repressing the enzyme VKOR, which is essential to blood coagulation. The mutations were in the gene *Vkorc1*, which codes for a key component of this enzyme, in the majority of 250 rodents trapped in areas where anti-coagulants are used.

ZOOLOGY

Restless rodents

Ethology **115,** 217–226 (2009)

Burrowing mole-rats (pictured below) constantly dig new tunnels and change nests even when the soil is dry and tough. Subterranean rodents had been predicted to keep energy-demanding digging to a minimum during the dry season.

Radim Šumbera at the University of South Bohemia in České Budějovice, Czech Republic, and his colleagues used radio-tracking to follow the underground movements of ten silvery mole-rats (*Heliophobius argenteocinereus*) in southern Malawi during a three-month period, then excavated and mapped the burrows.

J. ŠKLÍBA

The mole-rats switched nests about once a month, and on average each dug 0.7 metres of new tunnels daily and filled in 64% of old tunnels. Burrowing continued through the hot dry season, countering expectations that the rodents dig mostly while the soil is damp.

ATMOSPHERIC SCIENCE

Ozone in a warming world

Geophys. Res. Lett. doi:10.1029/2008GL036223 (2009)

The Montreal Protocol has been successful at phasing out ozone-depleting substances (ODSs), but scientists know that climate trends will also affect the ozone layer's recovery. New modelling work suggests this climate–ozone interaction could vary by region, hastening recovery in some areas while slowing — or even preventing — it in others.

Darryn Waugh at Johns Hopkins University in Maryland, Baltimore, and his colleagues modelled climate and ozone interactions, both with and without ODS emissions, from 1960 to 2099. They found that ozone levels in the upper stratosphere recover decades earlier than expected owing to greenhouse-gas-induced cooling, which slows the chemical reactions that destroy ozone. By contrast, upwelling air masses hinder ozone formation and prevent recovery in the lower stratosphere of the tropics and southern mid-latitudes.

The authors say that these variations need to be taken into account when evaluating recovery of the ozone layer in the future.

NETWORKS

Know a good dentist?

Phys. Rev. Lett. **102,** 058701 (2009)

If you need a dentist in London, who do you ask? Perhaps a friend who lives there? Even if they don't have a name, they can put you in touch with another friend who might. In this strategy, called 'greedy routing', you navigate the network of Londoners without knowing its global structure.

Now Marián Boguñá of the University of Barcelona in Spain and Dmitri Krioukov at the University of California, San Diego, prove that greedy is speedy. They show that greedy routing yields the fastest journey through networks such as the Internet. They suggest that switching to greedy routing could improve the Internet's speed.

CANCER BIOLOGY

Room to breathe

Cell doi:10.1016/j.cell.2009.01.020 (2009)

Improving the condition of tumour blood vessels may reduce the likelihood that the cancer will spread.

Abnormal blood vessels inside tumours impede the delivery of oxygen to cancerous cells as well as affecting the cells' sensitivity to chemotherapy. Meanwhile, oxygen-starved tumour cells are more likely to metastasize. To study this process, Peter Carmeliet of the Catholic University of Leuven in Belgium and his colleagues created mice that had only one functional copy of the *PHD2* gene, which encodes an oxygen-sensing protein called PHD2.

Tumour blood vessels in these mutant mice were not leaky like those in normal mice. And although tumours in the mutants grew normally, they received more oxygen and did not metastasize as often as tumours in normal mice.

JOURNAL CLUB

Nora Noffke
Old Dominion University, Norfolk, Virginia

An astrobiologist considers life's oldest oxygen.

The presence of atmospheric oxygen would have been necessary for the evolution of eukaryotes — organisms that group their genetic material into a membrane-bounded nucleus — so the question of when oxygen first became available is important in dating their rise. The availability of such oxygen is linked to the evolution of cyanobacteria, oxygen-producing microbes that appeared early in Earth's history and exist to this day.

Fossil microbial mats preserved in the Pongola Supergroup, a rock succession in South Africa, suggest that cyanobacteria were already highly diverse 2.9 billion years ago. But conclusive proof of their presence can be provided only by the presence of hydrocarbon biomarkers — stable chemical compounds found in the walls of single-celled organisms.

Work by Jacob Waldbauer at the Woods Hole Oceanographic Institution in Massachusetts and his colleagues focuses on biomarkers from shallow-marine deposits in the younger, 2.6-billion-year-old sedimentary rocks preserved in South Africa's Transvaal Supergroup. Detailed laboratory analyses extracted biomarkers called hopanes, possibly attributable to cyanobacteria, as well as steranes, biomolecules typically found in eukaryotes (J. R. Waldbauer *et al. Precamb. Res.* doi:10.1016/j.precamres.2008.10.011; 2008). The biosynthesis of steranes requires free oxygen; therefore, the fossil steranes imply that oxygen was readily available 2.6 billion years ago. This is at least 200 million years before a persistent oxygen-containing atmosphere is thought to have arisen.

Waldbauer *et al.* show that cyanobacteria had colonized the floor of Earth's ancient oceans by 2.6 billion years ago at the latest. Free oxygen has been available in the atmosphere ever since, and set the stage for the evolution of more complex organisms.

Discuss this paper at **http://blogs.nature.com/nature/journalclub**