New office to strengthen UK Arctic research

UK ARCTIC research is set for a boost after the Natural Environment Research Council (NERC) announced it will open an office to support UK Arctic researchers. The move confirms the country's commitment to polar science.

Until now individual UK researchers led their own Arctic research from a wide range of research institutes. The new NERC Arctic Office will coordinate UK Arctic research and build on existing expertise in polar science.

The success of the just-ended International Polar Year showcased how international cooperation can benefit research, and influenced the decision to open the office. Hosted by the British Antarctic Survey (BAS) in Cambridge, the office will help UK scientists get access to essential Arctic infrastructure, such as research ships and aircraft.

It will also manage the recently-signed *Memorandum of Understanding* between the UK and Canada, in which the two nations agreed to share resources and increase science cooperation. NERC anticipates negotiating further agreements with other Arctic rim nations to improve access to the Arctic for UK researchers.

'Many of the big polar questions are of global significance and best tackled not just by one group or country, but by a number of countries working cooperatively,' said Dr Cynan Ellis-Evans of BAS, who will head up the new Arctic Office.

The Arctic is changing faster than anywhere else on the planet. The region is widely acknowledged as an early indicator of environmental change. The United Nations Intergovernmental Panel on Climate Change agrees these changes stem from rising temperatures as a result of the greenhouse effect.

With many scientists predicting an ice-free Arctic within the next 20 to 30 years, melted ice from the Arctic is likely to have a major effect on global sea-level rise: sea levels are already rising by around 3mm every year and this may accelerate.

Carbon capture has a sparkling future

CO_2 has been stored safely and naturally in underground water in gas fields for millions of years, new research shows. The findings, published in *Nature*, bring carbon capture and storage (CCS) a step closer.

Politicians are committed to cutting levels of atmospheric carbon dioxide to slow climate change, and CCS may help cut levels of the gas until cleaner energy sources are developed.

But the risks of storing millions of cubic metres of carbon dioxide in depleted gas and oil fields have caused concern, not least because until now researchers couldn't be sure the CO_2 would stay trapped for the long term.

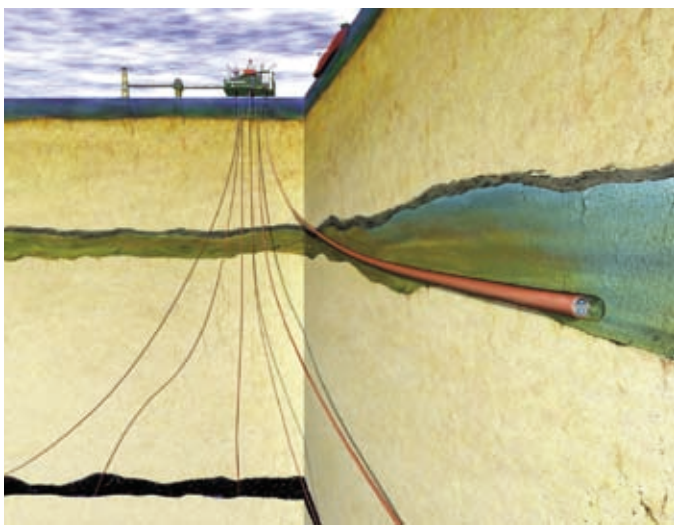
Naturally-occurring CO_2 can be trapped in two ways. The gas can dissolve in underground water – like bottled sparkling water. Or it can react with minerals in rock to form new carbonate minerals, locking away CO_2 underground.

