INTERVIEW
DR SANDY KNAPP ON HER FASCINATION WITH PLANTS

HOW TO BE...
AN EXPERT WITNESS

18 UK BAT SPECIES EXPLAINED

THE Biologist

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LIFE ON THE REEF

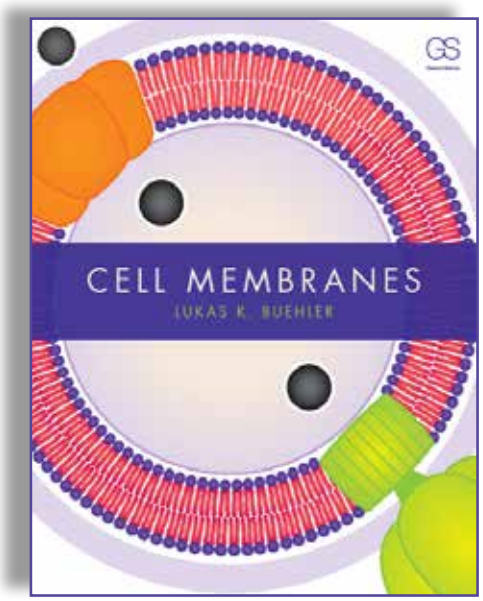
Unravelling the mysteries of coral

SOCIETY OF Biology

NEW FROM GARLAND SCIENCE

Cell Membranes

Lukas K. Buehler, Southwestern College, USA



June 2015 • Paperback
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Cell Membranes offers a solid foundation for understanding the structure and function of biological membranes.

The book explores the composition and dynamics of cell membranes—discussing the molecular and biological diversity of its lipid and protein components and how the combinatorial richness of both components explains the chemical, mechanical, and self-renewing properties of cell membranes.

Cell Membranes is a valuable resource for advanced undergraduate students, graduate students, and professionals.

Contents:

About the Author:

Lukas K. Buehler received his PhD in biochemistry from the University of Basel in Switzerland. He is a Professor of Biology at Southwestern College, Chula Vista, California, teaching general biology, cell biology, human physiology, and bioinformatics. His research interest is in biological membranes and how membrane transport proteins from diverse organisms—from bacteria to humans—function.

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From coral to court

Seen up close, especially when diving, coral is a mass of living colour

SUE NELSON
Editor

There are many reasons why university led to my career in journalism rather than science. These include gossiping during time meant for experimental physics, and managing my finals revision around the rehearsal schedule of Cardiff's Sherman Arena Theatre, as I was about to play Rita in a two week run of *Billy Liar*. Not surprisingly, a career on a media stage proved a better fit.

Another reason is that most journalists, even when specialists, are still generalists. If your beat is science, this specialism covers everything from biology to the biosciences to astronomy, forensics and chemistry. No human brain is large enough for a detailed knowledge of every science, but journalists are good at researching and getting up to speed quickly with the subject of a story, then writing about it in a way that will engage a wide audience. For butterfly brains this is ideal.

Many journalists, including myself, often have difficulty recalling recent short term projects as afterwards they are immersed in something completely different – almost like temporarily erasing part of the brain's hard drive in order to create more head space for something else. When I was younger, this was especially important as I juggled science, travel and comedy writing.

Somehow though, unlike the science stories or gags written for sketch shows, I can always remember the countries I've visited: snorkelling above stunning coral reefs off the coast of Bali, admiring a school of dolphins in the Straits of Gibraltar, or feeling seasick on a boat en route to see the Great Barrier Reef and realising, upon arrival, that it was all worth it. These memories returned with the article on coral by Brian Roy Rosen from London's Natural History Museum, which is hosting an exhibition on coral until mid-September (see page 12). Seen up close, especially when diving, coral is a mass of living colour, some with tentacles undulating with the current. Brian goes into some amazing detail about these medusas of the sea.

It also reminded me of an occasion where travel, comedy and science collided. Several years ago, I took the train to the Coral Reef Research Unit at the University of Essex to do a radio interview with a biologist. Once it was over, he asked me to follow him towards the exit as people often got lost on their way out. So, head down while checking emails on my phone, I followed him along several corridors and through a door before realising there was a wall ahead. I stopped and raised my head to find myself inside the gents' toilets with two terrified men at a urinal and a wide-eyed biologist so astonished at my presence that he was unable to speak.

There's a lot to be said for sticking to one thing at a time. But if you are interested in multitasking and expanding your career, turn to the section about becoming an expert witness (page 28). It includes the personal experience of microbiologist and editorial board member of *The Biologist* Ian Blenkharn.

Several board members will be stepping down over the next year after having served their terms. Thanks go to all of them for their enthusiasm, knowledge and support. Do think about applying to join the editorial board. I promise not to follow you into the loo.

BioPic

HUMMINGBIRD
By Thomas Padfield, course leader for Applied Science, Stanmore College
Pictured in the Santa Elena Cloud Forest Reserve, Costa Rica

NEXT STOP: LATITUDE FESTIVAL

Festival goers will get the chance to help record species at Latitude's Henham Park venue. Below: Society volunteers at Winchester Science Festival last year

JACK PASCO

Science outreach joint venture at music festival

The Society has added the Latitude Festival to its schedule of planned outreach events this summer.

As well as hosting activities and exhibitions at the British, Cheltenham and Glasgow science festivals, the Society will be attending the popular Suffolk music and arts festival, which attracts more than 25,000 people a year.

Following the success of the Society's 'Love Zoo' science bus at Wales' Green Man Festival last year, the Society is joining the British Ecological Society (BES) in trying to record as many species as possible in the woodlands, grasslands and lakes in Henham Park, where Latitude is held.

A team of Society staff and ecologists from BES plan to run a range of activities for festival goers including insect safaris, bat surveys, pond dipping and moth trapping. A 'Bio-Bus' field lab will help people learn more about what they find and all of the records collected will be added to the UK's National Biodiversity Network.

EVENTS
LATITUDE
The festival is at Henham Park, Southwold, Suffolk from 16–19th July

BioPic

A POLKA-DOT TREE FROG (*HYPSIBOAS PUNCTATUS*)
By Seline Dilmec AMSB
Found during a research trip in the Pacaya-Samiria region of the Amazon

Sovereign approves Royal title for Society

The Society has been given permission to become the Royal Society of Biology.

Granted by the Sovereign, acting on the advice of Ministers, the royal title recognises biology as a discipline and the contribution of biologists in the UK and beyond.

Chief executive Dr Mark Downs (pictured) said staff at the Society were "absolutely thrilled" by the news.

"The new status of the Society will help us to spread the word about the true value of biology and how it can contribute to improving life for all. This change recognises the collective efforts of many individual members and Member Organisations."

The name of the Society will officially change later this year after constitutional amendments and rebranding has taken place.

Opinion
Rebecca Nesbit
Scientific programme manager at Nobel Media

Rebecca's first novel, *A Column of Smoke*, was published last year.

Scientists: let's embrace fiction as well as facts

How story-telling can tell the truth about science

Novels can provide a glimpse into the culture and social attitudes of different times and places. You can experience other people's worlds during your morning commute, and this may be the closest you'll come to understanding the life of a soldier, detective or medieval queen.

This raises the worrying point of what opinion readers might build of scientists if novels were all they had to go by. Scientists in novels, it seems, are a dangerous bunch, liable to unleash a killer virus, build a deadly weapon or assemble monsters from body parts. Realistic portrayals of scientists are hard to come by. It's time we tackled the problem.

We're making great progress in getting scientific information into the popular domain, but how people react to science is still affected by their perceptions of scientists. Few readers of *The Biologist* will have read a paper about homeopathy, yet most of us are confident it's a placebo, because we hear of its ineffectiveness from scientists whose knowledge and motivations we trust. Would you come to a different conclusion if you didn't understand scientists?

By providing insights into their world, scientists can help writers portray science accurately. The organisation Cape Farewell, for example, brings together artists and scientists to address climate change. One of its expeditions inspired Ian McEwan's satirical novel *Solar*. The book's protagonist, climate scientist Michael Beard, is a horrible specimen who mistreats everyone he comes into contact with. Yet he still provides an insight into life as a scientist, with accounts of Arctic field trips and academic conferences.

We don't have to rely on professional writers, either. Scientists are all writers, and who better to write fiction about science than researchers themselves? Although causation is hard to prove, studies[1,2] show that fiction readers score more highly in tests of empathy, so it's worth offering people an insight into scientists' lives.

Fictional scientists are often mad or evil

The internet has opened up new possibilities for finding an audience. For example, Jennifer Rohn, a research scientist and author, has set up www.lablit.com, which deals with "real laboratory culture and the portrayal and perceptions of that culture – science, scientists and labs – in fiction, the media and across popular culture".

I've found writing about science extremely rewarding. Through my novel I wanted to accurately depict scientists involved in genetic modification. The image of greedy capitalists keen to bully the honest critics is pervasive, so it seemed time to set the record straight. My protagonist, Sally, certainly doesn't behave like a model scientist, even though her motivations are right. In fact, one of the themes I explore is how good intentions can drive people to do the wrong thing. She does, however, give a more realistic view of what scientists do and why they do it.

I hope many more scientists will join me in giving honest depictions of scientific life. The discussions around children who, when asked to draw a scientist produced pictures of bearded men, have become as clichéd as the images themselves. Fiction provides opportunities to tackle the problem.

> In fiction, realistic portrayals of scientists are hard to come by

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2) Mar, A. R. *et al.* Bookworms Versus Nerds: Exposure to fiction versus non-fiction, divergent associations with social ability, and the simulation of fictional social worlds. *Journal of Research in Personality* **40**, 694–712 (2006).

Jon Kudlick
Director of Membership, Marketing and Communications

Time for a refresh

Celebrations for the Society and *The Biologist*

Your new look magazine

As I write this, we have just found out that we have been given permission to become the Royal Society of Biology. This exciting news was closely followed by *The Biologist* receiving a Highly Commended accolade at the 2015 MemCom awards. So we have lots to celebrate.

Feedback about *The Biologist* from members has been overwhelmingly positive in recent years, too. In our last survey towards the end of 2013, the average reading time was 55 minutes – more than double the industry average. Also, the most common reply to naming the single thing that would improve the magazine was... 'Nothing'.

Some might say "if it ain't broke, don't fix it" but, as you will have noticed, we have not subscribed to that viewpoint. We have worked with our publishing partner, Think, to give the magazine a new look, logo and layout. The aim is to present a more modern publication, with space to show off our stunning images and to maximise the impact of the rich content in every issue.

We now have a more flexible format according to how much news we have to report. 'Up front' now contains a mix of the news, opinion, policy updates and views from the Society. This new column, Inside View, is for contributions from the Society's staff, Council or editorial board, so you will start to see a broader range of faces, and ideas.

The main features, interviews and regulars like 'Museum Piece' remain the same. More importantly, what hasn't changed is that we still need your help. Please keep sending your great BioPics and do contact us if you would like to write a feature article or an opinion piece.

We will be keeping an eye on whether this refreshed look and format garners further recognition and awards over the coming years. We're delighted with the new look, but that doesn't mean anything unless you agree, so please tell us what you think.

Business author Robert Kriegel wrote a book called *If it ain't Broke, Break it*. I don't think we've gone that far, but we do like to keep one step ahead.

> The aim is to present a more modern publication ... and to maximise the impact of the rich content

Becoming a biologist: top tips

Dr David Williams FSB

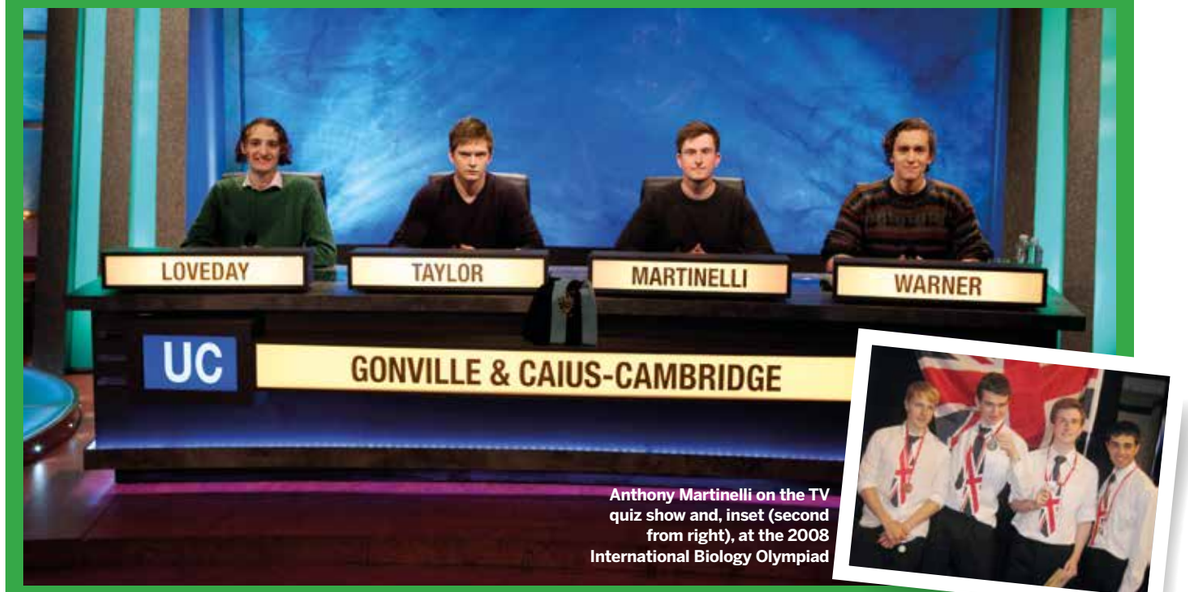
The Society has launched a new video with careers advice from 11 experts across the life sciences as part of its Biology: Changing the World (BCW) project.

The two-minute video uses clips from longer interviews held with the 11 scientists.

The scientists' tips range from "work very hard" (Dr David Williams FSB, University of Cambridge) to "don't be scared of maths and modelling" (Professor E J Milner-Gulland, Imperial College London).

The BCW project aims to celebrate great biologists of the past and present to inspire the biologists of the future.

A dedicated website for the project has more than 500 biologist profiles, video interviews and stories to explore. Visit biologyheritage.societyofbiology.org



Anthony Martinelli on the TV quiz show and, inset (second from right), at the 2008 International Biology Olympiad

Olympiad champ wins University Challenge

A former competitor in the Society's biggest biology competition has captained a team to victory in this year's *University Challenge*. Anthony Martinelli and his team from Gonville and Caius College, Cambridge, beat Magdalen College from Oxford in the final of the TV quiz show.

Martinelli was one of the highest scoring entrants in the 2008 British Biology Olympiad and went on to win a silver medal for the UK at the International Biology Olympiad (IBO) in India in the same year.

Speaking after his *University Challenge* win, he credited at least one correct answer to his preparation for the Society's competitions. "I found it funny that the last question of the whole competition was on botany," said Martinelli, "and the only reason I have any knowledge of the suffix '-aceae' is an afternoon spent at Kew Gardens training for the Biology Olympiad."

A record 6,189 students took part in this year's British Biology Olympiad. The Society and UK Biology Competitions are pleased to announce that the four students who will represent the UK at the IBO in Denmark in July are: Timothy Birkle, St Paul's School; Guy Cheng, Winchester College; Matthew Hankins, Reading School; and Rhys Thomson, Reigate Grammar School.

Martinelli is backing the Society's goal of hosting the 2017 IBO in the UK.

From the Treasurer

Over the financial year 2013-14, the Society has been engaged in an impressive range of high profile activities covering three main areas: science policy, education and careers, and public engagement activities including Biology Week.

In parallel with our increased activity, there has been an increase in turnover to £2,820,500 (up from £2,380,300 in 2012-13) and our total incoming resources have increased to £2,689,400 (£2,646,100 in 2012-13). We are extremely grateful for the substantial contributions from our eight 'enhanced funder' Member Organisations and particularly to the Biochemical Society, which has also provided a 'gift in kind' in the form of a member of staff seconded to work on policy issues.

As explained in my report last year, in the accounting year 2012-13, we received a large 'restricted' grant (funds that must be used for a specific, defined purpose – in this case, development of the accreditation programme) from the UK Commission for Employment and Skills, which had to be accounted as income in that year. The expenditure must be shown in future years and this, together with the unrealised loss on a defined benefit pension scheme closed in 2006, resulted in an expected overall deficit of £166,500 in 2013-14. Our unrestricted general fund, which supports most of our activities, showed a modest surplus of £22,000. Our funds carried forward on 30th September 2014 were £1,762,600.

Throughout the year, Council closely monitors incoming and outgoing funds, and maintaining and expanding our core activities and our benefits to members will be challenging over the next year. Council, therefore, agreed to a small increase in subscriptions from October 2015.

I would like to thank Mark Downs and his team at Charles Darwin House, our professional accountant Elizabeth Liberda-Moreni, Daniel Ross, the outgoing chair of the Audit Committee, and our auditors BDO LLP, for all they have done to ensure that the Society's financial position continues to be sound and transparent.

Pat Goodwin FSB
Honorary Treasurer

TURNOVER INCREASE

(2013-14)
£2,820,500
UP FROM
(2012-13)
£2,380,300

PLANT SCIENCE CONFERENCE IN BLOOM

▶ UK PlantSci meeting tackles topical global issues

More than 135 plant scientists, policymakers and educators came together for the fourth annual UK PlantSci conference in April. The meeting, organised by the UK Plant Sciences Federation, addressed issues such as how we will feed the world's growing population, how to stop the introduction and spread of new plant pests and diseases, and how to preserve biodiversity and other natural resources.

