<< Beetle Drive

Males of some animal species can adopt alternative reproductive strategies. For example, species may have two types of male, one of large size and horns that guard females, and one of smaller size that lacks horns and sneaks copulation. Such facilitative alternative phenotypes are thought to be regulated by a single developmental threshold. However, **Rowland and Emlem** (p. 773) show that dung beetles may have several qualitatively different threshold mechanisms that each regulate the expression of the same trait and affect the reproductive tactic used. Furthermore, in a surprising number of beetles, two thresholds influenced a single phenotype—the horn—suggesting that facultative male trimorphism occurs among a wide range of beetle species.

Protective Film Production?

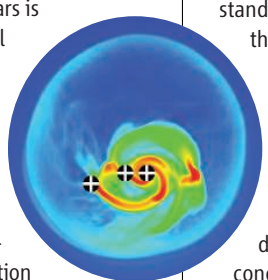
For crystallization controlled by nucleation events, impurities and boundaries can influence the free energy of a system, and thus drive the crystallization toward specific morphologies or crystalline forms. The crystallization of polymers occurs through the repeated folding of chains into lamellae and so boundaries also confine chain motion. **Wang *et al.*** (p. 757; see the Perspective by **Lemstra**) made a series of polymer films through a multiple folding process generating extremely thin, alternating layers of two different polymers, only one of which will crystallize. As the layer thickness was decreased, a preferred orientation for the crystals developed. Initially, this showed fold surfaces parallel to the interface layers, but, for very narrow layers, the lamellae aligned parallel to the interfaces. The crystals in these layers looked like single crystals, and presented a much tougher barrier for gas diffusion. This approach could potentially generate excellent protective films from common polymeric materials.

Legacy of Mass Extinctions

Mass extinctions restructure taxonomic composition of biota on a global scale. However, their legacy, in terms of subsequent patterns of evolutionary diversification, is poorly understood. **Krug *et al.*** (p. 767; see the Perspective by **Crame**) investigated how the end-Cretaceous (KT) mass extinction altered temporal spatial diversification dynamics. Marine bivalves provide excellent fossil records and a well-documented modern biogeography. Long-term shifts in the rate of species origination were identified for the cohort of bivalve genera residing in modern oceans, which show a clear and sustained increase in diversification following the KT event. For bivalves, virtually all of the world's bioprovinces today bear the signature of the KT mass extinction despite the climatic, tectonic, and biotic events of the intervening 65 million years.

No Size Too Large

Radiation pressure is thought to halt the formation of stars with masses greater than 20 times that of the Sun, yet, somehow, such stars are known to exist. The radiation pressure produced by the light emitted by these stars is stronger than their gravitational attraction, preventing them from accreting gas from their natal cloud. **Krumholz *et al.*** (p. 754, published online 15 January; see the Perspective by **Whitney**) present three-dimensional radiation-hydrodynamic simulations of the formation of massive stars, which show that the instabilities driven by the interaction between gravity and radiation allow accretion to continue up to unlimited masses. These instabilities also produce fragmentation, leading to a high proportion of multiple star systems among massive stars.



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Oxygen Reduction at Doped Carbon Nanotubes

Fuel cells catalyze the reduction of oxygen with platinum, but cost and scarcity of platinum have led to a search for other catalysts with similar characteristics. Carbon-based catalysts are one alternative, and **Gong *et al.*** (p. 760) report that carbon nanotubes, when doped with nitrogen atoms and grown as vertically aligned arrays, catalyze the oxygen reduction reaction in highly alkaline solutions with activities comparable to that of platinum. The high activity is attributed to the electron-accepting ability of the nitrogen centers creating a net positive charge on adjacent carbon atoms.

Awesome Ores

Ore deposits represent unusually high concentrations of metals or other minerals, often deposited from a fluid. A major question toward understanding their origins is the concentrations in the fluids prior to deposition. Until recently, it has not been possible to measure metal concentrations in the tiny fluid inclusions directly within most ore minerals. **Wilkinson *et al.*** (p. 764; see the Perspective by **Bodnar**) have now measured this concentration directly in two lead-zinc deposits. Metal concentrations were orders of magnitude higher than predicted from solubility arguments or from data on accessory minerals.

