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The cell surface landscape is richly decorated with oligosaccharides anchored to proteins or lipids within the plasma membrane. Cell surface oligosaccharides mediate the interactions of cells with each other and with extracellular matrix components. The important roles that carbohydrates play in biology and medicine have stimulated a rapid expansion of the field of glycobiology, the focus of the special section in this issue. [Illustration: Cameron Slayden]



**2381** Still on the rebound



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#### **SCIENCE EXPRESS**

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Direct Detection of Galactic Halo Dark Matter B. R. Oppenheimer, N. C. Hambly, A. P. Digby, S. T. Hodgkin, D. Saumon

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#### Observation of Vortex Lattices in Bose-Einstein Condensates J. R. Abo-Shaeer,

C. Raman, J. M. Vogels, W. Ketterle
 2301 Large and ordered vortex lattices are obtained in a rotating Bose-Einstein condensate.

A Bose-Einstein Condensate of Metastable Atoms A. Robert, O. Sirjean, A. Browaeys, ▼ J. Poupard, S. Nowak, D. Boiron, C. I. Westbrook, A. Aspect

2301 Spin polarization is used to suppress inelastic collisions in an ultracold cloud of metastable helium, forming a Bose-Einstein condensate.

### **TECHNICAL COMMENTS**

#### Noble Gases in Mantle Plumes

Drawing on experiments that showed, in mantle and plume-derived rocks, neon isotope ratios indistinguishable from those of meteorites, Trieloff et al. (Reports, 12 May 2000, p. 1036) argued that Earth's solar-type rare gas inventory likely was acquired "during accretion from small planetesimals previously irradiated by solar wind" rather than directly from the solar nebula. Ballentine et al. suggest that the signal found by Trieloff et al. may reflect limitations of the ball mill crushing technique they employed, as other release techniques have revealed higher neon isotope ratios, and that the data reported by Trieloff et al. do not show an expected correlation with argon isotope data. Trieloff et al. respond that the high neon isotope ratios cited by Ballentine et al. represent "the high-value tail of a statistical distribution," the Gaussian center of which agrees well with their reported value, and that the argon isotope data can be reconciled with their neon data when all available popping rock data are considered.

The full text of these comments can be seen at www.sciencemag.org/cgi/content/full/291/5512/2269a

SPECIAL FEATURES www.sciencemag.org/feature/data/carbohydrates.shl Carbohydrate Chemistry and Glycobiology: A Web Tour

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Review: Intracellular Signaling by the Killer Immunoglobulin-Like Receptors (KIR) and Ly49 D.W. McVicar and D.N. Burshtyn

Understanding the pathways that allow the immune system to recognize self.

### science's next wave

#### Canada: Picking Stocks C. Boulakia

In our "Financial Planning for Scientists" column, we explore some common methods for evaluating and picking stocks that should work no matter what the markets are doing.

#### US: A Match Made in Heaven M. Sincell

In this month's "Survive and Thrive," find out how to identify the perfect Ph.D. advisor-do your research and trust your instincts.

#### UK: Kingdom Come K. Urquhart

An interview with the U.K.'s new Chief Scientific Adviser, Professor David King, who talks salaries and offers advice for early caree scientists.

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Chemistry: This ad supplement discusses several career opportunities for chemists and perspectives on "ideal" candidates from several major employers in the life sciences. Look for it on page 2440.

### AD SUPPLEMENT / 13 APRIL ISSUE LAB TECHNOLOGY TRENDS

**Technologies** in Proteomics: This ad supplement will review advances in the technologies used in proteomics, with a special focus on their use in drug discovery. Look for it in the 13 April issue of Science.





