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Marie Curie Actions: Inspiring Researchers

Marie Curie Actions have been inspiring researchers for many, many years. We have built a legacy which has been nurtured through successive Framework Programmes, and which has made Marie Curie a global success. This legacy is now being passed to a new 'owner', Madame Odile Quintin, in a new Directorate-General, where I am sure it will thrive just as it has done in the past. I would like to wish Madame Quintin and Marie Curie all the best for the future.

Working as a researcher is probably one of the most exciting jobs one can have. It is intellectually challenging, requires passion, dedication and patience, but it is also extremely gratifying. There is nothing more exhilarating than having as a profession the task of discovering something previously unknown to humanity. Particularly when these discoveries can improve our health, protect the environment, allow us to communicate better, or look beyond the limit of the universe. Then again, such activity comes with added responsibilities, since researchers always have to ponder the consequences

of their findings and be socially dependable. They need to disseminate their research results extensively to enthuse the wider public with the extent of their discoveries.

During their careers, researchers will be exposed to different environments, interact with numerous colleagues from different disciplines and countries and act as vehicles to transfer their knowledge to other researchers. This is why researchers are often on the move, chasing new ideas in new surroundings and pushing the limits of conventional knowledge. However, this often comes at a cost, and researchers regularly endure lack of career stability as well as unfavourable employment conditions without basic rights, in stark contrast to other professionals of an equivalent experience and level of responsibility.

Researchers' careers are thus very particular and demanding, requiring a lot of dedication. This is why the European Commission has created and developed the Marie Curie Actions – for the benefit of the researchers themselves, helping them to follow a

fruitful and stable career path while ensuring that they receive competitive salaries with full social security rights. Top quality research needs highly skilled professionals who feel fulfilled and are able to have a work-life balance.

The European Commission supports the development of an open European labour market for researchers, free from all forms of discrimination, as well as the diversification of skills and career paths, both of which are essential to advance science and to underpin innovation in Europe. The Marie Curie Actions are particularly crucial to reaching this objective, and for over a decade they have played a key role in structuring the European Research Area by stimulating researchers' career development.

All the successful Marie Curie projects featured in this book show that scientific excellence depends on nurturing the human factor. Discover the inspiring stories behind the researchers funded over the years by the EU Marie Curie programme.



José Manuel Silva Rodriguez
Director-General for Research

A handwritten signature in dark ink, appearing to read 'Xen u!', with a horizontal line underneath the signature.

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Introduction

Research thrives in dynamic environments. New concepts and products arise from the exchange of ideas and the pooling of great minds. To foster this, mobility of researchers and freedom of research are essential, a fact recognised since the birth of European science.

Researchers have been on the move since Antiquity, when many science and philosophy scholars moved to Athens to learn from the most prestigious professors of the Academy, one of the focal points of intellectual life in Europe and the Mediterranean region. When Justinian closed the Academy of Athens in 529, philosophers fled to a more welcoming environment under the Persian king. This relocation of Greek philosophers in the Sassanide Empire greatly contributed to the advancement of Persian culture and science. Later, during the Middle Ages, when scientific progress in Europe was hindered, sciences such as astronomy, mathematics and medicine were being developed in the Arab world. This new knowledge circulated to Europe through the

thinkers of Al Andalus and from there reached the tolerant Toledo of the Three Cultures which became, through the development of the Translation School, a centre of intense cultural and scientific life.

Since these first steps, mobility of researchers, thinkers and philosophers has allowed the circulation of ideas, the exchange of concepts and the dissemination of techniques. Mobility, leading to greater collaboration, transfer of knowledge and learning of new skills, has become a central element of science and humanities and of economic development helping to improve people's everyday lives. Because of mobile researchers, local discoveries have had a major impact on human history. The mobility of researchers has not only allowed the transfer of new techniques but also lies at the root of the common cultural and scientific heritage of Europe and its Mediterranean neighbours, shaping its long tradition in developing science and humanities. During the Renaissance, the scientific collaboration and the circulation of ideas

opened the door to an increasingly better understanding of our world, insights which otherwise would have been confined to the movement's native Florence. It was thanks to this mobility that Enlightenment ideas and techniques spread to the New World, thereby inspiring the founding fathers of the United States. Without mobility, scientists like Marie Curie herself would not have contributed to the 20th century physics revolution.

Mobility is even more crucial in this early 21st century where humans understand that they are not the centre of the universe but strive to live in harmony with it, paying attention to climate change, sustainable development and societal impact. To face the 'Grand Challenges', new ideas, knowledge and techniques need more than ever highly trained researchers ready to propagate them, enrich them and make them effective. Such mobility needs to be encouraged, structured and sustained. At the same time freedom of research must be ensured. This is why the Marie Curie Actions were created.

Over the years the Marie Curie Actions have developed new ways of meeting these challenges. The Actions have fully embraced the strategic vision of the European Research Area, carefully identifying and addressing each need linked to its human resources aspects, positioning themselves ahead of time and establishing synergies with other EU-funded research programmes. Thanks to their bottom-up approach, giving researchers the possibility to freely choose their topic, it has been possible to offer them the best training in priority areas such as climate change, biodiversity or energy. The Actions help to improve the employability of these professionals by targeting areas such as the upgrading of researcher competences at all career stages. The Marie Curie Actions have promoted geographical and sectorial mobility and granted researchers financial independence. They have ensured that funding is awarded according to fair, transparent and high-quality criteria. As a result of this success, tens of thousands of excellent researchers have had the possibility to gain new knowledge and expertise

within the best European research groups and beyond through prestigious mobility fellowships.

Originally, the Marie Curie Actions were dedicated and best renowned for motivating postdoctoral Fellows to move around Europe and acquire new skills through individual fellowships. Their success led to an extension of funding for doctoral candidates, namely through the creation of more than a thousand research networks. These networks are ideal incubators for new interdisciplinary collaborations; they are recognised as the best place for a good career start and offer all the necessary aptitudes for a promising research career, including transferable skills. The diversity of the Actions has since increased.

The Marie Curie Actions have also embraced the importance of establishing closer links and collaborations between the private and academic sectors for the purpose of knowledge transfer. To support entrepreneurial culture, researchers are thus encouraged to join research groups in the commercial sector within networks or

as individual Fellows opening their minds to different research activity sectors. Additionally, specific actions have also been dedicated to the transfer of knowledge between academia and industry within stable networks.

