EDITORS' CHOICE

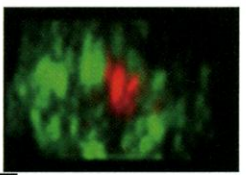
edited by Gilbert Chin

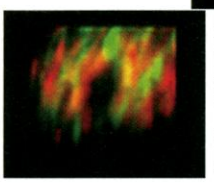
IMMUNOLOGY

Extending the T Cell Connection

The supramolecular activation cluster (SMAC) forms at the point of contact between a T cell and an antigen-presenting cell (APC). The term "immune synapse" has provided a useful analogy by which to describe the SMAC in CD4 T cells, although it has not been clear whether this terminology could reasonably be extended to other types of T cells.

Using three-dimensional digital microscopy, Potter *et al.* observed that SMAC formation also occurs in CD8 T cells and that, as with their CD4 counterparts, this requires a sufficient concentration of specific antigen displayed by the APC. In CD8 and CD4 T cells, SMACs were organized similarly, exhibiting central and peripheral domains containing signaling and adhesion proteins, such as protein kinase C and the integrin LFA-1, respectively. However, CD8 T cells appeared to differ from CD4 T cells in that engagement of the CD8 coreceptor presented an obligatory step in SMAC formation. Extension of the immune synapse model to CD8 T cells may help to unravel the programs of activation followed by these cells. — SJS





Protein kinase C (red, upper) localizes to the center while LFA-1 (green) and talin (red, lower) occupy the periphery.

Proc. Natl. Acad. Sci. U.S.A. **98**, 12624 (2001).

GEOPHYSICS

Assessing a Repository

Soon, a decision will be made by the U.S. Secretary of Energy on whether to recommend Yucca Mountain in Nevada as the site for storage of high-level radioactive waste. The waste would be stored in what is known as the saturated zone at Yucca Mountain. Here, water from rain and snow percolate downward to the water table, traveling along fractures in the rocks through the mountain and the repository level, which is now (and likely has been for hundreds of thousands of years) at least 200 meters above the water table. A major concern about the suitability of the site has been the possibility that waste might be mobilized or released by interaction with this percolating water over thousands of years. Flint *et al.* provide a timely overview of recent work on the unsaturated zone hydrology of Yucca Mountain, including an evaluation of the amount, distribution, and flow of water; they also examine modeling efforts aimed at assessing the overall hydrology and, ultimately, at predicting future outcomes should the climate change. — BH

Rev. Geophys. **39**, 447 (2001).

CHEMISTRY

Guest in a Green Solvent

Hydrocarbon solvents are used widely in the chemical industry for cleaning and coating and for reaction and separation processes. Environmentally friendly chemical synthesis uses alternative solvents such as ionic liquids, water, and liquid and supercritical carbon dioxide ($scCO_2$). The last is particularly attractive because CO_2 is inexpensive and environmentally benign (except as a greenhouse gas). Furthermore, changing the density of $scCO_2$ alters its effectiveness as a solvent, and this can be used to control reaction rates and yields.

Unfortunately, many reactants and catalysts do not dissolve readily in $scCO_2$. Several approaches have been used to overcome this problem. For example, surfactants have been designed that enhance the solubilizing properties of $scCO_2$, and microemulsions of water and $scCO_2$ have been used. Now, Yeung *et al.* show that Pd nanoparticles encapsulated within poly(propylene imine) dendrimers will catalyze chemical reactions in $scCO_2$. In two reactions, the catalyst produced high yield and selectivity with little degradation. — JU

Chem. Comm. **2001**, 2290 (2001).

BIOTECHNOLOGY

Large-Scale Growth

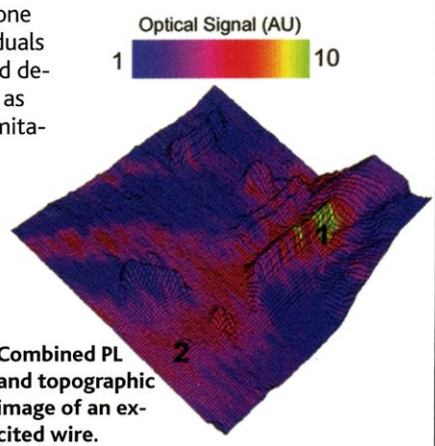
Since the derivation of human embryonic stem (ES) cells, there has been enormous scientific and political interest in the stem cell arena, with expectations that these cells may one day be used to treat individuals with spinal cord injuries and degenerative conditions such as Parkinson's disease. One limitation to growing these cells is that they require a layer of mouse embryonic fibroblast (MEF) feeder cells, which apparently promote maintenance of human ES cells in an undifferentiated state. Xu *et al.* show that human ES cells can be grown under feeder-free conditions as long as matrix proteins—Matrigel or laminin—are included in MEF-conditioned medium. These cells express the same factors as ES cells grown on MEF feeder cells. Furthermore, they have a normal karyotype, stable growth rate, and high telomerase activity and are able to differentiate into cells from all three germ layers. — BAP

Nature Biotechnol. **19**, 971 (2001).

