THIS WEEK IN Science

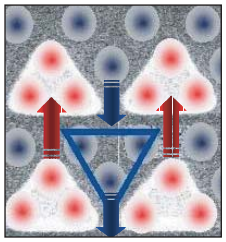
edited by Stella Hurtley and Phil Szuromi

Algal Clues to Antarctic Ice Shelf Ages

The naturally high variability of sea ice extent in Antarctica and the short duration of instrumental records have combined to obscure any clear record of sea ice coverage change. **Curran *et al.*** (p. 1203; see the Perspective by **Wolff**) present an ice core record of methanesulfonic acid, a species produced by algae living at the edges of ice shelves, which they show is related to the position of the nearby winter-spring sea ice edge observed in satellite data. They use this relation to reconstruct changes in regional sea ice extent during the last 155 years and show that the modern decline began in the 1950s.

Our Hot Legacy

Anthropogenic activity appears to have made a significant impact on North American climate during the last half century. **Karoly *et al.*** (p. 1200) used five different climate models to show that the changes observed in this region are too large to have been caused by natural variations alone, and can only be explained by including the effects of added greenhouse gases and sulfate aerosols. In contrast, during the first half of the 20th century, when the accumulated burden of anthropogenic components was only a fraction of what it is today, warming was most likely the result of natural climate variability.



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Magnetic Vortex Rectifier

Superconductors set up vortices of magnetic flux quanta in the presence of a magnetic field, when a current is carried, or when the sample is near the superconducting transition temperature. Vortex motion tends to be random. **Villegas *et al.*** (p. 1188; see the Perspective by **Hilgenkamp *et al.***) have fabricated a device for controlling vortex flow. They deposited a layer of superconducting niobium film on an array of triangular nickel islands, which can act as pinning sites for the vortices. When the system is driven with an external ac-current, the asymmetric geometry of the device leads to a net flow of vortices.

Did Filaments Form Faux Fossils?

The earliest purported fossils have been thought to be structures in nearly 3.5-billion-year-old Australian chert that resemble cyanobacteria and contain kerogenous material. It has recently been suggested, however, that these fossil-like structures could have formed inorganically. **García-Ruiz *et al.*** (p. 1194; see the news story by **Kerr**) show that silica-coated carbonate crystals in a chert-like matrix can form long filaments via self-assembly. When these filaments are folded or braided, they produce structures that closely resemble bacterial fossils, and the synthesis conditions are similar to that of a chert. Furthermore, hydrocarbons—which also can form abiotically—can condense onto the filaments, potentially removing such an association as a biomarker.

The Controller in the Brain

The prefrontal cortex subserves cognitive control—the ability to coordinate thoughts and actions in relation with internal goals. Cognitive control is a key function in human cognition that is often required in everyday behavior and that mediates higher cognition like planning or reasoning. The functional organization of the lateral prefrontal cortex and the related cognitive architecture underlying cognitive control are still poorly understood. **Koechlin *et al.*** (p. 1181; see the news story by **Helmuth**) propose a theory that describes the mental architecture of cognitive control in humans and its biological implementation in the prefrontal cortex. Experimental results from functional magnetic resonance imaging experiments agreed with the theory and exposed the overall modular, functional architecture of the human lateral prefrontal cortex.

Selective Breeding of Maize by Early Farmers

The domestication of teosinte, the wild forerunner of cultivated maize, took place in Mexico at least 6000 and possibly as long as 9000 years ago. Current knowledge about the domestication process is based almost entirely on the morphology of archaeological remains of corn cobs. **Jaenicke-Després *et al.*** (p. 1206; see the Perspective by **Fedoroff**) add a genetic dimension by sampling DNA from cobs 650 to 4300 years old. Their sequence data show that early farmers had already had a strong selective influence more than 4000 years ago on genes affecting morphology and protein and starch synthesis, and show that much of the genetic architecture of modern maize was already in place by that time.

Memories of a Breakup

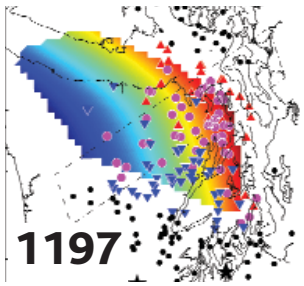
An air bubble trapped in syrup can break apart as it rises. **Doshi *et al.*** (p. 1185) examined droplets of a low viscosity fluid (water) entrained in one of high viscosity (silicone oil) and found that the dynamics of the drop breakup showed linear behavior. However, the fragmentation was sensitive to initial and boundary conditions, which is not typical of linear processes. The authors envision that it may be possible to engineer small-scale droplet behavior to allow for controlled encapsulation processes.