In order to encourage the return of European scientists, a series of reintegration mechanisms have provided the means for outstanding researchers to start their own research teams in Europe. They have also opened the best training activities to a wide range of researchers through the organisation of training conferences. The Marie Curie Actions are, moreover, open to the world, welcoming individual top-class researchers into European research groups and encouraging European researchers to acquire new skills outside Europe. Further international collaborations have been fostered by opening the Actions to the entire world's research groups. As a whole, the Actions have led to major discoveries in science, publications in prestigious scientific reviews and patenting. Overall, they are widely recognised as a flagship of what European funding does for researchers.

But the Marie Curie Actions are not only about making researchers mobile or helping them acquire new skills. They are also about ensuring that the researchers enjoy a rewarding career. The human aspect of research should not be disregarded, as it often has been. Results cannot be excellent if researchers are not motivated, inspired and fulfilled. The Actions have adopted this vision and are promoting better, more stable careers through employment contracts with full social security rights instead of traditional stipends. Given that a better work-life balance is known to motivate staff, they insist that their researchers take full advantage of their rights, including parental and maternity leave. Gender balance is also a major issue, and all efforts are being made to avoid Europe losing top-class researchers because of gender discrimination. Finally, **the Marie Curie Actions believe research should be based on a shared responsibility between science, policy and society, where public policy is based on evidence and where researchers engage with the rest of society to emphasise responsibilities and ensure freedom of thought.** In this respect they strongly encourage

researchers to disseminate their achievements to a wider public audience and raise awareness of the benefit of their results for citizens' everyday life.

The Actions have shaped the careers of many thousands of researchers and helped to change the R&D human resources landscape in Europe. Their name could not be more suitable: Marie Curie herself has inspired the generations of researchers that have followed her and strive to emulate her success. Like their namesake Marie Curie, who won the Nobel Prize twice, researchers are bright, professional, dynamic and independent.

Each scientific achievement hides the passionate human stories of researchers. You will read in this book about the people that shape your world. You will not only find out about their scientific achievements, but also how the human aspect was central to attaining these achievements and how an effective policy was crucial to reaching excellence in research. You will see how the Marie Curie Actions have been helping to make these stories a success.



FOSTERING COLLABORATION

Cross-border cooperation is the cornerstone of EU-funded research because it enables Member States to create new synergies and helps Europe maintain and improve its status as a global knowledge leader. By promoting mobility and networking between European researchers, Marie Curie Actions make a valuable contribution to fostering just this type of collaboration.



research borders

Research without borders

If anyone doubted the need for European scientific cooperation, they need look no further than CERN – the world's largest particle physics laboratory – for confirmation of its value and power. Over more than half a century, the European Organization for Nuclear Research has redefined our understanding of nuclear physics, generating five Nobel Prize winners along the way, and creating the World Wide Web in its spare time!

CERN epitomises what makes cross-border scientific collaboration so potent and effective. On the practical plane, transnational cooperation enables countries to pool their expertise, share often costly resources and facilities, tap into rare techniques and exploit niche skills.

Then, there is the more intangible human dimension. Bringing together scientists and researchers from different backgrounds and cultures helps bolster their

creativity, promotes lateral thinking and often results in new perspectives and insights. In addition, by drawing in top brains, international cooperation acts as a kind of guarantee of scientific excellence, while the involvement of numerous countries ensures that goals are realistic and achievable.

As the complexity and competitiveness of science and technology continue to increase exponentially, along with their demand on resources, collaboration has become not just a virtue but a must. In addition, collaboration between different countries creates powerful synergies among various scientific approaches and viewpoints.

Harnessing people power

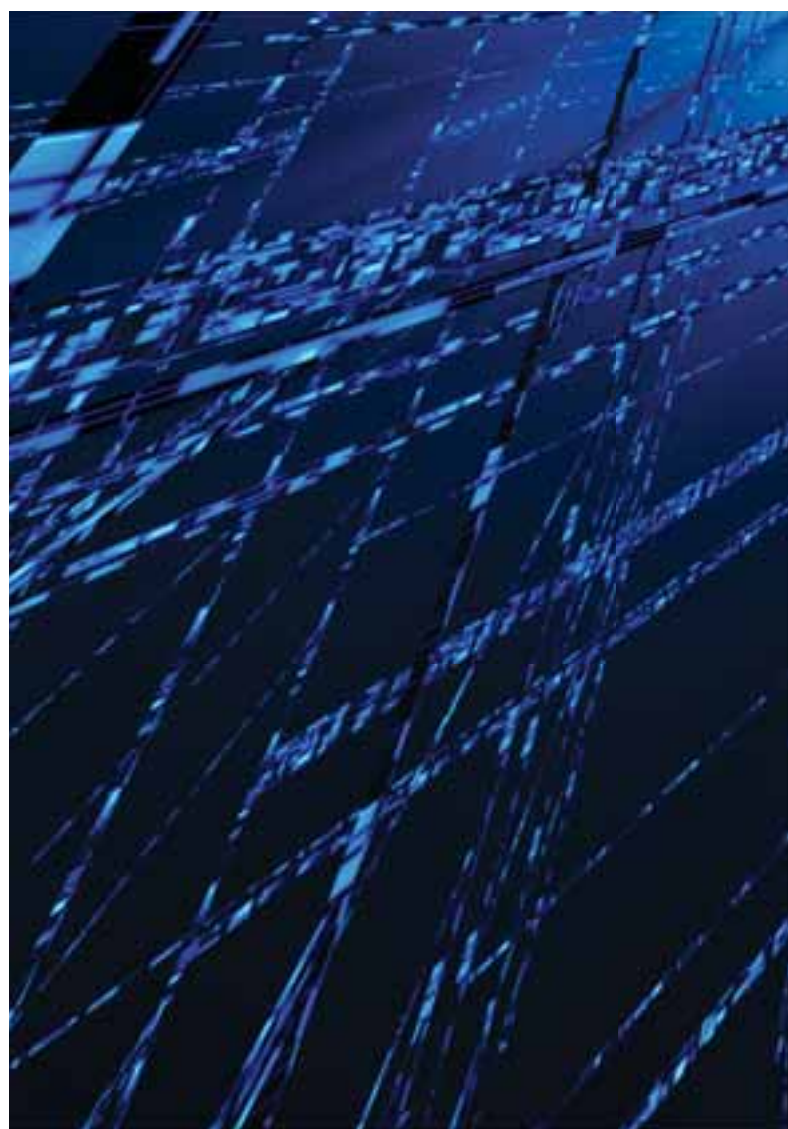
Effective collaboration is all about pooling scientific resources – and the resource that holds all the others together is the human one. Marie Curie Actions invest in the people who power scientific cooperation by enabling researchers to get mobile and connect with Fellows in other countries.