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## **THIS WEEK IN Science**

### Squeezing Condensates

Measurements in quantum mechanics are limited by the Heisenberg uncertainty relations, but these limits hold as a time average. It is possible to "squeeze" quantum-mechanical states so that the uncertainty limit for an observable, such as position, is beaten periodically. Quantum optics has created squeezed states for photons, and because the de Broglie wavelengths associated with atoms are much shorter than those of photons, the creation of squeezed atomic states should have an impact on areas such as high-resolution interferometry. Orzel et al. (p. 2386; see the news story by Voss and the related Science Express reports by Abo-Shaeer et al. and Robert et al.) show that the number edited by Phil Szuromi

2395 Chemical waves and patterns observed in reactions can be ex-

**Potential for Turing Patterns** 

plained by a mechanism proposed in the early 1950s by Turing. A critical ingredient for pattern formation in solution is that one species must diffuse much more rapidly than the others-a somewhat difficult requirement for small molecules. Recent theoretical work has suggested that reactions at electrodes could also exhibit Turing-type patterns if the electrode potential took the place of

the rapidly diffusing species and if fieldinduced migration replaced diffusion. Li et al. (p. 2395) now experimentally verify this theory for the reduction of



periodate on gold electrodes in the presence of camphor, an organic molecule that can condense on the electrode at certain potentials and inhibit reduction. Such pattern formation should be observable in many electrochemical systems and could operate at biological membranes that exhibit potential gradients.

states of atoms in a Bose-Einstein condensate can be squeezed, thus greatly reducing the variance in the number of atoms trapped in a particular well.

### **Catching Fennoscandia on the Rebound**

Fennoscandia has been rising since the retreat of a massive glacier at the end of the Pleistocene. Although there are decades' worth of tide gauge records for the coast of Sweden and Finland, it has been difficult to extract an estimate of sea level rise by subtracting the ground surface uplift. Milne et al. (p. 2381) completed a 7-year global positioning system (GPS) campaign and combined these land-surface deformation measurements with the tide gauge records to derive a more accurate regional sea level rise of 2.1 ± 0.3 millimeters per year. This value is consistent with the global average and relevant to models of global warming. They also derived a refined viscosity for the mantle and an elastic thickness of the lithosphere, which are fundamental inputs for mantle convection and crustal flexure models.

### **Tiny Breaths**

Marine biological control of the flux of CO<sub>2</sub> between the atmosphere and upper ocean is mediated by a combination of carbon uptake by phytoplankton photosynthesis, remineralization of organic carbon back to CO<sub>2</sub> (community respiration), and export of biogenic carbon to deeper waters. These processes also help control the distribution of biogenic carbon in the ocean. Rivkin and Legendre (p. 2398) show that there is an inverse relation between temperature and bacterial growth efficiency and that bacterial respiration accounts for nearly all of the community respiration. Besides their ecological implications, these results suggest that increases in sea surface temperatures will increase

### but provide needed inputs for more detailed numerical models.

### Turning On (and Off) a Nanocrystal

Quantum-confinement effects in semiconductor nanocrystals should make the electronic and optical properties of these materials more sensitive to the injection of extra charge carriers compared to the corresponding bulk materials. Wang et al. (p. 2390) demonstrate how electrochemical injection of extra carriers in CdSe nanocrystals quenched their photoluminescence. The photoluminescence could be recovered by reversing the bias, thus illustrating the potential of such an effect for optoelectronic applications.

sample undergoing tensile deformation. The results are inconsis-

tent with the two classical models, those of Taylor and of Sachs,

the proportion of the assimilat-

ed carbon that is remineralized

and thus decrease the solubility

of CO<sub>2</sub>. These effects would then create a positive feedback

between atmospheric CO<sub>2</sub> and

When a polycrystalline materi-

al is deformed, the individual

grains change shape through

the movement of dislocations

and through grain rotation.

Although many theories have

been developed to model this

process, experimental data for

the actual grain evolution have

been harder to obtain. Mar-

gulies et al. (p. 2392; see the

Perspective by Heidelbach)

used focused hard x-rays to

map out the evolution of sev-

eral grains in an aluminum

temperature.

The Details of

**Taking a Hit** 

### **Turning Over a New Leaf**

In plant development, the growing shoot changes from a juvenile, or reproductively incompetent state, to an adult state. Mechanisms governing this change were examined by Berardini et al. (p. 2405), who found that a protein termed squint, a chaperone-like protein, was involved. In mutants lacking squint protein, leaves exhibited adult properties early, but flowering time was unaffected. Surprisingly, the mutant plants expressed elevated levels of another heat shock chaperone protein, Hsp90, but the response of seedlings to heat shock was not affected

### Molecular Ruler or Measuring Cup?

At the base of the bacterial flagellum, there is a hook structure onto which the flagellin subunits are assembled. The total length of the flagellum itself is highly variable, but the hook structure is

SOURCE: Y.-J. U ET AL

CONTINUED ON PAGE 2273



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### CONTINUED FROM 2271 THIS WEEK IN SCIENCE

remarkably homogenous in its size. In examining the mechanism for this relative constancy, Makishima *et al.* (p. 2411) found that rather than using a molecular ruler to determine hook length, *Salmonella* appears to regulate the amount of subunits secreted for hook assembly.

