EDITORS' CHOICE

edited by Stella Hurtley

BIOMEDICINE

How Anthrax Toxin Kills

Recent concerns about bioterrorism have intensified interest in the bacterium *Bacillus anthracis*, the causative agent of anthrax. The pathogen's major virulence factor, lethal toxin (LT), is well characterized at the molecular level, but remarkably little is known about how it kills the infected host. One prevailing hypothesis suggests that lysis of *B. anthracis*-infected macrophages triggers the release of massive amounts of cytokines into the circulation, leading to endotoxic shock.

A new study raises questions about this pathophysiological model. Moayeri *et al*. injected LT into two strains of mice—one with toxin-sensitive macrophages, the other with toxin-resistant macrophages. Surprisingly, the two strains showed a similar course of disease, most notably characterized by the presence of hypoxia-induced liver damage and the absence of features typically associated with cytokine-induced shock. Thus, macrophage lysis is not essential for LT-induced death, and anti-cytokine therapies developed for septic shock may not be effective in patients with inhalation anthrax. — PAK

J. Clin. Invest. **112**, 670 (2003).

ATMOSPHERIC SCIENCE

Parisian Airs

Urban air pollution typically has many sources. These commonly include fuel combustion, industrial emissions, and emissions from fires, all of which (and more) mix with natural air. Tracing and identifying all of these contributions is necessary for understanding and potentially mitigating pollution sources.

Javoy *et al*. used carbon isotope analyses and concentration data to show that the mix of sources contributing to urban carbon dioxide levels can be accurately traced. They analyzed the carbon dioxide of Paris, which reflects contributions from all of the above sources and air transported primarily from the ocean and over mainland Europe. The approach was sensitive enough to identify respired carbon dioxide from people on the street and the effect of gardens. Furthermore, the River Seine seems to act as a conduit for bringing fresh air into even the center of the city. — BH

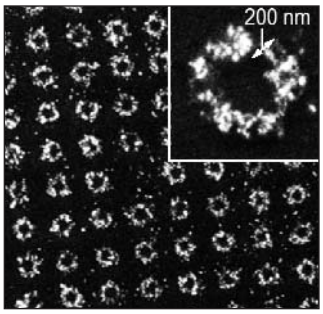
Earth Planet. Sci. Lett. 10.1016/S0012-821X(03)00397-2 (2003).

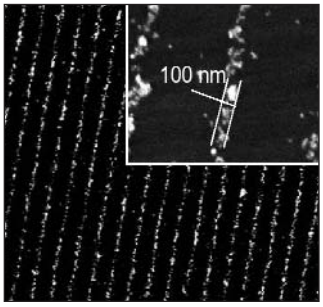
APPLIED PHYSICS

Small Copiers

Photocopies are created in a three-step process. First, light reflected from the white parts of the original is focused onto a charged printing "drum," where it locally dissipates charge. Next, positively charged toner particles are attracted to the remaining charged areas that were dark in the original. Finally, paper is run over the drum to pick up the toner.

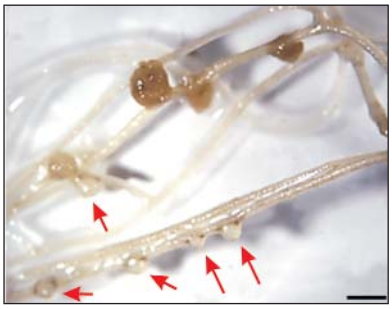
Barry *et al*. use similar steps to create a nanoxerographic process that can pattern very small carbon and metal particles with a resolution about 1000 times better than that of a typical photocopier. A silicon wafer was coated with either silicon dioxide or poly(methylmethacrylate) as the electret, which corresponds to the charged drum in the photocopier. A pattern was transferred from a stamped or lithographed master by bringing the two together and applying an external voltage. In a liquid-phase process, the charged electret and an aggregate of carbon or iron particles were both placed in a solvent and sonicated. Within a few seconds, the aggregate was broken up and the nanometer-sized particles assembled onto the electret. A gas-phase process was also tested in which particles were generated in a furnace and directed by an electric field toward the charged electret. The process is partially limited by the resolution of the master, but 100- and 200-nanometer features sizes were





Nanoparticle assemblies from the gas phase process.

CREDITS: (RIGHT) BARRY *ET AL*., *NANOTECHNOLOGY* **14**, 1057 (2003); (LEFT) VINARDELL *ET AL*., *PLANT CELL* **15**, 2093 (2003)



Left: Mature nodules (pink) in control plants. Right: Plants lacking CCS25A show healthy nodule primordia (arrows), but brown aborted nodules.