The Marie Curie programme seeks to instil in researchers an appreciation of the value and potential of collaboration from the earliest stages of their careers, and enables them to build or join transnational teams as they gain in experience. This kind of direct face-to-face interaction is crucial as it enables researchers to build up a full understanding of the team and its mission, and to work closely together to achieve their scientific goals.

The Marie Curie Actions help provide the human backbone to the integrated European Research Area (ERA), which the EU has been striving to construct in recent years. The ERA enables researchers not only to move and interact seamlessly, but also to benefit from world-class research infrastructures that can only be built and maintained through cooperation, and collaborate with world-class networks of European research institutions. It optimises and opens up European, national and regional research programmes to participation from across the EU in order to support the best research and coordinate efforts to address major challenges.

Broadening horizons

Marie Curie Fellows can tap into the infrastructure, capacities, knowledge and people in the network,



An abstract image on the left side of the page, featuring a complex, fractal-like pattern in shades of blue and white. The pattern consists of many thin, branching lines that create a sense of depth and movement, resembling a microscopic view of a material or a complex network structure.

thereby multiplying the potential of their work and widening their horizons. Most Marie Curie Fellowships cover not only a mobility element, with Fellows taking up positions in other European and non-European countries, but also often involve the Fellow cooperating with a different research team, thus gaining new experience.

Fellows who are part of a Marie Curie Network enjoy a welcoming environment where they can share information freely and seek complementarity rather than competition in their research endeavours. As an example, Marie Curie Networks offer researchers the opportunity to improve their skills and career prospects by joining established research teams, where they bond with other Fellows and create fruitful scientific relationships that can last for the rest of their careers, as well as expanding formal experience and knowledge.

Networks are a valuable bridge between academia and business, particularly small and medium-sized enterprises (SMEs) and start-ups. Marie Curie Actions specifically promote collaboration on joint research projects between academic and private-sector

researchers in which both sides are free to explore creative and innovative ways of working together in a way that translates world-leading European research into concrete applications.

The strongest link

Marie Curie Fellowships and Networks are not just a passing experience; their influence lasts much longer, as they help researchers shape their subsequent careers. Enduring links between research groups and individuals benefit all – the groups get to harness the enthusiasm, energy and talent of the Fellows, while the Fellows themselves grow and develop thanks to the experience and expertise of the institution.

In the longer term, and as the case studies in this and other chapters show, many former Marie Curie Fellows have found subsequent positions thanks to the contacts they made during their fellowship.

This chapter will highlight how Marie Curie Actions help researchers to cross physical borders in their efforts to traverse new scientific frontiers.



AQUACHEM

Water is life. It is key to many biological and chemical processes. And it is cheap and non-toxic, making it an important raw material for the chemical industry too, especially against a backdrop of increasing chemical production. Standing together against the flood of chemical waste, partners in the Marie Curie Network Aquachem set out to develop catalytic processes using water as a solvent.

A 'fluent' catalytic process

The term 'catalysis' generally refers to a process that can speed up or slow down chemical reactions with the help of a catalyst. During the process, the catalyst can be deactivated, but is never consumed. The addition of pairs of hydrogen atoms to a molecule – a process called hydrogenation – is one such catalytic process, used in the food industry to turn liquid vegetable oils into semi-solid fats, such as margarine. Hydrogenation usually requires a metal catalyst that will facilitate the binding of the hydrogen and, in this case, the unsaturated fatty acids in the vegetable oil. The degree of saturation in our margarine, attained through this process, will determine a number of properties, such as its melting point.

'Catalysed processes can bring about chemical transformations with high selectivities and yields in the desired products,' explains Dr Maurizio Peruzzini, research director at the Istituto di Chimica dei Composti OrganoMetallici (ICCOM) in Florence, Italy, the lead partner in the Aquachem network. On

the downside, catalysed processes often require a solvent to dissolve the catalyst. The solvent can then end up as a waste product and, in some cases, may even be toxic.

Solvents of the future

'Green solvents' could provide an alternative to potentially environmentally harmful solvents and have been the topic of many a conversation between researchers. Desired features: maximum efficiency, as little waste as possible, sustainable, recyclable, renewable, non-toxic, non-carcinogenic. The possible solution: water. 'Water is a cheap and non-toxic solvent, making it attractive in terms of economy and safety,' Dr Peruzzini points out. Yet, water as a solvent has some disadvantages, including the fact that a large amount of energy and time is usually needed to separate the product from the water.

This is where the Aquachem network comes in: 11 top laboratories from inside and outside Europe pooled their skills and know-how in order to advance sustainable chemistry and 'develop and implement the use of catalytic processes compatible with aqueous media, providing a unique training

ground for early-stage and experienced researchers,' Dr Peruzzini summarises.

Four years and an impressive 27 trained Marie Curie Fellows later, the partners consider their mission has been accomplished – and is a great success: 99 peer-reviewed articles in scientific journals, 6 PhDs and a joint patent are just some of the results emerging directly from the Aquachem network.

Research in a virtuous circle

As an indirect outcome, even greater things are expected from the former network partners. *'The success of the Aquachem project has been to create an established network of collaboration among various partners in Europe and to strengthen relationships among colleagues* in the same field of research,' emphasises the network's manager, Dr Luca Gonsalvi, also of ICCOM. 'This has led to ongoing collaborative projects which have lasted beyond the duration of Marie Curie funding. The initial core members of Aquachem had participated in the Hydrochem network, which had been funded under the European Commission's Fifth Framework

Programme (FP5). Expanding the research topic from hydride chemistry to aqueous-phase organometallics and catalysis required a larger network and more experts.

'At this initial stage, only one-on-one based collaborations were active,' Dr Peruzzini goes on to say. 'Now, after the end of the Aquachem project, almost all partners have built strong collaborations with most of the other partners met during the four years of activity.' This collaboration is ongoing and even thriving, with many network members having built up new, larger networks and joined research projects under the Seventh Framework Programme (FP7) or other transnational mobility schemes as part of smaller consortia.

A deeper understanding of chemistry

On a more individual level, too, the seeds sown during the Aquachem projects are still bearing ample fruit. Dr Vanessa Landeata – originally from Venezuela – spent one year at the lead institute in Italy. She has since returned to her native country, where she works as a researcher at the Universidad Simón Bolívar in Caracas. Despite the geographical distance,

she and her former Aquachem colleagues from Italy continue to work together via international collaborations. As a Fellow who joined the network from outside Europe, Dr Landeata found Aquachem 'was a great opportunity for those of us who wanted to get acquainted with the quality of science and excellent programmes that are being supported by the European Commission'.

