THIS WEEK IN Science

edited by Phil Szuromi

Large Archean Impact Event

Cratering left after the early solar system bombardment of Earth has long been eroded, but impact ejecta still remain in parts of the Archean cratonic crust. Byerly *et al.* (p. 1325) obtained lead-uranium ages for zircons from the lowermost ejecta layers found in South Africa and Australia. Consistent ages of 3.470 billion years for these widely separated sites suggest that a large impact event created a potentially global ejecta layer and probably altered any early inklings of terrestrial life.

1320 An Amorphous Continuum

At first glance, it would seem that there could be only one amorphous form of a material, but distinct amorphous phases with different connectivities and density can exist. For example, at low temperatures and high pressures, a high-density amorphous water ice can be created that, upon heating, expands to form a low-density amorphous ice. This transformation was believed to be a single-step process, but x-ray and neutron diffraction studies by Tulk *et al.* (p. 1320; see the Perspective by Soper) indicate that this transition occurs continuously. At each incremental stage of heating, a distinct metastable form was obtained that had its own structure factor.

And in Brevia ...

An analysis by Castro *et al.* (p. 1299) shows that the transdifferentiation potential for mouse bone marrow cells may be more limited than previously thought.

Freeing BeH_2

Theorists have been intrigued by BeH_2 because this molecule has only six valence electrons instead of the usual octet. Confirming their predictions has been hampered by the difficulties spectroscopists have had in generating the free molecule. The solid compound is formed from BeH_4 species, and spectra of isolated molecules have been obtained only after stabilization within a matrix. Bernath *et al.* (p. 1323) have now generated the free molecule with an electrical discharge in a high-temperature furnace. Analysis of infrared emission spectra reveal a symmetric, linear structure and provides highly precise bond distances.

The Mane Explanation

The mane of the male African lion is a sexual dimorphism whose adaptive function has been enigmatic. West and Packer (p. 1339; see the news story by Withgott) combine field experiments and 30 years of long-term data to address virtually every aspect of the biology of the lion's mane. They found that the darkness of a lion's mane is a reliable indicator of the male's hormonal and nutritional condition, that other lions respond to mane color, and that dark-maned males can better protect their offspring. Males grow darker manes in cooler months of the year and in cooler habitats, and shorter manes in hotter climates.

Developing a Taste for Toxins

In order to understand the underlying mechanisms of natural selection, individual differences upon which selection can act need to be observed. Geffeney *et al.* (p. 1336; see the Perspective by Huey and Moody) integrate studies of adaptive radiation in predator-prey arms races with an investigation of the neurophysiological mechanisms underlying a complex organismal trait. Garter snakes in western North America have developed resistance to the deadly neurotoxin possessed by their newt prey through the evolution of tetrodotoxin-resistant sodium channels. This adaptation has evolved multiple times within the framework of a geographic mosaic of coevolution.

Second Vertebrate Sequenced

The small size of the genome of the pufferfish, *Fugu rubripes*, about 1/10 that of the human genome, makes it a valuable model for studying the evolution of the vertebrates. Aparicio *et al.* (p. 1301; see the cover and the Perspective by Hedges and Kumar) present their results of whole-genome shotgun sequencing of *Fugu*. Although the genome of *Fugu* is much more compact than that of humans, the two have a comparable number of genes, and Fugu has some giant genes that resemble mammalian structures. However, about 25% of human genes do not appear to have counterparts in *Fugu*. There have also been extensive rearrangements during the 450 million years since mammals and teleost fish diverged.

CREDIT: MERRITT AND EKERS

X Marks the Merger

According to Einstein's theory of general relativity, gravitational waves should be produced by the merger of two supermassive black holes. Astronomers have been trying to determine where, when, and how often these mergers could occur. Merritt and Ekers (p. 1310) have found that a merger will reorient the spin axis of the more massive black hole, which in turn will alter the direction of the associated and observable jet ejected along its spin axis. Several X-shaped radio emissions observed from different galaxies, where the radio lobes from the old jet crosses the radio lobes from the reoriented jet, fit well with this model. The estimated event rate suggests that astronomers should be able to observe gravitational waves within decades.

