

# Advances

EXCELLENCE IN RESEARCH AND TRAINING IN PLANT AND MICROBIAL SCIENCE

## Continued Excellence of Science



This issue of 'Advances' showcases a year of continued excellence in scientific output. The list of high impact journals in which we achieve publication is tremendous and I am sure our readers would wish to join me in congratulating the teams concerned. Our science is having real and sustained impact – not only in terms of intellectual property, but also in terms of informing policy, and this is also reflected in the recognition that our scientists are receiving.

Phil Dale (in photograph) and Alison Smith were both awarded OBEs this year. Emeritus Professor Phil Dale was listed in the New Year Honours for his work on plant genetics, and Professor Alison Smith in the Birthday Honours for her services to plant biochemistry. There is a full profile on Alison on page 5 "Spotlight on a scientist".

Three Royal Medals, known also as The Queen's Medals, are awarded annually by the Sovereign upon the recommendation of the Royal Society's Council. This year's Royal Medals have been awarded to Sir John Pendry FRS, Dr Tim Hunt FRS and Professor David Baulcombe FRS, Group Leader in The Sainsbury Laboratory.

David's citation is

*"for his profoundly significant recent discoveries, for not only plants but for all of biology and for medicine"*.

The BBSRC's periodic review of JIC went very well, and we have carefully restructured our science programmes to meet the needs of the next few years. We have also merged our support and administration services with those of the neighbouring Institute of Food Research into 'The Operations Centre', which will give an annual cost saving of £700K for JIC. Both these events have led to staff losses, which have been distressing, but necessary for continued resilience and excellence.

This summer has seen the BA Festival in Norwich, which was a fantastic success with over 50,000 people attending events. Our scientists, supported by The Operations Centre, were heavily involved. I hope that you enjoy reading 'Advances'.

**Chris Lamb**

Director, John Innes Centre

## BA Festival: Seed to Seed

As part of the hugely successful BA Festival of Science in



Norwich in September, Prof Nick Harberd read extracts from his popular science book "Seed to Seed" at the King of Hearts Music Room. Nick's book was published by Bloomsbury Press in April 2006 and gives a fascinating insight into the life of a scientist and how discoveries from the laboratory explain the secret workings of the natural world. Nick is a Project Leader in the department of Cell and Developmental Biology working on the regulation of plant growth.

ISBN 0-7475-7039-6

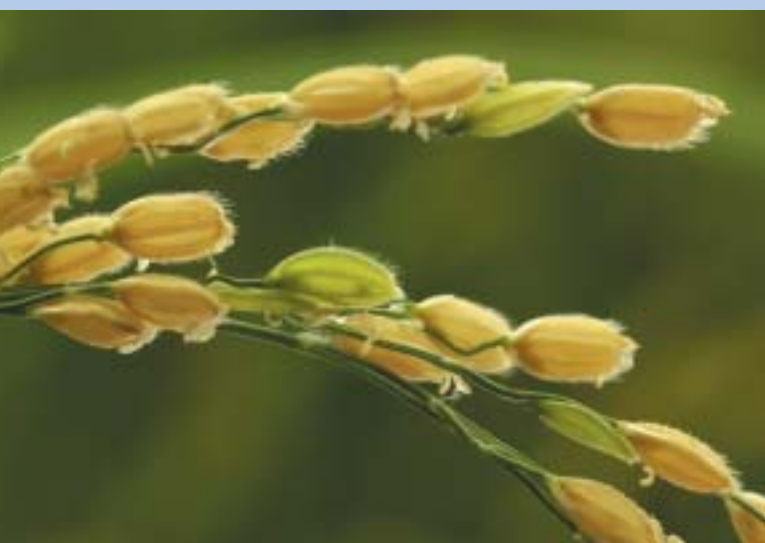
## Triple awards for top young scientist



Project Leader and David Phillips Fellow Giles Oldroyd was singled out as one of Europe's top life scientists by the EMBO Young Investigator Programme in November 2005. This prestigious award provides funds for research as well as a mentorship programme, sponsorship of lectures at international meetings, an annual symposium and a laboratory management course. This spring, Giles participated in Celebrating British Science, an event held as part of National Science Week

hosted by the Royal Society and the Department of Trade and Industry that paid tribute to Britain's leadership in science, technology and innovation. He won the 2006 Society for Experimental Biology Presidents' Medal. Giles' research hit the news headlines in June when his work on root nodulation was published in *Nature* (see centre pages).

Scientists at the **John Innes Centre** have been enjoying outstanding success with an abundance of papers being published in the prestigious international scientific journals, *Nature* and *Science* and other key publications. This first-rate publication record serves to highlight the continuing excellence of the scientific research on plants and microbes carried out at the Centre.