Dr Chiara Dinoi, an early-stage researcher from Italy who spent the majority of her fellowship at the Laboratoire de Chimie de Coordination at the French National Centre for Scientific Research (CNRS), agrees. Not only did she develop a deeper, more interdisciplinary understanding of chemistry and the challenges of modern research, she says, but her additional research training periods in four different laboratories within the network also '*led to a very fruitful exchange of ideas, results and experiences that significantly contributed to the growth of my scientific thought*' and made me more aware of the importance of sharing my knowledge with others and society'.

The Marie Curie programme is 'one of the best schemes for transnational mobility and scientific training for young European and third-country scientists,' concludes Dr Peruzzini. 'They should

be encouraged by their local governments and institutions to apply for such schemes in order to broaden their views and experience living and working in a truly international context to become the next generation of world scientists.'

Project acronym ■ **Aquachem**
Full project title ■ **Transition metal chemistry and catalysis in aqueous media**

Type of grant ■ **Training Network**
Budget ■ **EUR 1.9 million**
Duration of project ■ **23-12-2003 - 22-12-2007**
Scientific discipline ■ **Chemistry**

Lead partner ■ **Istituto di Chimica dei Composti OrganoMetallici (ICCOM) - Consiglio Nazionale delle Ricerche (CNR)**
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CARBIO

Carbon nanotubes are the epitome of versatility: their strength and unique properties make the tiny tubes of rolled-up carbon sheets a matter of intense interest to engineers, physicists and chemists alike. Only their potential toxicity has caused some in the biomedical field to shy away. The Marie Curie-funded Carbio project has however turned a corner, making the nanotubes biocompatible and opening up a world of biomedical possibilities.

Delivering the goods: carbon nanotubes

The potential of carbon nanotubes (CNTs) as drug-carrier systems and sensors for diagnosis and therapy at a cellular level is what the Carbio team set out to explore. The idea: the hollow tubes, which can be constructed with one, two or more walls, could be filled with drugs, sensors or even heating elements and then transport their load directly to where they are needed in the human body.

A dangerous but precious cargo

Project coordinator Dr Rüdiger Klingeler of the Leibniz Institute for Solid State and Materials Research (IFW) in Dresden, Germany, is enthusiastic about the project and its results. 'Studies of CNT interaction with biological environments provide the basis for applying the tubes for imaging, sensing and cancer treatment,' he says. 'Our work packages focus on the synthesis of CNTs, biocompatibility and bioactivity, imaging and sensing, as well as hyperthermia and medical studies.'

Carbio focuses on targeted anti-tumour therapy. Current cancer therapies are not targeted, which means that they often affect healthy tissues and cause side effects for patients. Employing biocompatible CNTs could effectively change that: scientists would wrap the tubes around their miniature cargo and the wrapping would stay in place until the whole package reaches its destination. The contents of the package would then be released and allowed to get to work where they are needed, there and only there.

But how can doctors stop the nanotubes from poisoning the patient? The Carbio researchers solved that particular problem by adding another layer to the wrap – a layer of DNA and ribonucleic acid (RNA) around the CNTs to make them biocompatible.

It's a wrap!

The use of carbon-wrapped nanocontainers has numerous advantages for medical applications. First, there are a number of materials that might be toxic but which will help bring a tumour under control or destroy it. The protective carbon shell would mean that this kind of material could be used more effectively in therapy. Second, the outer shell of CNTs can

be chemically modified to further enhance effectiveness. For instance, it can be made more – or less – soluble, so that a drug contained could be released rapidly or slowly, at the same time maintaining the initial physical and chemical properties of the encapsulated material.

Advances in production methods are making carbon nanotubes more viable every day. Some of these advances have been made in the framework of the Carbio project, improving the production process as well as reaching an unprecedented degree of purity in the tubes. The team has also already tested the containers with various ‘fillings’. Results so far are encouraging: no significant toxic effects have been identified.

The Carbio researchers specifically studied the all-important transfer of CNTs into cells and the release of drugs in cell culture experiments. They attained one particularly significant milestone when they developed a method to use CNTs for the transport and release of the anti-cancer drugs carboplatin and doxorubicin. Both are used in chemotherapy for a wide range of cancers and commonly cause nausea, vomiting and heart arrhythmias.

But Carbio's ambitions go further: the Fellows are also looking into the potential of Magnetic Resonance Imaging (MRI) and CNTs in cancer treatment. And they have developed a nanothermometer. This ingenious device can help monitor the temperature in tumour cells during hyperthermia therapy, a therapeutic method that aims to weaken or destroy the malignant cells with intense heat. The team is already working on enhancing it further, and additional investigations will improve the accuracy of the temperature sensors.

Laying the foundations

As work on the project itself continues, the fruitful Carbio collaboration has already led to over 10 related project proposals, both on a national and European level. And the original partners are hoping to receive further funding under the EU's Seventh Framework Programme in order to keep up the momentum of this ground-breaking research. Several patents are also pending, on *Particles for determining the local temperature*, for example.

Perhaps even more important, though, is the impact that the Marie Curie project has had on the relatively young field of CNT research. The Fellows' mobility has enabled them to spread their knowledge elsewhere and to fortify collaborations within the field. All Fellows have visited partner institutions several times and have conducted research together with their co-Fellow hosts. In addition, periodic Carbio meetings provide a fruitful platform for scientific discussions within the network, while workshops and summer schools bring the researchers together. An impressive 74 publications are already in print, bearing testament to Carbio's scientific success.

Dr Klingeler is convinced that part of this success is due to the consortium's truly interdisciplinary nature. Biologists, engineers and physicists from Germany, France, the Netherlands, Austria, Poland and the UK have joined forces on the Carbio project, which 'provides an excellent example of a multidisciplinary training network', Dr Klingeler says. *'No one lab in this consortium can work without the input of several of the partners and, as a result, the early-stage researchers have an extremely good overview of the work of the Carbio network as a whole.'*

'The laboratory leaders come from chemistry, clinical, biochemical and physics backgrounds, and the fact that they can communicate from such a diverse base is a triumph,' he concludes.