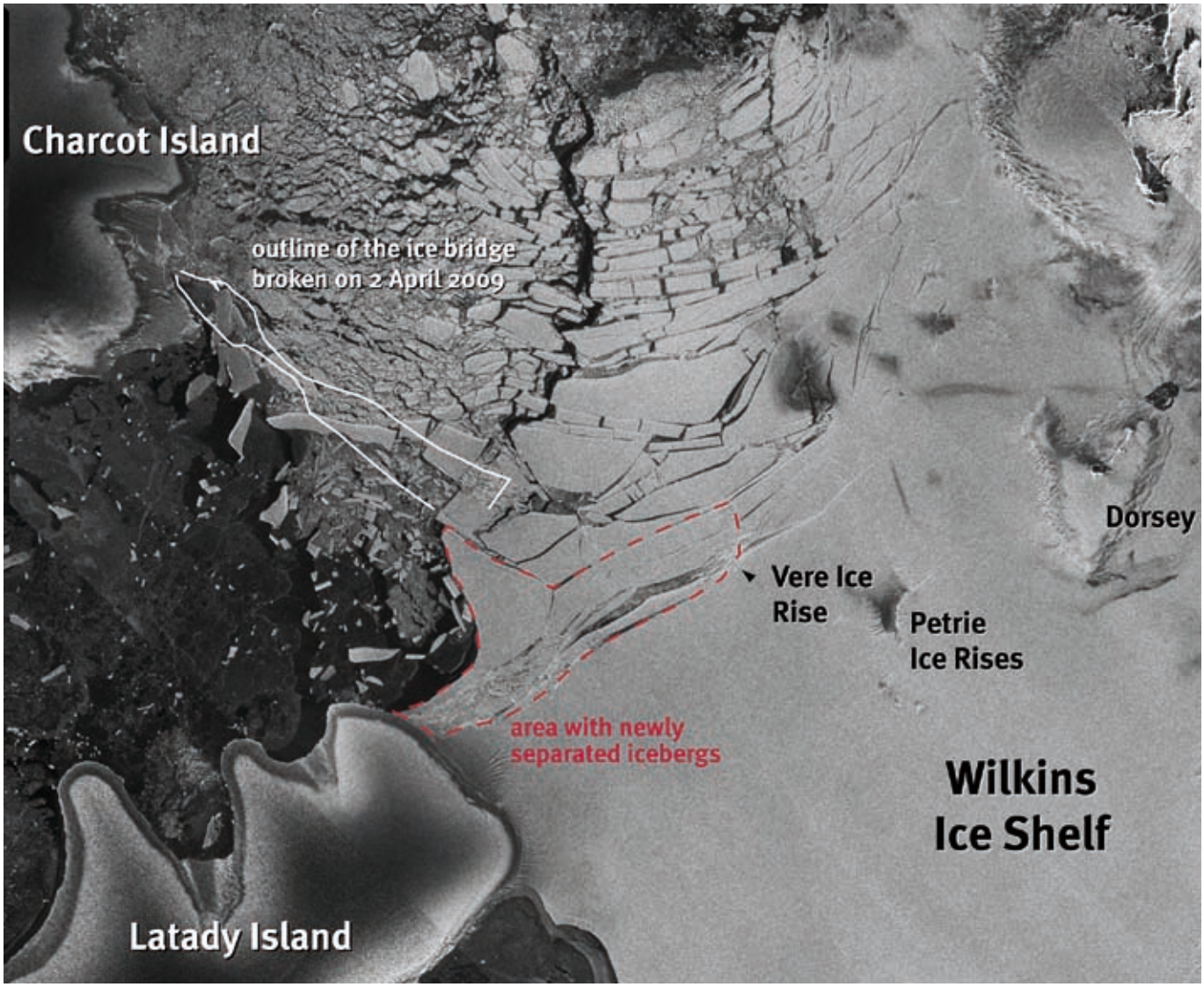
Previous research in this area used computer models to simulate injecting CO_2 into underground reservoirs in gas or oil fields and to predict where the gas is likely to be stored. Some models predict that the carbon dioxide would react with rock minerals to form new carbonate minerals, while others suggest that it would dissolve. Until now experimental studies to support either prediction have been missing.

An international team of researchers measured the ratios of the stable isotopes of carbon dioxide and noble gases like helium and neon in nine gas fields in North America, China and Europe. These gas fields were naturally filled with carbon dioxide thousands or millions of years ago.

