Emeritus Professor Louis Charles Birch (1918 – 2009)

Challis Professor of Biology for 25 years at the University of Sydney, Professor Charles Birch left a lasting legacy to the university and to the field of ecology.

It may come as a surprise to those who knew Professor Charles Birch as the renowned ecologist who challenged a central paradigm in ecology, that his research in pure science was born from a career forged in applied science.

He graduated from a degree in Agricultural Science at the University of Melbourne in 1939 and his first job was in the entomology department at the Waite Agricultural Research Institute in the University of Adelaide, where he received his Doctor of Science degree in 1941.

In his time at the Waite Institute, he forged a close relationship with his then supervisor H G Andrewartha who became his long-term collaborator and one of the major influences in his scientific career. With Andrewartha, Professor Birch worked on projects such as preserving the stockpile of wheat from being destroyed by insects, and predicting the spread of the Australian plague grasshopper, which had become dominant in the South Australian wheat belt.

It was during his six years of entomological research with Andrewartha that Professor Birch made one of his major and enduring contributions to the science of ecology. He demonstrated that external processes, driven by weather and other types of disturbance, were extremely important in controlling the numbers and distribution of animals. This was a radical challenge to dominant prevailing views that populations were self-regulating and that competition for resources prevented numbers increasing. Birch’s contribution culminated in the synthesis developed in his famous 1954 book, written with Andrewartha, The Distribution and Abundance of Animals. This book was a bible for a generation of ecological students and still influences many areas of ecology.

In 1948 Professor Birch joined the staff of the University of Sydney as senior lecturer in the Department of Zoology. Here he turned his attention to the Queensland fruit fly, which had become very abundant in areas where fleshy fruits were grown.

While investigating the southern spread of the fruit fly, Professor Birch found that the populations that managed to get south were changed populations that had evolved to suit that environment better. This precipitated his interest in a new field of research, looking at the relationship between ecology and evolution.

In 1954 Professor Birch was promoted to a Readership in Zoology followed by the Challis Chair of Biology, which he held from 1960-1984. Together with Professor Robert Crocker, Professor Birch left a lasting legacy to the University of Sydney by spearheading the amalgamation of the Departments of Zoology (founded in 1980) and Botany (founded in 1913) to form the School of Biological Sciences in 1962. In doing so, he aimed to create a larger department that would be better able to compete alongside the Schools of Chemistry and Physics within the Faculty of Science.

Alongside his distinction in ecological research, Professor Birch had a second passion that stemmed from his lifelong interest in the interconnections of biology, philosophy and theology. He was a strong believer of pan-psychoism – the belief that all life forms experience their environments and therefore have some degree of intrinsic value of themselves. As a student, Professor Birch developed an interest in philosophy in the hope of reconciling his Christian faith with science. At that time, and later at the University of Chicago, he was influenced by the thinking of the philosopher A.N. Whitehead and his friend, the biologist Sewall Wright, who played a very important role in his career.

Professor Birch’s science and philosophy came together in pioneering work on economic and ecological sustainability, which led to his spending 20 years on the World Council of Churches’ program on science, technology and the future, and his election to the Club of Rome in 1974. He was very involved in the Zero Population Growth movement and was also publicly opposed to the Vietnam War.

Throughout his distinguished career, Professor Birch was the recipient of a host of awards. He was elected to the Australian Academy of Science in 1961. He was awarded the David Syme Research Prize in 1953. In 1988 he won the Gold Medal of the Ecological Society of Australia, as well as the Ecological Society of America Eminent Ecologist Award. The Ecological Society of America later honoured him with an Honorary Life Fellowship, as did the British Ecological Society and the Academy of Environmental Biology, India.

In 1990, Charles Birch was awarded the Templeton Prize for progress in religion. He donated part of the proceeds of the prize to establish the annual Templeton Lecture at the University of Sydney, under the auspices of the Centre for the Human Aspects of Science and Technology. This generous gift has brought a succession of distinguished speakers to Sydney. The University of Sydney bestowed Professor Birch with the degree of Doctor of Science (honoris causa) at the Faculty of Science graduation ceremony in May 2000 and he was made a Member in the General Division of the Order of Australia in 2008.

In 2008, Professor Birch was interviewed by Professor Rick Shine for the Australian Academy of Science’s ‘Interviews with Australian Scientists’ program, which commissions interviews with outstanding Australian scientists to record details about their early life, development of interest in science, mentors, research work, and other aspects of their careers.