Project acronym ■ Carbio

Full project title ■ Multi-functional carbon nanotubes for biomedical applications

Type of grant ■ Training Network

Budget ■ EUR 3 050 500

Duration of project ■ 01-10-2006 - 30-09-2010

Scientific discipline ■ Life sciences

Lead partner ■ Leibniz Institute for Solid State and Materials Research (IFW) Dresden

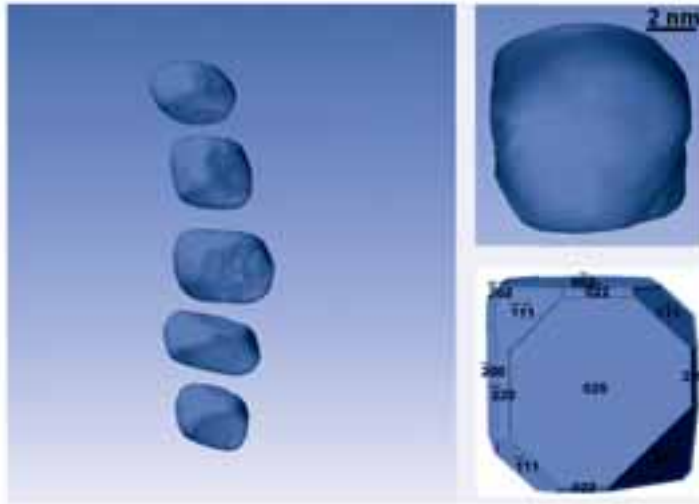
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CATALYSTS TOMOGRAPHY

'Everything between our hands is chemistry,' says Dr Ana Hungría. However, to examine the efficacy of the catalysts that she studies, hands and eyes are not enough. Not even conventional electron microscopy shows the particles with sufficient detail. The Spanish chemist went to the University of Cambridge in the UK to get a better picture of her materials.

Catalysts in close-up

Knowing her materials in every minute detail is a necessity for Dr Hungria in her quest to understand the full potential of catalysts. It is not only the chemical make-up, but also the topography of a catalyst – the catalytic particles' size, shape and structure – which determine its efficiency.

Precious, precious particles

'Catalysts are usually composed of very precious metals, for instance, gold or platinum,' she explains. 'You have to synthesise your catalysts in such a way that you have the maximum number of atoms on the surface of your particles. If the gold particles are very large, for instance, the catalyst will be very inactive, but if you have very small gold particles, a lot of atoms of gold on the surface, they can react easily.'

During her Marie Curie Fellowship, Dr Hungria was able to get a very close look at the structure of a variety of catalysts based on cerium zirconium oxide with palladium and nickel as their active component. 'This cerium zirconium mix is used

in three-way catalysts, the kind of catalysts that you have in your car,' she clarifies. 'These catalysts convert the carbon monoxide in the exhaust emissions into carbon dioxide (CO₂). Hydrocarbons also get converted into CO₂ and nitrogen oxides into nitrogen, turning all of them into less toxic gases than we had to begin with.' The findings of Dr Hungria's Marie Curie 'Catalysts Tomography' project might therefore ultimately help to improve the performance of catalytic converters in modern cars, further cleaning the most noxious gases from car exhaust fumes.

Twists and turns for a better picture

The technique Dr Hungria used to take this close look at her catalysts is called electron tomography and, according to Dr Hungria, 'the best lab in the world for doing electron tomography of materials' can be found right there on the historic campus of Cambridge University in the UK. In 2001, the Electron Microscopy Group at Cambridge showed that it was possible to create three-dimensional (3D) images of crystalline, high-atomic-number materials using a special set-up in a scanning transmission electron microscope (STEM) which

3D reconstruction of 'cubic' CeO₂ nanoparticles, showing mainly (002) planes. The tilt series of images was acquired every 2 degrees from -70° to +74° on a 200 kV FEI Tecnai F20-G2 TEM/STEM microscope.

included a specimen holder inserted into the microscope. This holder tilts the specimen little by little until enough images have been captured to reconstruct the material in 3D.

‘During my PhD, I used transmission electron microscopy as a tool,’ Dr Hungria says. ‘This method will give you a picture of your material similar to an X-ray image of your bones, but with electrons. What I did in Cambridge was more like a CT (computed tomography) scan: instead of taking one X-ray, you tilt the specimen over and over again. That way, you can reconstruct the three-dimensional shape of the object you are studying. This is very useful for many fields in science: in biology to see the structure of viruses, for instance. And in my field, the field of catalysis, you can see the 3D image and shape of your particles – if they are rounded or flat or whether they are on the surface or at the side of the carrier board.’

Cadiz – Cambridge – Cadiz

Now, Dr Hungria wants to install the highly useful technology at her home university, the University of Cadiz in Spain, so that she can continue her study of the tomography of

catalysts and other materials. Having learned all the necessary skills during her Marie Curie Fellowship in Cambridge, a Marie Curie Reintegration Grant is helping her to do just that. *‘The initial Marie Curie grant provided me with training in a very useful technique available in only a few laboratories in the world,’* she continues. ‘I can put the experience gained at the University of Cambridge to use in my new position at the University of Cadiz where we have acquired the software and the holder to perform electron tomography experiments.’

Moreover, both universities are continuing their fruitful collaboration as part of the Distributed European Infrastructure of Advanced Electron Microscopy for Nanoscience (Esteem), a network funded under the Sixth Framework Programme. ‘This project includes 11 labs in Europe. We collaborate freely and I sometimes still go to Cambridge for some measurements. What’s more, two other doctors from my new group in Spain have spent some time in Cambridge to complete their training in electron microscopy and learn about electron tomography.’ Several scientific papers have already come out of this new collaboration, making it just as productive as the previous one under Catalysts Tomography.

A rich scientific and cultural life

All in all, the fellowship was a great success: not only did it forge a close bond between two universities that still endures way beyond the final stages of Catalysts Tomography several years ago, but it also helped Dr Hungria's lab in Cadiz take the first steps towards this innovative imaging method. And what about Dr Hungria herself? Has she benefited to the same extent? Absolutely, she says: *'The results from an academic point of view have really had a great influence in my professional life, allowing me to find a position at the university of my choice.* And the experience of living in another country and in a city like Cambridge, with such an incredible cultural life, has surely enriched me as a person.

'I got to know British culture and also saw how scientific work is done there,' Dr Hungria adds. 'Without the help of this kind of fellowship you would stay in your own country throughout your career. And it's very important for your life as an adult to know that there are different places where people live and work in a different way.'

