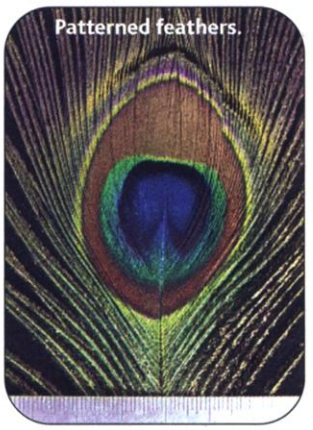
EDITORS' CHOICE

edited by Stella Hurtley

EVOLUTION

How Feathers Get Their Patterns



Patterned feathers.

The huge variety of color and pattern within the plumage of birds is the result of differential pigmentation both between and within individual feathers. The physiology and developmental anatomy of the pigmentation process itself is quite well understood, but the search for a set of general rules governing the actual pigmentation patterns within feathers has not been fruitful: The structural development of the feather has proved complex enough. By applying reaction diffusion equations to the production of within-feather patterns, Prum and Williamson have taken a step toward a general theory of pattern development. The model successfully simulates a wide variety of the within-feather patterns found in nature—bars, chevrons, concentric circles, spots, etc.—and generates testable predictions about their evolution and the biochemistry of their development. — AMS

Proc. R. Soc. London B **269**, 781 (2002).

ASTROPHYSICS

Big Flares from a Teeny Star

The distinction between planets and stars has become more difficult over the past 7 years with the discovery of extrasolar massive giant gas planets, low-mass brown dwarfs, and other low-mass objects that seem to lie somewhere in between. One criterion used to separate the species is the deuterium-burning mass limit, that is, the minimum mass an object needs to sustain deuterium fusion for at least a brief time and thus be considered a star.

Enter the enigmatic S Ori 55, a low-mass object, isolated and apparently free-floating in the sigma Orionis cluster. New spectra from the Keck I telescope obtained by Zapatero Osorio *et al.* indicate that this object is intensely flaring, giving off bursts of hydrogen alpha emission in a highly variable manner. Evolutionary models suggest that S Ori 55 is young (about 3 million years old) and has a low mass of about 0.012 solar masses, which puts it right at the deuterium-burning mass limit. If the flares are from a stellar chromosphere, due to magnetospheric mass infall, then this low-mass star is somehow able to maintain substantial magnetic activity while being at the limit of deuterium fusion. Alternatively, the flares could be due to mass accretion by S Ori 55 of surrounding disks as the star grows. — LR

Astrophys. J. **569**, L99 (2002).

PLANT BIOLOGY

Tasty and Bad for Bugs

In tuber crops, such as the potato, the storage proteins that accumulate in the plant cell vacuole support the growth of new plants. It is these same storage proteins and carbohydrates that give these tubers nutritional value. The storage proteins, however, may serve other functions as well. For example, in the potato, the protein patatin shows phospholipase A2 activity and inhibits the growth of worm larvae. Like the potato, the oca (*Oxalis tuberosa*) originates in the highland areas of the Andes, tolerates cool climates and very poor soils, and possesses tubers of equivalent nutritive value.

Now Flores *et al.* have shown that a storage protein from oca also does double duty. The protein ocatin accounts for up to 60% of the soluble protein in oca tubers and also turns out to have antipathogen activities. The protein sequence of ocatin resembles those of another group of proteins that are expressed intracellularly after pathogen attack. Thus ocatin provides both a nutritional store and potentially provides natural protection from phytopathogenic bacteria and fungi. — PJH

Plant Physiol. **128**, 1291 (2002).

BIOMEDICINE

Breast Cancer Risk in *CHEK*

Women with mutations in the *BRCA1* or *BRCA2* genes have a high risk of developing breast cancer; however, only 15 to 20% of overall familial risk for the disease can be explained by the presence of these two genes. According to current models, the residual familial clustering is unlikely to be due to rare mutations in additional high-risk genes but is more likely to be due to common variants of a large number of genes, each of which confers a small effect on disease risk.

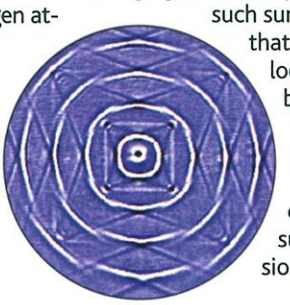
A large Breast Cancer Consortium has now identified the *CHEK2* gene on chromosome 22q as one of these so-called "low-penetrance" breast cancer susceptibility genes. *CHEK2* encodes a cell-cycle checkpoint kinase that is activated in response to DNA damage and prevents the cell from entering mitosis. A truncating variant allele of *CHEK2* that abolishes the protein's kinase activity was found to confer a twofold increase in the risk of breast cancer risk for women and a 10-fold increase in risk for men. — PAK

Nature Genet. 10.1038/ng879 (2002).

PHYSICS

Watching Ripples on Crystals

Throwing pebbles in a pond, or the patterns of sand that develop on a drum skin, are familiar examples of surface excitations that are ubiquitous in nature. Imaging the development of such surface waves that arise from local disturbances is fairly straightforward, because the surface tension of the material is low and so the waves produced are large and propagate relatively slowly. In a solid material, a crystal for example, the surface tension is relatively high and imaging the subsequent fast-moving surface excitations can present a challenge, especially when trying to assess their dynamical motion.