They found that underground water is the major carbon dioxide sink in these gas fields and has been for millions of years.

'We've been able to identify exactly where the carbon dioxide is being stored for the first time,' says Dr Stuart Gilfillan, the lead researcher who completed the project at the University of Edinburgh. 'We already know that oil and gas have been stored safely in oil and gas fields over millions of years. Our study clearly shows that the carbon dioxide has been stored naturally and safely in underground water in these fields,' he adds.





ESA

Wilkins Ice Shelf in Antarctic set to collapse after ice bridge breaks

AN ICE BRIDGE connecting an Antarctic island to the mainland and holding an ice shelf half the size of Scotland in place has broken for the first time in recorded history.

The bridge's break-up raises the possibility of the whole ice shelf disintegrating and is further evidence of the effect of global warming on the continent, say researchers.

The Wilkins Ice Shelf – on the western side of the Antarctic Peninsula – has been retreating since the 1990s. Last year, the European Space Agency's Envisat satellite captured images showing the collapse of a 520-square-mile section of the ice shelf. This left the shelf hanging by a thread.

More recent Envisat images revealed cracks in the 500-metre-wide bridge, and scientists were bracing themselves for the inevitable.

Researchers think the bridge helped hold the rest of the ice shelf in place and say that now the bridge no longer exists, ice can move freely into the open ocean. If the shelf now breaks up, it will be the biggest collapse on record, dwarfing the break-up of the Larson B Ice Shelf in 2002. The Larson B Ice Shelf covered 770 square miles, whereas the Wilkins Ice Shelf covers an area nearly 10 times bigger – 6,200 square miles.

In January this year Professor David Vaughan of the British Antarctic Survey visited the Wilkins Ice Shelf to place GPS monitoring equipment on the ice. Data from the equipment and data from ESA satellites meant the break-up of the ice shelf could be analysed far more effectively than any previous break-up.

Professor Vaughan told BBC News, 'We know that (the Wilkins Ice Shelf) has been completely or very stable since the 1930s and then it started to retreat in the late 1990s. But we suspect that it's been stable for a very much longer period than that.'

'The fact that it's retreating and now has lost connection with one of its islands is really a strong indication that the warming on the Antarctic is having an effect on yet another ice shelf,' he added.

Ice shelves float on the sea and can be hundreds of metres thick. Collapsing ice shelves do not affect sea levels. But with no ice shelf to limit their progress, sea-terminating glaciers can slide more quickly towards the sea, adding water to the oceans and contributing to sea-level rise.

UK energy blueprint for 2050 unveiled

CARBON must be removed from the UK's electricity sector by 2050 if the government is to stand any chance of meeting its own exacting 80 per cent emissions reductions targets.

But this is achievable, according to a report from the UK Energy Research Centre (UKERC).

The independent report – the Energy 2050 project – hands the UK government a blueprint to achieve emissions cuts and ensure a reliable energy supply. Recommendations include gradually phasing out cars and vans from towns and cities.

The report outlines several scenarios for the UK in the coming decades ranging from a faint-hearted approach delivering just 40 per cent emissions cuts through to a 'super-ambitious' 90 per cent reduction. Also included were scenarios based on swift decisive action now and the cheapest options.

Unfortunately for governments, the report says, 'it should be particularly concerning to policy-makers that these least-cost... scenarios do not produce decarbonisation scenarios that are anywhere near compatible with the European Union's renewables directive.'

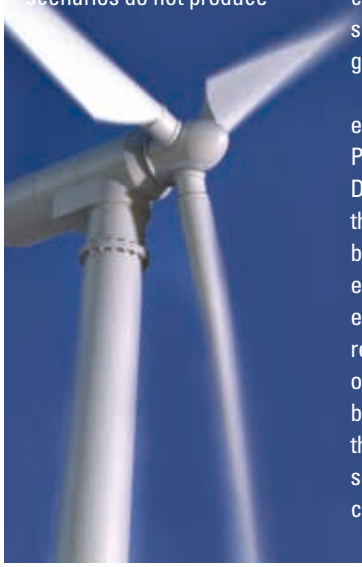
This directive requires at least 15 per cent of UK energy to come from renewables by 2020.

