Workers join the fight to save lives

From ants to antibiotics - a team of Norwich scientists could have found the key to life-saving drugs in a colony of insects. ROWAN MANTELL reports.

Tens of thousands of ants are on the move, scurrying across a rope bridge and swarming over hummocked, speckled soil. They are busy tending a fungus. Without it, they could not survive. And, it could turn out that without them, some of us might not survive.

The ants carry a bacteria which produces antibiotics to keep their fungus healthy – and a team of Norwich scientists has discovered that one of those antibiotics could become a key weapon in the fight against cancer.

Their work is now focused on constantly replicating cultures of the antibiotic-producing bacteria, but lead researcher Dr Matt Hutchings is still fascinated by the ants themselves – tens of thousands of which live just a few minutes walk from his University of East Anglia laboratory.

Two colonies of leaf-cutter ants are looked after by experts in the entomology department at the John Innes Centre and the excitement surrounding the news of their cancer-fighting bacteria has meant that they are fast becoming six-legged celebrities, with their own web-cam and guest appearances, or at least mentions, on national radio and television, as well as in international academic journals and conferences.

Dr Hutchings has worked with leaf cutter ants for five years and explains how they developed a system of farming (tending their fungus) around 50 million years before humans.

Native to central America, they live in colonies, often of millions of ants, and have evolved alongside a particular type of fungus. It survives by breaking down the leaves and petals the ants bring it; the ants survive by eating the resulting strands of a substance called gongylidia.

"They live in a place of abundant vegetation but they can't digest leaves, so they feed them to the fungus and then eat the gongylidia," explained Matt.

They look after their fungus in honeycomb-like "gardens," using their own antibiotics, produced by bacteria which lives on them, to keep it healthy. "They use it like weedkiller!" explained Matt.

These antibiotics are exciting not only Matt and his team of researchers, but scientists around the world.

This summer Matt and his team reported details of how the ants fight threats to their fungus, and the way in which the antibiotics might be engineered to work in human medicine.

They want to manipulate antibiotics called antimycins to target cancer cells without harming normal cells and to stop cancer cells developing resistance to chemotherapy.

Matt's team is also hunting through the genome of the bacteria on the ants, looking for new antibiotics and anti-fungal drugs.

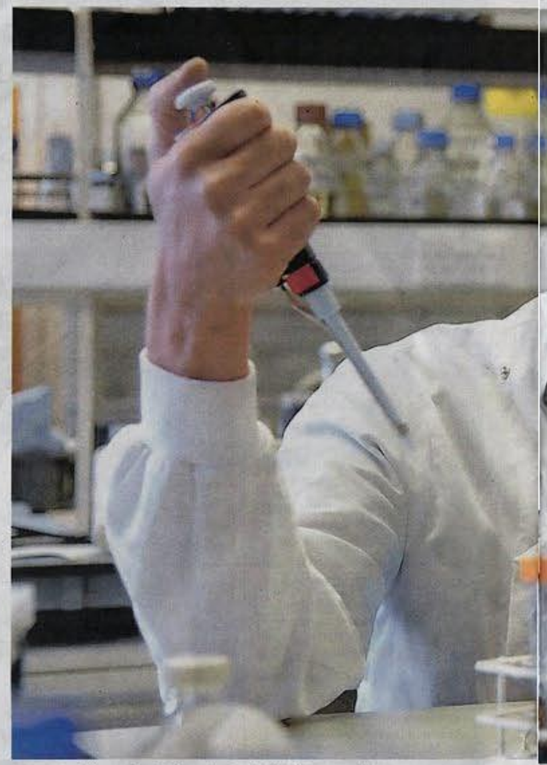
Matt explained that just about every antibiotic in use today was developed back in the heyday of the new wonder-drugs in the 1950s and 60s. Since then bacteria have fought back, developing resistance which has led to people dying of infections such as MRSA.

Until recently just the easiest-to-find antibiotics could be isolated from each suitable strain of bacteria, but as the genomes of bacteria are sequenced, scientists can search for new 'silent' antibiotics, with genes tightly wrapped within the DNA.

The exhilaration of being at the forefront of medical science is expressed by UEA undergraduate Beth Williams, who is one of six students spending her summer holiday working alongside Matt, as part of an international science competition – the 2013 International Genetically Engineered Machine (or iGem.)

"I love the fact that it literally is stuff that no-one has done before. Up until now I have been learning things that other people already knew but now we are discovering things that no-one knew," she said.

She is part of the iGem team rooting through the DNA of soil bacteria to try and find new antibiotics. They are developing a bio-sensor to identify as many antimycin-producing, strains of bacteria as possible. Some of these could eventually be genetically engineered to produce less toxic anti-cancer drugs.



■ Matt Hutchings, principal investigator leading the research team.
Picture: DENISE BRADLEY

Matt's full-time team is made up of three post doctoral researchers, three PhD students and a technician.

In their laboratory Petri dishes of fungi and bacteria are growing. There are more cultures of bacteria, either forcing different fungi to the edge of the dish, or being overrun by nasty-looking fur.

Much of the work is not visible to the naked eye, but Matt is a fan of the leaf-cutter ants' bacteria under the microscope too.

"They look very beautiful. They can produce coloured antibiotics that are blue or silver, yellow, red, orange or green," he said.

Another of his interests is the 'good' bacteria, essential to health, which lives in the human gut. Linked to this area of expertise are more dishes, the healthy tang of soil replaced by sinister-sounding labels such as E-coli and Salmonella.

Equipment ranges from the mundane – a microwave, shelves of glass jars – to special sterile units, and sealed areas where staff have to work in protective gloves.