Professor Birch never married and is survived by his twin, Sidney, and sister-in-law, Jenny. A private funeral was held 22 December 2009 and an official memorial is planned for 2010.
Welcome to the first Biology News for 2010, the United Nations International Year of Biodiversity. To many biologists, biodiversity is an important issue, and the School plans to increase awareness of this issue through a number of events. This year, the School marks 20 years of continuous research on the animals and plants of the Simpson Desert by Prof Chris Dickman and Dr Glenda Wardle. We can look forward to our two public lectures: the Keast Lecturer will be Prof Helene Marsh (James Cook University) who works on dugongs and the Murray Lecturer will be Prof Johnathon Losos (Harvard) who works on the behavioural and evolutionary ecology of lizards.

A variety of sausages have featured in our activities so far this year. Rick Shine’s group has received broad press coverage for their work using cane toad sausages to train native animals to avoid poisoning from eating toads. More conventional sausages featured in a bumper welcome to new students during O-week. Dr Greg Sword, Darron Cullen and Carla Avolio enthused and entertained our newest biologists while others set alight our BBQ to feed sausages to the masses.

Our enrolments in first year are strong again this year and I am very pleased that we have talented and enthusiastic team of teaching fellows from amongst our postgraduate students to play a major role in delivery of the laboratory classes. To ensure teaching fellows have a positive experience that provides good professional training we have appointed Frank Seebacher to the new position, Mentor of Teaching Fellows.

Last week, our incoming honours students presented an outstanding series of introductory seminars from honey bees to photosynthesis. I think we can expect great things come from this group! It is particularly pleasing that we have a number of international honours students this year.

Finally, it is a pleasure to congratulate our newly promoted Associate Professors: Neville Firth, Murray Henwood, Jan Marc, Greg Sword and Ashley Ward.

On a personal note, I am currently ensconced in the final stages of organisation of an International Plasmodesmata Conference to be held at the Quarantine Station at Manly in the last week of March. I am excited to welcome over 60 of my colleagues, mostly international, to enjoy the delights of Sydney and plasmodesmata.
I am acutely conscious of how much humans have damaged the planet. While we must eat and function with some degree of security, we have also plundered the earth and in doing so extensively damaged our resources. My research focuses on restoration of these damaged systems, and the sustainable use of resources.

The fungi are my passion. I became hooked on fungi quite by accident. My goal at university was to work with native plants. I took a unit in microbiology. The role of mycorrhizal fungi in plant uptake of minerals was described in one lecture: my life changed. I asked the lecturer to recommend further reading, and he lent me his copy of Harley on Mycorrhizal Symbiosis. I finished that overnight. From then on, everything was mycorrhizas. I completed an Honours project and then a PhD on ecology of mycorrhizal fungi. The lack of information on the fungal side of the symbiosis strongly influenced decisions I made about career and research directions. These developments ultimately led me to explore the biology of soil-borne fungi, and then other fungus/plant interactions.

Two themes have emerged in my laboratory. The first concerns carbon storage in soil. The IPCC indicated that some 30% of carbon dioxide in air came from agricultural soil. The reason for declining soil organic carbon is well understood: oxygen directly and indirectly degrades organic materials. Agriculture exposes the soil to more oxygen. Loss of organic carbon is associated with much faster soil erosion, declining plant production, increasing need for mineral supplementation and reduced resilience and resistance of soil to further disturbances.

Our research first examined the role of mycorrhizal fungi in restoring soil. This simple approach indicated that mycorrhizal fungi played a crucial role in the establishment of plants in extremely depauperate soils (Greg Pattinson), but mycorrhizal plants were insufficient in micro-aggregates by fungi will result in storage of more stable forms of organic carbon (Tom Mukasa Mugerwa). I predict that some melanitic root endophytic fungi will aggregate soil and in doing so deposit stable carbon in micro-sites. Carbon in micro-aggregates would oxidise more slowly if the micro-sites were covered with biofilm. Extraordinarily enough, though we know that some fungi release biofilm, and biofilm is found in soil, no-one has put the information together. We are starting to explore the development of fungal biofilm in soil using computer-aided tomography (Ning Zhang). The use of CT scanning was developed in the School by Dr Osu Lilje and so we are working closely with the Electron Microscopy Unit and Osu.