According to the report, decarbonising the electricity system is the top priority because this gives other oil-hungry sectors like transport an alternative supply, quickly reducing demand for carbon further.

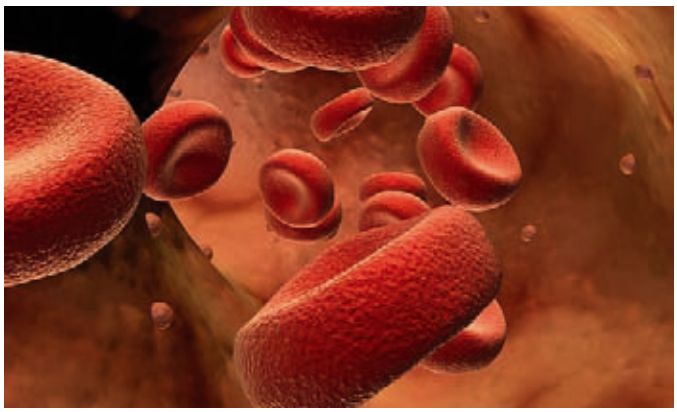
The report emphasises that carbon-free electricity generation need not mean using less electricity. Alternatives to carbon-emitting technologies are nuclear power, wind and wave generation and coal plants fitted with carbon capture and storage systems to pump carbon dioxide back into oil and gas fields or other geological reservoirs.

The Energy 2050 project, which began in 2006, recommends a large hike in the price of an allowance to emit one tonne of carbon to around £200 by 2050. This is 15 times the current European Union carbon price. But this figure shoots to £300-350 per tonne if governments delay taking action.

'UK energy-policy goals are extraordinarily ambitious,' says Professor Jim Skea, Research Director at UKERC. 'Meeting them will require efforts well beyond the bounds of historical experience. By looking at the energy system in the round, our researchers have shown not only that the goals can be met but that it is possible to reconcile them with wider technological, social and environmental changes,' he adds.



The geology of the human heart



Science Photo Library

GEOLOGISTS investigating how planets form have found an unlikely application for their research – modelling blood flow in diseased hearts.

The finding has already helped surgeons confirm the location of a potentially life-threatening blood clot in a patient at the Royal Bournemouth Hospital.

Professor Nick Petford, a geologist and Pro Vice-Chancellor at Bournemouth University, made the breakthrough while investigating the early formation of planets.

At the centre of a planet like Earth lies a solid core, made up mainly of iron with some nickel. Around this flows a liquid metal outer core.

'The question has always been: how did the core form?' says Petford. The theory is that terrestrial planets began as small chunks of rock that merged together. But scientists didn't know how liquid metal made it into the centre of the growing planet.

Researchers experimented on real meteorites to see what would happen when they were deformed by intense heat and pressure and how molten iron moved in millimetre-wide fissures. The experiments allowed Petford to work out how the liquid metal moves through cracks.

The breakthrough came when he realised the technique could be applied to other areas of science and even medicine.

He had taken detailed photographs of meteorites and their cracks and fissures. 'We solved the fluid flow equations around the meteorite straight from the images. But the trick is, it could be any image, not necessarily a meteorite,' explains Petford.

He teamed up with a heart specialist at the Royal Bournemouth Hospital. They experimented with MRI scans of carotid arteries, which pump blood from heart to brain.

The scientists imported the geometry of the arteries into their newly-developed software and used the same methods as before to model the flow. But instead of liquid metal, they were now simulating blood flow.

Blood flow through a heart depends on its shape: each heart is subtly different and has a unique blood-flow signature.

The scientists used the new technology on the heart of a hospital patient. Surgeons knew that somewhere in the diseased heart there would probably be an area of stagnant blood which could cause a clot.

