EDITORS' CHOICE

edited by Gilbert Chin

GEOPHYSICS

The Effects of Deglaciation

Our knowledge of the motion of Earth's major tectonic plates, which move at velocities of up to several centimeters per year, has come primarily from observations and dating of marine magnetic anomalies. As mid-ocean ridge magmas cooled, they locked in magnetic signatures that recorded the orientation of Earth's magnetic field and allowed the spreading and the geometry of ocean crust to be reconstructed. More recently, global positioning system (GPS) measurements, which have been made for about 20 years, have provided comparable resolution and perhaps a better indication of current plate motions.

Sella *et al.* provide a synthesis of GPS data from the past decade and compare it with the best estimates from magnetic anomalies. Overall, the agreement is good, although there are differences in the motions across the North American, South American, and Caribbean plate boundaries. The resolution of the GPS data is sufficient to show that the current plate motion for the Antarctic, North American, and Eurasian plates has been perturbed by the melting of the major ice sheets during the past 15,000 years. — BH

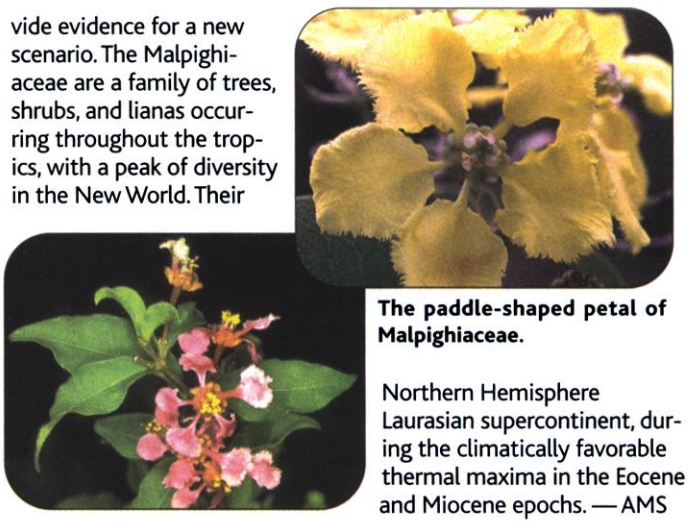
J. Geophys. Res. **107**, 10.1029/2000JB000033 (2002).

EVOLUTION

A Northerly Migration

Many groups of organisms have members in both Africa and South America. These disjunct distributions are commonly attributed either to an origin on the Gondwanan supercontinent before its breakup around 100 million years ago (Ma) or to long-distance dispersal across the widening Atlantic Ocean.

In a molecular phylogenetic analysis of the plant family Malpighiaceae, Davis *et al.* provide evidence for a new scenario. The Malpighiaceae are a family of trees, shrubs, and lianas occurring throughout the tropics, with a peak of diversity in the New World. Their analysis indicates that the family originated in what is now northern South America about 64 Ma, well after the breakup of Gondwana; at least six separate transoceanic dispersal events would have to have taken place to produce the current distribution, which seems unlikely. Instead, Davis *et al.* propose that the early Malpighiaceae spread mostly overland across the Northern Hemisphere Laurasian supercontinent, during the climatically favorable thermal maxima in the Eocene and Miocene epochs. — AMS

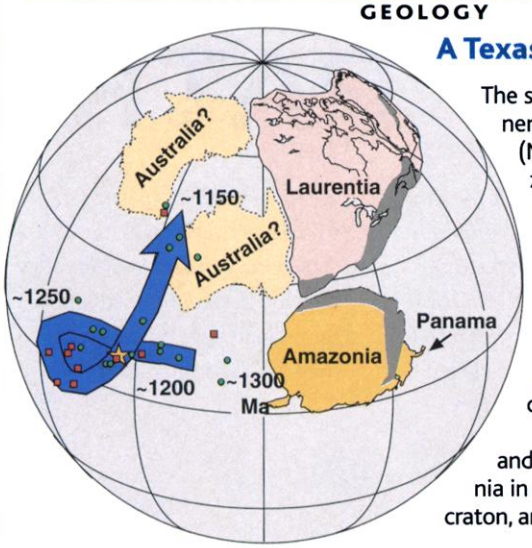


The paddle-shaped petal of Malpighiaceae.

Proc. Natl. Acad. Sci. U.S.A. 10.1073/pnas.102175899 (2002).

GEOLOGY

A Texas-Sized Collision



Collision between Amazonia and Texas (southernmost gray shading in Laurentia), with polar wander path in blue.

The supercontinent Rodinia, an accretion of all the continents, existed between 1200 and 600 million years ago (Ma). One piece of ground truth for this tectonic puzzle is the Grenville Province, a region of metamorphism and deformation that runs from Labrador to the Llano Uplift in Texas and formed the coastline of Laurentia. About 1200 Ma, the Grenville province collided with a cratonic piece (Amazonia) of South America. The rocks in the uplift provide evidence for this long-ago collision; however, it has been difficult to identify which piece of Amazonia collided with this proto-Texas region.

Tohver *et al.* studied a large sequence of gabbros and basalts from the Nova Floresta formation of Rondônia in western Brazil. These rocks are part of the Amazon craton, and Ar-Ar dating indicates that they are 1200 million years old. Magnetic characteristics of the rocks were used to determine the paleomagnetic pole and to fix the paleogeographic position of Amazonia. It appears that around 1200 Ma, one corner of this craton (oriented roughly 180 degrees from its present-day position) collided with the proto-Texas region and created the Llano Uplift. — LR

Earth Planet. Sci. Lett. **199**, 185 (2002).

