EDITORS' CHOICE

edited by Gilbert Chin

BOTANY

Marking Time in Development

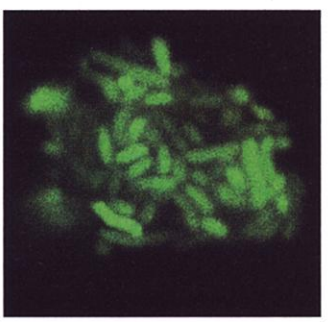
In its search for a host, the parasitic plant *Striga asiatica* must identify a valid target and then trigger its own development to form the parasitic structures, beginning with the attachment organ known as the haustorium. Quinones function as part of the signal transduction cascade that identifies a qualified host in the vicinity.

O'Malley and Lynn have pinpointed expansin gene transcription as a critical component of the mechanism by which the plant perceives that it has received enough signal to commit itself irreversibly. The expansin proteins that are ultimately expressed, given sufficient quinone signal, are responsible for perturbing the biochemistry of the cellulose fibers in the cell wall (as reviewed by Cosgrove) and thus changing its shape as the invading haustorium forms. Expansin messenger RNA accumulates in the presence of quinone signals until a threshold is reached; in a process akin to charging a capacitor, signal can be added discontinuously, although lengthy pauses will cause the accumulated signal to dissipate. — PJH

Plant Cell **12**, 1455 (2000); *Nature* **407**, 321 (2000).

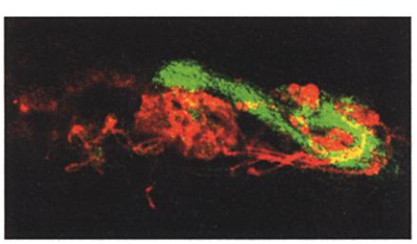
ECOLOGY/EVOLUTION

Recruiting a Luminous Partner



Symbioses between multicellular animals and microorganisms are commonplace in marine habitats. While a good deal is known about the mutual benefits derived from these associations, the mechanisms by which the partners make contact and establish a symbiosis every generation have remained mysterious. The turbulence of the marine environment and the vanishingly low concentrations of free-floating microbial cells present a substantial challenge.

The Hawaiian squid *Euprymna scolopes* has within its mantle cavity a light-emitting organ that depends for its function on colonization by the luminous bacterium *Vibrio fischeri*. Using a combination of transgenic and confocal microscopy techniques, Nyholm *et al.* find that the juvenile squid harvest their microbial partner by creating ciliary currents that cause the bacteria to aggregate on a mucus-like matrix; when *Vibrio* are present in the surrounding medium, this matrix is formed in response to a chemical signal that has not yet been identified. Several hours after inoculation and aggregation, the captured cells actively migrate along mucus strands to colonize the internal crypt spaces of the light-emitting organ. This partnership may typify mechanisms by which aquatic hosts increase the likelihood of encountering and capturing rare symbionts. — AMS



Collecting bacteria (green) in secreted mucus (red).

Proc. Natl. Acad. Sci. U.S.A. **97**, 10231 (2000).

SOURCE: (LEFT) NYHOLM *ET AL., PROC. NATL. ACAD. SCI. U.S.A.* **97**, 10231 (2000); (RIGHT) WANG, *PHYS. REV. LETT.* **85**, 2216 (2000).

GEOLOGY

Lunar History

Earth's tides are produced by the orbital interactions of the moon around the rotating Earth and those of the Earth around the sun. Tidal friction has slowed Earth's rotation (lengthening the day) and altered the moon's orbit. This history, extending back to about 1 billion years ago, has been inferred and measured by analyzing sedimentary rocks that fortuitously preserve features—such as rhythmic layering or crossbeds—produced by tides.

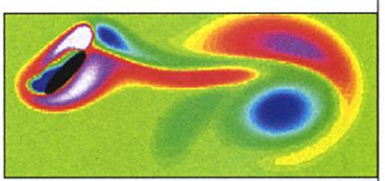
Eriksson and Simpson now analyze sedimentary rocks from South Africa dating to 3.2 billion years ago that apparently have a tidal origin. This age is much closer to the time of the moon's origin and would allow, if their interpretation is correct, inference of the moon's orbit in the Archean. Their analysis implies that tides were not unusually strong then and that the Archean lunar orbit was not markedly elliptical, making it similar to that seen today. This conclusion is consistent with formation of the moon by coalescence of material that was generated by an early giant impact into the proto-Earth (which would produce a near-circular orbit), as opposed to the capture of an already formed moon (which would have resulted in a highly elliptical orbit). — BH

Geology **28**, 831 (2000).

BIOPHYSICS

Flying in Two Dimensions

Although airplanes and animals fly in three dimensions, the basic way in which a moving fixed wing produces lift can be modeled as a two-dimensional flow (the familiar contours showing faster flow above the wing and slower flow beneath). The much greater difficulties in modeling the non-fixed wings characteristic of insect flight have suggested that the basic process may be truly three-dimensional and may depend on eddy-like currents moving up or down the wing surfaces. Wang now shows that two-dimensional flows are sufficient to produce lift for the case of the "figure-eight" wing motion seen for most flying insects, such as dragonflies and fruit flies. She solves the appropriate Navier-Stokes equation numerically to the fourth order and finds that this motion not only can create lift-producing vortices but also will shed them to avoid interference with those created in the next cycle of wing strokes. — PDS



Counter-rotating vortices during a wing downstroke.