The stagnant flow's location was not obvious from an MRI scan. But when the researchers used the software to analyse the scan they predicted the clot's location correctly.

'All vascular systems are different,' says Petford. 'We can now start to think about bespoke blood-flow models.'

A hundred questions to conserve biodiversity

CONSERVATION experts from 24 organisations including WWF, Conservation International and BirdLife International have identified 100 key scientific questions that, if answered, would help conserve global biodiversity.

Scientists say answering them swiftly could stem massive biodiversity loss.

The questions range from whether there are critical thresholds at which loss of biodiversity disrupts ecosystem functions and services to how nanotechnology affects biodiversity. Other contentious topics on the list include how ocean acidification might shape marine biodiversity and the impact of the changing water cycle.

According to the International Union for Conservation of Nature (IUCN), loss of biodiversity is accelerating despite a global convention committing governments to halt the decline. Experts say species and habitats are disappearing so fast that more effort must be focused on research that helps scientists understand what's behind the loss.

But the conservation topics academics study don't always match the information conservationists need to preserve biodiversity. The hundred questions, published online in *Conservation Biology*, could help bridge the gap.

'With the current crisis in the loss of habitats and species it is important that we ensure we are carrying out the most important research,' says Professor William Sutherland of the University of Cambridge, lead author of the study and Miriam Rothschild Chair in Conservation Biology. 'When research is designed to meet the needs of real natural-resource protection projects, it can lead to substantial gains for biodiversity,' he adds.

To address the mismatch, 761 conservationists from 24 of the world's leading conservation bodies and 12 academics generated a preliminary list of 2291 questions relevant to conserving global biodiversity.

The group of experts used email voting to short-list the 2291 questions before a smaller group of 44 met for two days to decide on the final 100 questions.

Before a question could be included in the 100, it had to meet eight strict criteria. For example, it had to be answerable through realistic research; it had to address important gaps in knowledge; and it had to be on a time and space scale that could be addressed by a research team.

The list builds on a successful exercise in 2008 to identify the top 25 emerging threats to UK biodiversity – also led by Sutherland.

Professor William Sutherland.

The trillion-tonne budget

SCIENTISTS have found a new way to look at the problem of global warming: instead of using carbon concentrations and emission rates, this new approach calculates the total limit for the carbon we can emit if global warming is to be kept in check.

The grand total is 1 trillion tonnes of carbon, according to research published in *Nature*. This may seem a lot, but we're already halfway to the limit.

Many countries accept that to avoid the worst global warming, the temperature rise must stay below 2°C. So far the international agreement describes the problem in terms of the so-called stabilisation scenario: reduce the amount of carbon released to the atmosphere per year until equilibrium is achieved, and then adjust emission rates to maintain the balance.

But the stabilisation approach relies heavily on parameters that are difficult to constrain and model. Now, a team of international scientists led by Drs Myles Allen and David Frame from the University of Oxford have discovered a new approach to the problem.

'What we found', says Allen, 'is that the relationship between temperature rise and total carbon emissions is predictable.' If we know how much the world has warmed so far in response to past emissions, and we set the total amount of carbon released since the industrial revolution started, 'then we can predict the response much more confidently than we can predict the response to a stabilisation scenario,' he adds.

Allen and Frame came up with the idea of a total carbon budget over four years ago, during a workshop in Exeter. The meeting's theme was: what carbon concentration should we be aiming for? 'We had some results at that time that suggested it was always going to be hard to predict when the warming would stop for any stabilisation concentration,' tells Allen. 'So we asked ourselves: what can we tell policy-makers instead?'

For practical purposes, this result is very clear: 'If 1 trillion is the absolute limit, the more carbon is emitted now, the less will be allowed to be released in the future,' says Allen.

Keeping to the trillion-tonne target would mean most of the world's oil and gas deposits have to stay where they are now – underground.

