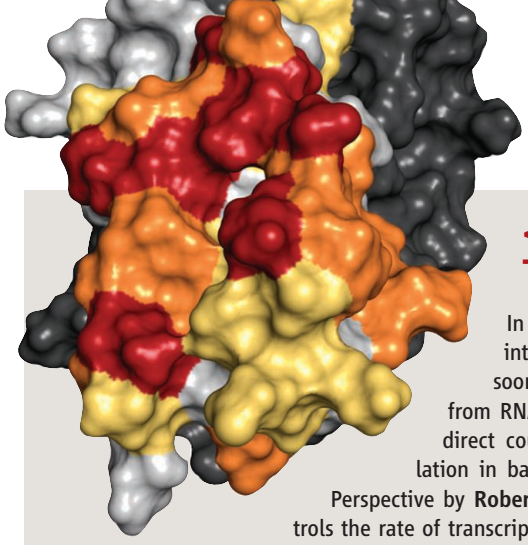


<< Transcription and Translation in Train

In bacteria, translation of messenger RNA into proteins by the ribosome usually begins soon after the ribosome binding site emerges from RNA polymerase. Now there is evidence for direct coupling between transcription and translation in bacteria. **Proshkin et al.** (p. 504; see the Perspective by **Roberts**) show that the trailing ribosome controls the rate of transcription by preventing RNA polymerase from spontaneous backtracking, which allows precise adjustment of transcriptional yield to translational needs under various growth conditions. **Burmann et al.** (p. 501; see the Perspective by **Roberts**) provide a potential mechanism for coupling by showing that the transcription factor NusG, which binds RNA polymerase through its amino-terminal domain, competitively binds either a ribosomal protein or the Rho transcription termination factor through its carboxy-terminal domain. Rho binding might occur after release of the ribosome from messenger RNA, thus linking termination of transcription and translation.

Triangulating to Mechanism

Cellular uptake and release of a variety of substrates are mediated by secondary transporters, but no crystal structures are known for all three fundamental states of the transport cycle, which has limited explanations for their proposed mechanisms. **Shimamura *et al.*** (p. 470) report a 3.8-angstrom structure of the inward-facing conformation of the bacterial sodium-benzylhydantoin transport protein, Mhp1, complementing the other two available structures. Molecular modeling for the interconversions of these structures shows a simple rigid body rotation of four helices relative to the rest of the structure in which the protein switches reversibly from outward- to inward-facing.

Breaking Convention

The defining characteristics of a superconductor are symmetry of gap function, which tells us something about how pairs of electrons move through the sample, and the strength of that pairing. Together, this information gives us the highest temperature to which the superconductor can remain superconducting. In conventional superconductors the gap function is symmetric, or s-wave, and tends to have low transition temperatures. The newly discovered iron-based superconductors also have *s*-wave symmetry, but the rather high transition temperatures, in addition to other properties, indicate that they are not conventional. **Hanaguri *et al.*** (p 474; see the Perspective by **Hoffman**) use scanning tunneling microscopy to provide direct experimental confirmation of the unconventional *s*-wave pairing of the superconducting carriers in these materials.

Microcapacitors for Manufacture

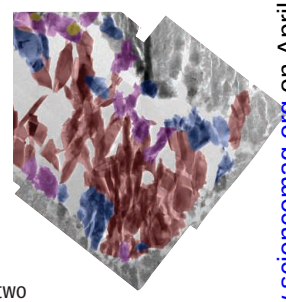
Capacitors can store small amounts of charge, and as they can charge and discharge quickly, they work well with batteries for recovering power, such as in regenerative braking in hybrid cars. For very small power requirements, capacitors have not been competitive with microbatteries, but using monolithic carbon films to store the charge, **Chmiola *et al.*** (p. 480) demonstrate the feasibility of such applications. The small pores in the carbon films are sufficiently large to allow electrolyte transport and can be made using a processing technique compatible with current chip manufacturing. Such microcapacitors can thus be integrated with electronics to make autonomous sensors or implantable devices.

Nanosynthesis Without a Twist

The synthesis of many nanoscale materials occurs under conditions of changing saturation because generation of product decreases the concentration of reactants. **Morin *et al.*** (p. 476) used a flow reactor to maintain conditions of low supersaturation during the growth of zinc oxide nanotubes and nanowires. Under these conditions, growth of the tubes was controlled by the release of stress, which prevented the torquing of the crystals along their axis. Since growth at different saturation conditions matched predictions, this looks like a promising method to develop rational and controlled synthesis of nanomaterials at large scale and low cost.