The first day opened with a lively keynote lecture by Guy Smith, vice-president of the National Farmers Union and, according to Guinness World Records, farmer of the driest farm in the British Isles. He discussed the issues farmers now face, including unpredictable weather and the loss of crop protection products from the European market. He emphasised that it was important for farmers to understand biodiversity on farms and work intelligently with science and technology to improve agricultural productivity and sustainability.

The second day began with a keynote talk by Professor Caroline Dean from the John Innes Centre about her pioneering work on the seasonal control of flowering. She described how her interest in environmental cues had been inspired by her experience buying tulip bulbs in California, where she had worked as a postdoc.

For further conference highlights, follow the twitter hashtag #PlantSci2015 or visit our Storify at https://storify.com/mimitanimoto/plantsci2015

Professor Caroline Dean gives her talk on the seasonal control of flowering

Dr Miriam Gifford, associate professor, University of Warwick

CSciTeach status for Society educators

The Society has elected the first applicants onto its new Chartered Science Teacher (CSciTeach) register.

Professor Graham Scott from the University of Hull (inset), Andrew Duggan from Middlesbrough College, Robert Johnston from St Mary's College Liverpool, and the Society's Sarah Cox have all achieved CSciTeach status.

The Society assesses members or Fellows working in primary, secondary and tertiary level education for the CSciTeach register via a licence from the Science Council. The register recognises the skills and expertise required to teach science. Applicants must demonstrate the impact they have made on students' learning, how they have developed as educators and how they have supported their colleagues across 12 competencies.

3Rs animal science event

The National Centre for the Replacement, Reduction and Refinement of Animals (NC3Rs) in Research will be hosting a one-day symposium in partnership with the Society's Animal Sciences Group.

The event will showcase the latest scientific and technological advances in the 3Rs – the replacement, reduction and refinement of the use of animals in research.

The symposium has been approved for continuing professional development by the Society and will be held on 10th June.

Each year the NC3Rs Prize recognises research that has positive implications for animal research. This year's winner was Oliver Britton, an Oxford University PhD student whose computer modelling of cardiac electrophysiology should allow drug developers to discard drugs that are toxic to the heart before animal studies are required.

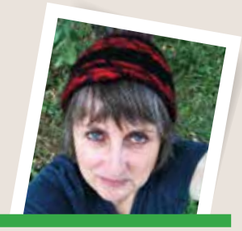
The 3Rs were developed over 50 years ago as a framework for humane animal research, and are now embedded in national and international legislation regulating the use of animals in scientific procedures.

Essay competition

The Society is giving undergraduate student members aiming to develop careers in animal science and technology the opportunity to win a Home Office training course. Applicants should submit a 1,000 word essay on the use of animals in research by the 10th July deadline.

More details on the prize and how to enter are available at www.societyofbiology.org/animalessay

Dawn Sanders
Associate professor in biology didactics at Gothenburg University, Sweden



Plant blindness: time to find a cure

We must help people see that plants are dynamic, social and vital to life

Society can no longer afford to view plants as the scenic backdrop to zoological theatre. As biologists, we know plants are essential to the processes underpinning the life support systems of our planet, but this ecological role is often rendered invisible in our fast paced lives.

The absence of plants in contemporary life is a problematic social condition, and one that requires urgent attention. We need a radical shift in focus to address 'plant blindness' and start shaping plant based narratives that engage human attention towards the important work that plants do.

Lily pads inspired 19th century engineering

Beyond the essential support plants give to living systems, they occupy numerous niches in human society: we eat plants, wear them, drink them, and use them to make furniture and medicines. The celebration of life and the mourning of death is often accompanied by flowers, and numerous product designs are inspired by plants – for example, the underside of a giant lily pad inspired 19th century civil engineering solutions that allowed for large expanses of glass.

People have long viewed plants as passive organisms that simply feed and reproduce. However, studies in plant behaviour[1, 2, 3] suggest that plants are dynamic, social and highly competitive organisms. Indeed, thanks to carnivorous plant research, we now know, for example, that *Drosera capillaris* is capable of competing with a spider for the same fly species. Some plants even communicate with neighbouring individuals to warn of the presence of a predator (see page 24).

We believe the time is ripe for replacing outmoded plant based narratives with multisensory, dynamic stories drawn from both modern plant science and contemporary technology and design.

> Mammals are not adapted to survive without plants

The critical message is that mammals, the taxonomic class to which we belong, are not adapted to survive without plants. In 2003, a botanical educator from University of Dundee Botanic Garden boldly stated that the contribution of plants to life on Earth could be represented by a simple equation[4]: Plants = Life. She argued that it was imperative that this powerful message be communicated to an ever expanding human populace, as the future, for plants, was looking pretty bleak. It is estimated that there are around 400,000 plant species in the world, and at least 25% are threatened with extinction. Humans are the main cause of extinction and the principal threat to species at risk[5].

This societal challenge is a significant opportunity to rewrite the private lives of plants back into the human narrative. If we fail to do so, the long view, for both plants and humans, is looking desolate.

This article was coauthored by Dawn Sanders, and Eva Nyberg from Gothenburg University, Sweden, along with Bente Eriksen and Bryndis Snæbjörnsdóttir, both of Lund University, Sweden.

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Many happy returns

Going back to work in the sciences after a career break takes planning, but there are sources of help for a successful return, explains Dr Catherine Ball

A returner is not a type of boomerang or an affliction you can't get rid of. It is someone – woman or man – who has taken an extended career break and wishes to return to their profession. A career break can occur for many reasons, such as caring responsibilities, illness, unemployment or a desire to change career paths.

There are a number of reasons why taking an extended period of time out can be particularly problematic for scientists. First, science is, by its very nature, a rapidly evolving and progressing subject. Techniques, theories and equipment can change dramatically in a matter of years. This means that returners can face real difficulties in remaining up to date.

The very culture of the academic science community can also be a problem – the competitive nature of science can leave part-time workers or returners feeling shut out.

Microbiologist George Carnell took a four year break from science after completing his undergraduate studies to pursue a career in the army. When he realised that he was more suited to life as a scientist than as a soldier, he found it difficult to get back into science.

Techniques, theories and equipment can change dramatically

"It is crucial to maintain contacts with previous supervisors and colleagues," says Carnell. "Returning to science was very difficult for me as I lacked a scientific referee."

Despite this, he successfully managed to get accepted on a master's course and is now working towards a doctorate at the University of Kent. He feels strongly that returners must not be shut out of the science community and offers advice to anyone considering making a return.

"I would recommend long term planning well before taking a break and, if possible, seeking advice and opinions on your plans. Make sure you are up to date with the key literature and, if possible, start to get involved online prior to making applications, using tools such as Twitter or ResearchGate."

A number of schemes also exist to help people back into an academic research career. The Daphne Jackson Trust runs a fellowship scheme that enables scientists to return to research after a break of two or more years. The fellowships balance an individually tailored retraining programme with a research project in a suitably supportive environment. Fellowships can be based in a university or research institute anywhere in the UK.

The Wellcome Trust has a similar scheme, the Career Re-entry Fellowship, and the Royal Society's Dorothy Hodgkin Fellowship helps those who require flexible working arrangements to fit in with their personal circumstances such as parenting, caring responsibilities or health issues. All of these schemes are open to men and women.

However, more needs to be done to support returners and to convey the message to employers and higher education institutions that returners are an untapped talent pool. The Society has established a Returners to Bioscience group to examine the experiences of those who face barriers returning to a career in the biological sciences.

This move is in light of our continued concerns about the loss of trained and committed scientists from the bioscience workforce. As part of an ongoing programme of projects, we have developed a Returner's Resources web page, containing useful information and resources for those wanting to return to work.

For further information about the Society's Returners to Bioscience group, or to provide a case study, contact policy@societyofbiology.org

Dr Catherine Ball is a policy analyst at the House of Lords Science and Technology Committee and was previously a science policy adviser for the Society.

FIND OUT MORE

SOCIETY OF BIOLOGY RETURNER'S RESOURCES
www.societyofbiology.org/returners-resources

DAPHNE JACKSON TRUST FELLOWSHIPS
www.daphnejackson.org

ROYAL SOCIETY DOROTHY HODGKIN FELLOWSHIPS
royalsociety.org/grants/schemes/dorothy-hodgkin

WELLCOME TRUST CAREER RE-ENTRY FELLOWSHIPS
www.wellcome.ac.uk/Funding/Biomedical-science/Funding-schemes/Fellowships/Basic-biomedical-fellowships

POLICY UPDATE

PPCs urged to support science

The Society wrote to as many new Prospective Parliamentary Candidates (PPCs) as possible in advance of the general election, drawing their attention to the importance of science in policy making, and asking them to support UK science and commit to the necessary investment if elected. We also asked the PPCs to consider the many ways in which science and science evidence will be relevant to policy making, and offered to be a link to expert advice.

Antimicrobial resistance workshops

The Learned Society Partnership on Antimicrobial Resistance (LeSPAR) is holding three interdisciplinary networking workshops. These events will bring together researchers from all career stages who have an interest in fundamental or translational research on the evolution and transmission of antimicrobial resistance.

The workshops will take place at Charles Darwin House in London on Thursday 25th June, the University of Dundee on Friday 3rd July and BioCity Nottingham on Tuesday 7th July.

The Society is part of LeSPAR in collaboration with the Biochemical Society, the British Pharmacological Society, the British Society for Antimicrobial Chemotherapy, the Royal Society of Chemistry, the Society for Applied Microbiology and the Society for General Microbiology.

See www.societyofbiology.org/amr for more information

Coral reefs are high diversity ecosystems, home to a staggering number of species

Animal, mineral, plant?

Corals may resemble beautiful marine plants, but, explains Dr Brian Roy Rosen, they are stinging walls of death for small organisms

How to categorise corals has teased enquiring minds for thousands of years. They have stony, mineral skeletons of calcium carbonate, in effect limestone, and are technically animals. But underwater they resemble shrubs or even flowers, and the cells of many species contain algal symbionts, which make them dependent on light, like plants. This is why they grow in elaborate plant-like shapes to maximise light capture.

Coral reefs are home to almost a quarter of all living marine species, and more than 500 million people depend on them for food, coastal protection and tourism. Yet global warming, pollution, overfishing and possibly ocean acidification are killing coral reefs. One in four of the world's coral reefs are dead and many more are threatened.

Apart from specialists, few people in Britain understand coral or its importance, so it is timely that this summer there is an unprecedented exhibition at the Natural History Museum in London called Coral Reefs: Secret Cities of the Sea.

Two hundred specimens of coral and other reef life vie for attention with everyone's favourite dinosaurs and mammals. Star attractions are a living reef aquarium, a virtual reef dive, and Charles Darwin's very own coral reef specimens from his Beagle voyage. Importantly, the exhibition also showcases the museum's current research on the geological history of corals and reefs in Southeast Asia. Research into coral biology has proliferated in recent years to find out how climate change is affecting corals and how to improve management of the coral reef ecosystem.

When corals and other mineral-depositing organisms such as coralline algae grow profusely enough, their skeletal limestone accumulates as reefs. These can be as substantial as the Great Barrier Reef, the world's largest reef complex, which stretches over an area of 344,400km^2 off the coast of Australia. The reef is also considered to be the largest structure on Earth built by living organisms.

The rocky three-dimensional structure of reefs creates the habitats that support the diversity of other organisms, ranging from bacteria to large, eye-catching vertebrates. Reef limestone also provides homes and protection for humans, as many tropical islands consist entirely of rock and sand of reefal origin.

Reefs can also provide coastal protection. In the past, people built houses from coral heads, and burned them for lime and cement. Most limestone derives from organisms such as corals, which means coral is of economic importance because of its contribution to concrete production.

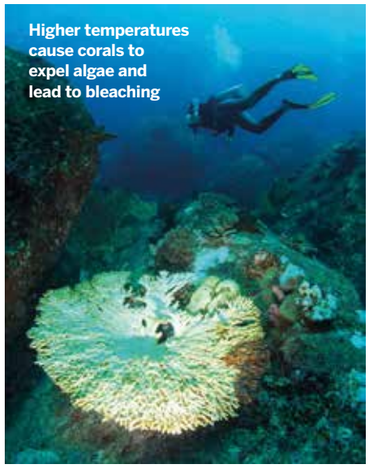
In classical times, corals were widely thought to be a form of seaweed that turned to stone when taken out of the water. This idea persisted until the early 18th century, when they were at last properly recognised as animals. However, the affinities and relationships of corals to other vegetative aquatic invertebrates such as hydroids, sponges, bryozoans and even coralline algae continued to be a mystery for another century or so.

Darwin, attempting to understand the confusing complex of 'zoophytes' ('plant-

Coral polyps can form large colonies by asexual reproduction, or cloning

Most corals on modern reefs are scleractinians (stony corals)

Marine biology
Coral



Higher temperatures cause corals to expel algae and lead to bleaching

animals') and 'corallines' he encountered during his time on the Beagle, resolved to dedicate his taxonomic researches to this question. In the end, though, he deferred his intended grand project to James Dwight Dana and turned instead to barnacles.

THE WALL OF DEATH

The word 'coral' still has no strict taxonomic meaning. Corals in the widest sense are simply vegetative aquatic organisms that have stony or horny skeletons. 'Coral' is now used to describe various groups of skeletonised cnidarians that have arisen from multiple lineages. Other familiar cnidarians include jellyfish, hydroids and sea anemones.

The entire Cnidaria phylum consists of the most primitive kinds of organisms that have proper tissues. These form two layers – the inner endoderm and the outer ectoderm – with a cell-less layer of jelly-like matter in between. All cnidarians have a sack-like body with a single orifice for feeding, waste and reproduction, and surrounded by tentacles. Their body plans have radial or biradial symmetry. Their nerves are organised as a network, as they lack a central nervous system.

Most striking is their unique specialised stinging cells, nematocysts, which spring a bristle-like thread into their victim's body, releasing toxin. Nematocysts have various functions, but are important for defence and for capturing prey. In some cnidarians (not corals), the toxins are powerful enough to kill or seriously wound a human. Corals are so densely armed with these stinging cells that to a small organism, a colony will seem more like a wall of voracious death than the harmless flower-like object we humans see.

Most of the corals growing on and building modern reefs are scleractinians (stony corals). Octocorals and hydrozoan corals are also important in some parts of a reef. Scleractinians have a long and abundant fossil history going back about 245 million years (mid-Triassic), while molecular evidence indicates that they consist of two separate groups that diverged from a common coralloid ancestor about 30 million years earlier (mid-Permian). There were also two other distantly related major groups of corals (rugosans and tabulates), that go back at least 485 million years (Ordovician), but which disappeared in the end-Permian mass extinction 252 million years ago.

LIFE CYCLE

All cnidarians are aquatic, and mostly marine. Hydrozoans especially have complex life cycles whose various stages include a swimming larva, a swimming, 'tentacles-downwards' (usually), jellyfish-like form (medusa), and a 'tentacles-upwards' form that is attached to the sea floor (polyp).

However, scleractinians, like all members of the larger group – the Anthozoa – to which they belong, have no medusa stage. In fact, for people more familiar with temperate rock pools than coral reefs, scleractinians can be thought of broadly as sea anemones with skeletons. However, unlike sea anemones, scleractinians, especially reefal species, build colonies up to several metres across – obviously a key factor in their reef-building potential – that live for hundreds, even thousands of years.

Scleractinians reproduce both sexually and asexually. Many scleractinians reproduce by spawning, often in mass spawning events during which adult polyps release thousands of eggs and sperm together. Remarkably, this happens during the night on just one or two predictable

Many scleractinians reproduce in mass spawning events

dates a year in line with the lunar cycle. A small, swimming larva results from the external fertilisation and, on settling, starts to deposit its first skeleton.

Although individual scleractinian polyps can greatly increase in size, this is most typical of solitary forms, some of which can reach tens of centimetres in diameter. Other scleractinians grow larger by making colonies via asexual reproduction, better thought of as cloning and sometimes also called modular growth.

Some species shed their clones completely and the parent remains solitary. For many other species, though, full cloning is arrested, so that clones remain permanently attached to the parent. In some species, the cloned polyps, although still attached, are more or less complete. In others, the clones develop no further than new mouth parts that open into one continuous communal body mass. In time, the cloned 'daughters' become parents of new clones that also remain attached, and so on. This eventually leads to colonies of thousands, even millions, of polyps.

The many variations in clone development, and in the patterns by which clones branch from each other, give rise to the great variety of colonial growth forms, especially on reefs. Corals can also vary these patterns within a single colony's history, or within a species, according to their environmental conditions, often in response to changes in surrounding conditions. Colonial growth is also a powerful means of survival from partial damage and colony breakage, often giving rise to whole new colonies when the separated parts of a colony, the ramets, grow into several thriving new colonies while still sharing the parental genotype.

In fact, no-one really knows how long such colony lineages, or genets, can last. Together with other organisms that have this kind of growth, such as bryozoans, sponges and many plants, they defy the usual notions of mortality and raise questions about how natural selection operates on such clonal systems.

INTER-REEF RELATIONSHIPS

Like all cnidarians, scleractinians are carnivorous, but half of all living species are also symbiotic with certain algae (zooxanthellae). These algae live within the cells of host corals (zooxanthellate corals or z-corals).

Photosynthesis by the algae fixes carbon as sugar-like substances that the host coral absorbs and uses as an energy source. The algae live in the relative protection of their hosts' tissues and so also have access to their own exclusive supply of carbon dioxide from the coral's respiration, as well as benefiting from the coral's waste nitrogen and phosphorus products.

