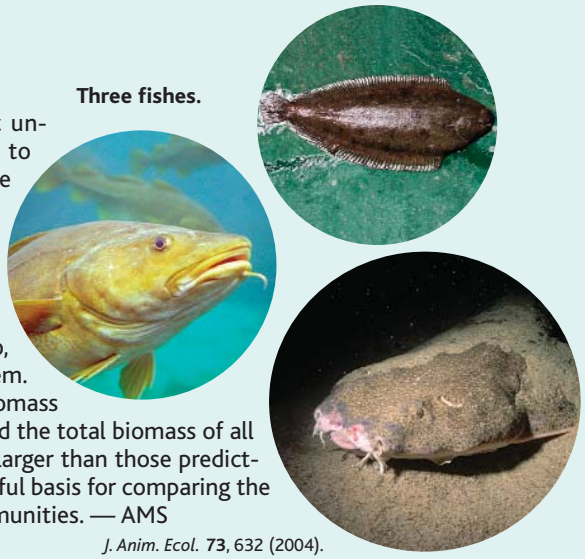
EDITORS' CHOICE

edited by Gilbert Chin

ECOLOGY/EVOLUTION

Establishing a Baseline



Three fishes.

There is abundant evidence that fish stocks are being exploited at unsustainable rates in many sectors of the world's oceans. In order to gauge the extent of human impacts, it is necessary to assess where stocks stood in prefishery times; however, accurate analyses are hampered because records did not begin until many years, and often centuries, after initial exploitation.

Jennings and Blanchard have devised a method for estimating what fish abundances would be in the absence of fishing, using macroecology theory that relates abundance, biomass, predator-prey mass ratio, and efficiency of energy transfer between trophic levels in an ecosystem. Applying it to the North Sea fishery, they estimate that the current biomass of fishes larger than 4 kg is only about 2.5% of its pretrawling level, and the total biomass of all fishes is nearly 40% lower than it would have been. These effects are larger than those predicted from existing time-series data, and this approach may provide a useful basis for comparing the impacts of fishing across different ecosystems and different fish communities. — AMS

J. Anim. Ecol. **73**, 632 (2004).

IMMUNOLOGY

Taking Aim at B Cells

Immunotherapies for autoimmune diseases and malignancies that involve B cells have focused largely on the removal or inhibition of the offending cells. This tactic has already been effective in treating non-Hodgkin's lymphoma with Rituximab, a chimeric antibody directed at the B cell surface protein, CD20. Despite some success using this mode of therapy, the mechanisms by which B cells are targeted have not been clearly delineated.

To explore pathways in anti-CD20 therapy, Uchida *et al.* generated a panel of murine B cell–depleting antibodies to CD20. The complement system has been considered a prime mediator in anti-CD20 depletion, and, although all the antibodies could kill cells using complement in vitro, B cell depletion still occurred efficiently in complement-deficient mice. On the other hand, in mice lacking the Fc receptor (FcR) common γ-chain, which is used both in complement and cell-mediated cytotoxicity, depletion was significantly compromised. The mechanism of anti-CD20 treatment implicated by these results was confirmed by showing that B cell depletion failed to take place in mice after macrophages had been removed. Defining the roles of FcγR-mediated phagocytosis during B cell depletion by anti-CD20 should help refine immunotherapy of B cell–dependent diseases. — SJS

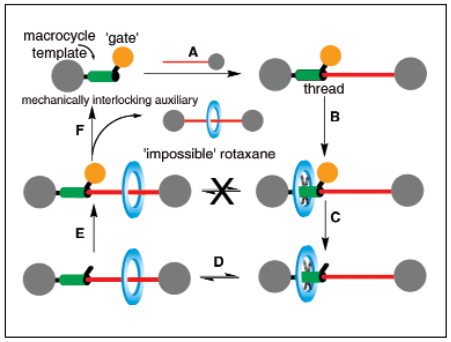
J. Exp. Med. **199**, 1659 (2004).

CHEMISTRY

Mechanical Synthesis

Rotaxanes consist of one or more ring-shaped molecules that are positioned around a thread or linear segment that is capped by bulky end groups, much like beads on an abacus. Despite their importance in the design of molecular machines, for example, they are difficult to make, as one typically needs to slip the thread through the ring and then cap the ends before the ring slips off. Most synthetic methods rely upon building recognition units into both the thread and the ring so that they stick together, which has limited the number of molecules that can be made.

Hannam *et al.* have come up with a more general synthesis route that should make it easier to incorporate functional compounds such as dyes, chromophores, or catalysts into the ring component, without regard for the chemistry of the thread. The authors initially built the stoppered thread so that at one end it contained a macrocycle template around which the ring could be assembled. The key was to include a gating element to the macrocycle template that would restrict translation of the ring. After the ring was completed, the gate was removed, and the ring pushed onto the thread. The gate was then put back into place, and finally, both it and the template were replaced by a second stopper. — MSL



Synthetic scheme for building rotaxanes.