This is where what Matt calls "genome mining" takes place and where excitement is building over the information being unearthed, originally literally from the colonies of leaf cutter ants, and now from the unravelling of the building blocks of life itself.

However, even if the science stacks up, Matt said it will be at least 10 to 15 years before the UEA research might move from Petri-dish analysis, through laboratory and clinical trials, to become a standard cancer treatment.

Norwich's leaf cutter ants and their fungus farming exploits hit the headlines this summer as Matt's team reported their most recent findings. The complexities of microscopic mutually dependent organisms, unravelling dna and cures for cancer might be at the cutting edge of human knowledge but Matt also enjoys communicating his work on Facebook and Twitter.

Matt has another claim to local fame, as a musician. He and his wife Cerian, were both members of the Norwich band Bearsuit – a John Peel favourite.

Matt grew up in Surrey and studied biology at university, becoming fascinated by the interaction between people and bacteria – some of which are essential to health while others are deadly.

He arrived at UEA in 2006 to run his own laboratory. He and Cerian have two young sons and he regularly talks to schoolchildren about his team's research and has taken part in science outreach sessions at Norwich Cathedral, Castle and Forum.

On Wednesday August 28 the UEA team of six undergraduate iGem students will be at the Forum in Norwich to talk about their work on antimycin-producing Streptomyces bacteria for the 2013 International Genetically Engineered Machine competition.

Leaf cutter ants

In their native south and central America, Acromyrmex octospinosus leaf cutter ants can create underground nests the depth of a three-storey house. Each nest has a queen and a hierarchy of other ants including foragers, farmers and child-minders.

A queen can live for up to 20 years in the wild, laying all the eggs for the colony. When she dies, the entire colony dies with her.

Two colonies of tens of thousands of the ants live in the entomology department at the John Innes Centre in Norwich, in tanks kept specially warm and humid.

There, the forager ants carry leaves and petals to their fungus, characteristically holding them above their heads.

Smaller gardener ants fend off fungus diseases using the white bacteria which grows on their bodies.

See them on the ant web-cam at www.hutchingslab.net/antcam

■ The research team at the UEA looking into a possible breakthrough in the fight against cancer by studying leaf-cutter ants.

■ The fungus that the leaf-cutter ants build.

Fighting cancer

■ Under graduates Becky Spanner, left, and Beth Williams, who are working on the research for the International Genetically Engineered Machine competition.

■ Lab technician Elaine Patrick.

The Norwich scientists focusing on the potential cancer-fighting antibiotics produced by particular bacteria on a specific species of an insect found half a world away are funded by the University of East Anglia, the Medical Research Council and the Natural Environment Research Council.

Other members of the team include: Dr Doug Yu, who is a reader in evolutionary biology, with a focus on ant symbiosis and the man who first got Matt Hutchings interested in leafcutter ants.

Professor Mervyn Bibb of the John Innes Centre who is an expert on the regulation of antibiotic production in Streptomyces bacteria.

Dr Ryan Seipke, who is a postdoctoral scientist at UEA who specialises in antimycins and the genome mining of ant-associated bacteria, assisted by technician Elaine Patrick.

John Munnoch who is a PhD student supervising the iGem undergraduate project on antimycins with Dr Richard Bowater ,who co-ordinates the team.

Dr Ian Bedford, head of the entomology department at John Innes Centre and a collaborator in the research.

Anna Jordan, who looks after the leafcutter ant colonies at the John Innes Centre.

Dr Matt Hutchings also supervises graduate students and technicians working on projects to increase antibiotic production in Streptomyces bacteria, develop synthetic biology tools for manipulating antibiotic production and investigate the gut biome of fruitflies.

■ Anna Jordan, assistant entomologist, with one of the colonies.

■ Principal investigator of the research, Matt Hutchings, left, with Ian Bedford, insectary manager at the John Innes Centre.

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In the countryside
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Anniversary break had plenty of wildlife 'extras'

To celebrate our 30th wedding anniversary, George and I spent a few days 'off-duty' in Suffolk. We both needed a break and after many days working at the computer, I was certainly ready for some exercise. While away we completed several walks, better described as a series of countryside strolls. We don't travel very fast and we don't get very far, because occasional bursts of energy are punctuated with numerous pauses to observe the wildlife we encounter.

One such excursion took us to North Warren, an RSPB reserve close to Aldeburgh. We chose to park in a small, well-hidden car park between Aldringham and Aldeburgh, before walking along a track towards Thorpeness Meare. At first our path was sheltering by waist-high vegetation on either side and several butterfly species were making good use of the extra warmth. There were lots of ringlets, meadow browns and gatekeepers, together with the first of what were to become numerous peacock butterflies. These were joined by ruddy darters perched on the bracken and an occasional common blue damselfly.

As we continued our route we reached a point close to the western end of Thorpeness Meare and here both the damselflies and the darters became more plentiful. As we looped back around the top of the site, they were joined by one or two four-spotted chasers. A rustling in the undergrowth as we crossed a small dyke alerted us to a grass snake partially hidden under the small bridge. We watched about half of the snake for several minutes, but it must have sensed our presence because it eventually moved deeper into the shade.

North Warren was one of the first RSPB reserves with the original purchase as early as 1939. Since then the reserve has grown and it now includes the heathland of Aldringham Walks to the north, plus an area of woodland and heathland running south to Aldeburgh. The route of an old railway runs through it and in the days of steam sparks are said to have caused frequent fires. In 1954 about 200 acres of heather were destroyed. Thankfully today, the route of the railway is merely an accessible track.