Such symbiosis has commonly been thought of as symmetrical – that is, of equally mutual benefit – but a more recent view suggests that the relationship is more asymmetric, with the coral host parasitically exploiting the zooxanthellae for their energy production.

The relationship between the corals and their zooxanthellae is sometimes a delicate balance, which is often upset when the coral experiences extreme conditions.

Coral bleaching occurs when surrounding water temperatures are too high. The metabolism of the photosynthetic zooxanthellae speeds up so much that they eventually become damaged.

The damaged zooxanthellae can create toxic excess of oxygen and other substances and the corals eventually must expel all their zooxanthellae through their mouths.

Without their zooxanthellae, their tissues lose their delicate colours and become translucent, revealing their white skeletons underneath. Unfortunately, this bleaching leaves the corals weakened and starving, often beyond recovery.

While corals may grow back and their zooxanthellae may re-establish themselves once the higher temperatures abate, the weakened corals are more susceptible to disease. Bleaching has become a greater problem as the oceans have warmed.

The world of corals and reefs is widely perceived to be under increasing threat. Sometimes they have recovered from adverse natural changes in the geological past, and sometimes not. Older kinds have become extinct and replaced by newer types, but this process can take millions of years. Right now, we worry that the pace of current change – in terms of climate change, pollution, overfishing and habitat destruction – seems too fast for the corals to respond.

The worst case scenario is for coral reefs to lose most of their corals. Their high biodiversity, three-dimensional structure will then degrade, giving way to more monotonous, lower biodiversity habitats, with a much simpler food chain dominated by seaweeds and other organisms that thrive in high-nutrient waters. Clearly, their value to humans, particularly as coastal protection and as a food source, will deteriorate as well.

Eco-gloom about these issues is understandable, but we do not yet fully understand all the processes involved, nor can we gauge the probability of longer term survival and recovery. Advancing our knowledge of the corals themselves is a crucial part of this. At the Natural History Museum, we are revealing and celebrating the importance, diversity, beauty and complexity of this apparently simple coral animal, its reefal habitats and co-habitants. The aim is also to help everyone become more aware and better informed about them for the task ahead.

Brian Roy Rosen CBiol FSB is scientific associate at the Natural History Museum's department of life sciences.

Caped crusaders

Each summer an army of volunteers monitors UK bat numbers and, according to Dr Kate Barlow, their recent findings are good news

Monitoring bats at Threave Estate reserve in Scotland

Brown long-eared bat (*Plecotus auritus*)

PHOTOS BY MIKE BOLAM (WITH THANKS TO NATIONAL TRUST FOR SCOTLAND AND ECHOES ECOLOGY)

At sunset on a warm, dry summer's day, hundreds of dedicated people are interested in more than just the view. Some sit in their gardens, carefully watching small gaps in the roofs of their houses. Others wander around towns and the countryside, through streets, fields and lanes, clutching beeping electronic devices. These amazing volunteers are all taking part in the Bat Conservation Trust's National Bat Monitoring Programme.

Since the programme was established in 1996, the Bat Conservation Trust (www.bats.org.uk) has been working with partners and volunteers gathering data on how our bat populations are faring. There are 18 species of bat in the UK, making up about a third of our mammal species. Many of our bat populations suffered considerable declines in the second half of the 20th century, driven by factors such as habitat loss through agricultural intensification and direct loss of bats from the effects of pesticides such as those used for timber treatment in buildings.

There is, however, a lack of quantitative evidence from this period that makes it difficult to determine the full extent of those declines. Then, during the 1980s and 1990s, there was an increase in interest in bat conservation in Britain, at least in part promoted by new legislation providing legal protection for bats from the Wildlife and Countryside Act 1981[1]. This resulted in improvements to the available information on distribution of bat species and locations of bat roosts, but there was still no clear picture of whether bat populations were continuing to decline, were relatively stable or were increasing in numbers.

One of the key problems is that bats are hard to monitor: they are small, nocturnal, often tricky to find and it can be difficult to identify species as they flit past in the dark. Survey methods commonly used include counts of bats in summer and winter roosts, capture surveys and, more recently following the development of bat detectors, acoustic surveys.

Checking the mist net at Threave

All monitored species are showing a stable or increasing trend

There is a general consensus among bat conservationists, both locally and globally, that monitoring bat populations is invaluable. This is not only to ensure their effective conservation and to determine how bats are responding to the unprecedented rates of environmental change, but also to provide a broader indication of the health of our ecosystems. However, there are still no standardised protocols for monitoring bats across countries or continents. In the 1990s, from work investigating habitat use by bats in the UK, researchers demonstrated that volunteers could be coordinated successfully to carry out bat surveys at a national level[1,2]. This work, and the increasing need to be able to report on the status of bat populations, led to the establishment of the National Bat Monitoring Programme, supported by government funding.

Our programme relies on volunteers to take part in different surveys throughout the year, including summer counts of bats emerging from maternity roosts, winter counts of bats in underground sites such as caves and mines that they use for hibernation, and summer bat detector surveys looking at activity levels of bats in different habitats.

Recently, we published our results, analysing data on 11 bat species collected by over 3,500 volunteers at more than 3,200 sites across the UK for a 16-year period from 1997 to 2012[3]. They show a generally favourable picture for the bat species that we monitor: a stable or increasing trend

Bat tracking at Kelton Mains

was found for all species over the period of the study from at least one survey type. This suggests bat populations are showing signs of recovery, almost certainly helped by the increasing public awareness of bats and interest in bat conservation in recent decades, combined with the legal protection for these species at a national and European level.

We must not become too complacent, though. While these are positive results, the current increases we are seeing in bat populations are likely to be only a small start in their recovery from previous losses. There is still much work to do, first to unravel the main factors driving the changes and second to expand our monitoring right across the range of bat species we have in the UK: some of our rarer species that are habitat specialists are not included in our monitoring programme as yet, as they are difficult to monitor or are rarely encountered. The National Bat Monitoring Programme therefore mainly shows us what is happening to the more common and widespread bat species and may not completely reflect all of the pressures and impacts on our bats.

What is exciting to me, though, is the success of our citizen science approach to bat monitoring. There has been criticism of citizen science projects and widespread concerns about the quality of the data. However, as the number of peer-reviewed publications emanating from citizen science programmes increases, the value of the data is becoming more widely appreciated, as was recognised last year by the Government in a parliamentary POST Note[4].

Our study has demonstrated how, through providing a structure and training for anyone who wants to get involved in bat monitoring, data collected by volunteers using standardised, multiple survey methods can be used to provide statistically robust population indices for a large proportion of our bat species at a national scale.

Our bat monitoring trends not only help us understand how bats are faring and shape our conservation work, but the data also contributes to EU Habitats Directive reporting and provides one of the 26 UK biodiversity indicators used to assess the UK's progress towards its biodiversity targets. We wouldn't be in a position to provide those key facts without the commitment and enthusiasm of all our volunteers. People power really does make a difference.

To find out more about the National Bat Monitoring Programme (NBMP), visit www.bats.org.uk/nbmp. The NBMP is run by Bat Conservation Trust, in partnership with the Joint Nature Conservation Committee, and supported and steered by Natural England, Natural Resources Wales, Northern Ireland Environment Agency and Scottish Natural Heritage. The NBMP is indebted to all volunteers who contribute data to the programme.

Dr Kate Barlow is head of monitoring at the National Bat Monitoring Programme and joined Bat Conservation Trust in 2008. After becoming hooked on bats during undergraduate expeditions to South America, she completed a PhD on the ecological differences between common and soprano pipistrelles.

MIKE BOLAM

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The Biologist guide to British bats

Key Common and widespread · Uncommon but widespread · Rare · Unknown

Brown long-eared bat (*Plecotus auritus*)
Long-eared bats are known as 'whispering bats' because their echolocation is so quiet. They have very sensitive low frequency hearing and often locate prey from the sounds made by an insect's movements.

Common pipistrelle (*Pipistrellus pipistrellus*)
Pipistrelles are the most common British bats. They mainly roost in buildings and trees, and feed over water, marshes, woodland, farmland, along hedgerows, in suburban gardens and urban areas.

Daubenton's bat (*Myotis daubentonii*)
Daubenton's bats look like small hovercraft as they fly over water, and can even be seen taking insects from the water's surface with their feet or tail. They roost in trees, tunnels, bridges and, occasionally, buildings.

Soprano pipistrelle (*Pipistrellus pygmaeus*)
The 'new' pipistrelle species was separated from the common pipistrelle in the 1990s. It is distinguished by its higher frequency call and pale facial skin. It roosts in larger colonies than the common pipistrelle.

Brandt's bat (*Myotis brandtii*)
Whiskered and Brandt's bats were only separated as distinct species in 1970. Brandt's bats mainly roost in buildings and trees, and feed in woodland, often near water.

Nathurius' pipistrelle (*Pipistrellus nathusii*)
Until 1997 this bat was known only as a migrant, but there are now a few breeding colonies in England and Northern Ireland. In Europe they roost in trees, but in Britain they roost in buildings.

Natterer's bat (*Myotis nattereri*)
This bat's broad wings enable it to fly slowly and prey on a variety of insects. They roost in old buildings, large-timbered barns and tree holes, and feed in open woodland, parkland, hedgerows and along waterside vegetation.

Noctule (*Nyctalus noctula*)
The second largest British species and usually the first to appear in the evening, the noctule has long narrow wings and flies in a straight line, very high and fast. They roost in trees, usually in woodpecker holes or rot holes.

Whiskered bat (*Myotis mystacinus*)
Whiskered and Brandt's bats are very similar species with shaggy fur, but the whiskered bat is slightly smaller than the Brandt's. They roost mainly in buildings and trees, and feed along woodland edges and hedgerows.

Barbastelle (*Barbastella barbastellus*)
A very distinctive bat with a pug-like face and large, wide ears that are joined together at the forehead. Only found in southern and central England and Wales.

Bechstein's bat (*Myotis bechsteinii*)
A woodland specialist, which roosts in tree holes, rarely in buildings, and feeds in woodland, from high in the canopy to near the ground. Found only in south east Wales and parts of southern England.

Greater horseshoe bat (*Rhinolophus ferrumequinum*)
The horseshoe bats can be distinguished from other British bats by their horseshoe-shaped noseleaf, which is related to their particular type of echolocation system. Found in south west England and south Wales.

Greater mouse-eared bat (*Myotis myotis*)
The mouse-eared bat was declared extinct in Britain in 1990. However, a single individual has been found hibernating in the south of England since 2002. There are no known summer roosts in Britain at present.

Grey long-eared bat (*Plecotus austriacus*)
This bat is similar in appearance to the brown long-eared bat, but is a little larger and greyer with a dark face. They roost in older buildings, barns, churches and trees. They are very rare, found only in southern England.

Leisler's bat (*Nyctalus leisleri*)
Similar to the noctule but smaller and with longer fur. They roost in tree holes and buildings, and feed over woodland, parkland and suburban areas. Rare, but locally common (up to southern Scotland), particularly in Ireland.

Lesser horseshoe bat (*Rhinolophus hipposideros*)
You can tell the two horseshoe species apart by the position of their wings at rest: the lesser horseshoe bat wraps its wings around its whole body, while the greater horseshoe bat's face can usually be seen.

Serotine bat (*Eptesicus serotinus*)
One of our largest bats, the serotine has broad wings and a leisurely flapping flight. They feed over pasture, parkland, woodland, tall hedgerows and gardens. Found mainly in southern England and south Wales.

Alcathoe bat (*Myotis alcathoe*)
This new species, very similar in appearance to whiskered and Brandt's bats, was first described in 2001 in Greece. In 2009, they were recorded in Sussex and Yorkshire, but distribution across the UK is unknown.

Animal behaviour
Bird song

How city life affects the way birds sing

BY SAM HARDMAN

Cities are home to more than half the people on our planet. The global population is growing at a faster rate than ever before and, by 2025, more than 60% of the world's population will live in a concrete jungle.

Our ever expanding cities are putting pressure on the species that remain in and around this urban environment. Songbirds are one group particularly well studied and, over the past 15 years or so, biologists have discovered fascinating behavioural adaptations that have allowed some species to become successful city dwellers.

One of the most notable features of cities is that they are incredibly noisy – be it heavy traffic, building sites or aircraft flying overhead. For songbirds, however, all this noise is more than just a distraction. It can seriously affect chances of finding mates and reproducing and, for males, it is likely to affect how well they can defend their territories. Males sing during the breeding season to attract females and to signal to other males that their territory is occupied and should not be entered.

City sounds can interfere with these signals, making communication among birds difficult and unreliable. The background noise of a city is typically a continuous low-pitch rumble concentrated at around 2kHz in frequency. Unfortunately for many birds, this overlaps neatly with the frequency range of their songs, which means they do not stand out from the background noise and may not be noticed by other birds.

One solution appears to be to sing at a higher pitch, so that the birds' songs

literally rise above the background noise and can be heard clearly. Evidence that birds sing at a higher pitch in noisy cities than they do in quieter rural sites has been found in numerous species, including great tits (*Paris major*)[1], blackbirds (*Turdus merula*)[2], European robins (*Erithacus rubecula*)[3] and song sparrows (*Melospiza melodia*)[4].

In great tits, the difference between the pitch of songs in urban and rural sites has been measured at 478Hz, and tests have shown that this is enough to substantially improve the distance over which song can travel in urban environments before it degrades and becomes inaudible[5].

Birds can also face noisy conditions in the countryside – for example, where running water or wind creates high levels of low pitch noise. By studying these naturally noisy sites, scientists have been able to confirm that it really is the noise in cities and not some other factor that is causing city birds to raise the pitch of their songs.

Henrik Brumm and Hans Slabbekoorn recorded the songs of white-throated dippers (*Cinclus cinclus*) living around noisy, fast flowing streams in Scotland, and found that the pitch of their calls was well above that of the background noise and higher than usual for this species[6].

The effect of natural background noise on song pitch has also been shown in African little greenbuls (*Andropadus virens*), which sing at a higher pitch in areas where the rainforest is merging with open grasslands (known as ecotone forests) than they do deep within the rainforest itself[7]. Analysis of these two habitats revealed that the background noise in the rainforest is largely concentrated at a higher pitch than in ecotone forests, where there is more low-pitch noise.

Evidence suggests that the pitch and volume of bird songs are closely intertwined

The evidence that birds change the pitch of their songs as an adaptation to noisy conditions may seem conclusive, but not everyone agrees. An alternative explanation for the observed shifts in song pitch is that higher pitched songs are actually just an unavoidable and possibly unimportant side effect of singing more loudly, and it is higher volume, not pitch, that allows birds in noisy environments to overcome background noise[8].

In support of this argument, Erwin Nemeth and Henrik Brumm, researchers from the Max Planck Institute for Ornithology, found that the typical increases in song pitch found in great tits and blackbirds may be too low to substantially improve signal transmission. But if the birds sing slightly more loudly, they could increase the distance over which their song could be detected more effectively[9].

Nemeth and Brumm suggest two possibilities for why the pitch of a bird's song would increase when it sings more loudly. First, the increase in song pitch observed in noisy environments could be a side effect of what is known as the Lombard effect (named after French scientist Étienne Lombard), in which animals unconsciously increase the volume and pitch of their calls when the level of the background noise rises.

The Lombard effect is known to occur in humans (such as the urge to shout to be heard at loud parties) and has also been shown in both lab and field studies of songbirds. Lab experiments on elegant crested tinamous (*Eudromia elegans*)[10], and budgerigars (*Melopsittacus undulatus*)[11] have shown that these species both sing more loudly and at a higher pitch when background noise increases, and the same result has been shown in the field in a study of nightingales (*Luscinia megarhynchos*) in Berlin[12].

A second reason why birds may increase the pitch of their songs when they sing more loudly is that both the volume and pitch of bird songs depend on the same song producing organ, which could limit how well birds can independently control pitch and volume. In birds, this organ is the syrinx, the bird equivalent of the mammalian larynx, and is located at the base of the windpipe connected to the lungs. Birds produce song by forcing air at high pressure from the lungs through the syrinx, causing membranes to vibrate to create sound. This sound can then be modified using numerous tiny muscles that alter the shape and tension of the sound producing membranes.

However, past studies of the avian vocal system have shown that without these tiny muscles altering the structure of the sound, both the pitch and volume of bird song unavoidably increase together. In other words, when birds sing more loudly they can't help but also sing at a higher pitch[13].

Of course, this may be totally irrelevant if birds are able to use muscles to independently control the pitch and volume of their songs, but there is evidence to suggest that the pitch and volume of bird songs really are closely intertwined.

One of the clearest examples of this comes from a study by Nemeth and his colleagues at the Max Planck Institute. They recorded blackbirds singing in sound proof chambers and showed that volume and pitch really were strongly correlated[8]. When blackbirds sing more loudly, they also sing at a higher pitch and this may be totally involuntary. Similar results have been found in other species including zebra finches (*Taeniopygia guttata*)[14] and ring doves (*Streptopelia risoria*)[15] suggesting this pattern may be widespread and present in numerous bird species.

It has become very clear over the past few years that urban noise is causing bird song to change, but opinion remains divided on whether pitch or volume changes are most important in improving song transmission in noisy environments. It is possible that both have important roles to play in helping birds to adapt to noisy urban areas, and hopefully future research will provide an answer to this question.

The study of how urban noise affects bird song is an active area of research and there are many unresolved questions that are likely to be answered in the next few years. Most importantly, we need to find out what the long term impacts of urban noise are on bird populations. Although many species of bird seem to be able to adapt to noise, we do not know how the dramatic changes we are causing to their environments will affect them in the long term. Furthermore, many species are not able to adapt to urban areas for numerous possible reasons – for example, they may not have the behavioural flexibility to cope with new environments, or they might not be physiologically capable of altering their songs or behaviour.