Project acronym ■ Catalysts Tomography
Full project title ■ 3-dimensional reconstruction of catalysts by scanning transmission electron tomography

Type of grant ■ Intra-European Fellowship
Budget ■ EUR 159 613
Duration of project ■ 01-01-2006 - 31-12-2007
Scientific discipline ■ Chemistry

Host institution ■ University of Cambridge
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CRONUS-EU

The Earth is under attack: cosmic rays hit our atmosphere every day. And it is a good thing they do, because the 'atomic debris' they leave behind can help scientists get a better grasp of rates of environmental change or the recurrence of natural disasters. Making young researchers literate in interpreting this atomic debris was the aim of the Cronus-EU network.

A trip back in time geology-style

As cosmic rays approach the Earth and hit the upper atmosphere, they cause a nuclear reaction cascade. The cascade rolls towards the Earth, but decreases rapidly when it hits the ground until it finally peters out at a depth of about three metres underground. In its wake, it produces terrestrial cosmogenic nuclides (TCNs) in rock and soil, rare isotopes of a variety of elements. Since those isotopes do not occur in rock or soil naturally and have long half-lives, scientists are able to glean information about when a landslide happened, for instance, or how the climate changed over the millennia, by analysing the isotopes' production and the decay.

'For TCNs to be useful to the Earth Sciences, their background concentration in geological material not exposed to cosmic rays must be extremely low,' network coordinator Dr Tibor Dunai of the University of Edinburgh in the UK explains. This is the reason why only particular isotopes of rare noble gases

such as helium-3 – a helium atom with two protons and one neutron instead of the usual two protons and two neutrons – or short-lived radionuclides, including beryllium-10, can be employed in this dating method. Beryllium-10, the most commonly used TCN, is a radioactive isotope of beryllium with six neutrons and four protons and has a half-life of 1.5 million years. 'So far, geological surfaces between 50 years and more than 10 million years have been dated successfully with this technique,' Dr Dunai adds. 'Few other geological dating tools cover a similar – six orders of magnitude – range where they can be applied.'

Revolutionising Earth sciences

Hence, TCNs are a great tool for environmental and Earth sciences, albeit with one considerable flaw: their lack of accuracy. 'A key requirement is the ability to establish accurate absolute chronologies and rates of landscape evolution,' Dr Dunai points out. 'The development of techniques to measure exceedingly low concentrations of cosmogenic isotopes that accumulate in surface rocks and soils during exposure to cosmic rays has

Inspection of the accelerator mass spectrometry (AMS) tank after delivery at Cerege in Aix-en-Provence; it is the core of the new accelerator for Earth sciences (ASTER) facility there.

© S. Merchel

led to an unprecedented ability to establish chronologies of environmental change over the past few thousand to several millions of years.

‘The use of cosmogenic nuclides has revolutionised Earth surface sciences over the last decade and they form the cornerstone for the new quantitative Earth surface sciences, which are progressively replacing the traditionally qualitative techniques used in such disciplines,’ he adds. ‘Advanced current applications demand accuracy of age determinations better than about 5%. Analytical uncertainties are usually low (2 to 3%). However, until recently the theoretical and empirical foundation to consistently calculate production rates of *in situ* produced terrestrial cosmogenic nuclides (TCNs) was only 10 to 20 %.’

Bound together in strength

In collaboration with its American sister programme Cronus-Earth, the Cronus-EU network set out to change that, and completed its mission very successfully. ‘Together, Cronus-Earth and Cronus-EU developed TCNs into an accurate absolute chronometer for use in solving a wide range of challenges,’

Dr Dunai reports, adding that the remaining uncertainties have effectively been reduced to less than 5%. ‘The ultimate goal was the development of an internationally accepted protocol that allows accurate age determinations which are consistent with the mature geochronometers that are currently available.’

But this was not the network’s only significant achievement. Whereas expertise in cosmogenic nuclides had been rather limited and spread very thinly, the Europe-wide training activities, summer school and networking initiated by Cronus-EU introduced a wider scientific audience to the technique and considerably strengthened its standing in Europe. What is more, ‘Cronus-EU overcame the fragmentation of the corresponding research community via the exchange of Fellows, training and visits by staff,’ Dr Dunai says. ‘Previously, most groups worked in relative isolation, whereas now bilateral and multilateral collaborations are common between former network partners.’

Time travellers

On a more individual level, the 13 postdoctoral researchers and 4 PhDs whom Cronus-EU took back in time via geological dating continue to benefit from their fellowships. Nuclear chemist

Dr Silke Merchel from Germany, for instance, spent her fellowship at the Centre Européen de Recherche et d'Enseignement des Géosciences de l'Environnement (Cerege) in France. 'For me, the geological focus in the training was key in order to understand the power of cosmogenic nuclides for geological applications,' she says. 'Fortunately, this kind of education was not only performed at the beginning of the project. Later, I learned how to take samples the best way possible. I also saw my first glacier ever and witnessed the results of the forces of ice on the underlying bedrock, which allow the dating of glacier movements and reconstruction of climatic changes in the past. In return, I could play a part in Cronus-EU by improving the chemical separation procedures, which are needed to successfully perform cosmogenic nuclide dating.'

Dr Merchel believes that her current position, as the head of the ion beam analysis division at the Forschungszentrum Dresden-Rossendorf in Germany, came her way precisely because of these experiences.

Fellow countryman Björn Schneider, PhD at the time of his fellowship at the Vrije Universiteit Amsterdam in the Netherlands, feels that Cronus-EU has contributed to his professional prospects to no small extent by providing a wealth of networking

opportunities very early in his scientific career. In addition, the international character of the network proved to have huge value. 'Having graduated in Germany, my international experience was rather limited,' he admits. *'The Cronus-EU network was like a guided tour through the international world of science for me.* Besides showing me the principles of an international scientific network, it stimulated the acquisition and transfer of knowledge to the benefit of the work of others and myself. The support from multiple institutes was of great help for deciding on a research strategy early on.'