EVENTS

25 June
Environmental Nanoscience Initiative
Reception to mark the end of the two-year Environmental Nanoscience Initiative (ENI) set up by the Natural Environment Research Council, the Department for Environment, Food & Rural Affairs and the Environment Agency.
House of Commons

30 June - 4 July
Royal Society Summer Science Exhibition
Features the Centre for Ecology & Hydrology display on the harlequin ladybird and the University of Bristol exhibition on using organic chemistry to understand how the Earth worked in the past.
Royal Society, London

31 August - 4 September
World Climate Conference
Climate prediction and information for decision-makers.
World Meteorological Organisation, Geneva

Air-powered flight evolved earlier than suspected

Mark Witton, University of Portsmouth

HOW DO BIRDS FLY? It helps to have wings, but these aren't up to the job without an efficient breathing mechanism built with special lungs and air sacs for added power.

Now scientists have discovered that ancient flying reptiles evolved the same features earlier than previously thought.

Pterosaurs first appeared about 230 million years ago, in the Late Triassic, and rapidly became masters of the skies at the time of the dinosaurs. Some of the later species were the largest flying animals of all time with a wingspan of up to 12 metres. They were able to grow large and still fly thanks to air sacs connected to the lungs to keep blood oxygen levels high, and hollow air-filled bones to make them lighter.

Today these adaptations for flight are seen only in birds. Dr Richard Butler and his colleagues at the Natural History Museum set out to find out how reptiles evolved them. The mainstream idea was that 'early pterosaurs did not have hollow, or pneumatised, bones and thus could have lacked air sacs', says Butler. 'It was thought possible that these features evolved independently in birds and pterosaurs.'

The team analysed fossils from two pterosaur species from the Triassic and one from the earliest Jurassic. They were looking for little openings called foramina, evidences of hollow bones connected to air sacs. 'We could identify and measure the openings in the sides of the fossil vertebrae,' explains Butler.

They found that the openings in these species had the same size and elliptical shape as the foramina recorded in late pterosaur fossils and modern birds. This means that they shared the same function and that early pterosaurs had a complex breathing system, well adapted to the demands of flight.

The findings, published in *Biology Letters*, have wider implications for the origins of flight and respiratory systems. 'It now seems likely that air-sacs and hollowed bones evolved much earlier than we thought,' says Butler.

The first animal to develop such a specialised breathing system was probably an ancient reptile that lived before the line of pterosaurs was separated from the dinosaur and bird branch.

British trees and shrubs face sudden death

Canker on an infected oak.

BRITAIN'S woodlands, historic gardens and lowland heaths are at risk of a new epidemic, and action is needed to prevent a repeat of the Dutch Elm Disease outbreak that killed most of the nation's elms in the 1970s.

The Department for Environment, Food and Rural Affairs (Defra) has commissioned scientists at Imperial College London to assess how it is dealing with a spreading outbreak of Sudden Oak Death disease, which is caused by two closely-related fungi: *Phytophthora ramorum* and *Phytophthora kernoviae*.

Both have been found in trees and shrubs in the New Forest, in South-west England and as far north as Staffordshire; it's believed they may have entered the country early in the decade and have been spreading ever since – slowly at first, but lately at a worrying pace. The Government has earmarked £25 million over five years to control them.

The disease gets its popular name from the havoc it has wreaked on oak forests in the US, killing millions of trees. In Britain beech is seen as most vulnerable, while rhododendrons are the key host species. This means that old woodland gardens, where shrubs like rhododendrons are often planted under a canopy of trees, are especially vulnerable.

Other common species at risk are ash, yew, magnolia and viburnum. And worryingly, heathers and plants of the *Vacinnium* genus, which includes shrubs like the bilberry, are also vulnerable. These plants are cornerstones of heathland habitats, which Britain has in exceptionally rich supply.

'We're at an early stage in the outbreak, and the evidence is still being collected,' says Dr Clive Potter, a geographer from Imperial's Centre for Environmental Policy who is leading a team that also includes economists, biologists and plant pathologists. 'But this is potentially one of the biggest threats to British trees and shrubs at the moment; some of the scenarios our models are producing suggest that a full-scale epidemic cannot be ruled out.'

