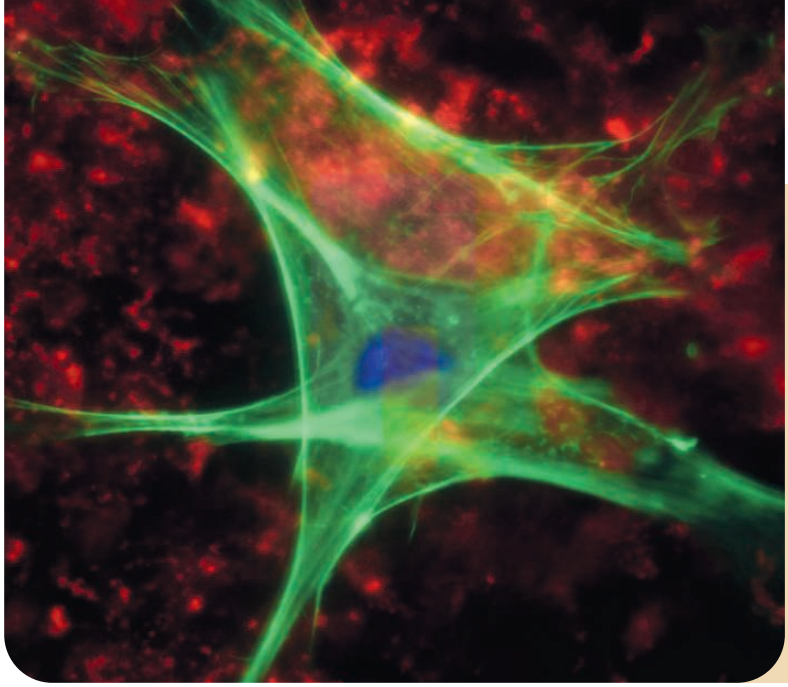

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<< Dissecting Ephrin-Receptor Interaction

Ephrins are transmembrane proteins that bind ephrin receptors on adjacent cells, leading to propagation of biochemical signals within both cells. **Jørgensen *et al.*** (p. 1502) devised a way to use differential isotopic labeling to distinguish cells engineered to express either the receptor or the ligand and to monitor bidirectional signaling events by mass spectrometry of the labeled peptides when the cells were mixed together. Signaling networks were constructed, and the information processing by the two interacting cell types was modeled. Changes in signaling within cells expressing just the ligand (ephrin) caused changes in the signal processing during the adjacent cell's response to binding of the ephrin receptor.

TAL Order

Xanthomonas bacteria attack their plant hosts by delivering their own transcription-activator–like (TAL) proteins into the plant cell nucleus and alter the plant's gene regulation (see the Perspective by **Voytas and Joung**). **Moscou and Bogdanove** (p. 1501, published online 29 October: see the cover) and **Boch *et al.*** (p. 1509, published online 29 October) have now discovered how the similar but not identical repeats in the TAL proteins encode the specificity needed for the proteins to find their targets. Each repeat is specific for one DNA base pair, a specificity encoded by hypervariable amino acid positions. Combining several repeats with different amino acids in the hypervariable positions allowed the production of new effectors that targeted new DNA sites.

Microquasar Spotted

Microquasars are binary star systems where a normal star sheds matter onto a neutron star or a black hole, generating x-ray radiation and jets of material moving at relativistic speeds. Microquasars have proved difficult to detect in high-energy gamma rays (> 100 megaelectron volts). Using the Fermi Large Area Telescope, **Abdo *et al.*** (p. 1512, published online 26 November; see the Perspective by **Bignami**) now report the detection of variable gamma-ray emission from the microquasar Cygnus X-3. The gamma-ray flux is modulated at the orbital period of Cygnus X-3, and its variation is correlated with the radio emission originating from the microquasar's relativistic jets.

An Odd Sort of Revolution

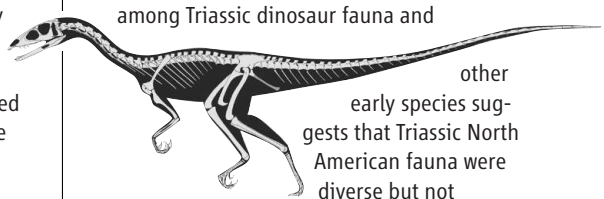
Joseph Hooker was the director of the Royal Botanic Gardens at Kew, London, when Charles Darwin and Alfred Wallace were presenting their ideas about evolution by natural selection. Hooker was a good friend of Darwin's and an ardent ally of evolutionary thinking, who came to realize that natural selection would have little impact on the taxonomist's endeavor. **Endersby** (p. 1496) reviews taxonomic practice in the 19th century, arguing that the concept of evolution was almost a sideshow in the energetic debate about whether to group varieties into single species or whether to divide species into endless varieties. On the one hand, Hooker was a "lumper," who found it hard to tolerate the thought of species constantly emerging, because it hindered his analysis of global patterns of species richness. On the other hand, Darwin's vision reconciled both modes of classification in revealing the genealogy of life on Earth.