APPLIED PHYSICS

Single-Wire Light Source

Clusters of oriented zinc oxide nanowires have been shown to exhibit ultraviolet lasing when excited by an optical source, but an open question is whether the same activity can be observed in single nanowires. Using near-field scanning optical microscopy to characterize the topography and photoluminescence (PL) of individual nanowires, Johnson *et al.* show that although many of the nanowires exhibit only enhanced emission and act as waveguides, the lack of lasing may be ascribed to chemical or mechanical damage during the dispersal process. However, for some well-isolated nanowires, narrowing of the emission spectra was observed. Although only a few of the nanowires showed this behavior and the threshold intensity to induce PL was higher than that required for arrays of wires, these results suggest that lasing does indeed origi-



Combined PL and topographic image of an excited wire.

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SOURCE: (LEFT) POTTER *ET AL., PROC. NATL. ACAD. SCI. U.S.A.* **98**, 12624 (2001); (RIGHT) JOHNSON *ET AL., J. PHYS. CHEM. B.*, 10.1021/JP012304T

nate from individual nanowires. Such nanoscale light sources may be expected to be critical components of microdevices and optical computing and data storage. — MSL

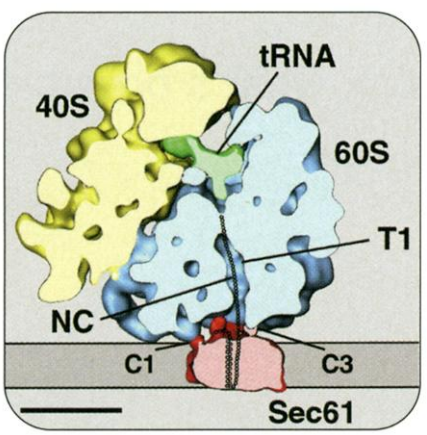
J. Phys. Chem. B., 10.1021/jp012304t.

BIOCHEMISTRY

Entering the ER

Atomic-resolution structures of prokaryotic ribosomes have added to our understanding of protein biosynthesis, but less structural information is available for eukaryotic ribosomes. Some eukaryotic proteins are inserted into or translocated across the endoplasmic reticulum (ER) membrane during translation. To accomplish this, the ribosome binds to a protein-conducting channel (PCC), which contains the heterotrimeric protein Sec61.

Spahn *et al.* present a cryoelectron microscopy reconstruction of the yeast 80S ribosome, which in comparison to the bacterial structure is homologous in core regions with expansion segments at surface sites. Beckmann *et al.* describe a translating yeast ribosome with the PCC bound at the outlet of a tunnel that conducts the nascent polypeptide. The diameter of the PCC is consistent with a complex of three Sec61 trimers, and Sec61 is connected to the ribosome by four contacts with ribosomal RNA and proteins. Surprisingly, the PCC shows an indentation instead of a central pore. Interaction with the signal sequence may not be sufficient to induce an open channel conformation, and the channel itself may act as a seal to prevent ion leakage across the ER membrane. — VV



Cross-section through the ribosome-Sec61 complex; scale bar, 10 nm.

Cell **107**, 361; 373 (2001).

ECOLOGY/EVOLUTION

Modeling Muskrat and Mink

Populations of predators and their prey often show cyclic fluctuations in density, especially in northern latitudes. In many cases, the cycles of predator and prey are synchronous, and the search for mechanisms driving the cycles has been an abiding quest for ecologists. In some predator-prey pairs, the strength of the synchrony and the phase coupling of cycles vary geographically, and such variation allows ecologists to tease apart the underlying causes of the population cycles.

Haydon *et al.* model time-series data from Hudson Bay Company fur-trapping records for muskrat and their principal predator, mink, across Canada. The population dynamics of the two species show very similar geographical patterns, becoming increasingly coupled and synchronized from west to east. The causes of these patterns appear to be a combination of climate and topography, with the signature of the North Atlantic Oscillation more pronounced in eastern and central Canada than in the mountainous west. — AMS

Proc. Natl. Acad. Sci. U.S.A., 10.1073/pnas.221275198.

CLIMATOLOGY

Hotter Than Ever

"Climate sensitivity" is a parameter used by climatologists to specify the increase in average global surface temperature in degrees celsius as a consequence of doubling the concentration of atmospheric carbon dioxide. This value is difficult to calculate, though, because there are large uncertainties in the responses of clouds and water vapor to the resulting warming, and in how those responses would modify Earth's radiation balance. The Intergovernmental Panel on Climate Change range of likely values for climate sensitivity is 1.4 to 5.8°C, although the full range varies from 0.1 to 10.0°C, and the derivations of these estimates make it hard to assign probabilities.

In order to construct a probabilistic estimate for climate sensitivity, Andronova and Schlesinger analyze 16 different radiative-forcing scenarios with a simple climate model using, in each case, a doubling of carbon dioxide, but with various combinations of additional factors such as tropospheric ozone, anthropogenic sulfate aerosol, the Sun, and volcanoes. They find that natural climate variability and uncertainties in the estimates of radiative forcing make 1.0 to 9.3°C the 90% confidence interval for climate sensitivity, implying that there is a roughly even chance that the best estimate lies outside the commonly accepted range. — HJS

J. Geophys. Res. **106**, 22605 (2001).