AUGUST 2005

## To flower or not to flower

Dr Phil Wigge's group working in collaboration with scientists at the Max Planck Institute in Germany identified the chemical in *Arabidopsis* that signals plants to flower in the right season and in the right place on the plant. These findings, reported in *Science* showed how



this molecule called FT triggers flower formation at the growing tip of the plant. Since flowers ultimately produce fruits and seeds, this discovery could have important future applications in crop plants.

## Smallest cereal genome sequenced

In the same week, the complete genome of rice was published in *Nature* by the International Rice Genome Sequencing Project. This collaboration of researchers from ten nations (including Michael Bevan and Ian Bancroft from JIC) was established in 1998 to obtain the sequence of the 389 Mega-base rice genome. Rice has played a significant role in human nutrition for the past 10,000 years and it is estimated that world rice production needs to increase by 30% over the next 20 years to meet the demands of an increasing population. Obtaining the genome sequence of rice will help the development of techniques that will increase yields to meet these needs. In addition, rice has the smallest genome of the major cereals and so provides an excellent model for studying other grasses.

SEPTEMBER 2005

## Detecting pathogen invasion

Ray Dixon's group published work in *Nature* describing a novel sensing mechanism for Nitric Oxide (NO) in *Escherichia coli*. Nitric oxide is used by eukaryotes to protect themselves against pathogen infection. In response to this, bacteria such as *E. coli* have evolved defence mechanisms that counteract the effects of NO. Prof. Dixon's work has identified how NO is detected by a protein called NorR that binds to it and activates genes required for the breakdown of NO.

NOVEMBER 2005

## Molecular summertime detector

This month saw a breakthrough in understanding how crop plants use day length to decide when to flower. David Laurie's group isolated a gene called Photoperiod-H1 that is involved in the circadian rhythm patterns of barley. Since different varieties of barley around the world have adapted to flower early or late depending on the regional climate, this work could help breeders grow new varieties that cope with changing agricultural conditions brought about by global climate change.

DECEMBER 2005

## Root hair cells provide a clue to cell growth

Liam Dolan's group working on root hair formation in the model plant *Arabidopsis* have identified and characterised a gene called Supercentipede1 that is involved in controlling the direction of growth of plant cells. By understanding how plants direct their size and structure, researchers hope in the future to be able to produce better performing crops with increased yield.

JANUARY 2006

## Switching identity

In another study of root hair cells of *Arabidopsis*, Silvia Costa and Peter Shaw published a paper in *Nature* describing how these cells can switch identity and turn into a different cell type during development in response to positional information. This work demonstrates how chromatin is re-organised, controlling expression of a gene that determines the fate of the cell.



## Restraining order for plants

In the same month, Nick Harberd's group published work in *Science*, detailing how DELLA proteins actively restrain growth in adverse conditions, enhancing the plant's survival chances in non-optimal environments.

FEBRUARY 2006

## Breakthrough for plant breeders

In February the work of Graham Moore's group made headline news following a major breakthrough in wheat genetics involving over thirty person years of work. Published in *Nature*, the team sequenced a gene complex called Ph1 that controls the pairing of its chromosomes. This knowledge could allow breeders to cross commercially grown varieties with wild varieties to give characteristics such as increased tolerance to drought, and has the potential to revolutionise wheat breeding.

MARCH 2006

## Big hit on small scale

JIC published its first nanotechnology paper in a new journal *Small*. This ground breaking fundamental research resulted from the collaboration between a chemist and a virologist and may have far reaching potential in medical as well as industrial applications. Using a harmless virus of Cowpea plants which has a unique structure that makes it an ideal scaffold for decoration with various chemicals to give different characteristics, their graduate student, Nicole Steinmetz, produced electronically active nanoparticles which can be thought of as "molecular capacitors".

APRIL 2006

## Resistance is futile

By studying variations of two natural antibiotics produced by the naturally occurring soil dwelling bacteria *Streptomyces*, called novobiocin and clorobiocin, Tony Maxwell and colleagues have determined which parts of the molecules are essential for their antibacterial activity. They hope that by varying other parts of the molecules they can design new antibiotics with better activity and fewer side effects in the fight against drug-resistant "Super-bugs" such as MRSA.



JUNE 2006

## Beginning of the end for nitrogen fertilizers?

Giles Oldroyd's group have triggered the growth of root nodules in legumes without the bacteria normally necessary. Plants such as legumes use bacteria in the root nodules to convert nitrogen from the air into a form that can be used by plants, a process called "nitrogen fixation". This achievement, reported in *Nature* is an important step towards transferring this ability to form nodules and fix nitrogen to other crops which could reduce the need for inorganic fertilizers and has been heralded by some as the start of the second agricultural revolution.