The second theme concerns the use of biological resources to regulate pathogen and pest problems. Fungi interact directly and indirectly with other organisms. Fungi require energy, and thus an endophytic life provides both food and protection to the fungus. We have shown that the plant benefits from this association. Disease in plants is reduced when the plants are colonised by specific fungal endophytes (Juliet Dingle and Noor Istifadar). Fungal entomopathogens may also colonise plants, and when in plants reduce the growth rates and reproduction of pest insects (Pampa Gurulingappa). These data have enormous ramifications now that we seek more ecologically sound approaches to food production.

The fungi are enormously diverse and perverse. They can be frustratingly difficult to manipulate, yet they are wonderful tools to use in research and technology. Resolution of the challenges that await humanity will inevitably involve the inclusion of fungi.
Who’s New?

In early 2010, the School welcomed Dr. Beata Ujvari to join Dr Nate Lo’s group as a postdoctoral fellow. Along with her role as a research fellow, Beata will work as an associate lecturer in genetics and bioinformatics, thus taking over the courses formally run by Dr Nate Lo prior to him being awarded a QEII fellowship in 2009. After completing her PhD in Hungary, on the conservation biology of an endangered snake species, Beata has been working in Sweden and Australia on various subjects.

Her interest spreads across the fields of molecular and evolutionary ecology, and includes the use of molecular techniques in conservation genetics, the molecular background of toxin resistance, host-parasite interactions, and recently, the molecular mechanism of aging and caste determination. As part of her postdoctoral research project in Sweden at the University of Lund she investigated the molecular background of female intrauterine choice of sperm, and developed AFLP methods for studying Tasmanian scincid lizards.

She moved to Australia in 2004, and started to work at the University of Wollongong on host-parasite interaction, immunocompetence and immunosenescence. The data generated from these studies demonstrated the profound impact of parasite infections on life-history traits, and revealed the significant effects of immune-genes on vertebrate longevity.

In her recent role at the University of Sydney she will continue her research with Nate on the population genetics of termite colonies and the molecular mechanisms of caste and sex determination in termites.

The ARC Centre of Excellence in Plant Energy Biology (PEB) has closed its node at the University of Sydney. The Sydney node was established in 2005 by chief investigator Professor David Day when Professor Day moved from the University of Western Australia, the site of PEB’s major node, to take up the role of Dean of Science at the University of Sydney.

For four years the Sydney PEB node ran within the School of Biological Sciences’ Macleay Building under the management of Dr Penny Smith. At the end of 2009, the Sydney node was closed and a new node at Flinders University was established where Professor Day has been appointed Deputy Vice-Chancellor (Research).

With the closing of the Sydney node, former PEB lab members have left the School and moved to new labs. Research assistant, Renee Simms, has moved to the Centenary Institute, which is still located at the University of Sydney; postdoctoral fellow, Dr Angela Ho, is undergoing significant change by moving to Norway; science communicator, Katynna Gill, now works full time as the media officer for the Faculty of Science; Dr Chevaun Smith has moved to Flinders University to join the SA node as a postdoctoral fellow with Professor Day.

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Dispatches

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Steve Simpson in Top 100 most influential people
By Katynna Gill

In 2009 Professor Steve Simpson was named in the top 100 most influential people in Sydney by the Sydney Morning Herald’s the(sydney)magazine.

The list of Sydney’s top 100 most influential people was released on 10 December 2009 in a special edition of the(sydney)magazine.

Dubbed ‘The Sleuth’ in the list, Professor Simpson was selected for his research on locust swarming, which led him to form the protein leverage hypothesis that also applies to more complex animals, including humans. His research, which started out as entomological but moved to dietary research in other animals, has implications for nutrition and obesity in humans.

Professor Simpson being named as 2009 NSW Scientist of the Year was highlighted in the listing, as was him crediting his mother, Pat, for his love of insects.

Professor Simpson was selected by a panel of eight experts in the Science and Technology section of the list, including Anna Patty (Sydney Morning Herald’s education editor), Kathy Ridge (environmental lawyer), Julie Robotham (Sydney Morning Herald’s health editor), Deborah Smith (Sydney Morning Herald’s science editor), Dr Norman Swan (ABC Radio’s presenter of The Health Report), Robyn Williams (ABC science broadcaster), and James Woodford (environment journalist for the Sydney Morning Herald).

Achievements

Postcard - David Cummings

I have spent all summer analysing biological samples collected from the Ocean Survey 20/20 - a major, multi-agency program that aims to survey biodiversity in New Zealand’s Exclusive Economic Zone by the year 2020.

