RESEARCH HIGHLIGHTS

EVOLUTION

The meek shall...

Proc. Natl Acad. Sci. USA doi: 10.1073/pnas.0709763105 (2008)

An elephant can expect to see sixty summers, a mouse perhaps two or three. But in evolutionary terms, it seems that large mammals are more ephemeral than their smaller brethren.

Mining a database of Eurasian fossil mammals, Nils Stenseth of the University of Oslo, Norway, and his colleagues found that small-bodied groups such as rodents last longer than those in large-bodied families, such as carnivores. Large mammals had both higher origination and extinction rates.

The team suggests that small mammals tend to last longer because they can escape hard times by burrowing or hibernating. The longest-surviving groups — such as moles and dormice — burrow, hibernate, or both. Most large mammals, meanwhile, must weather whatever the environment throws at them, and their slow reproductive rates and small populations make them more vulnerable to extinction.

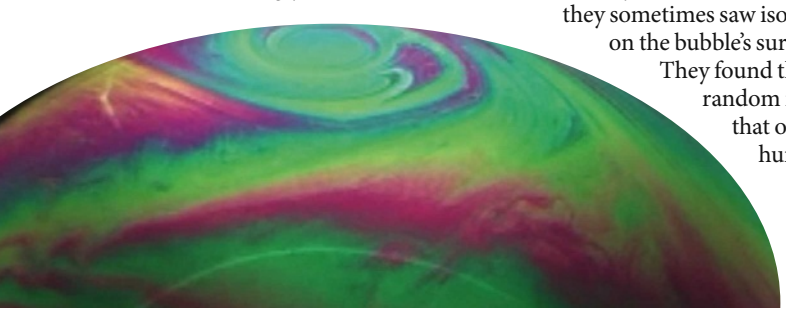
IMMUNOLOGY

Phantom germs

Proc. Natl Acad. Sci. USA **105,** 5549–5554 (2008)

Are nanobacteria real or merely lumps of abiotic matter? The latter, according to a pair of researchers who show that gradually precipitating calcium carbonate looks and behaves just like the purported microorganisms.

Nanometre-sized blobs that grow in liquid cell culture media have been shown to provoke immune responses and been linked to kidney-stone formation and cancer. But John Ding-E Young of Rockefeller University in New York and Jan Martel of Chang Gung University in Taiwan were able to produce many of these particles' characteristic properties with calcium carbonate lumps. The precipitates were membrane-delineated, vesicle-like particles of uniform size that aggregated in colonies, and exhibited cell-like division. Tellingly, nanobacteria-like particles the researchers obtained from human blood withstood massive doses of ionizing radiation. Furthermore, monoclonal antibodies supposedly specific for nanobacteria react with serum albumin, the most abundant protein in plasma.



