EDITORS' CHOICE

edited by Gilbert Chin

GEOPHYSICS

Snow Megadunes

Dune-like features were noted over some areas of the East Antarctic Plateau more than a decade ago. These megadunes are long-wavelength surface ripples with amplitudes of only a few meters and crests that can extend for 100 kilometers.

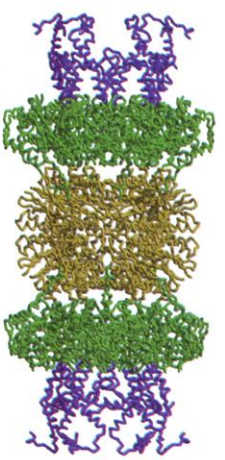
Using Advanced Very High Resolution Radiometer (AVHRR) images, Fahnestock *et al.* find three dune fields located in regions characterized by anomalously low rates of snow accumulation. The largest dune field covers about 300,000 square kilometers, and the crests run perpendicular to the prevailing winds. Low microwave emission derived from annual averages and high back-scattered microwave energy on the downwind slopes of the dunes observed in synthetic aperture radar images indicate that the snow is coarse-grained and probably formed on the downwind slope by recrystallization. They suggest that a standing wave may disrupt the near-surface temperature gradient, which is due to radiative cooling of the snow, and that standing waves would bring warmer air onto the downwind slope of the dunes and thus cause recrystallization over large areas. Therefore, snow dunes may form by a more complex surface-atmosphere interaction than applies to sand dunes, and variations in recrystallization may hamper climate reconstructions. — LR

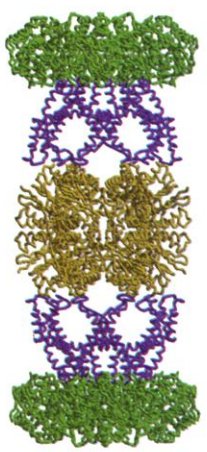
Geophys. Res. Lett. **27**, 3719 (2000).

BIOCHEMISTRY

Proteosome Activators and Regulators

The proteasome is a barrel-shaped macromolecular complex and functions to degrade proteins into small peptides. Sousa *et al.* have determined the structure of viral HslUV; HslU, a chaperone of the Clp/Hsp100 family, is an ATP-dependent activator of the HslV protease. Two hexameric HslU molecules bind to opposite sides of HslV with the HslU intermediate domains (magenta) extending outward. This quartenary structure differs from that determined previously for a bacterial HslUV complex. Binding of HslU induces a shift in the apical helices of HslV that propagates to the active site.





Two quarternary structures of the HslU (green, magenta)-HslV(yellow) complex.

In eukaryotes, apart from binding a 19*S* ATP-dependent regulator, the 20*S* proteasome also can bind to an 11*S* regulator, which appears to stimulate the release of peptides. Whitby *et al.* have determined the structure of the trypanosome 11*S* regulator bound to the 20*S* proteasome from yeast. They found that binding of the 11*S* regulator opened the pore, consistent with facilitating product export. This could result in the release of longer peptides and thus explain the role of 11*S* regulators in producing ligands for MHC class I molecules. — VV

Cell **103**, 633 (2000); *Nature* **408**, 115 (2000).

APPLIED PHYSICS

High-Performance Power Devices

Wide band gap semiconductors such as gallium nitride (GaN) are used in power electronics applications where the elevated operating temperatures preclude the use of lower band gap silicon-based devices, which would be hampered by high leakage currents. The GaN field-effect transistors made so far have shown good initial switching characteristics, but high-temperature operation has been hampered by various problems with the insulating oxide layers. In the search for a stable dielectric layer, Johnson *et al.* present findings that suggest that single-crystal gadolinium oxide (Gd_2O_3) is an attractive candidate for tackling this problem. They grow the oxide epitaxially on GaN and show in a device configuration that low interface defect density, low parasitic resistance, and low contact resistance all lead to improved performance. — ISO

Appl. Phys. Lett. **77**, 3230 (2000).

CLIMATOLOGY

Where Winds Meet

The Intertropical Convergence Zone (ITCZ) is where tropical easterly winds, known to sailors as "tradewinds," converge over the oceans. The ITCZ moves back and forth across the equator in an annual cycle, its position being determined largely by a combination of solar forcing and coupling between the atmosphere and surface ocean temperatures. The ITCZ is most variable in boreal spring, when it extends furthest south. The extent of this variability in the eastern Pacific is known to depend on the state of El Niño–Southern Oscillation, but what controls the location of the tropical Atlantic ITCZ is less clear. One hypothesis is that a northern midlatitude "atmospheric bridge" allows the Pacific to influence the Atlantic ITCZ. Another hypothesis, derived from an atmospheric General Circulation Model, is that the connection is maintained through anomalous Walker Circulation.

Chiang *et al.* present observations that this east-west, tropical air circulation connects the ocean basins, and that the interdecadal variability of this connection can be explained by a nonlinear relation between sea surface temperature and atmospheric convection in the eastern equatorial Pacific. — HJS

Geophys. Res. Lett. **27**, 3687 (2000).