Making C–O, Too

Polyketides, natural products that include important drugs such as the antibiotic erythromycin and the anticancer drug epothilone, are biosynthesized from acyl coenzyme A (CoA) precursors by polyketide synthases (PKSs). Known PKSs have differing structures and mechanisms, but all have a β-ketoacyl synthase (KS) domain that catalyzes the formation of C–C bonds in

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CONTINUED ON PAGE 1235

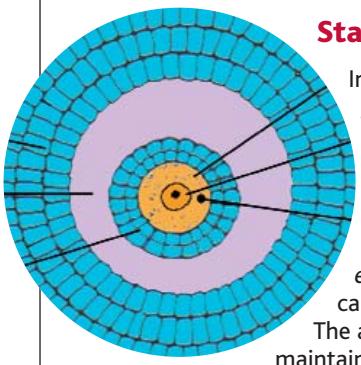
the polyketide backbone. Kwon *et al.* (p. 1327) have now identified and characterized the minimal genes required for forming C–O bonds in the synthesis of a cyclic polyther, nonactin, from *Streptomyces griseus*. Two KSs, NonJ and NonK, catalyze sequential condensation of CoA precursors by forming C–O rather than C–C bonds. This activity could potentially be engineered into other PKSs to create novel polyketides.

Interfering with Receptors

The family of receptors for epidermal growth factor (EGF) transmits signals critical for growth and differentiation of cells in a wide variety of tissues during development. Inappropriate expression of these receptors occurs in many human cancers, and Herceptin, an antibody against one of these receptors (HER2), is used in the treatment of breast cancer. Cho and Leahy (p. 1330) present the 2.6-angstrom crystal structure of the entire extracellular portion of one member of this receptor family, HER3. One of the L-shaped halves sits atop the other and assumes a toroidal shape with a protruding spur. Previously mapped regions of the EGF binding site, on the spur and the torus, must be brought together in order to interact productively with the ligand. Interference with this large-scale conformational change might offer a promising route to therapeutics.

Putting the Heart at Risk

About 450,000 people in the United States die each year from cardiac arrhythmia. A genetic study by Splawski *et al.* (p. 1333; see the news story by Marx) reveals that the risk of arrhythmia is slightly increased in individuals who carry a specific variant allele of the cardiac sodium channel gene *SCN5A*, a group that includes an estimated 13% of African Americans. Although this allele alone does not cause life-threatening arrhythmias, it increases the risk of arrhythmia in the setting of other, acquired risk factors such as the use of certain medications. This allele may be a valuable marker for identifying individuals in the general population who should avoid these additional risk factors.



Starts and Stops

In the mammalian ovarian follicle, several layers of somatic granulosa cells surround the oocyte and support its development. Within this structure, the oocyte begins meiosis, but then halts until luteinizing hormone triggers its resumption. How is meiosis halted? Studies to answer this question have been hampered in that removal of the follicle from an oocyte reinitiates meiosis. However, Mehlmann *et al.* (p. 1343) now present a technique in which oocytes can be injected while still surrounded by the follicular cells. The authors show that activity of the Gs G-protein is required to maintain the meiotic arrest in oocytes, and they suggest that a signal from granulosa cells may be acting through a receptor to activate the G protein.

Persistent Pores in Insulin Secretion

During stimulated secretion, a secretory granule fuses with the plasma membrane to release secretory granule contents. Takahashi *et al.* (p. 1349) have used two-photon excitation imaging to reveal the dynamics of the fusion pore during insulin secretion from pancreatic islets. The lifetime of the pore, which was made up mostly of membrane lipids, was much longer than anticipated from other studies with single cells.

Prince of Dendrites?

Neurons obtain signaling information through their dendrites, which may range in structure from simple thin extensions of the cell body to complex branched outreaches. Studying the ventral pore sensory organs of fruit fly, Moore *et al.* (p. 1355) find that the complexity of the dendritic arbor is regulated by a single gene, *hamlet*. Genetic manipulations that raised or decreased *hamlet* protein expression from its normal levels caused the local progenitor cell to produce neurons with single dendrites or with complex dendritic arbors during the early stages of neuronal development. Analyses of the gene sequence and subcellular localization suggest that *hamlet* might encode a transcription factor.

CREDIT: MEHLMANN *ET AL.*