F. SEYCHELLES/H. KELLAY

PHYSICS

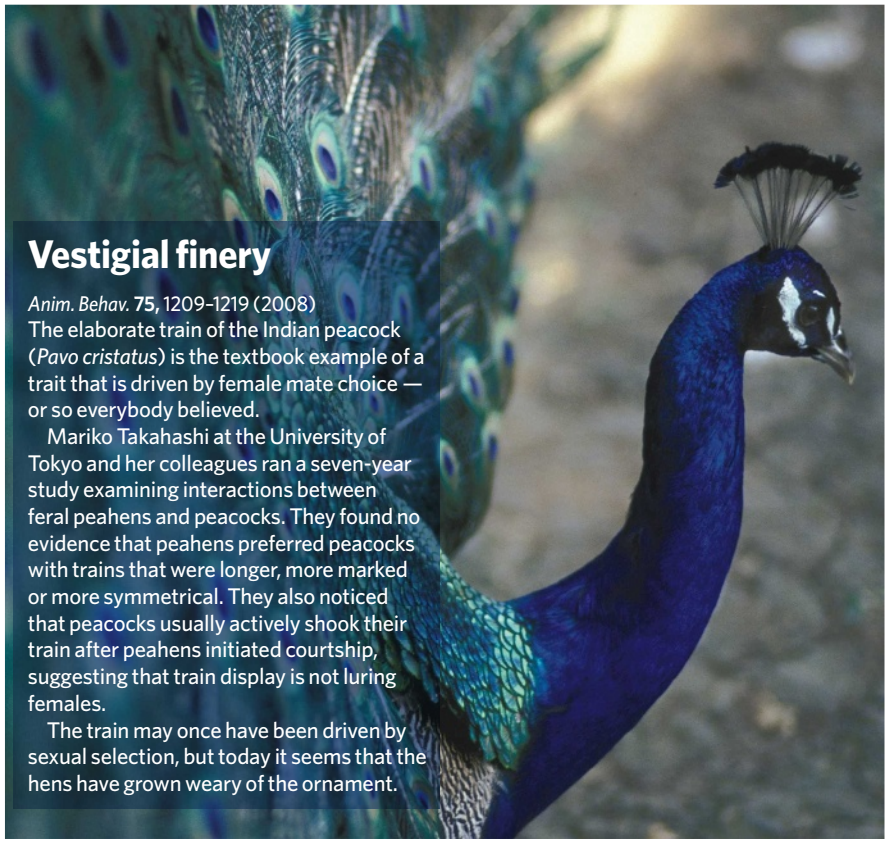
Tiny twisters

Phys. Rev. Lett. **100,** 144501 (2008)

Hurricanes span hundreds of kilometres across the globe, but a centimetre-scale version can be made on the surface of a soap bubble.

Fanny Seychelles of the University of Bordeaux in France and her colleagues blew a hemispheric soap bubble on top of a soapy solution. As they heated the solution, they sometimes saw isolated vortices form on the bubble's surface (pictured left). They found that the vortices' random motion resembled that of real-world hurricanes.

The authors say that bubble twisters are a useful lab model for studying turbulent fluids.



B. SACHA/CORBIS

Vestigial finery

Anim. Behav. **75,** 1209–1219 (2008)

The elaborate train of the Indian peacock (*Pavo cristatus*) is the textbook example of a trait that is driven by female mate choice — or so everybody believed.

Mariko Takahashi at the University of Tokyo and her colleagues ran a seven-year study examining interactions between feral peahens and peacocks. They found no evidence that peahens preferred peacocks with trains that were longer, more marked or more symmetrical. They also noticed that peacocks usually actively shook their train after peahens initiated courtship, suggesting that train display is not luring females.

The train may once have been driven by sexual selection, but today it seems that the hens have grown weary of the ornament.

ACOUSTICS

Undersea rain sounds

J. Acoust. Soc. Am. **123,** 1952–1962 (2008)

Measuring rainfall over the oceans is tough — there are few rain gauges and satellite radar resolution is poor. Jeffrey Nystuen at the University of Washington in Seattle and his colleagues have found a way around this: listening to the rain from underwater.

The researchers dropped a string of hydrophones to various depths in an area of the Ionian sea, near Greece, that is well covered by land-based radar. They separated the sounds of raindrops from noise due to drizzle, wind, ships and the clicks of diving beaked whales. The acoustic rainfall rates matched those deduced from radar. The results suggest that a hydrophone dropped to a depth of 2 kilometres could monitor rainfall over an area of 30–50 square kilometres.

EVOLUTION

Lungless life

Curr. Biol. 10.1016/j.cub.2008.03.010 (2008)

All hail the first lungless frog: *Barbourula kalimantanensis* of Borneo, a small, flat creature that lives in fast-flowing streams. Djoko Iskandar at the Bandung Institute of

Technology in Indonesia first described the frog 30 years ago. Now he, David Bickford of the National University of Singapore and Anggraini Barlian, also at the Bandung Institute, have determined by dissection that it is entirely without lungs. Instead, it breathes through its skin.

Lunglessness among the four-limbed vertebrates is rare; only two families of salamander and one species of caecilian — a limbless amphibian — are known to have evolved this trait. Unfortunately, the frog is endangered by habitat loss and gold mining, which warms, pollutes and muddies its formerly cool and clear home streams.

CLIMATOLOGY

Low cloud cover

Science **320,** 195 (2008)

The presence of fewer clouds could help to explain how global temperatures rose so markedly in 'supergreenhouse' events of the past.