AUGUST 2006

## Snapdragons take the evolutionary high road

Research on the evolution of colour variation in snapdragon (*Antirrhinum*) was published in *Science* in August. The research led by Enrico Coen in collaboration with Andrew Bangham at UEA used a pioneering computer modelling technique to trace how plants evolved in the wild from producing magenta flowers to yellow ones without producing in-between colours such as orange that are non-attractive to pollinating bees. These results provide a new way of looking at the evolution of two apparently distinct traits and will help scientists better understand biodiversity of plants in their natural environment.

## References

### August 2005

Wigge *et al.*, *Science* 309, 1056-59.  
International Rice Genome Sequencing Project, *Nature* 436, 793-800.

### September 2005

D'Autreaux *et al.*, *Nature* 437, 769-772.

### November 2005

Turner *et al.*, *Science* 310, 1031-1034.

### December 2005

Carol *et al.*, *Nature* 438, 1013-1016.

### January 2006

Costa & Shaw, *Nature* 439, 493-496.  
Achard *et al.*, *Science* 311, 91-94.

### February 2006

Griffiths *et al.*, *Nature* 439, 749-752.

### March 2006

Steinmetz *et al.*, *Small* 4, 530-533.

### April 2006

Flatman *et al.*, *Antimicrobial Agents and Chemotherapy* 50, 1136-1142.

### June 2006

Gleason *et al.*, *Nature* 441, 1149-1152.

### August 2006

Whibley *et al.*, *Science* 314, 963-966.



# SPOTLIGHT ON A SCIENTIST



**Prof. Alison Smith OBE is an expert on carbohydrate metabolism in plants. A childhood passion for nature has shaped**

**her career and is still evident in her favourite hobbies of walking, gardening and keeping exotic plants. Married to Mark Buttner, also a researcher at JIC, Alison describes herself as a metabolic biochemist with an interest in how whole plants grow, not just in biochemical pathways.**

## **How did you become a plant scientist?**

My family were all very interested in natural history and as a young child I loved planting and growing things in our garden. I went to University with the intention of doing ecology, but realised that the ecological questions that interested me actually needed tackling using biochemistry.

## **How did you begin working on starch?**

When I came to Norwich in the early 1980s, there was a lot of research going on into peas. A particular pea mutant is very important commercially for the frozen pea market and we began trying to discover the biochemical and genetic basis of this mutation. With my colleague Cathie Martin, we found that the mutant pea carried a mistake in a crucial gene for starch formation. I realised that even though starch is very important to plants and to us, very little was known about how it's made and subsequently used in plants.

## **Why is starch so important?**

It's the major carbohydrate in our diet, but it also has important non-food uses, in paints, thickeners, degradable plastics and even for biofuels. Increasingly we are seeing the potential for starch as an environmentally-friendly, renewable feedstock for many industrial processes. Our research helps us understand how we can best harness the massive potential for starch production by plants.

## **What motivates you as a researcher?**

Using the new opportunities that are always emerging. We have techniques today to explore things at a breadth and depth that was unimaginable when I was a PhD student. It is so exciting to be able to push our knowledge that much further. I also get enormous benefit and pleasure from being part of an international network of collaborating labs.



*A single granule of starch seen in cross section under the scanning electron microscope*

## **What is the best thing about your job?**

The potential for discovery. And the hope that one day our work will prove valuable for consumers, farmers, industry, and even the planet as a whole. I enjoy the time I spend working with "end-users", as it's important to think about how our science can and will be applied. I also get a real buzz from seeing people from my lab go on to enjoy successful, satisfying careers.

## **...and the worst?**

It is sometimes frustrating having to put interesting projects to one side because there are so many different strands I'd like to work on. But I have to prioritise so we stay focussed.

## **What is your "Holy Grail?"**

It changes all the time! As the field moves on, you have to move your targets accordingly. We are currently tackling questions that I would never have dreamed of 10 years ago. So I keep having to alter my research goals as we, and others, find out more.

## Cereals 2006

In June we met farmers and breeders at Cereals 2006, Europe's premier arable event. The JIC stand featured a Sustainable Arable Link Programme on maximising harvest index in oil seed rape, the Wheat



Genetics Improvement Network (WGIN) at JIC and examples of other research that provides a vital pipeline to plant breeders. Director Chris Lamb attended and highlighted the importance of the event, "Cereals 2006 was the perfect opportunity for us to talk to our key stakeholders". Our stand hosted the launch of MONOGRAM, the BBSRC cross-Institute programme for cereal genomics, coordinated by Dr Tina Barsby.