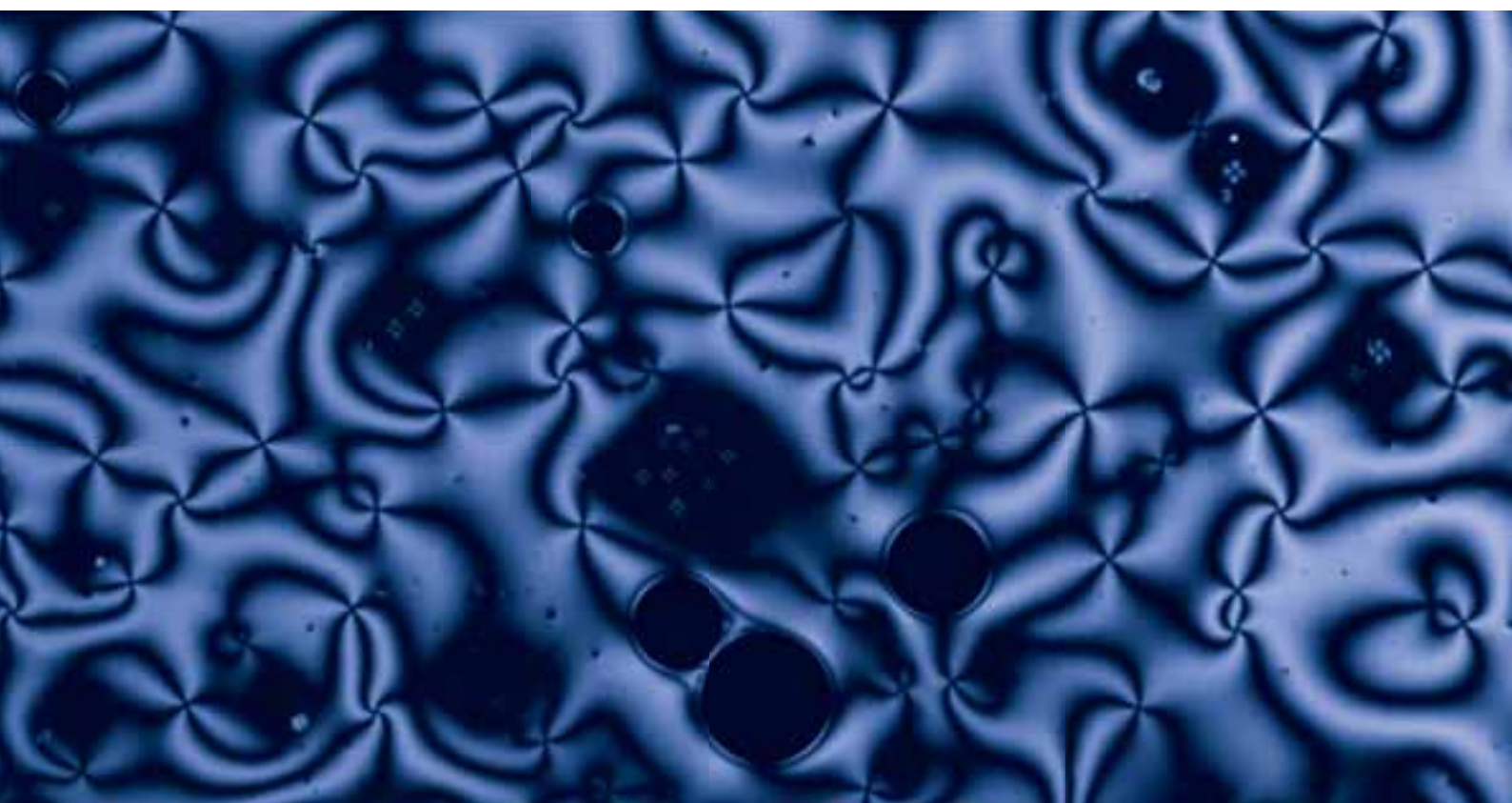
Project acronym ■ Cronus-EU
Full project title ■ Cosmic ray produced nuclide systematics on Earth – the European contribution

Type of grant ■ Training Network
Budget ■ EUR 3.42 million
Duration of project ■ 01-12-2004 - 31-11-2009
Scientific discipline ■ Environment

Lead partner ■ University of Edinburgh
School of Geosciences
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Coordinator: Dr Tibor J. Dunai // e-mail: tabor.dunai@ed.ac.uk

Host institutions ■ University of Edinburgh, United Kingdom - Glasgow University, United Kingdom - ETH Zürich, Switzerland - GFZ-Potsdam, Germany - Universität Hannover, Germany - Cerege, Aix-en-Provence (CNRS), France - CRPG, Nancy (CNRS), France - University Bratislava, Slovenia - Vrije Universiteit Amsterdam, Netherlands - Utrecht University, Netherlands

Other partners ■ TU-München (Germany, subcontractor to UHann)



HETEROLICS

The days of grainy graphics are long gone. High resolution and crystal clarity are what consumers are looking for in modern liquid crystal displays (LCDs) and LCD TVs. The vision of a young scientist from Russia and his mentor in the United Kingdom is now opening our eyes to even higher visual quality standards.

A clear vision

When Valery Kozhevnikov from Ural State Technical University in Yekaterinburg joined forces with Professor Duncan Bruce's team at the University of York for the Heterolitics project, the young chemist admits he 'knew nothing about liquid crystal'. Similarly, Professor Bruce's Liquid Crystal Group had not worked with light-emitting materials before the project, although they were intrigued by their potential. Together, they set out to create a new generation of liquid crystalline materials which might help to advance the current state of the art in organic light-emitting diodes (OLEDs), one of the latest trends in modern display technology.

OLED technology translates into outstanding display quality with low power consumption. Like many of his colleagues, Dr Kozhevnikov believes that OLEDs may even replace liquid crystal displays one day. So, what if the combination of the Russian researcher's expertise in organic chemistry and luminescent metal complexes, together with the British team's know-how in the field of liquid crystals could take these benefits even further?

A bright future ahead

This unique blend of knowledge and skills has opened up exciting possibilities. The Heterolitics research was published in *Angewandte Chemie*, 'one of the best journals in chemistry', Dr Kozhevnikov says proudly. Perhaps even more importantly, though, is the fact that the group has applied for a patent for one of the materials developed as part of the Marie Curie Fellowship. Many questions remain unanswered and the material still requires more study, Dr Kozhevnikov concedes, 'but it was enough to convince our patenting people'.

And naturally, the extensive links between Russia's Ural State Technical University and the UK's York University have not been severed just because the fellowship has come to an end. 'You might think that unless I return to my home university, there won't be any collaboration, but you would be mistaken,' emphasises Dr Kozhevnikov, who has been offered a position as a lecturer at the Northumbria University in the UK as a result of the Marie Curie Fellowship. 'My contacts facilitate the collaboration between our universities.' Dr Kozhevnikov is confident that Marie Curie marked the beginning of a collaboration that will continue to bear fruit in the future.

Typical texture of liquid crystalline phases observed under a polarised microscope – many more beautiful patterns have been observed during the fellowship.