We are changing the planet in ways that have never been seen before and we know many species are suffering. The first step in protecting animals from these changes is to understand how they are affected.

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“People care about plants but they don’t know they do”

Botanist Dr Sandy Knapp tells Tom Ireland how her fascination with plants took her across the globe and into the Natural History Museum, London

Interview
Dr Sandy Knapp FSB

Autumn mandrake (*Mandragora autumnalis*), potato (*Solanum etuberosum*) and grape groundcherry (*Physalis viscosa*) flowers. Illustration from *The Ladies’ Flower-garden of Ornamental Perennials* by Mrs Jane Loudon (1843)

NATURAL HISTORY MUSEUM, LONDON/SCIENCE PHOTO LIBRARY

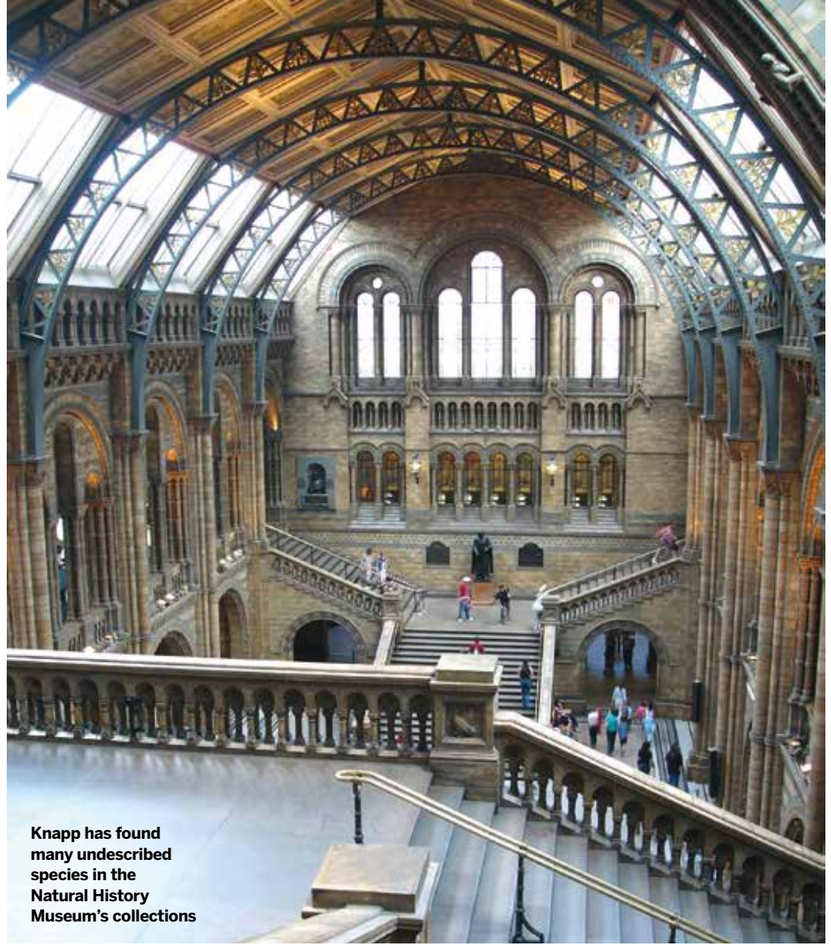
Sandra Knapp has travelled to countless countries in her search for new species in the genus *Solanum*, a hugely diverse group of flowering plants that includes tomato, potato, aubergine and pepper plants. She grew up in New Mexico, where a love of the outdoors eventually led to an interest in natural history. Knapp now manages the Natural History Museum’s vast plant collections as well as the *Flora Mesoamericana*, an inventory of the 18,000 plant species found in southern Mexico and the isthmus of Central America.

What led to you becoming a specialist in *Solanum*?

I went to a liberal arts college in California, where you don’t decide what subject you want to focus on until later. I wanted to do marine biology but the class was full, so I took a field botany class instead. We went out into the desert with microscopes, and it was amazing. So I just decided “this is really fun, I am going to do this”.

Initially I was interested in desert habitats and did a lot of exploration and hiking in the American south west. Then I went to Cornell and studied with Michael Whalen, who said I should work on *Solanum*, the plant he worked on. I didn’t really want to work on something he had already worked on, but he suggested I go on a course in Costa Rica for six weeks. I fell in love with the tropics and it was clear that these plants were fascinating and really complicated, and there were lots of them still to be discovered and described.

A painting of the southern magnolia (*Magnolia grandiflora*) inspired Knapp's *Flora* book



Knapp has found many undescribed species in the Natural History Museum's collections

It has kept me busy ever since. It's one of about 10 genera of flowering plants that have more than 1,000 species, which is unusual. Why are there so many? I see my work as an exploration of the diversity of this megadiverse genus. One reason they are put in the same genus is that their flowers all look the same. However, the rest of their bodies are really very different – I am interested in that.

When looking for new species, how do you decide where to look?
There are two types of collecting. When you're looking for something in particular, you go to places people have found it before or places like them. Another kind is going where people haven't been collecting before, and then you just collect everything that has flowers or fruits. Not necessarily biodiversity hotspots, either: just because something has a lot of species doesn't mean it is more interesting. Sometimes places are thought of as biodiversity hotspots because we've recorded everything that's there, so going to places that are less well known is important. There are very few regions people haven't been, but there are gaps. There are places that are not species rich, but knowing more about them is still important.

Wherever you collect, it is important to have permission to do so. Biodiversity is part of the national heritage of a country, as well as being of global importance, so getting the correct permits from local authorities is crucial. What's great is that you form working relationships with the scientists in those countries. However, it's no longer just hopping on a ship, collecting stuff and popping back.

Where has been your favourite place to collect species?
It's really hard to say. I've liked everywhere: I love the deserts, the tropics, the Andes. I had a job once where I was the Missouri Botanical Gardens' 'Man in Panama' – they gave me a trailer to live in and a truck to drive, and I had to collect a certain number of plants a month. It was fantastic. I tried to go to the Darién because nobody had collected there very intensively.

Plants do behave, even though they appear to just sit there

Do you have a favourite species or specimen?
I wrote a book called *Flora*, and the reason I wrote it was I was inspired by a painting by George Ehret from the museum that the librarians showed me, which is now on display at the museum. It's on vellum and shows *Magnolia grandiflora* – the southern magnolia – with its evergreen leaves and big, creamy flowers, and if the museum were burning down, that's what I would save. I absolutely love it.

Solanum dulcamara

How does working in a draughty British museum compare to that?
What's fantastic here are the collections. They are like an incredible physical database of things that occurred somewhere at some time. I find more species in the collections than in the field – specimens that were collected a long time ago and have never been described.

Do you think the museum displays enough plants?
There are some plants represented in our Treasures gallery and there are a lot of plants around in our new exhibitions. However, if you look up instead of sideways at the *Diplodocus*, the ceiling is covered in beautiful plant paintings. In fact, it is so magnificent that a colleague and I wrote a book on the botany of the ceiling.

The world is essentially divided into two types of person: people who look up at the ceiling and those who don't. Having something hanging from the ceiling means plants will really become more of a focus, which is great.

Did you ever imagine that changing the *Diplodocus* display in the Hintze Hall would cause such a furore?
I think we did because it's something that people care about. It's great for us because it shows people care about us. I think it's going to be exciting to have something new, and the *Diplodocus* hasn't been there forever anyway – there was a sperm whale and some elephants before that. When we were discussing the new display, I joked that we could suspend a huge potato from the ceiling.

Costa Rica is home to many species of *Solanum*

In this issue, Dawn Sanders argues that we suffer from 'plant blindness', a sort of inability to see the importance of plants (see page 9). Do you think they are overlooked by society compared to animals?
People care, but they don't know they do. I think people recognise that plants provide the oxygen that we breathe, which is pretty important. I sometimes give talks to schoolchildren and once asked: "Who has eaten a plant today?" None of them put up their hand. I said: "Who's eaten toast, or cereal, then?" Many of them had, but we just have so much less contact with nature due to our urbanised lifestyles.

Plants are interesting because they do behave, even though they appear to just sit there. It's just on a very different time scale, and we as a species struggle to perceive what's going on unless we can see it on sped-up footage or in some other way. Signalling between plants is fascinating – for example: if your neighbour is being eaten by a caterpillar, it produces signals that tell you to increase your alkaloid content – that's extraordinary. They do behave, it's just we don't see it – it's not like antelopes posturing.

Do you worry taxonomy is in decline?
I worry about the biology of looking at whole organisms in the field. But I think it's making a comeback, actually, with our emphasis on food security and caring for a planet. It's like a pendulum. There are fads in science, just like fashion goes back and forth between tight jeans and loose jeans. The pendulum is swinging back and we really do need to understand the organism if we are going to think about things in a more comprehensive way.

How do you explain why your work is important?
If you think about how things evolve and change, there are changes in the DNA sequence and at the molecular level but those changes are driven by the interaction and selection of the whole organisms themselves. Understanding those things – the whole organisms, how they're put together and how they interact with the environment – is really important as an additional set of information about life.

Across biology, things are becoming more 'molecular'. Molecular isn't more modern, it's just a different data set. It's not intrinsically better. Unlike physics, which often throws obsolete techniques away, we still use our old techniques. We keep adding different views on different scales, which is great.

Some scientists think the requirement to prove the impact of their work is narrowing the ambition of science. What do you think?
It could if impact were defined in a narrow commercial sort of way, but it isn't. Actually, that's one of the good things about the impact agenda. Scientists tend to think it means a commercial impact, but it can also be a societal impact – for example, coming to a museum can change people's lives. That is real impact, but demonstrating it is tricky – not as easy as showing commercial success, but arguably much more important. It's good for scientists to think how their work might change somebody's life.

Dr Sandy Knapp FSB is head of the plants division of the Natural History Museum, London. She specialises in the megadiverse genus *Solanum*.

How to be...

An expert witness

Advising the criminal justice system can be rewarding work for biologists, writes Nick Deal

Television dramas where hard-hitting barristers savage anyone in the witness box may deter many professionals from acting as an expert witness, but the reality is far from the fiction portrayed on screen. Being an expert witness can be a stimulating and rewarding adjunct to practice, and most cases settle without going to court.

An expert witness can be anyone with knowledge or experience in a particular field or discipline beyond that of a layman. They use their specialist knowledge to provide an opinion on an issue or facts in a case to help resolve litigation. While their opinion is generally sought by one party, the expert's overriding duty is to assist the court, and their report must be independent, objective and unbiased.

Solicitors instruct an expert to write a report or statement on a particular issue and to be prepared to give oral evidence in a court or tribunal. Expert evidence is fundamentally opinion evidence, supported by the expert's analysis of the facts and technical understanding of their subject.

Biology is a hugely diverse discipline and biologists can be required to act as experts in an enormous range of cases, from those involving disease to environmental issues. Dr Marie Anne Chattaway, deputy head of *E. coli*, *Shigella*, *Vibrio* and *Yersinia* Reference Service at Public Health England's Gastrointestinal Bacteria Reference Unit, has worked with gastrointestinal organisms for more than seven years. She became an expert witness for the first time last year when she was leading on an outbreak investigation that subsequently became a prosecution.

Biologists can act as experts in a wide range of cases

"I am keen to be involved in this part of the work," says Chattaway. "It is important that the microbiological context is explained clearly in the cases of outbreaks so the jury can make an informed decision."

Chattaway's role can involve giving an opinion on food or handling animals, and stating the likelihood that the organism from a particular source is related to the organism from a patient. So far she has not been required to go to court.

Experts in many fields of science and medicine may avoid putting themselves forward for fear of the reputational damage that may result from being challenged and contradicted, or not coming across well in court. However, Chattaway believes what she does is vital. "Expert microbiologists are required for this role. It is important to prevent the spread of any further outbreaks."

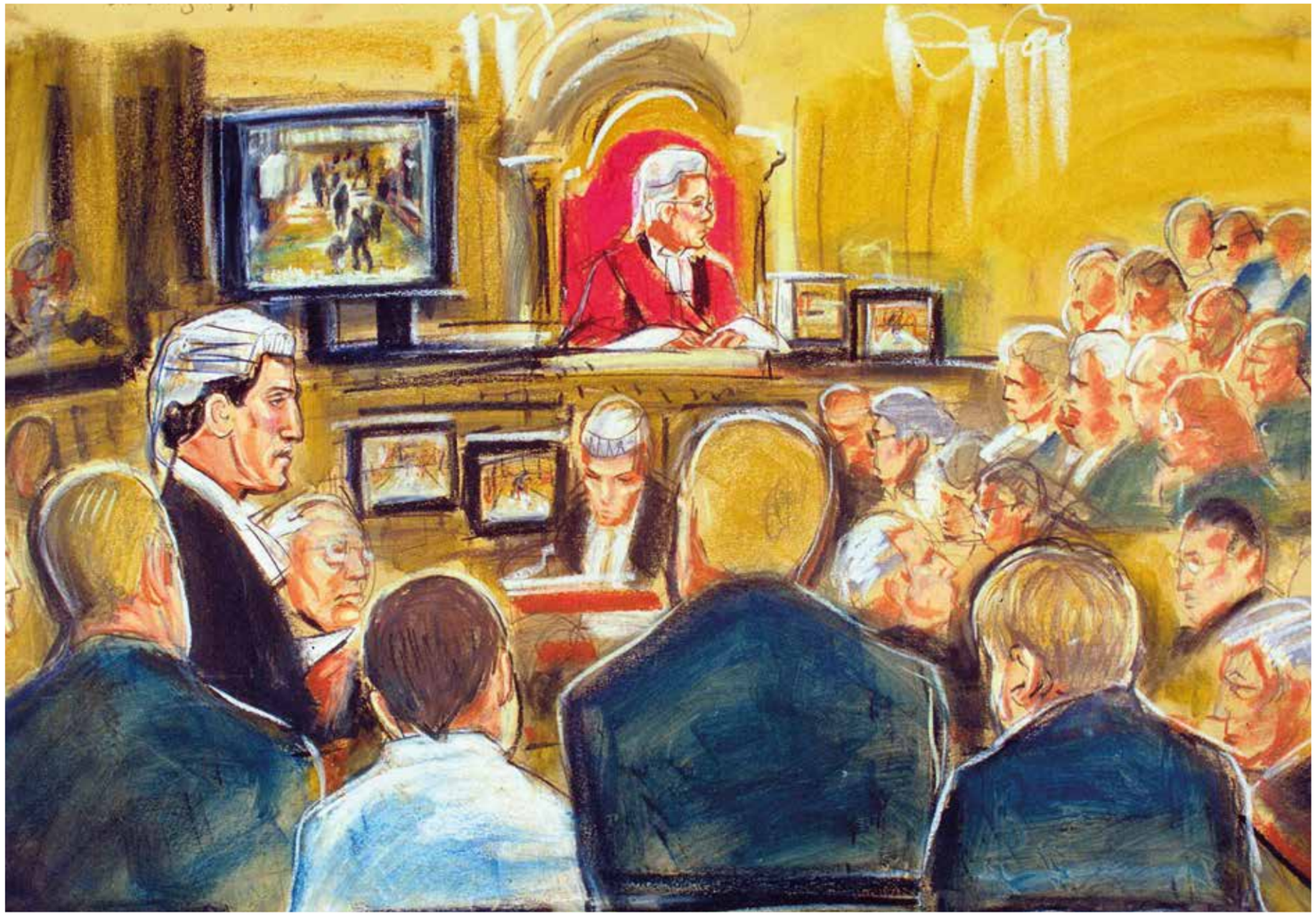
Training is not mandatory, but Chattaway feels it is important. "Although microbiologists are experts in their field, they are not necessarily trained to be an expert witness and there are important procedures to follow," she says.

Increasingly, instructing parties require evidence that the expert has the relevant qualifications and experience within their field, as well as having received formal training. If an instructing party can see that a report is well written, and that the expert has received training in how to act as an expert witness, they are far more likely to instruct them again in the future.

One thing that is obligatory is insurance, which can be obtained through professional bodies, expert witness organisations and general insurance providers.

When it comes to getting work, there are a number of agencies that publish directories of experts in their various fields. However, many find they get work based on their reputation and publications.

Nick Deal is a barrister and expert witness trainer for Bond Solon



Court sketch by Patricia Coleman (Rex_Shutterstock)

Court rules

In order to act as an expert witness, a person must have relevant and up to date professional training, qualifications and skills, together with insurance covering their expert witness practice. The latter may be obtained through professional indemnity insurers, expert witness organisations or other commercial providers.

While training is not mandatory, anyone accepting instructions to act as an expert witness should be familiar with the provisions of Part 35 of the Civil Procedure Rules and the associated Practice Direction, together with basic court procedure.

CASE STUDY

The path to instruction

Consultant Ian Blenkharn on becoming an expert witness

Almost 30 years ago, an unexpected phone call brought an invitation to be a witness in a Crown Court prosecution under the Control of Pollution Act 1974. A solicitor had located a brief research report I had published that was relevant to the case and persuaded me to accept 'instruction'. From there I embarked on what has become a substantial part of my career.

My first court appearances were exciting and challenging in equal measure, even surreal at times, but not particularly difficult. The questioning was similar to that which can follow presentation of contentious research data to a tough academic audience, although obviously far longer.

Perhaps I got away lightly. During subsequent court appearances, I have seen others fail badly under cross-examination, jeopardising and, on one particularly unpleasant if salutary occasion, ending what had previously been a hugely successful career.

