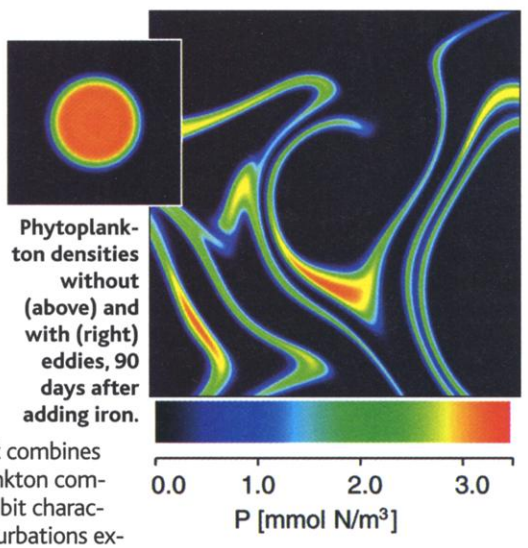
EDITORS' CHOICE

edited by Gilbert Chin

OCEANOGRAPHY

Limits to Growth

The realization that iron availability can limit phytoplankton growth has stimulated a wave of studies in which areas of the ocean that harbor low phytoplankton densities are fertilized with iron and productivity is measured. Moreover, it has been suggested that adding iron to the ocean could help to combat global warming by removing carbon dioxide from the atmosphere. As appealing as that might be, though, it is not clear what other effects might be produced by iron fertilization on the scale that would be needed to effect a reduction in atmospheric CO_2.



Phytoplankton densities without (above) and with (right) eddies, 90 days after adding iron.

Neufeld *et al.* present a mathematical model that combines the effects of stirring by ocean eddies and phytoplankton community growth. They find that plankton blooms exhibit characteristics of an excitable system—meaning that perturbations exceeding a certain threshold can induce a large and temporary deviation from the equilibrium state—and that a larger-than-expected, iron-induced bloom could occur through the development of a structure they call a "propagating bloom filament." The authors caution that more analysis of ecosystem and geoengineering interventions is needed before we can be confident of the possible outcomes. — HJS

Geophys. Res. Lett. **29**, 10.1029/2001GL013677 (2002).

ECOLOGY/EVOLUTION

Guts, Germination, and Seeds

Many plant species take advantage of the mobility of animals for the dispersal of pollen and seeds. A common form of seed dispersal is endozoochory, whereby animals ingest seeds and fruits and then pass the seeds in their feces; the seeds of some plants actually require passage through an animal gut in order to germinate. Pakeman *et al.* quantify this phenomenon in an ecological context by recording seed dispersal by rabbits and sheep in a variety of grazed habitats in Scotland, and by germinating seed from dung collected during the summer months. The seeds of almost 40% of the plant species recorded in these habitats were able to germinate successfully after passing through rabbits or sheep—a substantially higher proportion than previously thought. Regardless of habitat type, species with smaller seeds and those capable of persisting in a soil seedbank tended to predominate. — AMS

Seedlings germinating from sheep pellets.

Funct. Ecol. **16**, 296 (2002).

GEOPHYSICS

Mature Seismic Gap

The beautiful coastal ranges of Chile are seismically active, averaging a large-magnitude earthquake every 10 years. This activity is due to the subduction of the Nazca Plate beneath the South American Plate. The number of seismic instruments deployed in Chile is small, so it has been difficult to determine the seismic hazard and how much of the plate motion is accommodated in the crust. In particular there is a region along the coast between latitudes 35 to 37 degrees that has not experienced a subduction-zone earthquake since 1835. This region may represent a mature seismic gap that has a higher probability of a large earthquake than other regions along the subduction zone.

Ruegg *et al.* measured the interseismic velocity of surface locations above the subduction zone using Global Positioning System measurements. The coastal sites are moving about 40 millimeters per year relative to a stable South America. This suggests that the subduction zone is locked below the coastal sites, that strain is accumulating, and that a subduction-zone earthquake is likely. The 18 June 2002 earthquake (magnitude 6.6) at 31 degrees south near Coquimbo occurred north of the gap and may not have helped relieve strain. — LR

Geophys. Res. Lett. **29**, 10.1029/2001GL013438 (2002).

ANALYTICAL CHEMISTRY

Warmly Brought Together

Biological samples often present the challenge of handling a dilute sample in a small (nanoliter) volume; several methods have been developed for concentrating samples before they are introduced into separation columns. For capillary electrophoresis, one simple method is to use field gradients so that all of the analyte moves to one point along a channel. However, the electrodes needed to produce the fields can react with the sample. Ross and Locascio have developed the approach of temperature gradient focusing, which allows for concentration and simultaneous separation of analytes (DNA, proteins, and cells) in solution. A temperature gradient induces an electric field gradient in the solution in the microchannel biased for electrophoresis, and, by opposing the resulting analyte velocity gradient against the bulk flow of fluid, the analyte can be focused. Small analytes in a microfluidic system can be concentrated up to 10,000 times. — PDS

Anal. Chem. **74**, 2556 (2002).