PLANT BIOLOGY

Making a Nodule

Many plant cells are endoploid owing to the duplication of their genome in the absence of mitosis —a process known as endoreduplication. In the legume *Medicago trunculata*, the nitrogen-fixing root nodule cells show particularly high amounts of endoploidy and may have 64 times the usual complement of chromosomes. Vinardell *et al*. examined the role of the protein CCS52A, an anaphase-promoting complex activator, in the formation of endosymbiotic nitrogen-fixing nodules. CCS52A is produced after the nodule primordium forms and is required for the final stages of nodule maturation during which the cells become polyploid. Earlier stages in nodule development, involving proliferation of meristem cells, are not affected by CCS52A. CCS52A probably promotes endoreduplication in maturing nodule cells through degradation of mitotic cyclins that would otherwise promote entry into mitosis. Cells deficient in CCS52A did not undergo endoreduplication and are refractory to infection by rhizobial bacteria. Development of mature nitrogen-fixing nodules requires a balance between plant cell endoreduplication, bacterial infection, and host-cell growth concomitant with intracellular bacteroid proliferation. — PJH

Plant Cell **15**, 2093 (2003).

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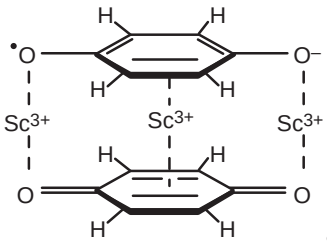
achieved for the gas- and liquid-phase processes, respectively. — MSL

Nanotechnology **14**, 1057 (2003).

CHEMISTRY

Higher Order Electron Transfer

Electron-transfer reactions often occur directly from donor to acceptor, and their rates tend to be linear with reactant concentration, or at most second order when metal atoms act as promoters. Yuasa *et al*. now report an example of third-order kinetics in which Sc^{3+} ions are needed to self-assemble a competent electron-acceptor complex. No reaction was observed between an Ir(2-phenylpyridine)$_3$ donor to a *p*-benzoquinone (denoted "Q") acceptor, which would have had to drive the electron more than 1 volt uphill. However, addition of Sc^{3+} ions formed a structure in which three Sc^{3+} ions are sandwiched between two Q molecules, as determined by electron spin resonance. The one-electron reduction that forms the Q^{-}–3 Sc^{3+}–Q complex is third order in Sc^{3+} and second order in Q. — PDS



J. Am. Chem. Soc. 10.1021/ja037098c (2003).

CELL BIOLOGY

Breaking the Nucleus, Making Mitosis

In animal cells at the onset of mitosis the nuclear envelope breaks down, releasing the condensed chromosomes into the cytosol where they encounter the mitotic spindle. The breakdown of the nuclear envelope involves the disassembly of the nuclear lamina and nuclear pores and the redistribution of the envelope membranes to the endoplasmic reticulum.

Salina *et al*. now show that several components of the disassembled nuclear pore complexes associate with chromosome-associated kinetochores —the parts of the condensed chromosomes that must interact with the mitotic spindle during chromosomal congression and partitioning. The assembly of these kinetochores together with nuclear pore components is essential for the correct function of the kinetochore in chromosome partitioning. In particular, one nuclear pore protein, Nup358, plays an essential role in the integration of nuclear envelope breakdown and kinetochore maturation and function, and lack of Nup358 can cause mitotic arrest. — SMH

J. Cell Biol. **162**, 991 (2003).

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A Matter of Taste

***Drosophila* courtship rituals**

Mating in *Drosophila* involves a stereotyped series of courtship behaviors in which the male fly successively orients toward the female, taps her with his foreleg, "sings," licks her, and finally attempts to copulate; courtship efficiency determines mating success. Courtship behavior is triggered by specific sensory cues, but the molecular mechanisms by which sensory stimuli are translated into behavioral responses remain unclear.

Bray and Amrein have now identified a male-specific receptor expressed in chemosensory foreleg neurons that appears to be required for efficient courtship. One gene, *Gr68a*, was selectively expressed in chemosensory neurons of male-specific foreleg taste bristles. Inactivation of synaptic transmission from these neurons led to reduced courtship intensity, decreased mating efficiency, and lack of success in mating when competing with wild-type males. Knockdown of the GR68a receptor through RNA interference had similar effects. By quantifying performance of the steps involved in *Drosophila* courtship, the authors determined that the behavioral deficit occurred after orienting but before singing. Thus, GR68a appears to be required for the recognition of the nonvolatile pheromones found on the abdomen of female *Drosophila*, and input from these pheromones during tapping appears to be required for successful completion of courtship behavior. — EA *Neuron* **39**, 1019 (2003).

CREDITS: (TOP) YUASA *ET AL., J. AM. CHEM. SOC.* 10.1021/JA037098C (2003); (BOTTOM) BRAY & AMREIN

Parisian Airs

Science **301** (5641), 1815.
DOI: 10.1126/science.301.5641.1815b