Further work soon followed. An invitation to appear at a public inquiry was an early gain, requiring just a few days' live evidence, but almost 12 months of preparation, meetings, briefings and supplementary reports. The fee paid off my mortgage at a stroke.

Although often complex, most cases are far less extensive. Only around one in 15 civil cases go to a final court appearance. Accounting skills and careful diary management are essential.

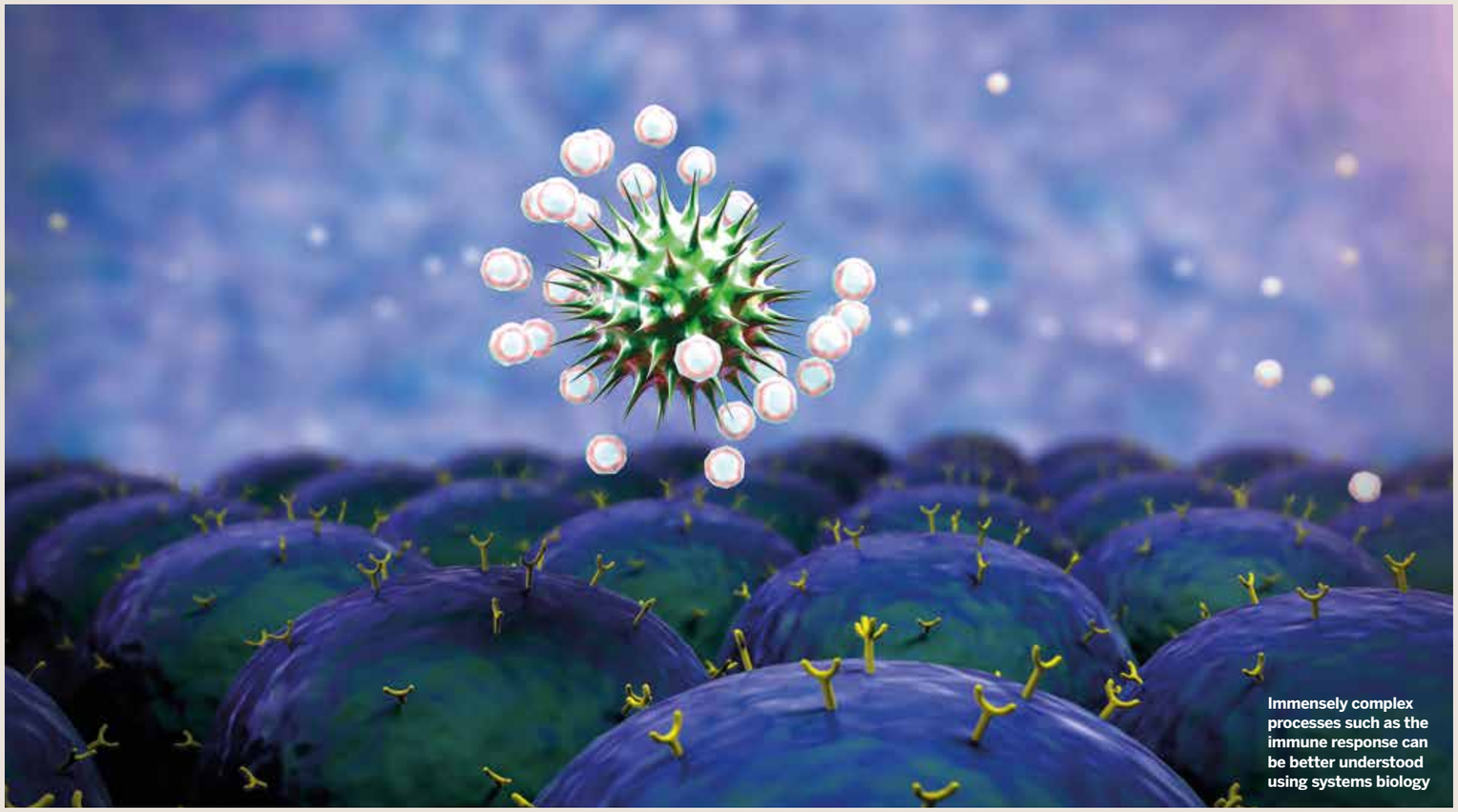
It is also vital to recognise the extent and limits of your knowledge and expertise, and never to stray beyond them.

Some universities offer internal training. More extensive training is also available, one of the most popular, although rather costly, leading to an accredited award. The course focuses in some part on the minutiae of the legal framework. Training in courtroom skills can't replicate the real thing.

An instructing solicitor will provide guidance, but the expert must resist pressure to moderate or augment a report solely to support the solicitor's partisan position. Honesty and integrity are the watchwords and have stood me in good stead throughout.

Ian Blenkharn is a microbiology, hygiene, waste management and safety consultant

Spotlight on
Systems biology



Immensely complex processes such as the immune response can be better understood using systems biology

The aim of systems biology is to understand vastly complex biological systems in a way that enables us to model and predict how they will behave. It often uses mathematical and computer modelling to define the rules and principles that govern and regulate systems, ranging from microbial cells to organs and even entire ecosystems.

Why is it important?
Systems biology is helping our understanding of complexity itself, not just the principles that underlie complex systems. Systems biologists aim to develop a quantitative as well as a conceptual understanding of biological phenomena, which allows the prediction and accurate simulation of extremely complex processes such as the immune response. The ability to model and predict what happens to systems under certain conditions is already having a profound effect on how theories are tested.

What exactly does systems biology involve?
In some ways, systems biology is more easily defined by what it isn't: it doesn't take an element of a living system and try to control other variables in order to study it. Systems biology uses information and data from a wide range of sources to build as full a picture as possible, with computer modelling at its core to understand how everything in such an immensely complicated system is related.

Although a systems approach can be applied to many areas of the life sciences, it is often focused on combining genomic, proteomic and other molecular data to understand entire cells or groups of cells.

Data from a wide range of sources build a fuller picture

How do I get into it?
Systems biology is a relatively new field, but there are around 15 universities with dedicated systems biology departments or research groups in the UK, and hundreds across Europe and the world.

Many opportunities are currently rooted in academia and fundamental research at PhD and postdoc level. In the UK, there are a number of systems biology master's degrees available, many of which focus on bioinformatics and computing. Undergraduate degrees in systems biology are less common, but are available, especially in the US. Such courses often have a molecular biology focus and may be combined with a related subject such as bioinformatics or computational biology.

Systems biologists are also employed in hospitals, the pharmaceutical industry, biotechnology companies and cancer institutions, where analysis of huge amounts of experimental data is required.

Where can I find out more?
The International Society for Systems Biology and the International Society for Computational Biology both provide information on systems biology careers, research and conferences.

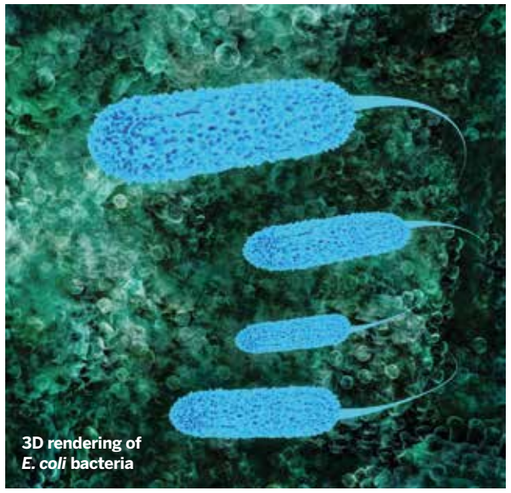
- **www.issb.org**
- **www.iscb.org**

First person
Stephanie Hays

"The aim is to produce *E. coli* that do not need to be fed sugar"

What does your research involve?
E. coli bacteria are often optimised to produce biofuels or useful medicines or chemicals. But the *E. coli* still need to be fed sugars to grow, and growing that sugar can take up space needed to grow food.

I am trying to engineer photosynthetic microbial communities of cyanobacteria and *E. coli*. The cyanobacteria capture solar energy and provide sugars to the culture. The aim is to produce *E. coli* that do not need to be fed sugar, which would mean you're not competing with land that could be used to grow food. The bacteria could be grown anywhere from out at sea to a desert, as long as you had sunlight and a closed environment.



3D rendering of *E. coli* bacteria

What else is being done in the systems biology department at Harvard?
I work in Pamela Silver's lab, where there's a very broad range of work going on, from development of artificial human chromosomes to carbon-fixing cyanobacteria to work on gut proteomes. The thing that binds all the work is that they combine systems biology and synthetic biology.

What does a typical day involve? Is it mainly lab work or computer modelling?
I'm definitely a wet-lab person. The system I work with is not well understood – we have nice models of *E. coli* and cyanobacteria, but when you put them together, they do things you wouldn't expect. I'm hoping to move to a more computational model when we have more data.

How did you get into systems biology?
From an early age I've liked the idea of symbiosis – how one thing depends on another. It's so complex and hard to explain how that works. I also wanted to do something that is really quantitative – I didn't want to be one of those scientists who just believe what they think is going on without having the solid numbers and data to really back it up and understand.

STEPHANIE HAYS
Profession
PhD student, department of systems biology, Harvard

Qualifications
BSc in biochemistry; master's in biophysics

Interests
Photosynthetic microbial communities, symbiosis, science education

Can you define systems biology?
In our department, we have tried to define it a bunch of times. It's interdisciplinary, using everyone's expertise. Instead of looking at individual components in isolation, you try to look at an entire system, whether that be all the interactions between proteins in a cell or in entire ecosystems. It's also about better measurement of experimental systems – not just taking a cell count, for example, but measuring metabolics, proteomics, the secretions of the cells into the media – to get a more comprehensive picture.

Where do you see the field going in the future?
Quantitative modelling can be applied everywhere. You can apply it to medicine or you can just apply it to research if you want to understand the biology of something. I'd say the discovery of new antibiotics will be one area where it will be particularly useful.

Members

Passionate about platelets and polo

STEPHANIE ARNOLD AMSB
Degree Bioveterinary science
PhD project Platelet recruitment

I am a Royal Veterinary College graduate with a degree in bioveterinary science. Having always loved animals and biology, I went through secondary school seeing myself graduating as a vet. Everything changed during my time at university, when I became awed by the vast and ever-changing world of scientific research.

As part of my undergraduate degree, I completed an industrial placement year at Novartis in Emeryville, California. I worked in the infectious disease pharmacology department, developing models of lung disease. It was an incredible experience that allowed me to develop my personal and scientific skills.

The placement year affirmed my desire to pursue a PhD in pharmaceutical sciences at King's College London, which I am excited to begin. My project investigates the mechanisms of platelet recruitment during the inflammatory response.

After the safety issues are addressed, it will be fascinating to see how induced pluripotent stem cells revolutionise medical science.

In my free time, I write a health and fitness blog, run, do yoga and play polo.

Stephanie developed models of lung disease during a placement

Engaging with others to 'solve nature's mysteries'

DR SOUVIK KUSARI CBIOL CSCI MSB
Works INFU
Passion Research
Hobbies Cooking

I am a senior scientist at the Institute of Environmental Research (INFU), Dortmund University, Germany. I earned a doctorate in natural sciences from Dortmund in 2010.

After working as a scientist at INFU for over two years, I became a visiting researcher at the department of plant sciences at Oxford University.

I believe that for every problem nature creates, it already has a solution. My research on chemical ecological networks between plants and associated microorganisms has yielded results by unravelling the multipartite crosstalk between the interacting organisms.

Collaborative research is essential. I feel it is vital for me to connect with people who know something I don't, as only then can a problem be approached holistically and solved comprehensively.

The Society is the perfect place for such mind-igniting interactions to happen. It has helped me reach out to and engage with others to solve some of nature's mysteries.

Research is my passion, but teaching is my investment. The return on my investment is the success of my students. This is my simple philosophy. I developed it in learning so much during my teaching and supervision activities.

When I am not in the field or in the lab, I like to cook. I love food, and cooking allows me to explore the 'art of science' away from my lab.

Propelled into microbiology

NEIL THORPE RSCITECH
Works Microbiology department, INM
Current projects Developing a mobile kit to detect bacteria

I joined the Civil Service in 1993, working for the submarine environmental chemistry unit at the Institute of Naval Medicine (INM). In 1999, I joined its helicopter crash team, travelling the world taking care of the environmental impact of crashes, including biological waste, fuel spills and carbon fibre debris. I helped clear 34 helicopter crashes in total.

In 2005, I was asked to volunteer to help out in the microbiology section by the section leader, as they were short staffed at the time. Apparently I was quite good and was asked to apply for the post of band D microbiologist, where, 10 years later, I still work.

I owe a lot to three people who have inspired me to greater things in my career, all of whom worked at the Institute. Mat Marshall introduced me to the helicopter crash team, and Louise Appleby and Cathryn Valentyne taught me everything I know about microbiology.

I joined the Society in May 2014 and achieved my RSciTech in January this year. Last year, I also validated a method for the enumeration (count) of *Pseudomonas aeruginosa* for accreditation with the UK Accreditation Service. We are currently looking into developing a method for *Legionella* analysis and developing a mobile kit for ships to keep an eye on *E. coli* and other bacteria while away from port.

Neil cut his teeth at the Institute of Naval Medicine in Hampshire

'So much universe...'

DR GAIL CARDEW FSB
Studied At Sussex University
Inspired by Biology teachers

I am the director of science and education at the Royal Institution and chair of the board of the EuroScience Open Forum, which will take place in Manchester in July 2016.

In my work, I enjoy the fact that encouraging people to think more deeply about science can be interpreted in a multitude of ways – from helping parents to carry out science activities with their children to encouraging scientists to think more broadly about their work by engaging with the public.

I was first inspired by my biology teachers, Mr Buckby and Mr Savill, who took us on wonderful field trips and introduced me to John Maynard Smith – I loved how he applied the elegance of mathematics to the messiness of biology. Discovering he would lecture me was one of my reasons for going to Sussex University. Chris Ford, my developmental biology lecturer and DPhil supervisor, opened my eyes to so many unanswered questions.

I've already attended one of the Society's leadership courses and it was incredibly useful – both in terms of content and meeting interesting people.

If I could change one thing about my life at work, I'd be in two places at the same time. As Terry Pratchett once said, "so much universe, so little time."

STUART CLARKE

Jane Goodall, whose way of life inspired Steve Appleyard

Aiming to inspire future scientists

DR STEVE APPLEYARD FSB
Profession Biology teacher
Based Scotland
Inspired by *The Selfish Gene*

I studied zoology at Edinburgh University in the 1990s, specialising in the study of animal behaviour and animal welfare with an MSc and PhD at the same institution.

I am currently a biology teacher at a small private school near Montrose. Biology sparked my interest when I was at school and now I want to do the same for others. I enjoy being able to inspire future biologists, medics, psychologists, dentists, geneticists and ecologists. Biology is such a broad subject that has relevance in a wide variety of career paths and importance in understanding many aspects of our lives.

I have since developed a strong interest in genetics and stem cells as a result of teaching these topics to my students.

I read Richard Dawkins' *The Selfish Gene* when I was at school and it was a revelation to me, explaining the reason for life to my teenage mind, and has been hugely influential. Iain Douglas-Hamilton's book about his study of elephant behaviour seemed like an amazing way of life, as did Jane Goodall's work with chimpanzees.

I joined the Society to be part of a group of people interested in biology. The frequent communications from the Society will help keep me up to date.

SOCIAL NOTICES

Meeting with Sir Mark Walport
7 June, 15:45–18:00
A Q&A with the Government's chief scientific adviser for senior representatives from the Society's Member Organisations. Charles Darwin House, 12 Roger Street, London WC1N 2JU.

Visions of Home, Habitat and Shelter
16 June to 4 July, 10:00–17:00
Exhibition of shortlisted images from the Society's 2014 photography competition. People's Palace, Glasgow G40 1AT.

Fellows' lunch – Leicester
23 July, 12:30–14.30
An informal lunch to discuss current biological issues and the Society's overall direction. Belmont Hotel, 20 De Montfort Square, Leicester LE1 7GR.

Fellows' lunch – London
15 September, 12:30–14:00
Charles Darwin House.

Fellows' and Members' event – North Wales
17 November, 18:30–20:30
Chateau Rhianfa, Beaumaris, Anglesey LL59 5NS.

Members
New, Transfer & Chartered Members

APRIL 2015 ELECTION

Affiliate
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Associate (AMSB)
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RSci MSB
William Bardega, Charlene Dambire.

Chartered Science Teacher (CSciTeach)

CSciTeach MSB
Sarah Cox, Andrew Duggan.
CSciTeach FSB
Robert Johnston, Graham Scott.

Registered Scientists (RSci)

Ian Baldwin, Esme Bevan, James Boot, David Burrows, William Finlay, Duncan Ingram, Fatoumatta Jobe, Alaa Latif, Gavin Metcalf, Daniel Potter, Ian Selmes, Abigail Shea, Katherine Stephenson, Sarah Tindall, Jonathan Willis, Katie Willis, Sophie Willis.

