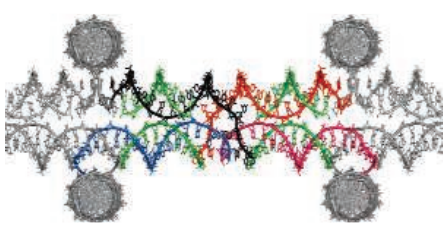
Vuelban *et al.* describe such a mirror, with a design based on electrocapillary actuation. A reflective membrane is placed atop a viscous dielectric liquid, which in turn floats above an aqueous electrolyte solution in a two-dimensional array of ~350-μm-diameter microchannels. The liquid levels in each microchannel can be independently adjusted by application of a voltage, thereby inducing precise local deformations in the mirror surface above. An advantage of the liquid system is the large dynamic range of inducible deformation. The authors demonstrate a prototype device with an ~2-ms response time. — ISO

Opt. Lett. **31**, 1717 (2006).

BIOTECHNOLOGY

It's Easy Being Green

Porous solids are widely used in chromatographic separations based on size and shape. Some pores are as large as proteins (for instance, in dextran- or agarose-based gel filtration), whereas others are as small as water molecules (as in molecular sieves used to keep organic solvents dry). Paukstelis has assessed the permeation properties of a self-assembled three-dimensional lattice constructed from four assembly strands [each 24 nucleotides (nt) long] and an 11-nt spacer strand. The estimated diameter of the largest internal solvent channel in crystals of this DNA array was 9 nm, which corresponds to a globular protein of 300 kD, but the measured size cutoff for negatively charged proteins appeared to be only one-10th this size (ovalbumin, no; carbonic anhydrase, yes), perhaps as a result of electrostatic interactions. Confocal microscopy revealed that the interior of a crystal soaked in a mixture of green fluorescent protein and a much bigger red maltose-binding protein was green and not red. — GJC



Model of DNA lattice showing spacer (green) and assembly (black, red, blue, and orange) strands.

J. Am. Chem. Soc. **128**, 10.1021/ja061322r (2006).

VIROLOGY

A Most Discerning Host

Viruses can inadvertently announce their presence by displaying tell-tale patterns—often in the form of their own double-stranded (ds) RNA—and hosts have evolved a panoply of

Continued on page 1109

CREDITS (TOP TO BOTTOM): C. BICKEL/*SCIENCE*; PAUKSTELIS *ET AL*., *J. AM. CHEM. SOC.* **128**, 10.1021/JA061322R (2006)

Continued from page 1107

intracellular factors to detect and decode these signals and to set in motion a cascade of antiviral responses. Recently two pattern recognition receptors, RIG-1 and MDA-5, were found to act as RNA helicases and signaling adaptor proteins.

Kato *et al.* and Gitlin *et al.* show that RIG-1 and MDA-5 are distinct in their tastes for viral dsRNAs. Thus, mice lacking the *MDA5* gene lost the ability to generate a type I interferon response to the dsRNA analog polyinosinic acid:polycytidylic acid [poly(I):poly(C)] and were more susceptible to infection with picornavirus. Kato *et al.* further compared this *MDA5*-dependent response with what happened in mice deficient in *RIG-1* and found a requirement for *RIG-1* in generating immunity to other dsRNA viruses, such as influenza and paramyxoviruses. With further antiviral dsRNA detectors likely to be discovered in mice and humans, elucidating the conformational or other features of dsRNA species important for selective pattern recognition would seem a useful avenue in the study of viral pathogenesis. — SJS

Nature **441**, 101 (2006); *Proc. Natl. Acad. Sci. U.S.A.* **103**, 10.1073/pnas.0603082103 (2006).

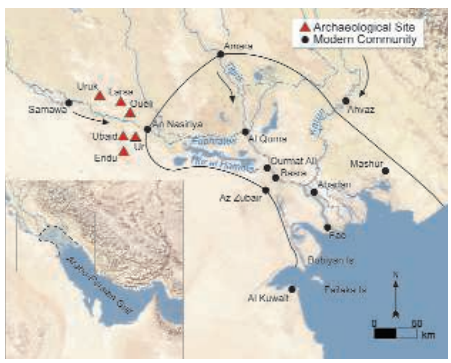
ARCHAEOLOGY

Did Climate Rock the Cradle?

The earliest cities and centralized state-level societies arose in Mesopotamia between 8000 and 5000 years ago. Anthropological archaeologists have long sought to uncover the factors underlying the Mesopotamian region's singular place in history as the cradle of civilization. In general, studies have focused on such contributing influences as technological and agricultural innovation, the rise of bureaucracy and political hierarchies, increased trade, and religious or military pressures. Fewer studies have examined the significance of environmental influences, such as climate patterns and shoreline movements due to shifting sea level.

Kennett and Kennett compare local climatic and geographical changes with concurrent societal developments in specific regions of the Persian Gulf between 15,000 and 6000 years ago. They suggest that early development was shaped by the formation of productive estuaries, the availability of ample fresh water, and the ability to transport goods over water. They also discuss the potential role of climate—particularly the increase in aridity between 6000 and 5000 years ago—in fostering the consolidation of settlements. Thus, they argue that the emergence of highly organized urban society was at least in part a consequence of the glacial-interglacial cycle and related climate changes. — HJS

J. Island Coastal Archaeol. **1**, 67 (2006).



Mesopotamia, then and now (the coastline as it was 6000 years ago is outlined in black).

CREDIT: JACOB BARTRUFF, UNIVERSITY OF OREGON

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<< The GABA Defense

During infection of plants by *Agrobacterium tumefaciens*, plants are wounded and then a tumor is induced, which becomes a source of opines: chemicals that stimulate the production of the quorum-sensing (QS) signal *N*-(3-oxooctanoyl) homoserine lactone (OC8-HSL). γ-aminobutyric acid (GABA) is produced by plants as part of the response to wounding. Chevrot *et al*. show that GABA stimulates expression of the *attKLM* operon in *A. tumefaciens*, which produces a lactonase that opens the ring and inactivates OC8-HSL. Consequently, OC8-HSL was undetectable in cultures of *A. tumefaciens* exposed to GABA. Proteins encoded by the *attKLM* operon were identified in a screen for proteins synthesized in response to the addition of GABA to cultures of *A. tumefaciens*. The induction of the *attKLM* operon was also monitored using a reporter assay, and in *A. tumefaciens* deficient for the GABA transporter system, GABA did not induce the reporter. The importance of GABA for the plant response was verified using transgenic tobacco plants that expressed a glutamate decarboxylase (GAD, the enzyme that makes GABA from glutamate) that was not inhibited by Ca^{2+}/calmodulin (GADΔC). Compared with wild-type tobacco, the plants with the GADΔC mutant developed less severe disease symptoms in two different virulence assays. Thus, GABA appears to serve as a communication signal between the plant and the pathogen. — NRG

Proc. Natl. Acad. Sci. U.S.A. **103**, 7460 (2006).

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