A Horse Is a Horse, of Course

The history of horse domestication is closely tied to the history of the human society. **Wade *et al.*** (p. 865) report on the sequencing and provide a single nucleotide polymorphism map of the horse (*Equus caballus*) genome. Horses are a member of the order perissodactyla (odd-toed animals with hooves). The analysis reveals an evolutionarily new centromere on equine chromosome 11 that displays properties of an immature but fully functioning centromere and is devoid of centromeric satellite sequence. The findings clarify the nature of genetic diversity within and across horse breeds and suggest that the horse was domesticated from a relatively large number of females, but few males.

Cluster Electronics and Catalysis

Many practical catalysts consist of small metal clusters on oxide supports, and the activity of these clusters usually varies with their size. In order to sort out some of the competing effects that lead to such variations, **Kaden *et al.*** (p. 826) size-selected palladium clusters (from single atoms to clusters up to 25 atoms) and deposited them on a crystal face of the rutile phase of titanium dioxide. X-ray photoemission studies and temperature-programmed reaction measurements showed that the activity of these model catalysts for CO oxidation was related to the electronic energy, which was reflected in the Pd 3d electron binding energy. Ion-scattering studies showed that the clusters formed flat single- or double-layer islands.

Simulating Surfaces

Although modern computational chemistry can often match or even exceed experimental accuracy in modeling gas phase reactions, the surface-bound processes involved in most practical catalysis pose a substantially greater challenge to theory (see the Perspective by **Hasselbrink**). **Díaz *et al.*** (p. 832) show that a modification to standard density functional methods can predict reaction barrier heights to within 1 kilocalorie per mole for the widely studied dissociative adsorption of dihydrogen on copper. In a complementary study, **Shenvi *et al.*** (p. 829) apply an efficient algorithmic framework to model transitions among multiple electronic states at a metal surface and successfully account for the complex dependence of nitric oxide scattering on the small molecule's vibrations and rotations.

Missing Mass Explained?

The motion and distribution of galaxies and clusters of galaxies within the universe suggest that there is far more matter than can be seen directly through telescopes. Alternatively, perhaps our understanding of gravity is flawed, leading to a mismatch between the gravitational field inferred from the observed mass distribution in the universe and the observed gravitational field. **Ferreira and Starkman** (p. 812) review the viability of modifying theories of gravity to solve the problem of missing mass. It emerges that theories of modified gravity remain viable but have become more complex, involving gravitating invisible elements. However, what you see is still not what you get.

Nitrogen Overload

The cycling of essential nutrients in terrestrial ecosystems has been altered by human activities. **Elser *et al.*** (p. 835) report a comparative analysis of lakes in Norway, Sweden, and in the United States that suggests that this is also true in aquatic ecosystems such as lakes. Deposition of anthropogenically derived atmospheric nitrogen controls whether N or P is growth-limiting for phytoplankton. Under elevated conditions of atmospheric N inputs, lake phytoplankton become consistently P-limited because the N:P ratio is strongly distorted. This is in contrast to conditions of low N deposition when lake phytoplankton are N-limited. These effects are even observed in remote lakes, demonstrating the indirect yet wide-ranging effects of humans on global food webs.

Entangling Rainbows

Quantum mechanical entanglement is at the heart of quantum information processing. In the

Continued on page 769

CREDITS (TOP TO BOTTOM): AL DODGE PHOTOGRAPHY; J. ELSER

Published by AAAS

Continued from page 767

future, practical systems will contain a network of quantum components, possibly operating at different frequencies. **Coelho *et al.*** (p. 823, published online 17 September) present a technique that can entangle light beams of three different frequencies. The ability to swap entanglement between different light fields should prove useful in advanced quantum information protocols on systems comprising different operating frequencies.

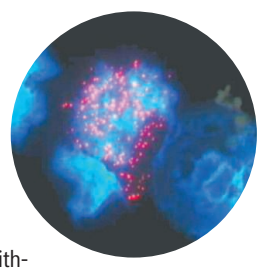
Long-Lost Pollinators

The rise of angiosperms in the Early Cretaceous (~140 million years ago) was accompanied by coevolution of a variety of insects, including flies, bees, and wasps required for pollination. **Ren *et al.*** (p. 840; see the Perspective by **Ollerton and Coulthard**) show that three families of scorpionflies had already evolved specialized mouth parts for feeding on the nectar of gymnosperms, as early as the Middle Jurassic (~170 million years ago). The diversity and specialization of these insects and related plant structures suggests that they were also involved in pollination. These families died out later in the Cretaceous as angiosperms began to dominate.

Butterfly Apartheid

Heliconius butterflies show differences in mimetic color patterns across geographic races associated with patterns of assortative mating, suggesting that ecological speciation may be ongoing. **Chamberlain *et al.*** (p. 847) demonstrate assortative mating on the basis of color pattern mimicry that generates reproductive isolation between *Heliconius cydno* species and subspecies within polymorphic populations in Ecuador. Furthermore, it appears that these traits are controlled by a single gene that affects color pigment in wing pattern formation and vision. Thus, these butterflies are indeed in the early stages of reproductive isolation that is being driven by an ecological trait, allowing observation of an incipient speciation event.

Slowing Brain Disease with Gene Therapy



X-linked adrenoleukodystrophy (ALD), the hereditary brain demyelinating disorder that was featured in the movie "*Lorenzo's Oil*," is typically treated by transplantation of bone marrow from matched donors. This treatment slows progression of the disease by introducing cells that differentiate into myelin-producing cells. **Cartier *et al.*** (p. 818; see Perspective by **Naldini**) tested an alternative gene therapy–based approach in two young patients without matched donors. A lentiviral vector was used to introduce a wild-type copy of the ALD gene into the patients' hematopoietic stem cells ex vivo. The modified cells were then infused back into the patients. Expression of the transferred gene was still detectable in the patients' blood cells 2 years later, and both patients showed neurological improvement and a delay in disease progression comparable to that seen with bone marrow transplants.

Bacterial Trigger of Plant Protection

Innate immunity can be rapidly activated to defend a host plant against a microbial pathogen. The rice protein XA21, which is thought to be a cell surface–located receptor with a kinase domain, activates the plant's defenses in response to infection by certain strains of *Xanthomonas* bacteria. **Lee *et al.*** (p. 850) have now identified the bacterial gene that encodes the protein, AvrXA21, to which the plant receptor XA21 responds. The 194–amino acid protein needs to be secreted and sulfated to trigger the rice plant defense responses. Similarities exist between the receptor XA21 and other immune response receptors in both plants and animals.

The Death of Cocco

Emiliania huxleyi is a coccolithophore, a class of unicellular phytoplankton that forms vast blooms mediating the oceanic carbon cycle through shedding of its calcium carbonate scales. *E. huxleyi* is routinely infected and killed by lytic viruses that can abruptly halt a bloom. **Vardi *et al.*** (p. 861) have found that in *E. huxleyi* strains that are sensitive or resistant to infection, a sphingolipid-based ''arms race'' appears to regulate cell fate during host-virus interactions. The lipid also serves as a biomarker for active infection that may help to quantify the role and activity of viruses and virus-mediated processes in the oceans. This information will help in assessing the biogeochemical impact of these plankton species.

Published by AAAS