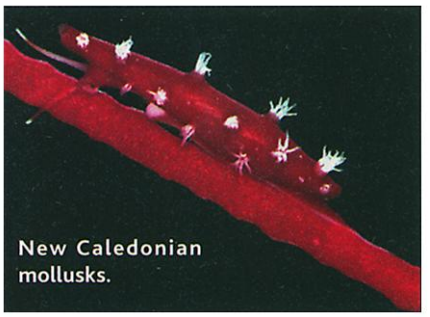
EDITORS' CHOICE

edited by Gilbert Chin

ECOLOGY/EVOLUTION

Multiplying Mollusks


New Caledonian mollusks.

Estimates of the total number of living species on Earth are still very approximate, ranging from a few million to tens of millions. Much of the uncertainty arises from patchy collecting, especially in the tropical oceans. In an intensive collecting program around New Caledonia in the western Pacific Ocean, Bouchet *et al.* recorded nearly 3000 mollusk species—more than twice as many as have been previously recorded from comparable areas. Most of these species were recorded from fewer than six of 42 collecting stations in the 295 km^2 study area, indicating the importance of relatively rare species in contributing to total biodiversity. It is still impossible to extrapolate from these figures to estimate total mollusk species richness in the tropical oceans to within less than an order of magnitude. Nevertheless, because mollusks contribute more than 50% of the total invertebrate species in the tropical Indo-Pacific waters, it is clear that total marine species richness is likely to be revised upward as further intensive collections are made. — AMS

Biol. J. Linn. Soc. **75**, 421 (2002).

GEOCHEMISTRY

A Cooling off Period

The earliest stage of Earth's history from 4.56 to 4.45 billion years ago (Ga) was hot and has been referred to as Hadean. The oldest known rocks date from 4.0 Ga and the oldest known water-derived sedimentary rocks from 3.8 Ga, consistent with a cooled Earth consisting of a stable crust and liquid water oceans. Whether the intervening stage from 4.4 to 4.0 Ga was hot, with boiling oceans and a steamy atmosphere, is not yet settled.

To estimate surface conditions during this period, Valley *et al.* compiled all of the oxygen isotopic data for detrital zircon grains with U-Pb crystallization ages between 4.4 and 2.6 Ga. All of the grains were enriched in the heavier ^{18}O isotope relative to standard mean ocean water, which is consistent with zircon crystallization in a liquid water environment and suggests that, as early as 4.4 Ga, the steamy Earth was already condensing into cool blue oceans. A cooling Earth would have been subject to the late heavy bombardment (LHB), a peak of bolide impacts in the inner solar system between 3.8 to 4.0 Ga (no oxygen isotopic concentrations are available from zircons within this period). Nevertheless, the heating of Earth's surface caused by the LHB could have been brief and might not necessarily have destroyed the nascent hydrosphere and the first inklings of life. — LR

Geology **30**, 351 (2002).

EVOLUTION

Stripped Down to the Bare Essentials

Coupling the belief that early forms of life arose under inhospitable conditions (high temperatures and low oxygen) to the reasonable assumption that simpler organisms are more ancient than complex ones would place *Methanopyrus kandleri* near the base not only of the "black smoker" chimneys in the deep ocean but also of the archaeal tree. Nevertheless, having sequenced the genome of this organism, which is capable of growing on H_2 and CO_2 at temperatures above 100°C, Slesarev *et al.* conclude just the opposite. A substantial fraction of the *M. kandleri* proteins can also be found in two other archaeal methanogens, and this trio consistently forms a cluster in trees of archaeal species when analyzed on the basis of genes and operons. Unlike its relations, however, *M. kandleri* shares only a small percentage of its proteome with bacteria, which the authors suggest may reflect having had fewer opportunities for lateral transfer in its extreme environment, and its present impoverished state (in terms of gene number and signal transduction pathways) appears to be a consequence of life as a minimalist. — GJC

Proc. Natl. Acad. Sci. U.S.A. **99**, 4644 (2002).

CHEMISTRY

High-Spin Keggin Ions

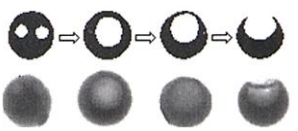
Polyoxometalate ions (POMs) are large cluster anions that contain metal ions and oxo ligands. Among these are the Keggin ions, $[XM_{12}O_{40}]^{3-}$, in which X is a nonmetal such as P^{V} or metal ion such as Fe^{III}, but M is always an early transition metal, such as Mo, V, or W, in a low-spin d^0 state. Bino *et al.* now show that a Keggin ion in which X and M are Fe^{III} atoms in the high-spin d^5 state can be formed by incorporating methoxy (OMe) and fluoride ions. The species $[Fe_{13}O_4F_{24}(OMe)_{12}]^{5-}$ was synthesized in 20% yield by reacting $FeF_3 \cdot 3H_2O$ and pyridine in hot methanol. Strong exchange interactions were inferred from preliminary magnetic susceptibility measurements. These results open up new synthetic opportunities for POMs, which have found many applications in materials science and catalysis. — PDS

J. Am. Chem. Soc. 10.1021/ja025590a.

CHEMISTRY

Been to the Barber?

