EDITORS' CHOICE

HIGHLIGHTS OF THE RECENT LITERATURE

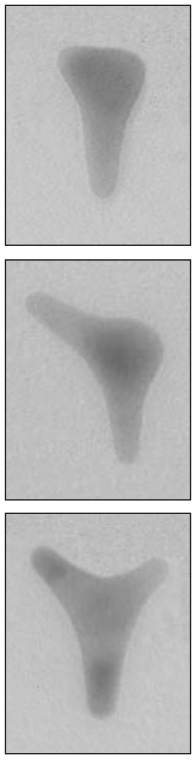
edited by Gilbert Chin

NANOSCIENCE

Arms of Gold

Branched-arm nanoparticles have been synthesized from several semiconductors, including CdS and ZnO. These approaches succeed by means of the sequential growth of two distinct crystal structures (such as wurtzite and zincblende) and have employed high-temperature conditions.

Chen *et al.* report on the room-temperature synthesis of gold nanocrystals with either triangular or diamond-shaped centers (which are about 10 nm in diameter) that can grow up to three or four arms, apparently in a stepwise fashion. Ascorbic acid was used to reduce $HAuCl_4$ in the presence of the surfactant cetyltrimethylammonium bromide and much larger silver plates (about 220 nm by 25 nm in size). Further reduction of Au^+ complexes was achieved by adding NaOH. The particles formed have no twin boundaries or stacking faults along the arm junctions, indicating that they form as single crystals. Although there are several open questions on how crystal growth is directed, the particles themselves might present an interesting starting point for studies in nanoelectronics. — PDS



Mono-, bi-, and tripod nanocrystals.

J. Am. Chem. Soc. 10.1021/ja038927x (2003).

***Littoraria irrorata*.**

ECOLOGY/EVOLUTION

Molluscan Agriculture

The practice of cultivating fungi as a primary food source has evolved multiple times: in leaf-cutting ants, in termites, and in several groups of beetles. In many cases, these fungus-farming insects have a major influence on the structure and function of their native terrestrial ecosystems.

Fungus farming has now been found in a very different organism—one that lives in a semi-aquatic realm. Silliman and Newell surveyed the feeding habits of the marine snail *Littoraria irrorata* in salt marshes on the Atlantic cost of North America. The snails graze on saltmarsh cordgrass, *Spartina alterniflora*, opening wounds that are colonized by ascomycete fungi on which the snails feed. The facilitation of fungus colonization by the snails significantly depresses cordgrass growth, disproportionately beyond the physical damage inflicted by the snails. This phenomenon is widespread in salt marshes along the Atlantic coast, and the authors speculate that similar fungus-farming relationships may be as yet undiscovered in marine habitats. — AMS

Proc. Natl. Acad. Sci. U.S.A. **100**, 15643 (2003).

APPLIED PHYSICS

Counting Photons

The successful implementation of quantum information strategies will depend on the development of photon emitters and detectors that are capable of producing and resolving a desired number of photons in a particular pulse of light. For added practicality, these devices should operate at ambient temperatures, as opposed to the existing detectors that do the job efficiently but operate at cryogenic temperatures.

Achilles *et al.* have developed a scheme based on an optic-fiber setup and a couple of standard avalanche photodiodes (APDs). Usually, APDs can distinguish light from no light, but cannot resolve the number of photons in a pulse of light. By splitting the input light pulse into two equal pulses, introducing specified delay times in the paths of two pulses, and then splitting each of those pulses again into two further pulses, the authors effectively create a train of single photons that can be counted by the photodiodes sequentially. By adding up the number of individual incidences at the photodiodes, they show that this simple technique can be used to reconstruct the photon number statistics of weak light pulses with high probability. — ISO

Opt. Lett. **28**, 2387 (2003).

IMMUNOLOGY

Making First Contact

The notion that most malignant and premalignant cells are detected and destroyed by the immune system before tumors can become established has managed to endure despite controversy and relatively little direct evidence. One instance where early immune surveillance may operate is in the disorder preneoplastic gammopathy (MGUS). In this condition, individuals accumulate transformed plasma B cells in the bone marrow, but infrequently progress to the corresponding malignant condition, multiple myeloma.