Phys. Rev. Lett. **85**, 2216 (2000).

CELL BIOLOGY

Molecular Bulldozing

In order to control a variety of gene expression processes the cell stores control factors, known as transcription factors, away from nuclear genes in the cytosol. To be doubly sure, the cell sometimes even stores these proteins as integral membrane proteins; in response to a specific signal, the cell then must liberate the transcription factors from the appropriate membrane so that they can enter the nucleus and activate their target genes.

Hoppe *et al.* examined the details of a system that regulates the ratio of saturated and unsaturated fatty acid synthesis, and discovered an interesting twist. In the case of two

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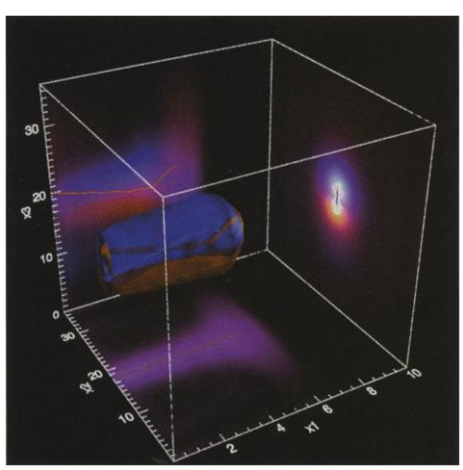
related yeast transcription factors known as SPT23 and MGA2, the cell uses the cytosolic ubiquitin-proteasome degradative pathway to cleave the transcription factor from the membrane. The proteasome pathway is not usually used in site-specific cleavage, but generally degrades its substrates to small peptides. The details of how the proteasome makes its way to the requisite cleavage site near the membrane and of how complete degradation is blocked remain to be elucidated, but as ever in biology, it appears that there are as many variations on a theme as there are themes to discover. — SMH

Cell **102**, 577 (2000).

PHYSICS

Double Helical Light Beams

Two laser beams traveling side by side in vacuum do not interact, irrespective of how closely they approach. In a nonlinear optical medium, however, light-light interactions are quite different, as evidenced by the self-focusing effect seen when an intense laser beam passes through such as medium. Theoretically, the self-focusing can be described by associating a potential well, induced by the nonlinearity, with the propagating laser beam. Ren *et al.* present a model



Attractive interactions between two laser beams (red and blue).

CREDIT: REN *ET AL.*, *PHYS. REV. LETT.* **85**, 2124 (2000).

that shows that one propagating laser beam can interact with and influence the trajectory of a second beam. Under appropriate conditions, their model calculations show that the attractive force between the two beams can result in them spiraling around each other. The results may have potential in future light-steering applications in which light may be directed with light. — ISO

Phys. Rev. Lett. **85**, 2124 (2000).

PHYSIOLOGY

Fanning the Flame

Increasing the rate of fluid flow across a chemosensory structure, for instance, by sniffing, would be expected to counteract the tendency of sensory receptors to habituate to odorant molecules presented continuously. In a quantitative analysis of the male silkworm moth *Bombyx mori*, Loudon and Koehl describe several additional effects that together magnify by orders of magnitude the impact of wing flapping on improving the detection of female sex pheromone. They show that a larger volume of air is carried past the moth's antennae and that the increased velocity of air flow results in greater infiltration of the sensilla on the antenna. Furthermore, the sensilla would rapidly capture all of the available pheromone at air velocities that a walking moth (these moths rarely fly) would experience; again, fanning the wings serves to replenish the local reservoirs of pheromone. — GJC

J. Exp. Biol. **203**, 2977 (2000).

MICROBIOLOGY

A Target to Miss

The incidence of life-threatening fungal infections is on the increase, and so too is the incidence of fungal resistance to the standard azole drugs used to inhibit sterol 14α-demethylase, an enzyme required for the biosynthesis of ergosterol, which is an essential fungal cell membrane constituent. Polyenes are an alternative antibiotic, but these are unattractive due to their toxicity; therefore, the hunt is on to find other leads. Sterol biosynthesis has long been regarded as a potential target, both in medically important fungi and in plant crop diseases. Inhibition of an upstream enzyme in the sterol pathway, squalene synthase, in the laboratory yeast *Saccharomyces cerevisiae* leads to cell death, but its importance for pathogenic fungi in vivo has not been assessed.

Nakayama *et al.* made mutants of the pathogenic fungus *Candida glabrata* in which the gene for squalene synthase was turned off via a tetracycline-regulatable switch. Although growth in laboratory media was hampered, the *C. glabrata* mutant remained viable and pathogenic in mice. It turns out that the mutant fungus can scavenge cholesterol from the host serum to correct its defect, one reason why many of the ergosterol biosynthesis pathway inhibitors, some of which have been released for use in human infections, may be ineffective. — CA

Antimicrobial. Agents Chemother. **44**, 2411 (2000).