Phonon propagation on the surface of a TeO_2 crystal.

Using ultrashort laser pulses, Sugawara *et al.* have generated and dynamically imaged tiny

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CREDITS: (TOP) PRUM AND WILLIAMSON, *PROC. R. SOC. LONDON B.* **269**, 781 (2002); (BOTTOM) SUGAWARA *ET AL.*, *PHYS. REV. LETT.* **88**, 185504 (2002).

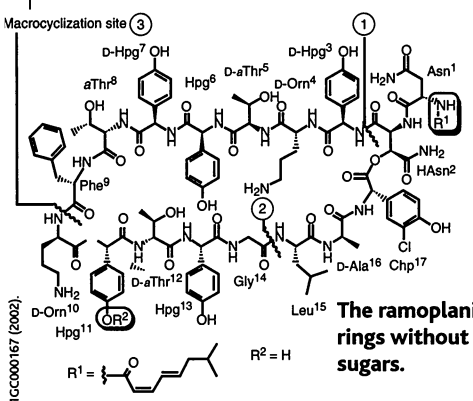
ripples of sound—acoustic phonons—on the surface of a tellurium oxide crystal. An intense laser pulse created the local disturbance of the crystalline lattice, and a train of weaker probe pulses was used to image the development of the waves as they propagated across the surface. In addition to providing beautiful patterns, the technique should prove useful in studying effects such as phonon focusing or phonon waveguiding. — ISO

Phys. Rev. Lett. **88**, 185504 (2002).

CHEMISTRY

Lower Closing Costs

Among the antibiotics that are of interest in combating Gram-positive bacterial strains, especially those strains that are vancomycin-resistant, is ramoplanin. This cyclic depsipeptide, which bears lipid and glycogen side



The ramoplanin rings without sugars.

chains, forms a 49-membered ring and thus presents a formidable challenge for total synthesis. Jiang *et al.* now report that the A2 form of ramoplanin without its sugar side chains can be made from three smaller subunits. Although one might have anticipated low yields for the final ring-closure step, the formation of β sheet–like structure and the closure at the D-amine terminus lead to a yield of about 90% for this final step. — PDS

J. Am. Chem. Soc. 10.1021/ja020237q (2002).

DEVELOPMENT

Blood and Guts

The Runt domain transcription factors are downstream targets of transforming growth factor-β (TGF-β), implicated in regulating mammalian developmental processes, including hematopoiesis (RUNX1) and osteogenesis (RUNX2). Li *et al.* report that the third runt-related factor, RUNX3, is a negative cell growth regulator. RUNX3 is expressed primarily in the mouse gastrointestinal tract, particularly in stomach epithelial cells. Mice lacking RUNX3 exhibited increased proliferation and decreased apoptosis of gastric epithelial cells. Primary cultures of RUNX3-null gastric epithelial cells were less sensitive to the growth inhibitory effects of TGF-β as compared to wild-type cells. In gastric cancer cell lines and tumor-derived tissue, RUNX3 is frequently silenced and undetectable. Thus RUNX3 is anti-oncogenic and its loss may account for certain cases of gastric cancer.

Loss of functional RUNX1 is related to leukemogenesis in mice, and its mutations are associated with acute myeloid leukemia. Kalev-Zylinska *et al.* have cloned and characterized RUNX1 in zebrafish and show that it is also involved in hematopoeisis. Reducing its expression resulted in defective blood and vasculature development. This genetically tractable model system may prove useful to screen for molecules that modulate RUNX protein function. — LDC

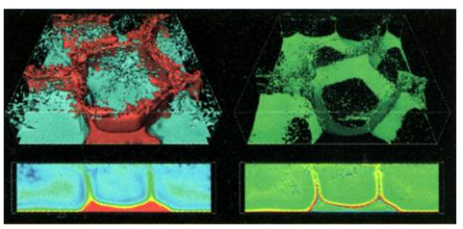
Cell **109**, 113 (2002); *Development* **129**, 2015 (2002).

GEOPHYSICS

Modeling the Mantle

Earth's mantle makes up most of the outer half of the planet. Decades of seismic and geochemical studies have revealed a far-from-complete view of the flow and dynamics in the mantle, which affect Earth's heat flow, gross topography, and the composition of many volcanoes. A recent view is that the deep mantle forms a distinct chemical region beneath an irregular boundary that undulates over many millions of years and extends about 1500 km from the base of the mantle. But this region has been difficult to resolve seismically.

Tackley, in a series of numerical models, examines what this deep layer might look like and how various conditions would be expressed in seismic data. Although it is possible to balance a hotter region with a denser chemical composition to reduce the seismic signature, other factors should



Basic pattern (top) and cross-section (bottom) of internal boundary layer.

produce layering that is not observed. Other models can fit some, but not all, of the constraints, so models based on seismic data do not converge with geodynamic models. Stay tuned. — BH

Geochem. Geophys. Geosys. **3**, 10.1029/2001GC000167 (2002).

CREDITS: (LEFT) JIANG *ET AL.*, *J. AM. CHEM. SOC.* 10.1021/JA020237Q (2002); (RIGHT) TACKLEY, *GEOCHEM. GEOPHYS. GEOSYS.* **3**, 10.1029/2001GC000167 (2002).