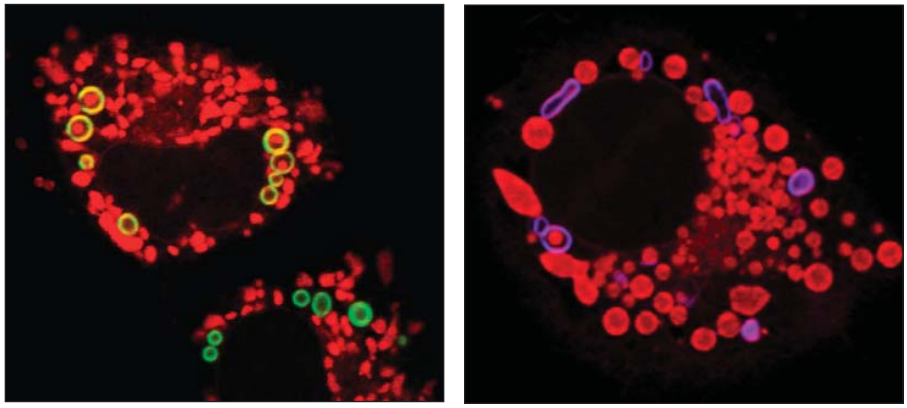
Dhodapkar *et al.* observed that T cells from MGUS patients reacted readily to antigens derived from the patients' own premalignant cells but that equivalent tumor-specific responses could not be elicited from T cells from multiple myeloma patients. The MGUS-reactive T cells predominated in the bone marrow and produced interferon-γ in response to antigen-presenting cells loaded with MGUS cell extracts as well as to autologous plasma cells. The corresponding loss of these reactive bone marrow T cells with the development of clinical malignancy suggests that, under normal circumstances, immune detection of premalignant events may be important in preventing tumor development. — SJS

J. Exp. Med. **198**, 1753 (2003).

MICROBIOLOGY

A Mitochondrial Wrap

Salmonella enterica is responsible for food poisoning and typhoid fever. Part of the pathological program induced by *Salmonella* involves the programmed cell death of macrophages. After infecting a macrophage, *Salmonella* use their type III secretion system to inject the cells with a protein, SipB, which eventually causes cell death. Hernandez *et al.* describe in detail how SipB induces cell death. When SipB alone was expressed in cultured cells, it induced the production of multilayered membrane structures reminiscent of autophagosomes, which are seen



SipB (green, blue) colocalizes (yellow, purple) with mitochondria (red).

CREDIT: HERNANDEZ *ET AL.*, *J. CELL BIOL.* **163**, 1123 (2003)

when the endoplasmic reticulum (ER) wraps around other organelles within the cell that are destined for degradation. Consistent with this, the SipB-induced structures contained markers for both ER and mitochondria, and, in *Salmonella*-infected macrophages, SipB was localized within disrupted mitochondria. Thus, it seems that *Salmonella* induces the death of these target cells by disrupting mitochondria and promoting autophagy. — SMH

J. Cell Biol. **163**, 1123 (2003).

ASTROPHYSICS

How Low Can a Black Hole Go?

Black holes have been detected in many systems, and the range of their estimated masses is thought to reflect different mechanisms of formation. Stellar mass black holes (those with masses of 3 to 15 solar masses) are the remnants of supernovae, and any star with a mass greater than about 3 solar masses will collapse and form a black hole; on the other hand, lower mass stars will form neutron stars. Supernova models suggest that lower mass black holes should be more abundant than higher mass black holes and that there should be a continuum from neutron stars to stellar mass black holes. Observations, however, reveal a gap at 3 to 5 solar masses, where no black holes have been identified.

Gelino *et al.* may have filled this gap with a lightweight black hole candidate. Based on optical and infrared photometry of the soft x-ray transient GRO J0422+32, they estimate that the primary object in this binary system has a mass of 3.97 solar masses. This object falls within the mass gap and is the lowest estimated mass for a black hole so far. Thus, lightweight black holes might actually be abundant (consistent with supernova models), just very difficult to detect. Further observations of this and other lightweight black holes will help to refine supernova models that rely on theories about the fundamental physics and equation of state of collapsing stars to hyperdense objects. — LR

Astrophys. J., in press (astro-ph/0308490).

HIGHLIGHTED IN *SCIENCE*'S SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT

Science's stke www.stke.org

A Deadly Feedback

Both mitochondria and the endoplasmic reticulum (ER) are involved in apoptosis, and release of cytochrome c from the mitochondria and calcium from the ER contribute to cell death. Calcium release is also involved in many nonpathological signaling processes, and Boehning *et al*. show that the interaction of cytochrome c with the inositol trisphosphate receptors (IP_3Rs) of the ER may drive calcium release to pathological levels. An interaction between these two proteins was identified in a yeast two-hybrid screen, and they were coprecipitated from cells treated with a broad-spectrum kinase inhibitor that induced apoptosis. Furthermore, fractionation of apoptotic cells showed that cytochrome c had accumulated in the ER fraction and had been depleted from the mitochondrial fraction. Normally, nanomolar cytoplasmic calcium stimulates IP_3Rs to open, thus releasing ER stores of calcium. In contrast, at micromolar concentrations, calcium inhibits IP_3R-mediated calcium release. Therefore, cytochrome c, released from the mitochondria in small amounts, would bind to the IP_3R and prevent calcium inhibition of ER calcium release; the resulting global increase in calcium would trigger a massive release of cytochrome c in a positive feedback loop. — NG

Nat. Cell. Biol. **5**, 1051 (2003).