Micelles and vesicles form in solution through an interplay of hydrophobic and hydrophilic effects, and their size and shape are highly sensitive to changes in the architecture of the molecules and to small variations in solvent conditions.



Mechanism of bowl formation; schematic, above; micrographs, below.

Most micelles are of the star type, consisting of a thin core surrounded by a thick corona. However, for highly asymmetric triblock copolymers, the reverse occurs, and a large core is surrounded by a thin or "crew-cut" corona. To make these materials, the polymer is dissolved in an organic solvent that accommodates both blocks, and then water is added.

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SOURCE: (TOP LEFT) P. LABOUTE/IRD; (TOP RIGHT) S. SCHIAPARELLI/UNIVERSITY OF GENOA; (BOTTOM) *LANGMUIR* 10.1021/LA0155921 (2002)

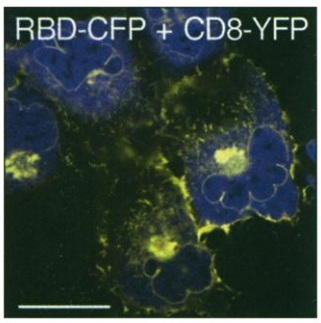
Working with triblock copolymers built on a long polystyrene core and functionalized isoprene end blocks, Riegel *et al.* have observed a new bowl-shaped morphology that they attribute to the coalescence of bubbles within the micelle, which occurs when the water is added to drive off the solvent. They found that the bowls preferentially formed at higher polymer concentrations and only in solvents that could dissolve both homopolymer materials. A wide dispersion of sizes was seen, indicating that this structure is only kinetically stable and does not represent the equilibrium state. — MSL

Langmuir 10.1021/la015592t (2002).

CELL BIOLOGY

Intracellular Signal Transduction

The classical pathway of signal transduction starts with an extracellular ligand binding to a cell surface receptor that undergoes a conformational change, activating an intracellular cascade that generates diffusible second messengers and culminates in a physiological readout. However, much of the machinery for generating second messengers is not localized exclusively to the cell surface, but can also be found on intracellular membranes; for example, on the Golgi complex or endosomes. Chiu *et al.* developed a fluorescent probe to examine exactly where one of the key membrane-associated signal transducers, Ras, is activated. Ras proteins localized to the Golgi responded to external signals, and when they were were engineered to relocate to the endoplasmic reticulum, they were similarly responsive. The consequences of localized Ras activation were distinct; thus, by restricting and controlling the distribution of signal transduction machinery, cells may be able to tailor their responses to external stimuli. — SMH



Ras on the Golgi.

Nature Cell Biol. 10.1038/ncb783 (2002).

CLIMATE SCIENCE

Not an Easy Balancing Act

A commonly proposed strategy for sequestering atmospheric CO_2 is increasing the mass of terrestrial vegetation, typically by reforestation or improved agricultural practices. One consequence of this approach would be a reduction of the amount of mineral dust injected into the atmosphere. Lower concentrations of atmospheric dust could, in turn, decrease the delivery of aeolian iron to the ocean, thereby reducing marine productivity in some regions and diminishing the rate of CO_2 uptake. Therefore, increases in CO_2 sequestration on land could produce decreases in CO_2 uptake by the ocean. Ridgwell *et al.* use a global carbon cycle model to examine this antagonistic relation and find that the rate of oceanic uptake of anthropogenic CO_2 could be decreased by as much as 9% by large-scale modification of terrestrial ecosystems. These results underline the importance of using integrated whole-Earth approaches for evaluating carbon dioxide reduction strategies, and show that carbon sequestration by land plants cannot be relied on as a substitute for emissions reductions. — HJS

Geophys. Res. Lett. **29**, 10.1029/2001GL014304 (2002).

HIGHLIGHTED IN *SCIENCE*'S SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT

Science's stke www.stke.org

Distinctive Mitochondria

It has long been unclear whether mitochondria are actually individual intracellular organelles or instead form a continuous network like the endoplasmic reticulum. Their morphology, of course, has implications for signal transduction: For example, a continuous network would allow local calcium signals to be disseminated throughout the cell, whereas in a discontinuous population, some could be depolarized to promote apoptosis while others continued to generate the energy required for the cell death program. Using fluorescent photobleaching in multiple cell types, Collins *et al.* present evidence that the mitochondria are structurally distinct. Fluorescent indicators that respond to membrane potential also indicated that mitochondria are electrically independent. The authors emphasize that mitochondrial morphology itself is malleable and likely reflects the status or recent history of the cell. — LBR

EMBO J. **21**, 1616 (2002).

CREDITS: CHIU *ET AL., NATURE CELL BIOL.* 10.1038/NCB783