The team is already doing related research into the problem, with funding from the Rural Economy and Land Use (RELU) programme.

It's thought that Sudden Oak Death is spreading partly via the nursery trade and the movement of plants around the country that it involves; existing rules on plant passports and inspections for disease may have to be tightened.

Cone cells let bees get a grip on flowers

BEES hold on to flowers using special petal cells that act like velcro, according to new research published in *Current Biology*. The small cone-shaped cells provide grip and allow a bee to stop beating its wings and start collecting nectar.

Foraging for nectar is a complicated business and bees use every possible trick to make it easier.

It's known that bees favour flowers with conical cells on the petals, but the cells' exact function was still being debated.

Previous research suggested that conical cells are attractive because they focus light on the petal, raising its temperature and making the colours more intense. Plant scientist Dr Beverley Glover at the University of Cambridge put forward a new hypothesis – that the conical cells are there for grip.

Glover's team experimented on snapdragon flowers and their pollinator, the bumblebee. First, they established that bees can indeed recognise different flower textures with their feet. To rule out colour and smell, the team used two types of pure white snapdragons: a normal variety with conical cells and a mutant with flat cells only.

They added a bitter solution to the flowers with flat cells and sweet nectar to the conical-celled flowers. The bees were then allowed to visit the flowers freely, and quickly learned that the rough texture meant goodies and smooth petals hid a nasty surprise. After 20 visits the majority of the bees took off immediately after landing on the bitter flower without even attempting to drink.

'Since the only difference between the flowers is the shape of petal cells, we can conclude that the bees recognised the different types based on touch alone,' says Glover.

The team used an odourless resin to mimic snapdragon petals with conical cells and flat cells. When the casts were horizontal, the bees visited the two types equally without preference. But as the scientists tilted the casts more and more, bees started going for the one with conical cells. When the resin flowers were vertical, the bees' preference for conical cells was clear.

Films of bees approaching the casts show them struggling to land on the vertical flat-celled petals, with their middle legs slipping over the smooth surface. But when they approach the rough-textured casts, the bees managed to grip the conical cells.

Hazy skies boost plant carbon intake

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PARTICLE pollution in the air is making plants absorb more carbon dioxide from the atmosphere by diffusing sunlight, new research reveals.

The paper, published in *Nature*, shows that hazier conditions caused by clouds and particles in the air, or 'aerosols', have caused plants to absorb 25 per cent more carbon between 1960 and 1999.

The increase was partly offset by the fact that the same aerosols and clouds also reduced the amount of sunlight reaching the Earth so that the total level of photosynthesis fell. But hazy skies meant that the photosynthesis that did happen was more efficient.

The net effect was a 10 per cent increase in the amount of carbon stored by the land even after the drop in photosynthesis was taken into account.

'The overall effect was to enhance the land carbon sink even though the total solar radiation has decreased,' says lead author Dr Lina Mercado, a vegetation modeller at the Centre for Ecology & Hydrology (CEH).

Plants perform better when they are being illuminated from several directions at once by light reflected off clouds and airborne particles, rather than under intense sunlight from a single direction. The more diffuse light means fewer leaves are completely shaded at any given moment.

The effect had been observed before in studies of temperate and tropical forests and croplands, but this is the first time it has been incorporated into a global climate model to estimate the total effect from all vegetation.

The findings suggest a conundrum – efforts are afoot to cut aerosol pollution, which consists primarily of sulfates but also includes particles of dust, sea salt, smoke and soot.

These aerosols can cause lung problems when people breathe them in. But making them less common in the atmosphere will make it harder to meet targets for reducing greenhouse gases like carbon dioxide, by reducing plants' ability to absorb those gases.

