Physical chemistry

Salts leave fingerprints in acid

J. Phys. Chem. B **107,** 2875–2878 (2003)

Adding salt to a solution can be a perplexing business. First, it can change the pH, but even more puzzlingly, the effect depends on the chemical identity of the ions — not just on their charge, but on whether they are bromide, chloride or whatever.

Such effects have been reported before, but Mathias Boström *et al.* have subjected them to close scrutiny. They find, for example, that the pH of two otherwise identical solutions, measured using a standard glass-electrode technique, can differ by up to 0.5 for identical concentrations of potassium bromide and sodium perchlorate.

This specificity of an added salt recalls the well-known Hofmeister effect: the tendency of different ions to precipitate proteins from solution. It is a mystery thought to be bound up with the effect of ions on water's structure, and has implications for the way particular salts modify the cell environment.

Boström *et al.* suggest an explanation: that the pH effect arises because ions close to the interface of the water and the glass electrode are not distributed evenly, which in turn affects ion-specific electrostatic dispersion forces at this interface. These forces can alter the way hydronium (H_3O^+) ions interact with the glass surface — precisely the kind of interaction picked up by the glass-electrode technique. **Philip Ball**

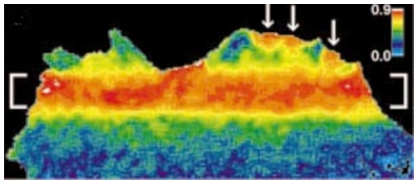
Cell biology

Fast-track for actin

Science **300,** 142–145 (2003)

Cells move or change shape by making polymers of actin protein at their leading edge — the resulting actin filaments then push on the cell membrane, forcing it outwards. It is commonly thought that the actin monomers required for polymerization reach the leading edge by the random, rather slow process of diffusion. Daniel Zicha and colleagues now show that this is not always the case.

Using a microscopic technique called 'fluorescence localization after photobleaching', Zicha *et al.* tracked actin monomers moving over large distances within live cells. Combined images of cells containing actin molecules labelled with two different fluorescent proteins, obtained after photobleaching one of the fluorescent labels in a small area of the cell (white brackets in picture), allow the fate of the bleached actin to be followed. This shows a strikingly swift movement of actin to the rapidly protruding edges of the cell (white arrows) — far faster than could be explained by simple diffusion.



Leading edge: images of actin in a cell on the move.

The authors suggest that a hydrodynamic flow created by the cellular shape changes themselves promotes the fast actin movement they have seen. **Mirella Bucci**

Human evolution

Being manipulative

J. Hum. Evol. **44,** 225–254 (2003)

Lucy's hands were as deft as ours, according to a new analysis of fossil hand-bones of *Australopithecus afarensis* — the species to which Lucy belongs. The hands of *A. afarensis* have previously been described as chimp-like. But based on their study of several different skeletons found at one site in Ethiopia, David M. Alba and colleagues conclude that the hand proportions were "fully human". They claim that the finding throws into doubt the idea that human-like hands evolved as an adaptation for tool-making. There is no evidence that *A. afarensis*, which lived in East Africa about 3.5 million years ago, made stone tools: the first tools only appear in the archaeological record about a million years later.

Australopithecus afarensis was bipedal. Released from the demands of locomotion, the hands may have been free to respond to pre-existing evolutionary pressures, perhaps for grooming and feeding, and were later co-opted for making tools. Humans have shorter fingers and so relatively longer thumbs than our ape cousins. This allows the tips of all five digits to be brought together, making our hands better at manipulating objects. **John Whitfield**

Immunology

A numbers game

Immunity **18,** 343–354 (2003)

Our cells are covered with tiny protein fragments that are bound to class I molecules of the major histocompatibility complex (MHC). They tell the immune system about the proteins being produced in the cell — whether it is infected by a virus, for instance. It takes fewer than ten MHC class I molecules bearing their viral fragment load to launch an immune response.

So far, so efficient — but what does it take to display ten such complexes on the cell surface? Michael F. Princiotta and colleagues have studied the economics of the process, and tell a tale of staggering numbers and apparently enormous waste.

They find that cells maintain a content of around 2.6 billion proteins, using about 6 million ribosome particles to make them, at a rate of 4 million proteins per minute. More than 30% are immediately degraded, at a rate of 2 million proteins per minute. Amidst this wholesale demolition, protein fragments are produced for presentation by MHC class I molecules. But only 1 in 40 degraded proteins results in a suitable fragment, and only 1 in 50 fragments makes it to the endoplasmic reticulum, where it can meet with an MHC class I molecule. So 2,000 proteins need to be degraded for a single fragment to be displayed.

Wasteful? Perhaps. But, as the authors point out, "ultimately, selection pressure in evolution is exerted by other similarly inefficient organisms and not arbitrary standards of efficiency conjured by human intelligence". **Marie-Thérèse Heemels**

Nanotechnology

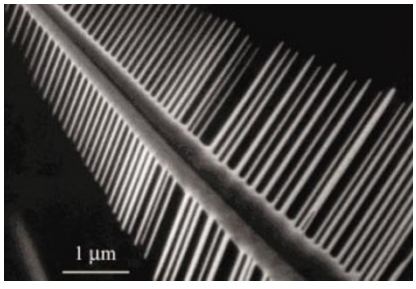
Dendritic lasers

J. Am. Chem. Soc., advance online publication doi:10.1021/ja034327m (2003)

Nanowires that act like tiny lasers have been grown in a parallel, orderly array like the teeth of a comb, producing a bank of miniature light sources that might be useful for photonic technology and nanoscale electromechanical devices. Significantly, they demand none of the complex fabrication procedures used in conventional device manufacture for microelectronics and optoelectronics.

The nanowire 'combs' made by Haoquan Yan *et al.* (see picture) are the products of spontaneous self-organization. The researchers grew needles of zinc oxide, a light-emitting semiconductor, from zinc powder heated with oxygen gas. The needles, about a micrometre or so wide, are decorated with dendritic side-branches regularly spaced about 0.1–2 μm apart, each branch a crystalline rod of zinc oxide about 10–300 nm wide.

When pumped with laser light, these arrays of wires produced emission in the ultraviolet that had the narrow wavelength band characteristic of lasing. For arrays with larger rods and larger spaces, the spots of light from each nanowire tip could be resolved individually. **Philip Ball**



Fine-tooth comb: zinc-oxide nanowires.