The key, say Lee Kump and David Pollard of Pennsylvania State University, is the number of tiny particles in the atmosphere that serve as nuclei for clouds to condense around. In the unpolluted atmosphere, these are mostly aerosols produced by organisms such as ocean algae. The researchers used a global climate model to simulate the climate 100 million years ago. They found that if rising temperatures cause algae to be less productive, and thus provide fewer aerosol seeds for clouds to form around, clouds would be thinner and less reflective.

This would have cut the amount of solar energy reflected back into space, leading to even more drastic warming.

B. VAN BOCXLAER

PALAEONTOLOGY

Unpunctuated

Evolution **62–63,** 511–520 (2008)

Palaeontologists have re-evaluated one of the first pieces of evidence to support 'punctuated equilibrium' — the theory that evolution can proceed in fits and starts — and found it lacking.

In the late 1970s and early 1980s, fossil molluscs (pictured above) from the Turkana Basin, Kenya, were interpreted as showing three bursts of rapid evolutionary change during a 3.3-million-year period. Now, Bert Van Bocxlaer of Ghent University in Belgium and his colleagues say that changes in the mollusc species can be explained more prosaically: environmental change in wet periods caused new species from outside the basin to colonize the area.

QUANTUM PHYSICS

Missing holes add up

Phys. Rev. Lett. **100,** 136804 (2008)

Quantum computing might be done on a gossamer-thin sheet of carbon, suggest Thomas Pedersen of Aalborg University in Denmark and his co-workers. Their calculations show that a single sheet of graphene — a graphite-like material comprising a monolayer of hexagonal carbon rings joined edge to edge — could supply an array of 'quantum bits' (qubits) when perforated with a regularly spaced lattice of nanometre-scale holes.

Omitting holes in the lattice creates localized defects in the sea of electrons spread across the sheet, which act like particles with quantum-mechanical spin. Different spin states can be used to encode bits of binary information, and adjacent spins can interact with each other for data processing. In addition, the lattice produces a controllable energy gap that could pave the way for graphene-based semiconductor devices.

BIOMEDICINE

Resisting radiation

Science **320,** 226–230 (2008)

High doses of ionizing radiation, such as those used in radiotherapy for cancer, can cause many of the body's normal cells to self-destruct. But a tool pinched from cancer's own arsenal might keep those cells alive.

Elena Feinstein of Cleveland BioLabs in Buffalo, New York, and Andrei Gudkov of the Roswell Park Cancer Institute, also in Buffalo, developed a drug from a bacterial protein, flagellin, that activates a cell-survival pathway, known as the NF-κB pathway, that is constantly active in the majority of tumours.

Mice given 0.2 milligrams per kilogram of body weight of this protein — flagellin — survived usually lethal doses of radiation, up to 13 joules per kilogram of tissue.

JOURNAL CLUB

Bob O'Hara
University of Helsinki, Finland

A statistician wonders about the influence of additive variance.

Where complex problems are concerned, it makes things simpler if some factors can be safely ignored. In quantitative genetics, one such assumption is that the bulk of genetic variation is additive. That is, the effect of an allele — a particular version of a gene — can be adequately described by its average effect in a population. But we know that genes often do not act additively; alleles interact, both with others of the same gene (a phenomenon known as dominance) and those of different genes (epistasis). All this contributes to the total genetic variation. But does this matter?

This question is tackled by Hill *et al.* (*PLoS Genet.* **4,** e1000008; 2008). Reviewing the literature, they show that additive genetic variance is often close to total genetic variance. The authors then look at some mathematical models with strong non-additive genetic effects, and average over reasonable distributions of allele frequencies to show that the genetic variance is mainly additive. So non-additive genetic variation is usually of minor significance and we can continue to concentrate on additive genetic variance.

This is probably true on average, but may not always be so. Any trait is affected by only a finite, and in some cases small, number of genes. So averaging over all possible allele frequencies may say little about a particular case. There is also a much subtler problem. The authors conclude that additive genetic variance swamps other types of variation largely because most alleles common to a population occur with close to 100% frequency. But these extreme frequencies also reduce the total genetic variance. So, in practice, a lot of traits with strong additive effects might be classified as having no detectable genetic variation, and overall the importance of additive genetic effects would be diminished. Is this a genuine problem? Ah, more research is obviously needed.

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