The OS 20/20 project is focusing on two large, deep ocean domains: Chatham Rise to the east of New Zealand and Challenger Plateau to the west. So far, voyages to these domains have revealed diverse and abundant biological communities living in a range of environments - from rugged seamounts and reefs to plains of muddy sediment and current-scoured sands at depths of over a kilometre.

In 2007, two voyages were deployed in order to sample the biological communities in the different habitats. The voyages returned with over four tonnes of biological samples for analysis. I am one of the biologists working on these samples.

The samples were collected using a variety of equipment - an epibenthic sled to collects samples while being towed along the seafloor, a hyperbenthic sled to collect macroscopic fauna just above the seabed, and sediment corers to sample organisms and physical properties of the sediment.

For my Phd research, I am working on two species in particular - a sea snail (Fusitriton magellanicus) and a quill worm (Hyalinoecia longibranchiata) - that were collected from sites at 500 – 1050 metres below sea level.

The Challenger Plateau is considered nutrient poor and the Chatham Rise, nutrient rich. By examining stable isotope signatures and condition indices of the two species, I will determine if there are differences in the nutritional ecology of species at different depths and sites.
Native meat ants to diminish cane toad population

By Katie Szittner

With cat food as bait, scientists from The University of Sydney’s School of Biological Sciences have succeeded in showing that native meat ants can assist in controlling the spread of cane toads.

In March last year Professor Rick Shine and colleagues Georgia Ward-Fear and Greg Brown found encouraging evidence of the deadly effect of native meat ants on young cane toads. Now they have further proven their thesis by luring ants to cane toads with cat food.

Professor Shine and his colleagues observed ant-toad interactions on the Adelaide River floodplain 60km east of Darwin, Northern Territory, in the Australian wet-dry tropics during last year’s dry season. Ant densities and toad mortalities increased “more than fourfold” with the addition of cat food baits, says Professor Shine.

The research, funded by the Australian Research Council and published in the February edition of the Journal of Applied Ecology, reveals that meat ants can be used with low risk of collateral damage to native wildlife. The approach is also logistically feasible, low technology and inexpensive.

Unlike many previous efforts at pest control in Australia, like the cane toad itself, the use of meat ants promises to be “a useful component of a broadly-based ecological approach,” says Professor Shine.

“If we understand the vulnerability of the cane toad we can develop a number of combined tactics to combat this deadly invader,” he says.

The team observed the effect of native meat ants on cane toad metamorphs (the first stage of the toad’s terrestrial development) near bodies of water, and explored the cane toad’s vulnerability to the native predator as a potential means of controlling cane toad numbers.

When cat food was introduced as bait, ant numbers grew and cane toad numbers declined more quickly. "The end result," the study explains, “is that higher ant densities kill more toads, and kill toads of a wider range of body sizes.”

The research continues from a study published by the team last year, which revealed an ecological and behavioural ‘mismatch’ between cane toads and meat ants. While meat ants posed little enduring threat to native frog and toad species, cane toads were found to be poorly-equipped to escape them.

Cane toads are easy targets for meat ants because unlike their native counterparts they do not try to avoid them at great speed. In addition, cane toads are likely to use the ineffective tactic of crypsis, or immobility, instead of more active escape tactics.

The study found 98 per cent of metamorph toads were encountered by meat ants and 84 per cent were attacked within a very brief (two minute) period. Over 50 per cent of attacks were immediately fatal, while 88 per cent of ‘escapee’ toads died within 24 hours.

It is hoped the technology will form part of a multi-pronged attack on cane toads. "No single control will be a silver bullet to eradicate the cane toad from the Australian landscape," says Professor Shine.
The theme for the 2010 Sydney Science Experience was CSI: Cool Science Investigator, which involved learning about and using forensic science techniques. For three days – 13 to 15 January – 120 high school students participated in science workshops around campus and worked together to solve a heinous crime.

The crime involved visiting distinguished ecologist, science celebrity and Nobel Laureate, Professor Byron Diversity who was found dead in a cabin in the Blue Mountains National Park. Professor Diversity was due to give a public lecture at the University of Sydney the next day. As a crack team of forensics experts, the students had to solve this crime and find which of six suspects was the killer.