Nutrient Sensing and Gene Expression

Prefoldins (PFDs) belong to a family of small–molecular weight proteins that act as molecular chaperones. **Gstaiger *et al.*** (p. 1208) describe an unusually large member of this family, URI, that forms a large (>1 megadalton) complex with other small–molecular weight prefoldins and a subunit shared by all three RNA polymerases. In yeast and human cells, URI is a target of nutrient signaling and participates in the control of nutrient-sensitive gene expression. Thus, URI may act as a molecular scaffold for a signaling pathway that coordinates nutrient availability with gene expression.

Slab Earthquakes: To Dehydrate or to Transform

Earthquakes that occur within the slab of crust and mantle material carried down at a subduction zone present an important seismic hazard: Many urban areas are situated near subduction zones, and these earthquakes can have higher recurrence rates than interplate earthquakes. **Preston *et al.*** (p. 1197) analyzed intraslab events from the Juan de Fuca plate, which is subducting beneath northwestern Washington State, and were able to di-



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CREDITS: (TOP TO BOTTOM) VILLEGAS *ET AL.*; PRESTON *ET AL.*

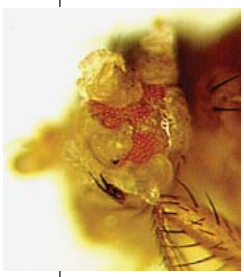
vide the events into two groups. Events in the mantle, shallower than 45 kilometers, were caused by dehydration of serpentinite, and events in the subducted crust, deeper than 45 kilometers, were caused by the transformation of basalt to ecologite.

Rock and Rho Beat Amyloid Beta

Some nonsteroidal anti-inflammatory drugs have been shown to reduce the secretion of the amyloid-beta peptide. **Zhou *et al.*** (p. 1215) show that this effect may be due to their interaction with the small guanosine triphosphatase Rho and its effector kinase Rock. Directly inhibiting Rock led to reductions in the levels of beta-amyloid observed in the brains of Alzheimer's disease model mice. Thus, Rho and Rock may be important players in Alzheimer's pathogenesis, and may represent targets for therapeutic intervention.

Immunological Synapse Regulation

The immunological synapse coordinates intercellular communication between T cells and antigen-presenting cells, but the signaling functions of this structure have not been clear. Experiments and computer modeling have led **Lee *et al.*** (p. 1218; see the Perspective by **Malissen**) to propose that T cell receptor (TCR) clustering in the synapse enhances receptor signaling but also potentiates a higher rate of TCR degradation—a type of adaptive control function that regulates the strength and duration of T cell signaling in response to a specific ligand.



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Modeling Metastasis in *Drosophila*

The majority of cancer-related deaths are caused by metastasis—the spread of secondary tumors from the primary tumor. **Pagliarini and Xu** (p. 1227) developed a genetic screen in *Drosophila* for mutations that can cause metastatic behavior in otherwise noninvasive tumors created through expression of oncogenic Ras. Metastasis in the *Drosophila* model system displayed many characteristic features seen in the mammalian phenomenon, including basement-membrane degradation, loss of E-cadherin, and the induction of cell invasion. Oncogenic Ras played an important role in driving invasion and metastasis, because mutations that caused loss of cell polarity alone did not promote metastatic behavior on its own or in combination with various other oncogenes.

Curing Diabetes in Autoimmune Mice

Nonobese diabetic mice develop spontaneous, autoimmune diabetes as a result of a faulty immune system that does not properly eliminate T cells that recognize the mouse's own pancreatic islet cells. These T cells then go on to destroy the islets that normally produce insulin. Treatment of these mice with spleen cells from related mice can re-educate the immune system and cure the diabetes. Although the correction of the immune system is partially successful even with irradiated (and therefore dead) spleen cells, **Kodama *et al.*** (p. 1223) show that complete correction of the disease requires live donated splenocytes, which fully correct the immune reaction against the islet cells, allowing for complete regeneration of the destroyed islets. In addition, these infused cells contribute to the new cell populations in the islets and the pancreatic ductal epithelium, probably by transdifferentiation.

Bonds Among Baboons

Two studies document the beneficial character of social support groups and the depth to which nonhuman primates understand social networks (see the Perspective by **Dunbar**). **Bergman *et al.*** (p. 1234) show that female baboons can discriminate between conflict that occurs between individuals within the same maternal lineage, and that which occurs between females from distinct kin groups and thus may have greater potential repercussions. From an analysis of long-term demographic data, **Silk *et al.*** (p. 1231) show that a greater involvement of female baboons in grooming others and in being groomed correlates with greater infant survival. Hence, bonds with kin (both males and females) provides an adaptive benefit for successful family life.

CREDIT: PAGLIARINI AND XU