### Having Trained Reserves in Place

Long after T cells first deal with a pathogen, small numbers persist so that immunological memory is not lost in the event of reinfection. Using fluorescently tagged antigenic tetramers, Masopust *et al.* (p. 2413; see the Perspective by MacKay and Andrian) tracked memory CD8<sup>+</sup> T cells and observed a marked preference of these cells for a range of nonlymphoid tissues, including the lung, liver, kidney, and gut. T cells from each site could respond immediately to antigen by producing interferon- $\gamma$  and by killing target cells. Because most infections occur at such peripheral sites, these results emphasize the importance of having a ready supply of memory T cells that can be delivered to wherever the immunological action might be.

### Learning and Relearning

Experimental extinction, the disappearance of a conditioned behavior after repetitive trials in the absence of the unconditioned stimulus, is not simply a kind of forgetting but rather a new learning phenomenon. To address the cellular mechanisms underlying this phenomenon, Berman *et al.* (p. 2417) studied conditioned taste aversion in the rat insular cortex. Both acquisition and extinction of conditioned taste aversion were impaired by inhibition of protein synthesis and involved  $\beta$ -adrenergic receptor activation. Acquisition, but not extinction, was decreased by antagonists of muscarinic receptors and *N*-methyl-D-aspartate receptors and also by mitogen-activated protein kinase inhibitors. There are thus clear differences between memory encoding and consolidation during retrieval.

### Making the Transfer

The origin and movement of neurotrophic factors such as brain-derived neurotrophic factor (BDNF) between nerve cells has been controversial. Kohara *et al.* (p. 2419) used BDNF tagged with green fluorescent protein to follow anterograde synaptic transport from axons of neurons to postsynaptic cells. This synaptic transport of the growth factor is absent when neuronal activity was blocked by tetrodotoxin and was enhanced after reduction of inhibition. These results constitute direct evidence for an anterograde, trans-synaptic transport of BDNF.



### **Blocking a Survival Pathway**

In several neurodegenerative diseases, proteins that bear expanded polyglutamine repeats aggregate, a process that somehow leads to the demise of neurons. Nucifora *et al.* (p. 2423) studied the interaction of aberrant versions of huntingtin (which is affected in Huntington's disease) and atrophin (which is affected in dentatorubral and pallidoluysian atrophy) containing expanded polyglutamine repeats. These aberrant proteins avidly bound to the transcriptional coactivator CREB-binding protein (CBP) and prevented the transcription of target genes known to be crucial for neuronal survival.

### **Exploiting a Preexisting Condition**

Phosphorylation is usually assumed to regulate signal transduction by triggering a conformational switch. Volkman *et al.* (p. 2429; see the Perspective by Buck and Rosen) show that in the signaling protein NtrC, activation by phosphorylation involves stabilization of a preexisting conformation. Nuclear magnetic resonance measurements of backbone dynamics show that both active and inactive conformations are populated in unphosphorylated NtrC, with the inactive form favored. Phosphorylation shifts the equilibrium far toward the active conformation so that conformational exchange virtually disappears. Thus, allosteric regulation of single domains may be important in signal transduction.

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Fig. 2. Autoradiograms of a 20.7 kb Lambda PCR fragment sequenced with MBL202 Fwd primer using USB's Thermo Sequenase Radiolabeled Terminator Cycle Sequencing Kit. PCR clean-up performed with: (a) ExoSAP-IT; (b) a column designed for PCR clean-up.

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Fig. 1(a) BATCOCCGGGEFACCGAG C NCGAATTO GINAATCA TG TOA TA 30 40 50 60 Fig. 1(b)

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