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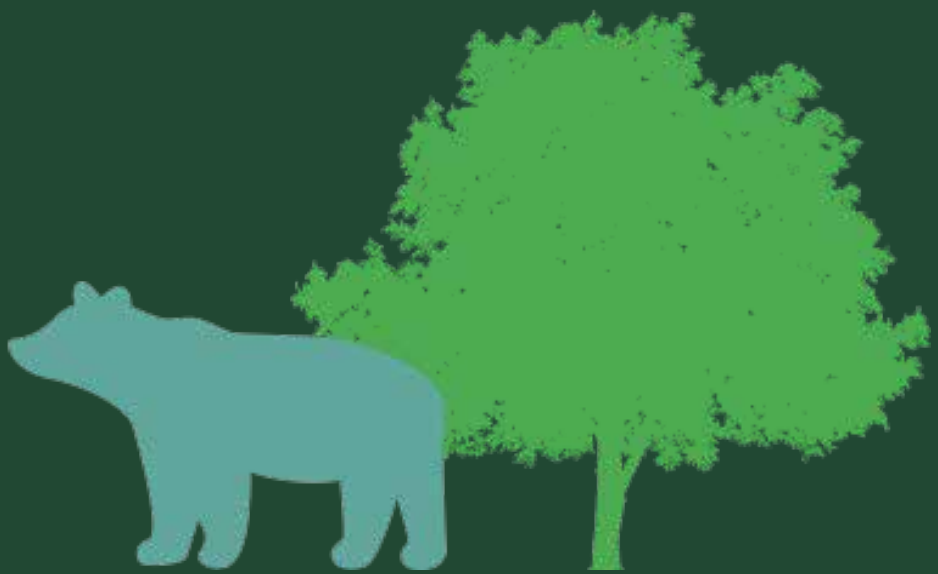


Reviews

THE CHOANOFLAGELLATES: EVOLUTION, BIOLOGY AND ECOLOGY
Barry F C Leadbeater
Cambridge University Press, £80.00

This book is a beautiful, current compendium on choanoflagellates, the sister group to the Metazoa.

The majority of these tiny creatures inherit their skeleton from their mother cell. Rib-like 'costae' aggregate into a shell-like protective outer covering called a 'lorica', a complex procedure that takes only a matter of minutes after cell division. They then spend the long interphase synthesising and storing the costae for their progeny.

Much of the book is about this lorica business, but there are useful chapters on their ecology, where we learn that they contribute up to 20% of heterotrophic nanoflagellates in marine, brackish and fresh water, and outperform others in eating bacteria; their biochemistry, particularly those enzymic reactions that are like/unlike animals; and particularly their phyletic relationships.

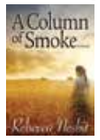
There are many DNA sequence stories, and the author is very sensible about the issues, noting how many genes there are in common – and different – among the various organisms, maintaining the association between choanoflagellates and animals.

***Sphaeroeca*, a choanoflagellate that forms small colonies**

I'll confess here that Leadbeater was an old associate of mine. However, this really is a super book, with beautiful pictures (even though that often means captions over the page), and a very nice layout. What a pity it'll only be read by about 100 people. There'll be a lot of copies in libraries, though.

PROFESSOR JACK COHEN FSB

A COLUMN OF SMOKE
Rebecca Nesbit
Brambleby Books, £8.99



A Column of Smoke weaves together a fictional story about love and relationships with a topical scientific dilemma. We follow Sally, a young postdoctoral researcher who has to make some difficult decisions in both her work and personal life. She is part of a team of scientists investigating genetically modified crops and when, due to unforeseen circumstances, their field trial is cut short, it could mean all they have been working towards has been lost. The question is, what is the right thing to do, and will Sally do it?

I enjoyed *A Column of Smoke*. You feel for Sally as she finds herself in a sort of no-man's land in an awkward state of indecision in both her relationships and her scientific career. The characters are well thought out and have a depth that emerges throughout the novel as you learn more about them. The science permeates the book and gives a good backdrop for the story as it unfolds; showing the excitement of cutting edge research, but also the mundaneness of the repetitive procedures scientists must go through when collecting their data.

The author, entomologist and former Society press officer Rebecca Nesbit, writes in this issue (see page 5) how she hopes more scientists will try writing fiction as a way of bringing fresh perspectives on science to the general public. I hope they do too.

SARAH COX CSCITEACH MSB

CLAXTON: FIELD NOTES FROM A SMALL PLANET
Mark Cocker
Jonathan Cape, £14.99

Claxton is a welcome addition to the burgeoning field of nature writing and its already high class output. The book sets out to explore the author's relationship with his local patch in East Anglia and does so in a series of 12 monthly diary entries with the emphasis on local. This is, in essence, a nature journal in the tradition of Gilbert White *et al.*

Cocker notes in his introduction that *Claxton* is, above all, about place. It is also a quietly joyous celebration of environment and nature, and how they can positively affect one's whole outlook on life. A recurring theme is the value of routine in walking and soaking up your local patch. Cocker is keen to explore the ordinary and yet manages to bring out global themes at every turn.

The writing is beautiful throughout, complemented in the hardback edition by exquisite illustrations. *Claxton*, despite its short length, is a book to be savoured and read slowly. I will certainly reread the chapters during the appropriate month and so be reminded on a regular basis, as Cocker puts it, "to look more closely at my immediate surroundings" and in doing so "give shape and meaning to my whole outlook".

PETER ANDERSON MSB

Once an elevated railway, the High Line in New York is now a parkway

Keep taking the tablets

DRUGGED: THE SCIENCE AND CULTURE BEHIND PSYCHOTROPIC DRUGS
Richard J Miller
Oxford University Press, £12.99

Drugged is an amazingly well researched book that takes the reader through the history and social impact of psychotropic drugs throughout human history. Miller describes the use of these drugs for religious, spiritual, recreational and medicinal purposes. He also outlines the history of the major pharmaceutical companies and the process of drug development, as well as suggesting where the future may lead as we improve our understanding of how and why drugs affect our bodies.

This is indeed an eye-opening book that leaves the reader well informed about what psychotropic drugs are and how they work. Miller tells the story of how many common prescription drugs were discovered and developed, including the processes needed to get them approved by the FDA or equivalent. He gives the reader detailed and interesting information about the origins of many household names such as Prozac, Aspirin and Valium, and the scientists behind their development.

Miller outlines the biochemistry of these drugs and adds to his explanations with images and diagrams including archive photos – for example the 'tincture of cannabis' that used to be sold in chemists. He puts these developments in context and presents the stories behind each one in a novel way.

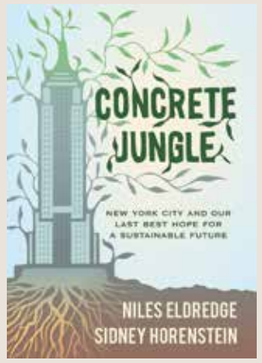
I would recommend this book to anyone who is curious about the human society's complicated relationship with psychotropic drugs and who wishes to improve their understanding of how these substances affect our bodies.

HELEN STAMP

Drugs have been part of society throughout history

Nurturing nature in New York

CONCRETE JUNGLE: NEW YORK CITY AND OUR LAST BEST HOPE FOR A SUSTAINABLE FUTURE
Niles Eldredge and Sidney Horenstein
University of California Press, £24.95



As major cities around the world continue to grow, they place an increasing demand on their surroundings for resources. Some resources such as water have a local effect, but others, like food, may well have wider, even global implications.

The authors, both born and bred New Yorkers, use their home city to argue that such places can hold the key to ensuring the survival of animal and plant species – indeed, whole ecosystems – even when they are under enormous pressure.

Much of *Concrete Jungle* is given over to the history of New York and how its continual expansion has affected the surrounding areas, destroying habitats and polluting the environment. As one who knows and enjoys New York, this is a fascinating read, and New Yorkers will find much to interest them in discovering often overlooked historical features.

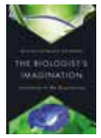
Eldredge and Horenstein suggest that cities are the best places to see environmental restoration because it is the big, rich cities that have the great institutions such as museums and universities, as well as the power bases for many important NGOs, which can bring about change.

What is interesting is the change being brought about at grassroot levels. Manhattan now boasts many community and rooftop gardens, and the elevated railway line turned park, the High Line, is a major tourist attraction. There are ambitious schemes in hand to clean the Hudson and East rivers to encourage the recolonisation by fish and shellfish. Farmers markets have blossomed and become an important retail outlet for farmers from New York and the surrounding states.

Early days, but very promising nonetheless.

DR LEIGHTON DANN

THE BIOLOGIST'S IMAGINATION: INNOVATION IN THE BIOSCIENCES
William Hoffman and Leo Furcht
Oxford University Press, £22.95



Not so many years ago, biology was the 'poor relation' of the rest of the sciences. Lacking the precision of physics and chemistry, it was 'soft' science, largely observational, qualitative and speculative in its theoretical pronouncements.

But now, this book's authors assert, "biology is the biggest science, with the most scientists, the most funding, the most scientific results, the most ethical significance, and where we have the most to learn, given its billions of years of experimental results". Modern biotechnology, it is claimed, is the exponential driving force of global technological change, productivity and, hence, economic growth.

This exceptionally well researched and engagingly presented account of the growth of biotechnology in medicine, agriculture, manufacturing and pharmaceutical industries is a veritable *tour de force*. Despite the authors' specialised medical background, important dimensions of their argument – with origins in the history of technology (the Industrial Revolution), the philosophical basis of capitalism (Adam Smith), medieval physiology (epitomised by the University of Bologna) and Darwinian theory – are incorporated with impressive subtlety into their thesis. In essence, their message is that capitalism, entrepreneurship and concentrations of expertise, together with that vital ingredient, imagination, are humanity's only hope to "sustain and revitalise the health and wellbeing of the living systems that support us".

Yet such triumphalism would surely sound hollow to the vast majority of people whose lives biotechnology has not yet reached, or it has affected adversely. Arguably, only an impoverished imagination would appear to pay so little attention to the demands of global justice.

PROFESSOR BEN MEPHAM FSB

THE MAN IN THE MONKEYNUT COAT: WILLIAM ASTBURY AND THE FORGOTTEN ROAD TO THE DOUBLE HELIX
Kersten T Hall
Oxford University Press, £18.99

This is essentially a sympathetic biography of William Astbury, with a lot of wise comments on the incidents and the accidents of his life. The problem was that he was in Leeds, far from the action occuring in Cambridge and London at the time. He had set up a department that he wanted to be called 'molecular biology', a term he invented. Funded by the Worshipful Company of Clothworkers, he used X-ray crystallography photos to demonstrate, initially, that the keratin of hair – wool – was a long, stretchable molecule and became committed to the idea that all of biology was 'worked' by the change of shape of protein molecules.

Hall shows how this physics oriented approach led Astbury away from the DNA story, but in my opinion he spends too much of the book on analysis of the DNA/Franklin history.

From the Braggs (father William Henry and his son, William Lawrence), through a variety of characters, including Kathleen Lonsdale (née Yardley, the first female Fellow of the Royal Society), Linus Pauling and Alfred Mirsky, to Oswald Avery, Astbury was on the edge of the burgeoning biophysics, but after his failure to get MRC funding at Leeds, he lost heart.

This is an excellent, stylish historical account of the early days of biophysics. Yet I didn't like the cover cartoon, nor the title. To end, a nice quote from Astbury: "… the important thing is not to grow up".

PROFESSOR JACK COHEN FSB

xkcd humour lost in translation

WHAT IF? SERIOUS SCIENTIFIC ANSWERS TO ABSURD HYPOTHETICAL QUESTIONS
Randall Munroe
John Murray Publishers, £14.99

Randall Munroe is the creator of popular web comic *xkcd*. If you are not familiar with *xkcd*, it is a humorous stick figure cartoon strip about technology, mathematics and life as a scientist. The UK edition of *What If?* is a collection of questions submitted by *xkcd* readers that Munroe has answered in cartoon form and previously published online.

The questions wonder what would actually happen in ludicrous conditions and scenarios – for example, what would happen if you put the entire population of Earth on Rhode Island? Or, what would a mole (the unit) of moles (the animals) look like?

I'm not sure if I got the joke. My first smile appeared on page 88 – something about C4 explosives and boomerangs – and it was not until page 191 that I laughed, when the clever connection was made between travelling in the International Space Station and the Proclaimers' 1988 song *I'm Gonna Be (500 Miles)*.

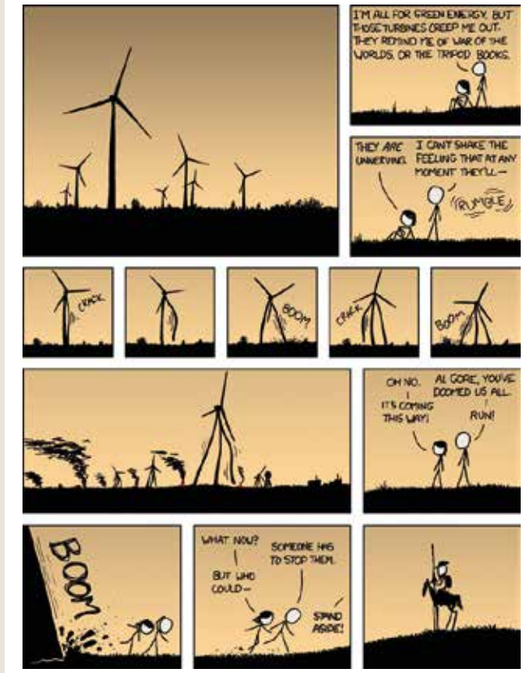
Although the volume is badged as a UK edition, it appears to be a sparsely edited assortment from the original web source, full of North American references. Baseball, ice hockey, and "the most and least flown over states" seemed to provide a somewhat blinkered view of the world at large while paradoxically attempting to inform with some big scientific ideas, mainly in physics.

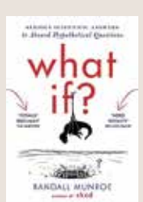
That I didn't get it led me to wonder if, rather than my humour being bypassed, the source material was missing something in the translation from the author's web comic.

When I visited xkcd.com, the humour and fun quickly returned. The original blog is interesting and accessible and well linked to wider resources such as YouTube videos, safety documentation and other items.

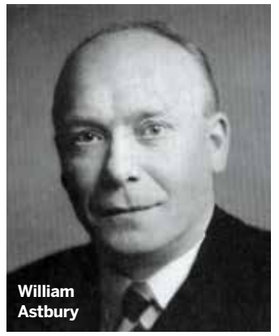
It's worth taking a minute to look up the web comic: you'll find it informative and entertaining. Enjoy this excellent blog, its science, humour and illustrations. Do, however, save yourself £15, as it simply does not translate comfortably into book form.

NICKY SOUTER FSB





xkcd.com: What would happen if wind farms went *War of the Worlds*?



William Astbury

Several forest types are covered, including tropical rainforest, temperate forests, Mediterranean forests and dry forests. Climate changes affect all forest types, and there are useful comparisons between different forests.

A balance of observational and experimental work is presented to predict the factors of influence for the future. Shifts in rainfall patterns are predicted for the tropics and are likely to have unforeseen consequences. Increases in extreme weather events such as droughts and intense precipitation are already affecting forests.

Many other human induced environmental factors are discussed, such as air pollution, the effect of introduced species and the results of selective logging. There are a number of permanent forest plots in both temperate and tropical forests and it is clear that these are the source of many ongoing observations about climate change, such as the increasing biomass in some places owing to carbon fertilisation. Carbon mass balance studies show that tropical forests are still acting as a carbon sink, but for how much longer is uncertain.

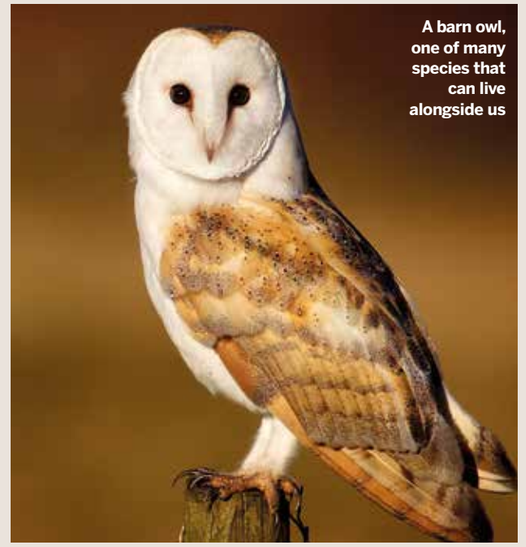
Overall, one is left with the impression of how fragile forests are and the serious dangers to them from a changing climate. This is an important book for ecologists and anyone who is interested in or teaching about the effects of climate change. Some good suggestions for further research are made and there is a useful index of the many topics addressed.

PROFESSOR SIR GHILLEAN PRANCE CBIOL FSB

FORESTS AND GLOBAL CHANGE
David A Coomes, David F R P Burslem and William D Simonson (Eds)
Cambridge University Press, £35.00

It is now well-known that the forests of the world are affected by changes in climate. Each of the 15 chapters of *Forests and Global Change* are written by authors who presented data to an Ecological Society symposium.

The first of three parts is on forest dynamics and global change, the second on species traits and responses to changing resource availability, and the third on detecting and modelling global change.



A barn owl, one of many species that can live alongside us

Secret lives of your uninvited guests

HOUSE GUESTS, HOUSE PESTS: A NATURAL HISTORY OF ANIMALS IN THE HOME
Richard Jones
Bloomsbury Publishing, £16.99

Humans have a contrary attitude towards the animals that cohabit our local environment. Where we take delight in seeing a variety of vertebrates and invertebrates in our gardens, parks and woods, we are less thrilled to find the same creatures sharing the inside of our homes (with the few exceptions that are seen as domestic pets). This paradox is explored in great detail in this enjoyable read.

The context is set by explaining how each nook and cranny of people's houses provides a warm and hospitable new niche for mammals (think mice and bats), birds (think swifts and barn owls), as well as the more obvious creepy crawlies that we more readily identify as pests – wasps, moths, flies, spiders, beetles, woodlice, ants and the like. Mention is made of how these creatures came to live with or, in some cases, on us.