Sun Stuff

Comets are thought to be remnants of the Sun's protoplanetary disk; hence, they hold important clues to the processes that originated the solar system. **Matzel *et al.*** (p. 483, published online 25 February) present Al-Mg isotope data on a refractory particle recovered from comet Wild 2 by the NASA Stardust mission. The lack of evidence for the extinct radiogenic isotope ^{26}Al implies that this particle crystallized 1.7 million years after the formation of the oldest solar system solids. This observation, in turn, requires that material formed near the Sun was transported to the outer reaches of the solar system and incorporated into comets over a period of at least two million years.



Of Monsoons and Megadroughts

The Asian monsoon is the weather system that has the greatest effect on the greatest number of people in the world. Naturally then, knowing better how climate change might affect the monsoon is tremendously important. One obstacle that prevents a better understanding of future behavior is a poor knowledge of its past. **Cook *et al.*** (p. 486; see the Perspective by **Wahl and Morrill**) help to fill this gap with a 700-year reconstruction of the monsoon from tree-ring data obtained throughout Asia. The reconstruction chronicles monsoon failures and megadroughts, as well as patterns of precipitation, and can thus be compared with other relevant climate records to allow links with sea-surface temperatures to be better understood.

Separated About Lift

The uplift history of the Andes of South America is a contentious issue, with the two main hypotheses polarizing from rapid growth between

Continued on page 404

CREDITS (TOP TO BOTTOM): BURMANN *ET AL.*; MATZEL *ET AL.*

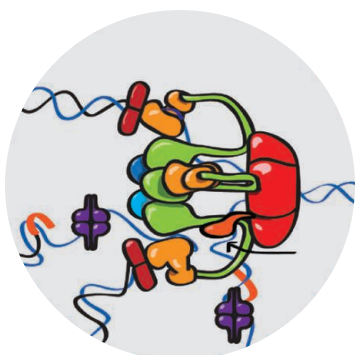
Continued from page 403

roughly 10 and 7 million years ago to more gradual elevation over most of the past 40 million years. The oxygen isotopic composition of soil carbonates has been used as a proxy for altitude and to measure the timing of uplift. **Poulsen *et al.*** (p. 490, published online 1 April) applied a global atmospheric general circulation model to show that the oxygen isotopic composition changes seen in carbonates formed in the late Miocene were driven more by changes in the amount of precipitation than by the altitude at which the precipitation forms. Consequently, it seems that oxygen isotopes are not a reliable paleoaltimeter, and Andean uplift may not have been as precipitate as thought.

A Little Selection for a Lot of Rarity

Studies on how selection works have tended to focus on the effect of a single trait. This necessarily means that rare alleles that can be acted on by selection appear to experience high levels of frequency-dependence selection. However, selection may act on multiple traits at any one time. **Doebeli and Ispolatov** (p. 494) present a theoretical framework examining how multiple rare traits can persist and potentially drive speciation. The authors show that only low levels of frequency-dependent selection are needed to explain the observed high levels of allelic diversity in nature.

Forking Replisomes



Replisomes are multiprotein machines that replicate DNA. Significant insight into how they work comes from in vitro studies, but how replisomes are organized in living cells has remained unclear. **Reyes-Lamothe *et al.*** (p. 498) have watched the replisome in living *Escherichia coli* cells using single-molecule fluorescence spectroscopy with millisecond time resolution. Cells expressing fluorescent derivatives of 10 different replisome components revealed both the stoichiometry and spatial distribution of the components at active replication forks in *Escherichia coli*. A similar technique could be used to study other molecular machines as they function.

HIV and *Salmonella*

HIV-positive individuals who are infected with nontyphoidal strains of *Salmonella enterica* often succumb to high morbidity and mortality. Why this is the case is unknown. **MacLennan *et al.*** (p. 508; see the Perspective by **Moir and Fauci**) have uncovered a dysregulated antibody response to *Salmonella* that is the likely culprit. Sera from HIV- infected individuals do a poor job of killing *S.* Typhimurium, despite surprisingly elevated antibody titers. Experiments showed that HIV-infected serum inhibited the power of normal serum to kill *Salmonella.* Inhibition was specific to antibodies against lipopolysaccharide (LPS), a component of the cell wall of *Salmonella*. Hence, HIV-infected sera was able to kill *Salmonella* strains lacking LPS, and removing LPS immunoglobulin G from infected sera permitted *Salmonella* killing. Thus, not only does HIV cause defects in cell-mediated immunity but it also seems to impair humoral immunity, with severe consequences for multiple infections.

Reading Influences and Achievement

When it comes to learning to read, children are immersed in a variety of influences. Debate rages over what aspects are affected and what importance to attribute to genetic influences, the effect of good teaching, the tools used, the family environment, and so on. **Taylor et al.** (p. 512) analyzed reading achievement from kindergarten through to fifth grade in mono- and dizygotic twins from a diverse population. The results show that better teachers allow children to fulfill their genetic potential.

CREDIT: REYES-LAMOTHE *ET AL.*