## Award at BBC Gardeners' World Live

In June Dr Ian Bedford's Entomology team won a Highly Commended Award in the Educational category for their insect display at the BBC Gardeners' World Live Show which incorporated a Plant Pest & Disease clinic. Visitors brought along samples and specimens for identification, and the team gave advice on controlling problems using environmentally safer options. Live common pests as well as some of the more topical 'invasive' species provided visitors with a 'hands-on' experience. The exhibit also featured exotic species that demonstrated camouflage, predation and how certain insects are being used to benefit agriculture. The show attracts over 125,000 visitors and is held in association with The Royal Horticultural Society.



Ian Bedford said "It is the garden show created for gardeners by gardeners and we were delighted to win an award for the second year running."

## Taking the phobia out of science learning

Head of Metabolic Biology, Professor Anne Osbourn has established a Science, Art and Writing (SAW) initiative that uses scientific images as inspiration for poetry and artwork, so encouraging children to explore and understand the science behind the images. A selection of the children's artwork and poetry from the first SAW pilot project was published last year in a book called "See Saw". Since then Anne has run more SAW projects in schools across Norfolk and in the US, and she has also founded the SAW Trust ([www.sawtrust.org](http://www.sawtrust.org)) as a means of rolling the initiative out in the UK and elsewhere.

She pioneered these projects during her sabbatical year at the School of Literature and Creative Writing at the UEA, funded by a NESTA (National Endowment for Science, Technology and the Arts) Dream Time Fellowship. Anne's more recent activities have been funded in part by Society in Science. A SAW handbook for teachers will be published in early 2007 and a second anthology of children's work is also planned. SAW featured at the BA Festival, and two of Anne's poems were commended by the leading UK poet Jacob Polley in Norwich Café Writers Poetry Competition this September. One of these poems was about cytogenetics. This was inspired by experiments carried out in Anne's laboratory by Dr Eva Wegel as part of a BBSRC-funded research collaboration with Professor Peter Shaw.

## MAKING Faces

As part of the hugely successful BA Festival of Science in Norwich in September, The Norfolk Contemporary Art Society, in partnership with the JIC, the Teacher Scientist Network and the Sainsbury Centre for the Visual Arts staged an exhibition in the Forum, called *Making Faces*.

We are all dominated by our need to look at and interact with the faces of others. We detect emotion, we know whose face it is we are talking to, we fall in love with them, and we make images of them. This obsession is

reflected in the close attention of both scientists and artists to faces in general and to particular faces.

The exhibition featured commissioned artwork from UK artists Simon Tegala, Keith Piper and Alexa Wright, who collaborated with leading UK scientists working on various aspects of face biology to explore how faces are made in the womb, how neural activity in our brains allows us to identify and understand faces and their associated expressions and how we construct gender, age, and ethnicity from a glance.



The project also used mathematical modelling by Enrico Coen (JIC) and Andrew Bangham (UEA) to create a 4D bronze head sculpture of Charles Clarke MP that featured at the exhibition. An illustrated book reflects some of the ethical and social issues thrown up by contemporary research in the area, as well as charting the artists' responses to these concerns. The exhibition was funded by a Society Award grant from the Wellcome Trust. Creator of the project and Deputy Director of Science at JIC, Prof. Keith Roberts recently became a JIC Emeritus Professor after a distinguished research career in cell biology of over 35 years.

[www.makingfaces.org.uk](http://www.makingfaces.org.uk)

### Contact details:

**Communications Team,  
Norwich BioScience  
Institutes, Colney,  
Norwich NR4 7UA, UK**

Tel: +44 (0) 1603 255217

E-mail:  
[jic.communications@bbsrc.ac.uk](mailto:jic.communications@bbsrc.ac.uk)

### Updating our contacts

We are updating the records on our mailing list. If you would like to continue receiving a copy of *Advances* and/or the Institute of Food Research newsletter *Science & Innovation*, please return the enclosed form to the Communications Team (address to left).

ISSN 1740-665X

### About JIC

JIC is an independent, international centre of excellence in plant science and microbiology. Our mission is to carry out fundamental and strategic research, to train scientists and to make our findings available to society.

### Data Protection

The mailing list is not sold or otherwise distributed outside the Norwich BioScience Institutes.

### Legal Statement

John Innes Centre is a company limited by guarantee.

Registered in England No. 511709 Registered Charity No. 223852.

John Innes Centre is grant aided by the Biotechnology and Biological Sciences Research Council.