Great-Appendage Arthropods

The "great appendage" arthropods, which lie near the base of the arthropod phylogenetic tree, are characterized by a large clawed limb at the front of the head and have only been found in the Burgess Shale–type deposits of the Cambrian. **Kühl *et al.*** (p. 771) report the discovery of a much more recent great appendage arthropod from 100 million years after the Cambrian, preserved in the Hunsrück Slate, the famous pyritized fossil deposit near Bundenbach in Germany. This arthropod is a kind of chimera, which retains

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primitive characters in an otherwise more advanced arthropod morphology. Thus, great appendage arthropods persisted for much longer than previously assumed, and their absence in the fossil record probably reflects a lack of suitable preservation sites.

Counting Centrosomes

Accurate chromosome segregation during eukaryotic cell division requires a microtubule spindle, formation of which in animals is driven by centrosomes. In order to maintain genome stability, centrosomes must be duplicated once every cell division cycle along with the genomic DNA. **Hemerly *et al.*** (p. 789) show that Orc1, a component of the Origin Recognition Complex (ORC) essential for DNA replication, also acts at centrosomes to control their copy number. Orc1 inhibits Cyclin E–dependent reduplication of the centrosome, and its localization to centrosomes is directed by the Orc1-binding partner Cyclin A.

Social Climbing

Many ant colonies are infiltrated by specialized social parasites that penetrate unharmed to feed on the rich resources concentrated within ant nests. **Barbero *et al.*** (p. 782) show that the larvae and pupae of a large blue (*Maculinea*) butterfly social parasite mimic the distinctive sounds made by their host ant's queen, eliciting similar enhanced care from the workers. The queen ants make different sounds from the workers in ant societies, and the workers behave more protectively when they hear a queen's sounds. Thus, the parasite is afforded better care and higher social status.

Little Killers

Platelets plug damaged blood vessels when activated by exposure to collagen, and can also adhere to and promote the sequestration of malaria parasites within narrow peripheral blood vessels, contributing to cerebral pathology. Their generally sticky nature also means that platelets are valuable adjuncts to front-line defenses against early stages of pathogen attack. **McMorran *et al.*** (p. 797) now show that, despite their pathological role later in infection, platelets are important to the innate host responses against the initial stages of malaria. Platelet inhibitors, including aspirin, remove the lethal effects of platelets on the malaria parasite *Plasmodium falciparum* in vitro. Mice engineered for platelet deficiency succumbed more rapidly to infection with a similar parasite *Plasmodium chabaudi*. In both cases the platelets stuck to the infected red blood cells and killed the parasite.

Working Memory and Dopamine

Working memory—the ability to retain information for short periods of time—is important for a wide range of cognitive functions. Dopaminergic neurotransmission plays a central role in working memory. **McNab *et al.*** (p. 800) investigated whether cognitive training changes the density of cortical dopamine D1 receptors and subcortical dopamine D2 receptors. Intensive training in volunteers induced an increase in working memory capacity, which correlated with changes in D1 but not in D2 receptor binding potential. These training-induced changes indicate an unexpectedly high level of plasticity of the human cortical dopamine D1 system and emphasize the mutual interdependence of behavior and the underlying brain biochemistry.

Axonal Regeneration in Nematodes

During nervous system development, a huge number of axons reach out toward their connections. In the adult, however, such outgrowth is much less common. When an adult nerve is injured, neurons are sometimes able to grow out new axons, but in humans, this imperfect process occurs more readily for nerves of the peripheral nervous system. **Hammarlund *et al.*** (p. 802, published online 22 January) now shed some light on the molecular tools that support axon regeneration in the nematode, *Caenorhabditis elegans*, and differentiate the process from normal development. In worms in which a genetic fault leads to excessively brittle axons, or in which a laser is used to cut axons, regeneration of the axon from the remaining stump depended upon a key kinase pathway. This kinase functions early in the road to regeneration, but does not seem to be involved during initial development of the axons.

CREDIT: BARBERO *ET AL.*

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