Fluid mechanics

Different strokes for nano-folks

Phys. Rev. E **69,** 062901 (2004)

Swimming isn't easy when you're small. Humans can propel themselves through water using a cyclic set of motions, thanks to inertia following the forward stroke. But at the microscopic scale, inertia is negligible and viscosity dominates. In this situation, a cyclic sequence that looks the same backwards and forwards in time gets you nowhere — the second half of the cycle cancels the first. That's why a scallop can't move by simply opening and closing its shell. So micro-swimmers have to be more inventive with their strokes.

Ali Najafi and Ramin Golestanian have devised a sequence of moves that should propel a very simple microscopic swimming device. The 'swimmer' is a mechanism of three spheres connected in a linear arrangement by two piston-like arms. The middle sphere has a power source that extends or contracts the two arms. First, the rear arm contracts; then the forward arm does the same; then the rear arm extends, followed by the front arm. A simple analysis shows that this time-asymmetric sequence should push and pull the device through a viscous fluid.

But will it really work? Making such a tiny device, using either microfabrication technology or, at an even smaller scale, molecular assemblies that can produce mechanical displacement, is a daunting but not unrealistic challenge, the authors believe. **Philip Ball**

Chemistry

On the other hand…

Angew. Chem. Int. Edn **43,** 3317–3321 (2004)

Why are amino acids left-handed? Non-biological chemistry generally produces equal numbers of left- and right-handed molecules, called enantiomers, yet life chooses to use just one form to build proteins. One explanation is that, as the first chemical reactions of life began, a minute initial imbalance in enantiomers underwent some reaction that left them predominantly left-handed. The only example to date of such a process, reported by Kenso Soai in 1995, relies on chemistry that would be impossible in the conditions that are thought to have prevailed on the prebiotic Earth.

Suju P. Mathew *et al.* now report analyses of another reaction that can pull itself up by its bootstraps in this way, one that is more compatible with the conditions on the early Earth. It not only generates an organic product that speeds up its own reaction, but also increases the proportion of left-handed versions of itself in the mixture.

Tantalizingly, this reaction relies on an amino-acid catalyst, proline, as a source of asymmetry. The authors believe that proline and the reaction product bind together to make a more effective catalyst. They hope that a better understanding of the reaction mechanism will in time enable them to produce a truly autocatalytic system, in which the reaction product itself acts as the catalyst. **Mark Peplow**

Natural hazards

Houses on fire

Geophys. Res. Lett. **31,** L12212 (2004)

In regions that are prone to wildfires, the edge of town can clearly be a risky place for human habitation. But just how risky? Putting numbers to fire hazard is essential for developing rational planning regulations (how far from the bushland should houses be built?) and fair and realistic insurance premiums.

Keping Chen and John McAneney have used aerial and satellite images of bushfire damage in Duffy, Canberra (2003), and Como-Jannali, Sydney (1994), to deduce how far such fires penetrate into urban settlements. They find that homes more than 700 metres from the adjacent bushland are generally safe, and that the percentage of houses burned down decreases linearly with distance from the edge of the bush.

In both these and other cases of severe bushfires, around 60% of the homes within the first 50 metres were destroyed — a remarkably consistent figure, given the varying circumstances of the fires. Chen and McAneney conclude that most of the houses were set ablaze by wind-borne embers rather than by radiant heat or direct contact with the fire. **Philip Ball**

AFP PHOTO/*CANBERRA TIMES*

Duffy, Canberra, on fire in 2003: bushfires threaten the outskirts of towns and cities.

Human evolution

Small faces

J. Hum. Evol. **46,** 655–677 (2004)

There is evidence that prehistoric humans had larger facial features than we have today. But why should this be? One theory is that the advent of cooking and other forms of food processing lessened the workload on our chewing apparatus, in turn reducing the amount of facial growth that is stimulated during development. Research showing the influence of diet on growth in a small mammal now lends support to this idea.

Daniel E. Lieberman and colleagues studied the development of the rock hyrax (*Procavia capensis*), bizarrely the closest living relative of elephants. Like humans, the rock hyrax's molars are directly beneath its eye sockets, so that its chewing style should resemble our own in some respects.

From the age of five to six months, the animals were either given a diet of raw and dried food, or fed the same diet cooked until soft. After a further three months, those raised on soft food showed around 10% less growth in certain facial areas. The authors believe that the difference between the two groups mirrors the differences we see between modern humans and our ancestors raised on less processed diets. **Michael Hopkin**

Developmental biology

Primitive streak singled out

Development **131,** doi:10.1242/dev.01178 (2004)

During the early stages of a chick embryo's growth, any part of the embryo has the ability to form a 'primitive streak', which defines which part will ultimately form the head and which the tail. Federica Bertocchini *et al.* now show why, during normal development, only one such structure typically forms.

On one side of a chick embryo, the researchers implanted a ball of cells that make Vg1, a protein that triggers formation of the primitive streak. Some time later, they implanted a second identical ball on the opposite side.

When the second ball of cells was inserted 6 hours or more after the first, it was unable to trigger a second primitive streak. This suggests that Vg1 switches on production of an inhibitor protein, which speeds across the 3-mm embryo at 0.5 mm per hour — up to ten times as fast as comparable molecules — and shuts down primitive-streak formation elsewhere.

Bertocchini *et al.* have yet to identify the inhibitor protein, but they believe that a similar mechanism lays down the body axis of mammalian embryos. They speculate that identical or conjoined twins may sometimes form because of problems with the inhibitor or the system that transports it across the embryo. **Helen Pearson**