Jones' enthusiasm in conveying facts worthy of dinner party anecdotes shines through and reveals him to be the notable entomologist and natural historian that he is. While *House Guests, House Pests* is, by admission, unashamedly northern European in perspective, so would suit this readership, a nod is given to invaders in warmer climes.

As someone who has observed two geckos climb the wall while writing this review, I content myself that their discreet (and discrete) droppings are offset by the efficiency with which they catch all manner of biting insects. They are included here – but are they a guest or a pest?

PROFESSOR ANDREW TAYLOR-ROBINSON CBIOL FSB

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Events calendar
June–December 2015

North Wales members are invited to Erddig Hall house and gardens

BEDS, ESSEX & HERTS

EARLY CAREER BIOLOGISTS NETWORKING EVENT
MONDAY 29 JUNE 11:00–15:00

Free networking event for PhD, postdoc students and other researchers at an early stage in their career. Includes the chance to visit the R&D site of a local multinational pharmaceutical company. Booking is essential.

GlaxoSmithKline, David Jack Centre for R&D, Park Road, Ware, Hertfordshire SG12 ODP.

SHUTTLEWORTH VISIT – THE SWISS GARDEN
SUNDAY 12 JULY 14:00–16:00

A fantastic opportunity to visit the historic Swiss Garden at Shuttleworth, full of botanical curiosities. The garden is exquisite, with lakes, thatched buildings, grottos and roaming peacocks. Spaces are limited, so please book your place. Free for members and £5 for non-members.

The Swiss Garden, The Shuttleworth Collection, Old Warden Aerodrome, Biggleswade, Beds SG18 9EP.

AGM: WINE AND CHEESE AND A RIVER BOAT CRUISE
SATURDAY 26 SEPTEMBER 19:00–21:00

The AGM will feature a wine and cheese tasting and a John Bunyan Boat river cruise on the River Ouse. Meet at the Priory Marina, Barker's Lane, Bedford MK41 9DJ. It costs £10 for members, students and under-16s; and £28 for non-members.

DEVON & CORNWALL

HOOKED ON MICROSCOPY
SATURDAY 24 OCTOBER 10:00–16:00

A family friendly event to mark the 350th anniversary of Robert Hooke's *Micrographia*. Activities include using microscopes, specimen drawing and competitions.

Exeter Cathedral and Chapter House, Cathedral Yard, Exeter, Devon.

EAST MIDLANDS

SUMMER'S EVENING AT THE HAMMOND ARBORETUM
TUESDAY 16 JUNE 18:30–21:30

Just over 100 years ago, Francis Hammond, the then headmaster of Market Harborough Grammar School, bought the land at the bottom of his garden to create an arboretum, and it is a hidden gem. Join us for light refreshments, a guided tour and time to explore.

Hammond Arboretum, Robert Smyth School, Burnmill Road, Market Harborough, Leicestershire LE16 7JG.

NORTH WALES

VISIT TO ERDDIG HALL
THURSDAY 15 OCTOBER

Join us for a visit to the 485 hectare (1,200 acre) country house, park and formal walled garden and its annual apple festival. More details will be available nearer to the event.

AGM AND CHRISTMAS LECTURE
TUESDAY 3 DECEMBER 19:30

Professor Brian Moss will give a talk entitled 'Why our conservation policies are spectacularly wrong'. The AGM and a buffet will follow.

Bod Erw Hotel is at junction 27 on the A55, just off the roundabout (SJ031746).

NORTH WESTERN

ANNUAL SCHOOLS QUIZ
THURSDAY 25 JUNE 9:00–15:30

The annual event will be held at UCLAN, with 100 students competing for a grand prize, and a special event for the teachers and tutors who lead them. We welcome new participants to enter a team. Everyone goes home with something to remember the day, and the top four schools all receive prizes.

FOR MORE DETAILS www.societyofbiology.org

Event reports

KENT, SURREY & SUSSEX

PANDEMIC VIRUSES
11 MARCH 2015

Lecture by the Pirbright Institute's Professor John Fazakerley FSB

The Pirbright Institute, formerly the Institute for Animal Health, has an international reputation as a centre for the control, containment and, where possible, elimination of viral diseases of animals.

Its director, Professor John Fazakerley FSB, described the impacts of dangerous and potentially pandemic viruses on livestock, food availability, and the prosperity of farmers and other communities. He talked about the spread of Ebola in West Africa, as well as other diseases including foot and mouth, which cost the economy around £8bn in 2001, and the H5N1 influenza virus, which can cause large economic losses if spread to intensively farmed chickens. H5N1 can occasionally infect human cells, causing a respiratory disease with a mortality rate of at least 50%.

Professor Fazakerley also included African swine fever, a haemorrhagic disease of pigs with mortality rates approaching 100%, and West Nile fever, which can cause encephalitis in horses and humans, and is a major public health concern in the US and Europe.

Centres like Pirbright bring together scientists from a range of fields such as virology, molecular biology, immunology, epidemiology and entomology, and provide them with the high quality biocontainment facilities required for their work.

DAVID WARE FSB

Bird flu outbreaks can wreak economic havoc

PLANTS FOR BUGS
25 MARCH 2015

How our choice of plants affects insect pollinators

Members take a tour of the study plots at RHS Garden, Wisley

On a cool but dry spring day, members visited RHS Garden, Wisley, to hear about an ambitious project to investigate the effects of native and non native plants on fauna in the garden. It is important work, as research suggests that, excluding lawns, the average UK garden contains 70% non-native plants.

Helen Bostock, Dr Andrew Salisbury and the Plants for Bugs team have set up 36 plots with a mixture of 14 species of plants including bulbs, perennials, shrubs, grasses or ferns, and climbers, native to one of three geographic zones: Britain (native), the Northern Hemisphere excluding UK (near native) or the Southern Hemisphere (exotic). The plots are monitored for invertebrates. The data from these measurements are now being analysed and the first results on pollinator behaviour should appear shortly in the *Journal of Applied Ecology*.

Early results have suggested that honeybees tend to favour native or near native plants, whereas long tongued bumble bees and solitary bees showed no preference for plants' origin. However, for gardeners who wish to support a wide range of pollinating insect species, it is clear that the more flowering plants a garden can offer throughout the year, from different regions, the greater the number of bees, hoverflies and other pollinating insects it will attract.

After a highly interesting visit, I'm sure many of us will be following the publication of further results and conclusions.

For those who are interested in insect friendly gardening, the Royal Horticultural Society has produced a list of recommended plants on its website, at www.rhs.org.uk.

DAVID WARE FSB

From Mars to mitochondria in schools contest

EAST MIDLANDS

REGIONAL SCHOOLS COMPETITION
14 MARCH 2015

A high standard of entries made it a tough call for this year's judges

Top seniors (above) and highly commended juniors (right)

More than 100 visitors streamed into the University of Leicester for our schools competition, hosted by GENIE, the Centre for Excellence in Teaching and Learning in Genetics.

Students from years eight to 13 were celebrating the start of the British Science Week (formerly National Science & Engineering Week).

In the junior section, pupils had prepared posters on the theme 'extreme biology', while the older students submitted essays. Their interpretations were all very different, and provided a challenge for the teams of judges.

The apprehensive students were quizzed by the judges on their approach and the content of their poster or essay. This, the most testing aspect of the competition, is what makes it so special.

While Dr Shaun Cowley of the University of Leicester's Department of Biochemistry gave his talk, 'Stem cells: from the origins of life to tissue regeneration', the judges discussed the entries.

Rhea Suribatala and Shreeya Thakrar scooped the £50 first prize in the junior section with their poster 'Mitochondrial manipulation', while runner-up Adam Dodd received £20 for his exposition on tardigrades entitled 'When the going gets tough, the tough get going'. A runner-up prize also went to Orieanna Reeve-Chen and Namrata Joshi for 'The world's toughest bacterium'.

In the senior section, Lauren Church won with her essay 'Extreme biology: Moving to Mars'. The two runners-up were Freya Hartshorn with 'Where do we draw the line' and Aditi Pandey with 'The extremes of medical treatment: Nanotechnology and robotic surgery'.

ROSEMARY HALL MSB

A spring walk among the wildlife

KENT, SURREY & SUSSEX

WOODLAND ON MARKSTAKES COMMON

19 APRIL 2015

An abundance of bryophytes at East Sussex event

Bryophyte enthusiast Jacqueline Hutson helps members improve their knowledge of mosses and liverworts

Carpeted with bluebells and wood anemones, and filled with ash, beech and hornbeam, this attractive woodland made for a lovely spring walk, enhanced by some early purple orchids and some massive old oaks, one reported to be more than 300 years old.

There was also at least one wild service tree, the fruits of which, sold under the name of chequers, were reportedly used to flavour beer.

In the glades, which had been cleared of bracken, bramble and silver birch by volunteers, heathers were becoming re-established, and there were several small ponds, probably the result of earlier clay workings, which contained a range of moisture loving plants, sphagnum moss and, reportedly, three species of newt.

Our guide, Jacqueline Hutson, is a bryophyte enthusiast, who ably revised our knowledge of (or introduced us to) the mosses and liverworts to be found in the woods.

These rather primitive plants lack a vascular system and so are typically found in moist areas such as dense woodland where they can grow as carpets and mounds on the ground, as well as clothing the trunks and branches of the trees.

During our walk we found both *Acrocarpus* mosses such as *Mnium hornum*, with its leaves edged with a row of double teeth, and *Pleurocarpous* mosses, such as *Kindbergia praelonga*, with its heart shaped leaves on creeping stems and narrower leaves on its branches. Among the liverworts, we found leafy specimens such as *Lophocolea heterophylla*, with its delicate translucent shoots, and thalloid species such as *Metzgeria furcata*, with its thick midrib and forking thalli.

It was a most informative and enjoyable event.

DAVID WARE FSB

NORTH WALES

THE RETURN OF THE BEAVER

4 DECEMBER 2014

Adrian Lloyd Jones expounds the benefits of beavers at St Asaph

The advantages of beavers outweigh control measures a hundredfold

ALLARD MARTINIUS

Beavers were the subject of a talk by Adrian Lloyd Jones of the North Wales Wildlife Trust at St Asaph in early December. The lecture was followed by the branch AGM and an excellent buffet at the Bod Erw Hotel.

Adrian has led the project on returning the beaver to Wales since 2005. Over that period, he has examined the habits of the European beaver (*Castor fiber*) in parts of mainland Europe, where beavers have lived for decades.

In Wales, beavers were already very rare in the time of Giraldus Cambrensis (c. 1146–1223), as they were hunted for their valuable pelt, meat and other parts of their anatomy that were thought to have medicinal properties. Castoreum, the secretion found in beavers' castor sacs, contains salicin from wood bark, which may have had anti-inflammatory effects. However, the medicinal properties thought to derive from a beaver's testicles appear to be a myth.

Looking at the ecology and habitat of beavers on the European mainland provides clues to how these animals might respond to and affect UK habitats. They don't eat fish, but do like aspen trees, eating bark when they need to. They burrow as well as build lodges, and fell trees to make dams.

The beaver is considered a keystone species that provides benefits for others. It is said that the biomass of fish in a beaver area is as much as 80 times greater than elsewhere, and when beavers abandon a lodge, otters can move in. Their burrows can collapse and they can drill through dykes. Control measures include, among other things, electric fencing, trapping (using apples as bait) and removing animals, but it has been estimated that the benefit of beaver outweighs the cost of control measures a hundredfold. Beavers can damage field crops, but this tends to occur where the riverside buffer zone is very narrow.

In Wales, there are excellent locations for planned experimental releases of beavers, but sites are now sought where problems are more likely to occur than in the more isolated upland valleys originally proposed. This will enable investigation of their impacts on aquatic features such as salmon, and provide experience in addressing negative impacts.

JOHN SOLBÉ MBE FSB

Dr David Elphinstone shows off Myerscough College's new glasshouses

GLENN UPTON-FLETCHER AMSB

NORTH WESTERN

AGM AT MYERSCOUGH AGRICULTURAL COLLEGE

28 MARCH 2015

Members cultivate an interest in horticulture and husbandry

An idyllic setting for our AGM, Myerscough Agricultural College lies within the heart of the Lancashire countryside. The college was founded in 1894 and is set in 700 hectares (1,730 acres) of green belt owned by the Duchy of Lancaster.

The college aims to maintain a balance between education, commerce and research, the latter ensuring links with universities in Manchester, Liverpool, Lancaster and Preston. The working farm on site has more than 1,000 ewes and 200 dairy cattle.

The AGM heard the chairman's report, along with an update on the branch activities from the previous year, a review of some past challenges and a look at the year ahead. The elections went smoothly, with new committee members appointed.

Following the AGM, we were invited to view some amazing images taken by award winning wildlife photographer Glenn Upton-Fletcher AMSB. His subjects range from mites on burrowing scorpions, to the lifecycle of tadpoles, to elephants in Zimbabwe (see below). Glenn will be running two courses to support branch activities this year (16th May and 5th June).

After lunch, delegates went on a tour of the college by Dr David Elphinstone, beginning with the state-of-the-art glasshouses, where all parameters are computer controlled and the plants produced are sold in the college garden centre.

Kathy Kissack greeted us at the Veterinary Nursing School, with its working kennels and cattery. The 400 students in the school are training for a range of roles from nursing care assistants to graduate veterinary nurses. Students practise on simulated dogs, which are very lifelike, rehearsing techniques such as taking X-rays, anaesthetising and bandaging.

JEAN WILSON MBE CBIOL FSB

An image by Glenn Upton-Fletcher

GLENN UPTON-FLETCHER AMSB

Observing a common vole

Lessons in how to track and trap

NORTH WESTERN

MAMMAL TRAPPING

18 APRIL 2015

Animals caught on camera at Lancashire wildlife hot spot

We gathered early on a crisp spring Saturday morning not far from Ormskirk on 12 hectares (29.6 acres) of rather special woodland.

After a brief introduction and splitting into two much smaller groups, we were expertly guided through the traps, approaching each one with excitement.

A thermal imaging camera added even more interest and enthusiasm to the proceedings and led to some fascinating and engaging conversations on possible uses, projects and research ideas.

The heat signals from the different mammals and the way they changed were fascinating and a challenge to track. From numerous common voles and shrews to the much rarer pygmy shrews and the endearing wood mice, we had plenty to record.

After the main survey of the traps, we were treated to a short introduction to photographing small mammals. The day finished with a more leisurely and intimate guided tour of the whole site, which boasts an orchard, bluebells and a river.

It was a fully subscribed and memorable event that we hope to repeat.

GLENN UPTON-FLETCHER AMSB

An introduction to photographing mammals

NORTHERN

AGM AND LECTURE ON DISEASE AND WAR

18 APRIL 2015

Tales of mighty leaders v microbes, and our body's war against disease

The branch met at Durham University in the Holgate Conference Centre at Grey College. The formal meeting was held in the morning and, after a welcome and introduction by the chairman, Dr Clifford Wood, the year's events were reviewed, including successful visits to the Durham Brewery in June and to Northumbrian Water Scientific Services in November.

We were pleased to welcome Dr Penny Fletcher, events and public engagement manager for the Society of Biology, and Dr Jane Magill, regional coordinator for Scotland and the north of England, who gave short presentations.

Dr Wood said he would not seek re-election and thanked the committee for their support during his 10 years in office. Professor Sandra Edwards left the committee during the year as did Dr Douglas Wilson, and Dr Christine Masterson did not wish to continue. Dr Cathleen Thomas and Dr Brian Degger were elected to the committee.

After a buffet lunch, Professor Olivier Sparagano, associate pro vice-chancellor for research at Coventry University, gave a lecture entitled 'The Emperor versus the Microbes'. He looked at the progression and failures

Napoleon Bonaparte

of the Roman Empire and the brilliant successes and setbacks of Napoleon.

In wars, the main killers were not always soldiers: statistics show that more casualties were a result of disease. He suggested that in counteracting infection, the immune system follows the same strategy as humans in war, and that we should learn from the best leaders, build the best armies, gather intelligence and develop new strategies.

The body's own soldiers and weapons equate to the innate and adaptive immunity of defending cells and antibodies. The use of new techniques such as molecular diagnostics and vaccine development was illustrated by research against the poultry red mite, a parasitic pest of economic importance.

After a persuasive and entertaining talk, the conclusion was that the more you know about bugs the better to win the battles.

MIKE ROWELL

New branch discussions at Irish Academy

DUBLIN MEETING

23 FEBRUARY 2015

Reception looks at the future of the Society in Ireland

The Society held an evening reception at Dublin's Royal Irish Academy to facilitate discussion between members based in the Republic of Ireland and Northern Ireland.

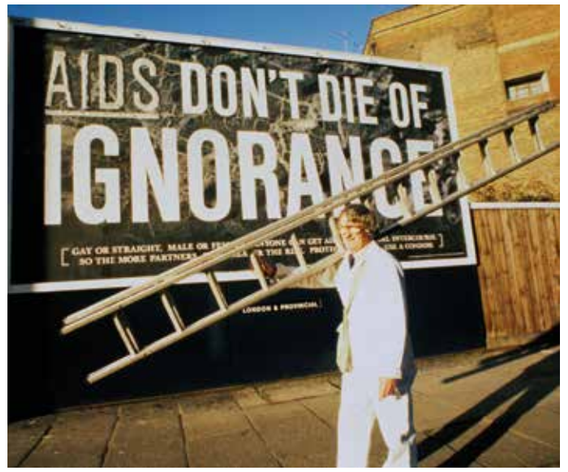
The event was a great networking success, enabling discussion on potential collaboration between colleagues in the two countries and on the possible formation of a Republic of Ireland branch.