On the first day, the students received a briefing package, giving details of the crime scene, profiles on the six suspects, police statements, and evidence to assist them in solving the crime. Over the next three days, they learned from professionals in the field (for example there were lectures from a forensic pathologist and a member from Forensic Services in the Police Service) as well as analysed additional evidence in practical sessions. On the last day, suspects were put on trial and students used the forensic evidence gathered from the workshops to determine who was the real killer.

The Sydney Science Experience demonstrates through hands-on lectures and presentations the reality behind a lot of popular forensic television shows. Students perform a variety of forensic techniques in workshops run by various science disciplines. Biology workshops saw students typing blood and analyzing DNA found at the crime scene, visualizing blood with Luminol, and lifting and analyzing fingerprints. Students also learned to ‘clean’ digital photographs with Physics, identify human bones with Anatomy, work out where a person has been using their muddy footprint with Agriculture and test for the presence of poison with Chemistry. This evidence is then brought to the mock crime scene on the final day and used against the six suspects.

Each year, students participating in the Sydney Science Experience are treated to a ‘surprise activity’, the identity of which is kept hidden from them right up until the activity starts. This year, the activity involved a series of challenges that students had to complete as quickly as possible. In total there were 12 groups competing against each other to perform tasks such as: constructing and then throwing a paper airplane over 10 metres, working out how to get a cork out of a wine bottle (without breaking the bottle), throwing a water balloon as far as possible (without breaking the balloon) and using the branch of mathematics called topology to separate two people tied together with handcuffs. The final challenge had each group constructing a water tower, using only 50 straws and masking tape, which could hold a full beaker of water without falling down. Groups constructed a variety of creative towers and students watched with fear and pride as the towers were tested and eliminated with larger and larger beakers of water.

To find out what really happened at the 2010 Sydney Science Experience, log on to the Faculty of Science’s outreach website: sydney.edu.au/science/outreach/experience

You can watch a video with student interviews and footage from the science workshops and surprise activity.
Virus expert Professor Eddie Holmes to speak at Sydney Science Forum

One of the world’s leading experts in virus evolution, Professor Eddie Holmes, will address the recent issue of global epidemics when he speaks at a Sydney Science Forum lecture on Thursday 18 March.

In his only Sydney public lecture, Professor Holmes will address the fundamental questions of how epidemics start and spread, and whether we can predict when they will occur. This is the first Sydney Science Forum lecture for 2010 and will be held at 5:45 pm in Eastern Ave Auditorium, The University of Sydney.

Professor Holmes, an evolutionary biologist from the Pennsylvania State University, specialises in the evolution of diseases caused by RNA viruses – such as yellow fever and dengue – and has recently published a book on the topic titled, The Evolution and Emergence of RNA Viruses (Oxford Series in Ecology and Evolution).

In his Sydney lecture, “On the origin of epidemics”, Professor Holmes will discuss how evolving RNA viruses are able to jump species boundaries and emerge in humans, sometimes with devastating effects. As case studies, he will examine in detail the origin and spread of influenza and dengue – two viruses that pose great public health concerns to Australia.

Professor Holmes currently holds the title of Eberly College of Science Distinguished Senior Scholar in the Centre for Infectious Disease Dynamics at the Pennsylvania State University. He is also an affiliate member of the Fogarty International Center at the National Institutes of Health, USA.

Originally trained as an Anthropologist – his doctorate research focused on the evolutionary history of human populations – Professor Holmes became interested in viruses after taking up a postdoctoral research position at the University of California in the town of Davis. During his time at Davis, the nearby city of San Francisco was suffering very badly from the AIDS epidemic caused by the human immunodeficiency virus – HIV. Professor Holmes became fascinated by the origins of the HIV epidemic and the potential of applying his knowledge of evolution to the study of viruses such as HIV.

From his early postdoctoral research in HIV, Professor Holmes has continued to publish prolifically on the topic, including four publications in the journal Nature. He has also expanded his research to include a number of different viruses, including Hepatitis B and C, yellow fever, dengue, rabies, bat lyssaviruses and influenza.

As an expert in virus evolution, Professor Holmes has been involved in a number of scientific panels that have discussed the threat posed by both avian and swine influenza. In 2001, he was a member of the UK Royal Society working group advising the UK government on the safety of genetically modified plants for food. To date, Professor Holmes has published almost 250 articles and his collected works have been cited over 10,500 times.

Corrections and Clarifications
Dr Clare McArthur’s “Spotlight” (Issue 10 Biology News) miscredited the photo of the rock wallaby. The photo should be credited to Katherine Tuft.