Quick Spin Flips

Quantum computation holds the tantalizing promise of vastly improving the efficiency of traditional computers. Among the many solid-state candidates for storing and manipulating quantum information, nitrogen vacancy centers in diamond are especially attractive because they can be used at room temperature and stay operational for milliseconds at a time. To use this coherence time efficiently, it is important to achieve fast manipulation of the spins in the system. **Fuchs *et al.*** (p. 1520, published online 19 November; see the Perspective by **Gerardot and Öhberg**) used pulses of strong microwave magnetic field to probe the dynamics of single spins in a nitrogen vacancy center. In this "strong-driving" nonlinear regime, extremely quick spin flips of less than a nanosecond in duration were observed, offering the possibility that up to a million operations could be performed on a single spin during its coherence time.

Early Dinosaur Discovery

Our understanding of the evolution of early dinosaurs is hampered by limited material, especially compared to the many Jurassic and Cretaceous samples. **Nesbitt *et al.*** (p. 1530) provide a complete view of a Late Triassic theropod based on several nearly complete skeletons from New Mexico. The dinosaur elucidates the likely relationships between early theropods and shows that some prominent features were already derived by this time. Comparison among Triassic dinosaur fauna and other early species suggests that Triassic North American fauna were diverse but not endemic, perhaps arising from earlier migrants from South America.



Gas Leak Inspection

The solid portion of Earth was formed from accretion of material and debris formed in the primitive Solar System. Earth's early evolution included the differentiation of its interior and the development of a primordial atmosphere. Heavy noble gases in the atmosphere could have been acquired during the initial accretion process or may have accumulated later through gravitational volatile capture. **Holland *et al.*** (p. 1522) show that Kr and Xe trapped in the upper mantle have isotopic signatures characteristic of early Solar System material similar to meteorites rather than those of the modern atmosphere and oceans. Thus, noble gases trapped within the young Earth did not contribute to Earth's later atmospheric composition.

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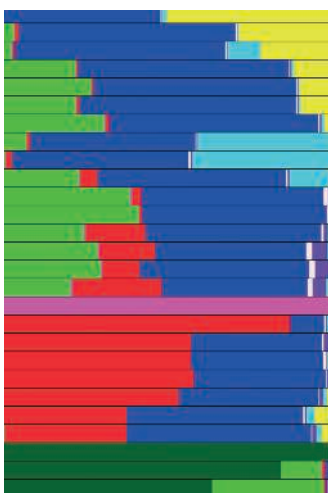
Framework for Change

Organic aerosols make up 20 to 90% of the particulate mass of the troposphere and are important factors in both climate and human heath. However, their sources and removal pathways are very uncertain, and their atmospheric evolution is poorly characterized. **Jimenez *et al.*** (p. 1525; see the Perspective by **Andreae**) present an integrated framework of organic aerosol compositional evolution in the atmosphere, based on model results and field and laboratory data that simulate the dynamic aging behavior of organic aerosols. Particles become more oxidized, more hygroscopic, and less volatile with age, as they become oxygenated organic aerosols. These results should lead to better predictions of climate and air quality.

Dissecting Amyloid Formation

Amyloid fibrils are associated with clinical disorders ranging from Alzheimer's disease to type II diabetes. Their self-assembly can be described by a master equation that takes into account nucleation-dependent polymerization and fragmentation. **Knowles *et al.*** (p. 1533) now present an analytical solution to the master equation, which shows that amyloid growth kinetics is often limited by the fragmentation rate rather than by the rate of primary nucleation. In addition, the results reveal relationships between system properties (scaling laws) that provide mechanistic insight not only into amyloid growth, but also into related self-assembly processes.



CREDIT: JIN *ET AL.*

Patterns of Early Migration

In order to gain insight into various migrations that must have happened during movement of early humans into Asia and the subsequent populating of the largest continent on Earth, the **HUGO Pan-Asian SNP Consortium** (p. 1541) analyzed genetic variation in almost 2000 individuals representing 73 Asian and two non-Asian populations. The results suggest that there may have been a single major migration of people into Asia and a subsequent south-to-north migration across the continent. While most populations from the same linguistic group tend to cluster together in terms of relatedness, several do not, clustering instead with their geographic neighbors, suggesting either substantial recent mixing among the populations or language replacement. Furthermore, data from indigenous Taiwanese populations appear to be inconsistent with the idea of a Taiwan homeland for Austronesian populations.

An Innervative Small RNA

Amyotrophic lateral sclerosis (ALS) is a relentless disease characterized by progressive degeneration of motor neurons that control muscle movement, leading to muscle atrophy and paralysis. **Williams *et al.*** (p. 1549; see the Perspective by **Brown**) show that a small noncoding RNA that is selectively expressed in skeletal muscle, miR-206, senses motor neuron injury or loss and helps ameliorate resultant muscle damage by promoting regeneration of neuromuscular synapses. Expression of miR-206 was dramatically induced in a mouse model of ALS, and when this RNA was removed from mice by genetic manipulation, the disease progressed at a faster rate. The salutary effects of miR-206 appear to be mediated through a signaling pathway in muscle cells involving histone deacetylase 4 and a fibro-blast growth factor modulator, activation of which leads to release of factors that promote nerve-muscle interactions.

Norbin Knockout

Metabotropic glutamate receptors (mGluRs) are critical neurotransmitter sensors implicated in central neuronal functions like learning and memory and in diseases of the nervous system. **Wang *et al.*** (p. 1554) searched for proteins that interact with mGluR5a and identified a previously unrecognized component of the receptor signaling complex. The protein Norbin directly interacted with the receptor. Loss of Norbin in mice or cultured cells showed that it is necessary for the accumulation of mGluR5a in the cell membrane, for normal modulation of synaptic plasticity, and for some behavioral responses.

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