Angew. Chem. Int. Ed. **43**, 3260 (2004).

APPLIED OPTICS

Laser Beam Profiling

One factor that determines the quality of a laser beam is the intensity profile of the beam cross section. As solid-state lasers become smaller, laser beams become more tightly focused, and as the field generally moves toward nano-optics, the requirement to develop techniques to characterize such beams simply and effectively becomes increasingly urgent. Ditlbacher *et al.* use a stepped layer of gold to enhance the interaction between the light and the gold surface in order to excite surface plasmons in the vicinity of the step-edge. The surface plasmons then leak radiation into the underlying substrate at a specific angle. As the laser is scanned across

CONTINUED ON PAGE 151

the step-edge, a photodiode provides a relative measure of the intensity profile across the laser beam with submicrometer resolution. — ISO

Opt. Lett. **29**, 1408 (2004).

ASTRONOMY

To Be or Not to Be Iron

Analyses of comets, asteroids, meteorites, and interplanetary dust particles have suggested that magnesium-rich olivine (forsterite) comes from pristine, primordial objects like comets, whereas iron-rich olivine (fayalite) comes from the alteration (possibly by liquid water) of minerals on a planetesimal or asteroidal body. Observations of dusty disks around stars have found magnesium-rich olivine, but not an iron-rich signature of anything that might be considered a precursor to terrestrial-like exoplanets or asteroids.

Honda *et al.* report the detection of iron-rich olivine dust around the Vega-like star, HD145263, from high-resolution spectra obtained at the Subaru 8.2-m telescope. If their identification is correct, then HD145263 may have an asteroid belt like that of the current solar system or a number of planetesimals, such as those modeled for the early solar system. Collisions between the asteroids or planetesimals would create the dusty disk of debris around the star, yielding the observed signal of iron-rich olivine. — LR

Astrophys. J. **610**, L49 (2004).

PHYSIOLOGY

A Fast-Acting Pathway

In vertebrates, thyroid hormone is needed for normal physiology and development. Although thyroid hormone is known to regulate transcription via thyroid hormone receptors, there is a puzzling temporal aspect of hormone effects. Signaling to the nucleus has been shown to operate on the order of days; however, with exposure to thyroid hormone, rapid effects have been seen in vivo.

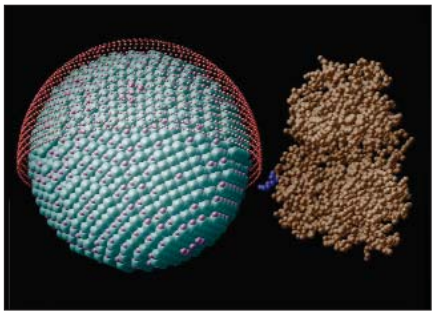
Scanlan *et al.* have synthesized several thyroid hormone analogs and examined their potencies. One of the thyronamine derivatives, T_1AM, occurs naturally in the brains of vertebrates. When injected intraperitoneally, it caused hypothermia and inactivity in mice. Cardiovascular performance was also affected: In an ex vivo heart model, injection of T_1AM produced a rapid reduction in cardiac output. In contrast to prior understanding of thyroid hormone function through regulation of expression, these results support a model in which thyroid hormone response is mediated on a much shorter time scale by differential processing of thyroid hormone and by signal transduction via G protein–coupled receptors. — BAP

Nature Med. **10**, 638 (2004).

BIOPHYSICS

GPS on a QD

Cadmium selenide–zinc sulfide (CdSe-ZnS) core-shell quantum dots (QDs) are inorganic particles (roughly 5 to 10 nm in diameter) exhibiting stable and intense luminescence. Their size and spectral properties make it feasible to consider derivatizing QDs with dye-labeled proteins in order to fabricate optical sensors possessing biochemical activity, such as the specific and sensitive binding of a ligand. Medintz *et al.* have performed a detailed characterization of one such QD-protein hybrid, in which maltose-binding protein (MBP) is covalently modified with a dye at one of six positions, which are distributed over the MBP surface, and then coupled to the QD via a short spacer attached at



Orientation of MBP relative to the QD showing Lys^{370} (purple) and ZnS shell (pink-teal).

Lys^{370}. The crystal structure of MBP is known, and thus spherical approximations of the dye locations could be calculated. By measuring fluorescent resonance energy transfer from the QD to the dye for each of the six types of MBP-QDs, the authors are able to determine the best-fitting structure of the complex, in a fashion analogous to that of a satellite-based global positioning system. — GJC

Proc. Natl. Acad. Sci. U.S.A. **101**, 9612 (2004).

CREDIT: MEDINTZ *ET AL., PROC. NATL. ACAD. SCI. U.S.A.* **101**, 9612 (2004)

A Fast-Acting Pathway

Science **305** (5681), 151.
DOI: 10.1126/science.305.5681.151b