'Future policies on emissions reductions should take account of the fact that when we clean the air of aerosol pollution, plant photosynthesis will fall and part of the carbon sink will no longer be there,' says Mercado. 'So it will be harder to stop climate change and we will need to make bigger reductions in CO_2 emissions.'

The research team included members from the CEH, the Swiss Federal Institute of Technology, the Met Office Hadley Centre and the University of Exeter.

Low pollution levels linked to hospital admissions in rural areas

LINKS between high levels of air pollution and hospital admissions in large towns and cities are widely known. But new research – the first major study based on rural populations – connects much lower levels of pollution with hospital admissions.

Researchers based at the University of East Anglia examined 1050 hospital admissions in the rural county of Norfolk, UK, during a 13-month study. All 1050 patients had been clinically diagnosed with chronic obstructive pulmonary disease (COPD), sometimes used as an umbrella term for severe lung complaints like chronic bronchitis and emphysema, which results in restricted airflow to the lungs.

The team found that relatively slight increases in carbon monoxide, nitric oxide, nitrogen dioxide and other oxides of nitrogen were associated with more hospital admissions. An increase of ten microgrammes per metre cubed of nitrogen dioxide led to a 20 per cent increase in the odds of a patient needing hospital treatment for COPD.

The paper, published in the *Journal of Epidemiology and Community Health*, contributes to the debate on whether there are threshold levels below which pollution is benign.

COMPETITION

DR DAVE REAY'S *Your Planet Needs You! — A Kids' Guide to Going Green* introduces younger readers to the science of climate change, and tells them how they can make a difference. Published by Macmillan Children's Books and the Science Museum, it's available from all good bookshops. We have five copies to give away to lucky readers – to enter, answer the question on the PlanetEarth *Online* website: www.nerc.ac.uk/planetearth. Closing date: 1 October.

VIPER'S VENOM IS TAILORED TO ITS PREY

A SNAKE has venom adapted to kill its favoured quarry, new research suggests.

This might seem obvious, but it contradicts a common idea among experts on the evolution of snakes, many of whom have thought they are so toxic, and inject so much more venom than necessary to kill their prey, that the composition of their venom isn't subject to evolutionary selection.

But Axel Barlow, now a PhD student in the School of Biological Sciences at Bangor University, found evidence to the contrary while researching his undergraduate dissertation, which was part of a wider project funded by the Leverhulme Trust.

'Some people have argued that these venoms are so toxic that minor changes in venom composition are not significant,' says Barlow. 'But there is an increasing body of evidence suggesting that venom is under strong selective pressure. This research is the final nail in the coffin for the hypothesis that venom composition is neutral in evolutionary terms.'

The research could have important implications for how doctors treat snake bites. Differences in venom between species of snake can complicate this; understanding how these differences arose in the course of evolution could help create better antivenoms.

The research appears in *Proceedings of the Royal Society B*. Barlow worked with the genus of saw-scaled vipers; these snakes, which live in North Africa, Arabia and the Indian subcontinent, are closely related but eat very different things.

The scientists studied the genetic differences between four species within the genus to reveal the evolutionary relationships between different kinds of saw-scaled viper. 'This is the first study that shows that shifts in diet over the evolutionary history of the saw-scaled vipers go alongside changes in venom toxicity,' Barlow says.

They then analysed the venom of the four species, and dissected preserved museum specimens to look at their stomach contents and learn about their favoured diets, looking out for species that eat a lot of arthropods – these are creatures with hard exoskeletons, like insects or scorpions. Lastly they tested how lethal each kind of snake's venom was to scorpions.

They found that arthropod-eating species do indeed have venom that's more toxic to arthropods. But strangely, this adaptation showed itself only in the amount of venom needed for a kill, rather than in incapacitating and killing prey more quickly.

This means these snakes need less venom to kill but can still bite a scorpion and have it run away for some time before dying.

Barlow says more work is needed to understand why; one might imagine that killing prey quickly would be a major advantage to snakes, reducing the risk of losing their quarry and the time they are exposed to predators while following it.