BIOCHEMISTRY

Cluster Analysis

The oxygen that we breathe comes from the four-electron oxidation of two water molecules. This reaction is catalyzed by a cluster of four oxygen-bridged manganese atoms in photosystem II (PSII); their precise arrangement has not yet been determined. Following a suggestion that naturally occurring manganese oxide minerals may have been the source of the Mn_4 cluster, Sauer

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CREDITS: (LEFT) ROBIN J. PAKEMAN/THE MACAULAY INSTITUTE; (TOP) NEUFELD *ET AL.*, *GEOPHYS. RES. LETT.* **29**, 10.1029/2001GL013677 (2002); (RIGHT) SAUER AND YACHANDRA, *PROC. NATL. ACAD. SCI. U.S.A.* **99**, 8631 (2002)

and Yachandra have compiled a group of allowed geometries. Carrell *et al.* have summarized the extensive body of spectroscopic work on PSII and model compounds and list possible Mn_4 structures that would fit within the 3.8-angstrom resolution electron density of the PSII complex. One of the mutually favored candidates is a funnel-shaped Mn_4O_6 core, containing a central tetrahedral manganese atom. — GJC

Proc. Natl. Acad. Sci. U.S.A. **99**, 8631 (2002); *J. Biol. Inorg. Chem.* **7**, 2 (2002).

IMMUNOLOGY

Regulating Graft Rejection

Achieving immune tolerance to transplanted tissues remains a major hurdle in organ transplantation. Increasingly, it is becoming clear that protocols aimed at improving graft-specific tolerance will need to consider regulatory T cells, because these lymphocytes are known to be important in suppressing immune responses.

Graca *et al.* have explored the mechanism behind a form of profound acquired tolerance, induced in rodents through administration of therapeutic nondepleting antibodies directed at T lymphocytes. Recipient mice that underwent this treatment accepted foreign skin grafts from donor mice. In their current work, the retransplantation (from the recipients) of the tolerated grafts onto third-party mice was sufficient to induce tolerance in those mice to subsequent grafts that otherwise would have been rejected. Regulatory T cells that had infiltrated the grafted tissue (after the initial transplant) were responsible for the transfer of tolerance, because depleting the T cells from the skin graft after transplanting it a second time resulted in rejection. These results are supportive of a functional role for suppressive regulatory T cells within transplanted tissue. — SJS

J. Exp. Med. **195**, 1641 (2002).

BIOMEDICINE

A Matter of Fat

Although adipose tissue (body fat) generally gets a bad rap in the context of human health, a growing body of research indicates that this tissue produces several hormones, or "adipokines," that are essential for normal feeding behavior, metabolism, energy balance, and vascular tone. Among the fat-derived hormones is adiponectin, a protein whose serum levels are high in lean individuals and low in obese individuals.

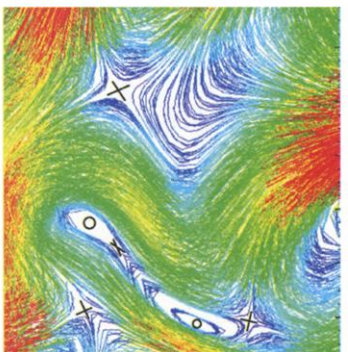
Previous work had suggested that adiponectin might also regulate insulin sensitivity. This link is strengthened by new work from Kubota *et al.* and Maeda *et al.*, who independently generated mice genetically deficient in adiponectin. When placed on a high-fat diet, mice lacking this hormone showed a weight gain comparable to that of control mice, but, in contrast to controls, they developed moderate to severe insulin resistance, a hallmark of type 2 diabetes. Intriguingly, Kubota *et al.* also report that the adiponectin-deficient mice might be more susceptible to vascular disease, as evidenced by the animals' exaggerated response to mechanical injury of the femoral artery, a model that mimics human atherosclerosis. These results support the view that adiponectin is a critical molecular link between obesity, diabetes, and atherosclerosis. — PAK

J. Biol. Chem. 10.1074/jbc.C200251200 (2002); *Nature Med.* 10.1038/nm724 (2002).

PHYSICS

Stretch and Fold

Mixing in fluid systems is normally associated with turbulent flows, where the high energy of the system causes neighboring fluid elements to diverge. However, mixing can be produced in less energetic, time-periodic systems by introducing chaos into the agitation pattern, which causes stretching and folding of the fluid elements. Voth *et al.* have monitored experimentally the local flow dynamics in two dimensions, using approximately 800 fluorescent particles to track the fluid elements. From the trajectories of the particles, a Poincaré map of the local velocities can be constructed; of particular interest are the elliptic (circles) and hyperbolic (crosses) fixed points where there is no net fluid motion. Introducing a fluorophore revealed regions where the fluid elements are stretched, and, by analyzing snapshots, the authors are able to correlate lines of stretching with the elliptic fixed points. — MSL



Poincaré map showing points of large (red) and small (blue) displacements.

CREDIT: VOTH *ET AL.*, *PHYS. REV. LETT.* **88**, 254501 (2002)

Phys. Rev. Lett. **88**, 254501 (2002).