MICROBIOLOGY

Getting Enough Air to Survive

After infection by tubercle bacteria, the host battles the invader to a standoff, at least as long as the immune system functions effectively. Upon entry, the pathogen subversively invades the immune system through inactivated macrophages; the distressed and infected host cells then emit signals that recruit activated macrophages to encapsulate the site of infection in a characteristic granuloma, or tubercle. Nitric oxide (NO) produced by these macrophages controls pathogen growth by inhibiting aerobic respiration in the bacteria and contributing to the formation of toxic peroxynitrite. Tubercle bacteria do not have flavohemoglobins (which other pathogens use to detoxify NO) but instead have three types of distinctive truncated hemoglobins (trHbs). Ouellet *et al.* have found that the trHbs act in concert in mycobacteria to acquire enough oxygen to support the conversion of NO into innocuous nitrate. — CA

Proc. Natl. Acad. Sci. U.S.A. **99**, 5902 (2002).

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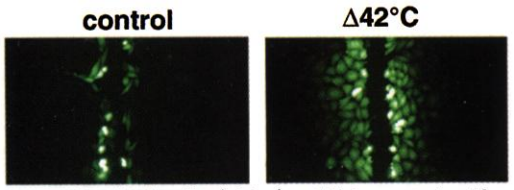
CELL BIOLOGY

Mind the Gap

Cells that are subjected to a variety of stresses, such as heat shock, make fundamental changes in the way they process misfolded proteins in order to retrieve, where possible, proteins that have not been damaged fatally. In looking at the stress response of cells, VanSlyke and Musil noticed changes in the way that misfolded proteins



Heat-shocked cells (right) exhibit more Lucifer yellow–conducting gap junctions than unstressed cells (left).

within the endoplasmic reticulum (ER) are processed. Generally, misfolded or incompletely assembled proteins are transported out of the ER and into the cytosol for degradation by proteasomes. However, in stressed cells, this dislocation reaction appears to be less efficient, allowing proteins that might previously have been removed from the ER to complete their folding and assembly and subsequently to be transported to the cell surface. The authors specifically examined the folding and transport of components of gap junctions, and the net effect of stress was the assembly of excess functional gap junctions at the cell surface. — SMH

J. Cell Biol. **157**, 381 (2002).

CLIMATE SCIENCE

Modeling Atmospheric Circulation

The Quasi-Biennial Oscillation (QBO) is a cyclic atmospheric process with a period slightly longer than 2 years; it involves reversals of the easterly and westerly phases of equatorial zonal stratospheric winds. The QBO dominates the interannual variability in the tropical stratosphere and causes a secondary circulation with an associated response in the temperature distribution and global effects on trace gas distributions. Thus, general circulation models must simulate the QBO accurately if they are to predict climate more reliably. Giorgetta *et al.* have developed a model that successfully simulates the QBO by incorporating improved spatial resolution, a realistic simulation of tropical convection, and the effects of gravity waves. With these improvements, their model yields a QBO very similar to the observed one, forced from a broad spectrum of atmospheric waves (as expected from observations) and without the need for specific ad hoc adjustments. — HJS

Geophys. Res. Lett. **29**, 10.1029/2002GL014756 (2002).

APPLIED PHYSICS

Clear Reflections

Optical components such as mirrors can be made to very high specification. However, because of stresses arising during operation, mirrors can warp, sag, or bend. For very high-specification systems, adaptive optics uses feedback to iron out the deformations by making tiny mechanical adjustments via a network of actuators attached to the underside of the mirror. Vdovin *et al.* describe an actuation system that is relatively inexpensive and may be suitable for applications that are not extremely demanding. Their demonstrator system comprises 19 resistors placed in a hexagonal array underneath a flexible mirror. The resistor length is temperature-dependent, and each resistor is controlled and adjusted by a current source. With a response time of 5 seconds and actuator motion of about 6 micrometers, this simple setup is ideally suited to correcting slowly varying deformations and aberrations in mirror systems. — ISO

Opt. Lett. **27**, 677 (2002).

EVOLUTION

Mixing and Matching, Maybe

The central position of ribosomal RNA (rRNA) in molecular phylogenetics has recently been reinforced, both by its demonstrated importance in translation and by the evolutionary proximity of nucleic acid machinery (mediating replication and transcription) in eukaryotic and archaeal lineages. Nevertheless, the heated discussion concerning metabolic enzymes has been stoked by the provision of new genome sequences. Now, Canback *et al.* suggest that the eukaryotic glycolytic enzymes cannot have been obtained en masse from the mitochondrial symbiont, because they do not cluster with the enzymes of α-proteobacteria. On the other hand, these protein trees and those of other metabolic pathways are not simply isomorphic with that of rRNA, which may in part be due to lateral gene transfer among the ancestors of extant α-proteobacteria and even between eukaryotic hosts and pathogenic bacteria. For a historical view of the continuing debate about the origin of the mitochondrion, see Martin *et al.* — GJC

Proc. Natl. Acad. Sci. U.S.A. **99**, 6097 (2002); *Biol. Chem.* **382**, 1521 (2001).

CREDITS: VANSLYKE AND MUSIL, *J. CELL BIOL.* **157**, 381 (2002)