Society chief executive Dr Mark Downs FSB presented an overview of the Society's important contributions to biology and its impact on society in general, while regional branch coordinator David Urry MSB provided information on the reorganisation of the branches and their support infrastructure.

Professor Gerry McKenna FSB told how members from the Republic of Ireland might become involved in the branch's activities and possible funding opportunities to facilitate this.

Members from south of the border also expressed a desire to create a branch in the Republic of Ireland to help facilitate joint activities.

DR GLENN DICKSON CBIOL FSB



Students at a Northern Ireland branch talk were shown hard hitting AIDS awareness advertisements from the 1980s

REX / ALMERO BARNARD MSB

NORTHERN IRELAND

SCIENCE AND STORMONT CONFERENCE

13 OCTOBER 2014

Branch members attend stimulating discussion on science education

This event was hosted by the Royal Society of Chemistry and facilitated by Basil McCrea, chair of the All-Party Group on Science and Technology at Stormont, the seat of the Northern Ireland Assembly. The Northern Ireland branch of the Society was well represented and there was an opportunity to meet the Society's director of parliamentary affairs, Dr Stephen Benn.

The theme of the conference was 'Science Education in Northern Ireland'. In addition to formal presentations spanning primary, secondary and tertiary education in the province, there were two lively panel Q&A sessions. The presentations led to stimulating and productive discussions that provided much food for thought for all present.

DR RICHARD BRIGGS CBIOL FSB

A LEVEL UPDATE

18 FEBRUARY 2015

Dr Declan McKenna explains the unique difficulties of treating HIV

Our annual A Level Update, aimed at A level pupils, is designed to take a topic from the syllabus and demystify it, with a guest expert lecturer. This year's update was held at the W5 science and discovery centre, with support provided by Arlene Todd from STEMNET. This year, Dr Declan McKenna of the University of Ulster gave the guest lecture on the human immunodeficiency virus (HIV).

His lecture began with the origins of HIV, its detection and impact on the human immune system. We were shown the hard hitting adverts from the 1980s, when the spread of the virus was at its greatest. He went on to explain the mechanism of the virus and how it differed from other viruses, resulting in unique difficulties for treatment. He gave an overview of molecular techniques used to detect such viruses in the lab.

Dr McKenna's analogy of a new drug sweeping the streets of a city, with a police force tackling the problem, helped us to remember the cell types of the human immune response. Despite the serious topic, the talk was stimulating, humorous and educational. The delivery will certainly help students in their examinations and will most likely encourage some to embark on a career in biology.

There was a brief break to give the pupils and teachers a chance to visit some of the STEM ambassadors and employers present, who had stalls in the foyer. Afterwards, Dr Ann McGinty of the Queen's University Belfast gave a short talk on research and careers in biology.

JONATHAN SHIELDS AMSB

SOUTH WALES

BATTLING INFECTION

16 MARCH 2015

Inaugural event takes on antimicrobial resistance and the anti-vaxxers

Despite modern scientific advances, infectious diseases remain one of the major threats to public health. As we have seen from recent events both locally and globally, there are still many controversial issues around how we treat and prevent diseases, from measles to Ebola. As such, the inaugural event of the recently established South Wales branch was an engaging audience-led panel discussion on battling infection.

The panel was made up of a group of academic, medical and policy experts based in the South Wales region, and the event was chaired by Dr Beatrix Fahnert FSB, chair of the South Wales branch committee.

The discussion covered a number of areas, including how the over-prescription of antibiotics for viral infections is promoting antibiotic resistance. It also covered the rise of the 'anti-vaxxers', which is of great relevance at the moment following the outbreak of measles in California and, closer to home, in Neath and Swansea.

Members discussed the lost art of home remedies and how exposure to a 'good dose of dirt' for children could stimulate the immune system, reducing the reliance on healthcare systems and pharmaceuticals.

There were also displays and demonstrations showcasing research in the field, with a cheese and wine reception following the discussion.

This was an excellent first event for the branch, attracting 177 people and providing a great opportunity to meet and listen to experts in the field.

DR CLAIRE PRICE MSB

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YOUR BRANCH NEEDS YOU

EAST ANGLIA branch committee is looking to recruit new members and fill a number of roles. If you are interested in joining the committee and helping to organise events, contact branch secretary Amanda Burton, eastanglia@societyofbiology.org

Biofeedback

Sense about soil

Joe Turner rightly highlights the crucial role of soil in sustaining humanity and supporting ecosystems ('On Shaky Ground', *The Biologist* Vol 62(2) p8). However, he proceeds to paint a very dark picture of UK soil science research, training and funding.

This is not the case. Several research councils actively support soils based research and training. A casual search of the Natural Environment Research Council's (NERC) grants database reveals 250 live grant, fellowship and training awards containing the word 'soil' with a total value of £68m.

For example, NERC and the Biotechnology and Biological Sciences Research Council have launched programmes directed at soil science worth approximately £13m. At the Institute of Biological and Environmental Sciences at the University of Aberdeen, we have around £10m worth of live research funding for soil, have graduated around 120 soils related PhD students since 2009, and soil science is taught across several undergraduate and postgraduate training programmes.

Many organisations promote soil science, including the British Ecological Society, whose Plants, Soils, Ecosystems focus group has more than 300 members.

Although we can't rest on our laurels, I am confident that the UK has the talent and skills available to tackle the important issues of sustainability of soil, water and food that Joe Turner raises.
Professor David Johnson FSB

Millions of pounds have been committed to UK soil research in recent years

Too much pressure

Tom Ireland's dialogue with Greg Clark ('For the Record', *The Biologist* Vol 62(2) p28) raised the issue of fundamental versus utility targeted research.

Clark said "people were understandably nervous in advance" when asked about alleged pressure put on scientists to aim their research at specific applications as opposed to pursuing 'blue skies' (fundamental) research.

The subject is perennial. My 2003 thesis, Managerialism and Academic Science (MPhil, Nottingham University Business School), comprehensively explored the attitudes of a cohort of academic natural scientists, all of them active researchers.

My research found that 81% of the scientists questioned claimed that "fundamental research was being compromised" by such pressures. Further, 87% stated that the traditional academic science domain was vital.

Yet, 81% stated that they would not ignore such pressures and 81% claimed that there was "greater personal advantage" in applied/utilitarian research.

Perhaps, even then, scientists were 'understandably nervous' about the issue. However, their views revealed a shrewd awareness of lucrative funding streams from private venture capital wanting to solve specific industrial/technology/medical dilemmas. The hope of ensuing lucrative product development also helps science to maintain its primary aim: to enhance the lives of citizens and society through discovery.
Cedric Richmond CBiol FSB

Speed speciation

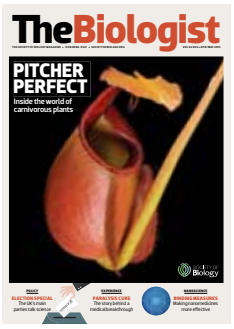
In the last issue, Cedric Richmond's letter 'New or just evolved?' ('Biofeedback', *The Biologist* 62(2) p45) questioned what we really mean by a 'new' species.

The theory of evolution is under the microscope. The fossil record has long revealed unusually high speciation rates after mass extinctions, and rapid speciation has also been observed in several environments, such as the cichlid fishes of African Great lakes and in Hawaiian cave planthoppers.

Sympatric speciation – that is, non-geographical separation – is significantly involved in many of these recent observations. For this, sexual selection seems essential for the swift formation of a barrier against dilution by the sibling and parent genomes.

This is achieved when genetic elements for signals in one gender, which attract the opposite gender, are linked with the adaptive targets of selection. These signals form a repertoire of features exhibited differentially in the two genders. They include song, dance, scent, colour and adornment. Natural and sexual selection can together reinforce each other to hasten the development of a species boundary and thus minimise invasion from competing subspecies.

This can explain observations of accelerated rates of speciation, involving early stage, often unobservable, competition between sibling nascent species as well as parents. It suggests an additional route for evolution which is fitful or digital in the course of speciation, compared with the slow anagenesis of current theory.
John B Owen CBiol FSB



Get in contact

Send your comments to Biofeedback, Society of Biology, Charles Darwin House, 12 Roger Street, London WC1N 2JU or email biologist@societyofbiology.org

The Biologist reserves the right to edit letters where appropriate.

We have around £10m worth of live research funding for soil

Crossword

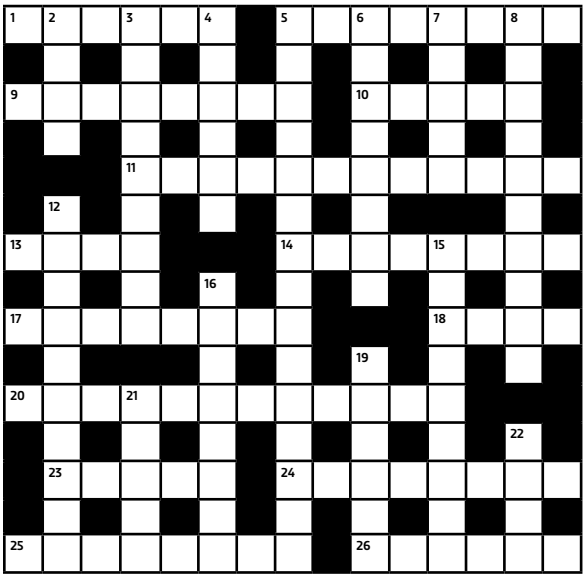
Solve summer's biology brain teaser and you could win a £25 book token

Across

1 Headgear is the wrong way round on back of head (6)
5 Terrible cat smell (4,4)
9 I'm pieced together somehow (8)
10 Dwell by river (5)
11 Otters seen to swim around (12)
13 Ascent, not cold to start with (4)
14 I'd poison cocktail (8)
17 Centres for aged ones have swimming facilities (4,4)
18 Area surrounded by nothing (4)
20 Angry, I govern badly (8,4)
23 A source of coal possibly (5)
24 Heartless city council outrages inhabitants (8)
25 What can go with prison bars? (4,4)
26 Leading scientists yet still they exhibit modesty (6)

Down

2 A politician starting to speak can up the volume (4)
3 Ideal, best placed for use against a wall (4-5)
4 Hide misery that's around death (6)
5 Cool car, big limo taking one around (15)
6 Loudest I perform is when nobody else is around (8)
7 Small inlet by river provides shelter (5)



Volume 62 No 3
compiled by Doug Stanford

8 I try and signal about reason for silence (10)
12 Near enough what one does with presents (4,2,4)
15 Hard up writer, curious doesn't have a cent (9)
16 Small water life decay provided given a long time (8)
19 Gets rid of wild civets (6)
21 One makes proof stronger yet (5)
22 Mourn for tree (4)

This issue
All across answers are from the world of biology and their clues lack any further definition. Down clues provide the normal combination of a definition supported by a cryptic indication.

How to enter
To be in with a chance of winning a £25 book token, please send us your completed puzzles by 29th June 2015. Please include your name, address and membership number with your entry – an email address would be handy too. Post your entries to: Crossword, *The Biologist*, Society of Biology, Charles Darwin House, 12 Roger Street, London, WC1N 2JU.

Last issue's winners
Well done to the winners of the Apr/May issue crossword. They are John O'Connor CBiol MSB and David Kemp CBiol MSB. Book tokens are on the way.

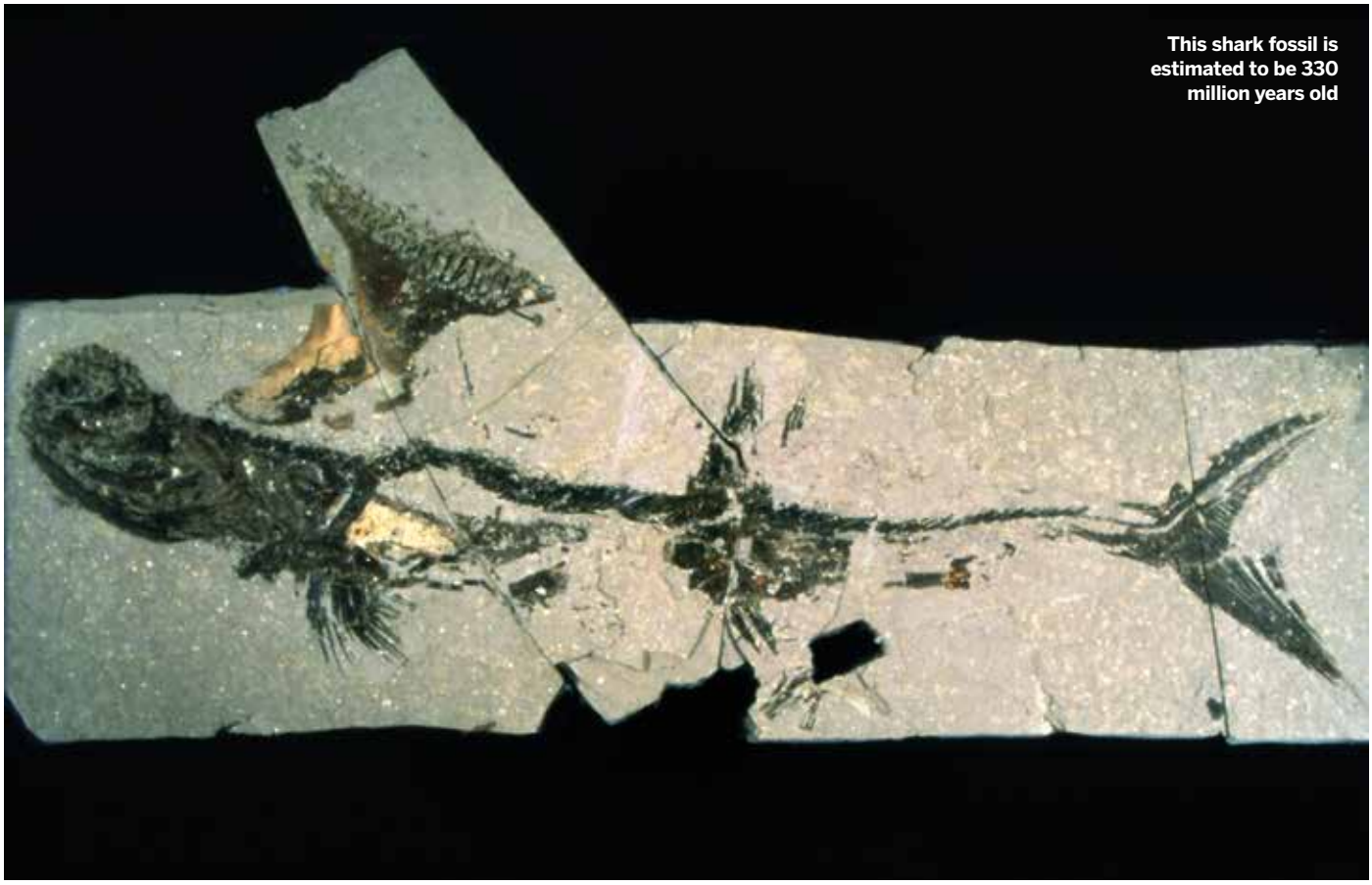
Last issue's solution
Vol 62 No 2

In the next issue of THE Biologist

Sir David Attenborough in conversation with Alice Roberts ● Our guide to fossil hunting in the UK ● The importance of cell cultures to science

Museum piece

Biological exhibits from around the world



This shark fossil is estimated to be 330 million years old

#14: The Bearsden Shark

Hunterian Museum, Glasgow

Think of the rural outskirts of Glasgow and you probably don't picture sharks swimming through tropical lagoons. Three hundred million years ago, however, conditions in shallow waters here were perfect for the preservation of marine life. When ancient sharks and other bony fish died, they quickly sank into thick mud below the tropical waters of the period, leaving the area with a wealth of exceptionally well preserved and rare fossil specimens.

In 1981, fossil hunter Stan Wood came across an amazingly well preserved and unusual shark while walking his dog around Bearsden, half a dozen miles north west of Glasgow. The area lies on a geological shale formation known as Manse Burn, which is now recognised as one of the most important shark fossil sites in the world.

Wood's 'Bearsden Shark' is estimated to be 330 million years old and is the most complete shark of its age – only the teeth and spines of fish this old had been found before this discovery. Thanks to the unique conditions of the area and the carboniferous period, the cartilage of the shark remains intact and even the remnants of its last meal can be seen inside its stomach. Palaeontologists believe the shark must have been quickly buried in oxygen-poor black mud, which prevented scavengers and other organisms breaking it down. Over time, this mud would become the black shale formations found in the area.

Following the discovery of the Bearsden Shark, a team of workers from Glasgow University's Hunterian Museum, led by Wood, excavated and exposed a quarry in the Manse Burn shale bed just a few metres wide, and discovered many new specimens, including several unique bony fish and other complete sharks. Some specimens were so well preserved that even blood vessels and muscle could be seen.

Why the anvil shaped fin?

The remnants of its last meal can be seen

The Bearsden Shark was described in 2001 as *Akmonistion zangerli*, a species previously unknown to science with a strange, toothed fin shaped like an anvil behind its head. Palaeontologists have only been able to guess at the fin's purpose.

The original fossil is now on display at the Hunterian Museum. The museum also houses scientific instruments used by James Watt, Joseph Lister and Lord Kelvin, objects from Captain Cook's Pacific voyages and the anatomical teaching aids of founder Dr William Hunter, as well as a large collection of archaeological and historical artefacts and artworks.

The Hunterian Museum is open Tuesday to Saturday, 10:00–17:00, Sunday 11:00–16:00. Admission is free

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