ECOLOGY/EVOLUTION

Tasty Galls

Many herbivorous insects are able to induce the formation of galls on their host plants. Although this ability has arisen independently in diverse insect orders during the course of evolution, its adaptive significance has remained unclear. One hypothesis is that gall-inducing insects interfere with the production of defensive chemicals by the gall tissues, rendering the gall tissues more palatable than other plant parts. Nyman and Julkunen-Tiitto investigated this possibility by studying six species of nematine sawfly gallers on their willow hosts in Lapland. In all of the interactions, they found that the sawflies reduced significantly the levels of defensive low-molecular-weight phenolic compounds in the galls. Thus, it appears that the gallers are able

CONTINUED ON PAGE 1655

SOURCE: SOUSA *ET AL.*, *CELL* **103**, 633 (2000).

to redirect the biosynthetic pathways leading to these compounds; the gall and its biochemistry represent an extended phenotype of the insect. — AMS

Proc. Natl.Acad. Sci. U.S.A. **97**, 13184 (2000).

MICROBIOLOGY/IMMUNOLOGY

Allergies, Asthma, and IL-10

The increasing prevalence of allergic responses, such as asthma and eczema, among children in developed countries, has been explained by their reduced likelihood of exposure to bacterial and viral pathogens. These infections are thought to shift the type of immunity towards a T helper 1 (T_H1) cell response, which leads to the elimination of the pathogens, and to reduce the expression of T_H2 cytokines, which are associated with allergy. In less-developed tropical countries, infections with parasitic worms (helminths) are very common in children. Paradoxically, such children exhibit few allergies even though immune responses to worms are of the T_H2 type.

In a study of Gabonese children harbouring various helminths, but otherwise vaccinated against common childhood infections, van den Bigelaar *et al.* measured a heightened ability to produce interleukin-10 (IL-10). This is an anti-inflammatory cytokine that suppresses allergic reactions, even in the presence of the T_H2 cytokines and IgE antibodies generated by the response to infection. Consistent with this result is the observation that the lung macrophages of asthmatic patients are relatively deficient in producing IL-10. — CA

Lancet **356**, 1723 (2000).

NEUROSCIENCE

An Enduring Sensory Map

The ability to sense and process olfactory information is central to the feeding, predatory, and mating behavior of most organisms. Mice have two million olfactory sensory neurons, and each expresses only one of a thousand different odorant receptor genes. Neurons expressing a given receptor project axons to two of 1800 discrete synaptic structures, or glomeruli, within the olfactory bulb. This pattern of projections provides a precise two-dimensional map of receptor activation in the brain, and it is established within the first two weeks of life.

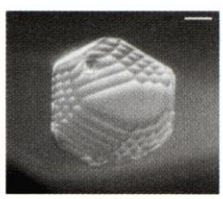
In adult organisms, olfactory neurons die and are replaced, yet the ability to perceive specific odors persists for a lifetime. To explore how the integrity of the olfactory map is maintained, Gogos *et al.* used a genetic approach to kill groups of neurons expressing a particular odorant receptor gene. The synapses in the olfactory system reformed with precision after this neuronal ablation. Thus, the determinants governing the establishment of the olfactory map during development persist throughout life, and the target selection that occurs during regeneration is likely to recapitulate developmental events. — PAK

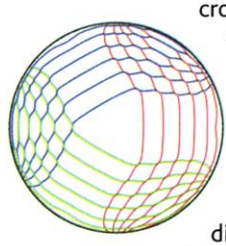
Cell **103**, 609 (2000).

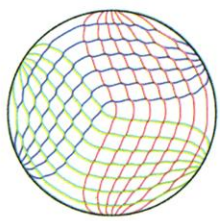
MATERIALS SCIENCE

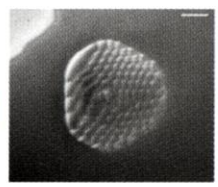
Thrown for a Dislocation

Dislocations not only affect the mechanical properties of materials but also can affect the performance of semiconductor devices, especially in cases where islands or thin films can relieve strain through the movement of dislocations. Liu *et al.* used transmission electron microscopy to image the movement of dislocations in cobalt silicide ($CoSi_2$) islands (about 1 micrometer in diameter) grown on the (111) surface of silicon. At elevated temperatures (850°C), they observed glide dislocations nucleating at the island edge and then moving along planes parallel to the (111) interface. They were able to reproduce the dynamics of these dislocation networks quite accurately in simulations: line tension forces and interactions between dislocations both were important factors while "image" forces,









Images of $CoSi_2$ crystals (scale bars are 250 nanometers) and calculated evolution of added dislocation loops.

which take into account the particle shape and interaction with the substrate but add greatly to the complexity of the calculation, provided only a minor contribution.— PDS

Phys. Rev. Lett. **85**, 4088 (2000).

CREDITS: LIU *ET AL., PHYS. REV. LETT.* **85**, 4088 (2000).