Other researchers from Ural State Technical University will be visiting Duncan Bruce's group in the framework of a new joint research project. Of course, the Fellow and Professor Bruce have built a lasting relationship. *'I think in terms of collaboration, we have 100% success here,'* Dr Kozhevnikov goes on to say. 'And even as a lecturer somewhere else, I will still be working with Duncan on many projects.'

Like matches in a box

So, what is so special about this new liquid crystalline material? Dr Kozhevnikov explains: 'Normally, the material for OLEDs is amorphous. It doesn't have any structure or order. Our liquid crystal molecules are quite unique because they self-organise into well-defined architectures. Some are very similar to matches in a box. If you shake the box, they align themselves in a particular way. The molecules in liquid crystals do roughly the same.' Others have the shape of a disc and these discs self-organise into columns, like a stack of coins.

If it can be transferred to OLEDs, this special self-organising quality could be a huge step forward for the technology: 'For

OLEDs, the light is produced by applying electricity, so you need very good charge-carrier mobility throughout the device,' Dr Kozhevnikov remarks. 'If the molecules are not organised randomly but in a specific order, this mobility might be improved really significantly. So, if you have liquid crystal materials, you might achieve better devices.'

'In addition, if the molecules are specifically organised, they can emit light in a specific way,' Dr Kozhevnikov goes on to say. 'They might emit light in one direction more efficiently than in the other. This is so-called polarised emission, which is very important, even for present technology in liquid crystal displays.' Hence, the researchers believe that merging LCD and OLED technology in this way would lead to both higher energy efficiency and higher quality at the same time.

Light at the end of the tunnel

The patent application has been filed. A Japanese company showed interest in the material when Professor Bruce presented the concept to them on a visit to Japan. This discovery might be tapping into a multi-billion market, revolutionising the world of

displays, thanks, in part, to his and Valery Kozhevnikov's work. It is also an achievement that would not have been possible without the 'driving force' of the Marie Curie grant behind it. This allowed Dr Kozhevnikov to set up his research in a stimulating new environment in a very good lab with the best equipment, resources and networking opportunities, providing him with lots of ideas that 'actually then evolved into very good science'.

All in all, this proved to be a scientifically rewarding and, as Dr Kozhevnikov adds, 'enjoyable' experience, perhaps not least because the fellowship enabled him to take his family along to the UK with him. *'No other grant would have made it possible to move with my family. But Marie Curie does have this instrument to support family,'* he says, offering Fellows a chance to have a normal family life outside of the lab.

Project acronym ■ Heterolics
Full project title ■ New heterocyclic liquid crystals

Type of grant ■ Incoming International Fellowship
Budget ■ EUR 150 350
Duration of project ■ 01-10-2005 - 30-09-2007
Scientific discipline ■ Chemistry

Host institution ■ Department of Chemistry
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HYDROGEN 1S-2S

Accurate clocks are crucial to many of the systems on which we have come to rely – such as telecommunication networks and global positioning. And yet, even the most reliable clocks will lose some of their accuracy in the long term. Research into ultra-precise optical atomic clocks may take us one step closer to keeping perfect time.

Tick, tock – every light oscillation counts

Given the outstanding quality of the top-of-the-range clocks available today, the need for greater precision may not be immediately obvious. But in telecommunications, better clocks would be very welcome indeed – the smaller the units into which they can split individual seconds, the greater the amount of information that can be transmitted. And for systems which depend on synchronicity, the fact that all clocks run fast or slow to some extent remains a problem. Positioning systems, for example, triangulate the exact location of objects based on the time taken to receive their signal. Unless the systems are perfectly synchronised, they could miss the mark by several metres.

The key to clockwork precision

Microwave atomic clocks, the most accurate timekeeping devices in existence, are setting the standard, but even they

can be improved. The quest for greater precision took a young researcher from Latvia to the Max Planck Institute of Quantum Optics (MPQ) in Garching, Germany. During the Hydrogen 1S-2S project, Dr Janis Alnis studied a tiny energy shift in hydrogen atoms that results in a change of the hydrogen spectra, and investigated how this shift can be measured more accurately with the help of laser spectroscopy.

‘Now we measure hydrogen with 14 digits of precision,’ he explains. However, the aim is to be even more accurate: ‘At present, microwave clocks enable us to measure with 15 digits of precision, but optical standards would allow us to measure frequency with 17 digits of precision, and so to measure time more precisely. Optical clocks tick much faster than microwave clocks, and the same number of ticks can be counted in a shorter time interval.’

At the moment, the caesium atomic clock – in which a microwave counter records the oscillations of the outer electron in caesium atoms vibrating more than 9 billion times per second – is considered to be the most accurate. An optical atomic clock would potentially be up to a thousand times

more accurate. Such a clock could be based on counting the frequency of laser light that is exciting some well-defined optical transition in atoms flying in a vacuum – for example, in atomic hydrogen.

Going the extra mile for accuracy

Dr Alnis developed a taste for physics and electronics while he was still at school, so his decision to study physics came as no great surprise. He started out with a Bachelor's degree, majoring in electronics at the University of Latvia in Riga. However, 'in electronics, there was not much research at the time' in Latvia, he explains. So, as Riga was home to a very successful research group in laser spectroscopy and optics, Dr Alnis decided to change his specialisation.

After his doctoral research and several research stays abroad, Dr Alnis asked Professor Theodor Hänsch at the MPQ, whom he remembered from a conference, if he could join the professor's group as a postdoc. Happy to be accepted, he applied for Marie Curie support for the Hydrogen 1S-2S project at the end of his first year.

Under the mentorship of Professor Hänsch, who was awarded the Nobel Prize in physics in 2005, Dr Alnis and his colleagues developed extremely stable Fabry-Pérot resonators. They 'consist of two parallel mirrors which are separated by a spacer. They are necessary to pre-stabilise lasers for precision experiments,' Dr Alnis explains. An improved resonator design, which is now being implemented by several other groups, helped to create 'some of the world's most stable diode lasers with sub-Hz spectral line width,' he notes. 'We have two such lasers. For fine-tuning, we listen to the amazingly stable difference between these two huge optical frequencies on the loudspeaker – and it's like music.'

Shaping the future of time

Due to its outstanding stability, the diode laser system is of great interest to the antimatter spectroscopy group at the European Organization for Nuclear Research, CERN, which is pursuing a long-term project to compare optical transition frequencies in hydrogen and anti-hydrogen. And CERN is not alone in its interest in Dr Alnis' research. Leading metrology institutions worldwide have sought his cooperation in connection with

their work on the next generation of atomic clocks. During his time as a Marie Curie Fellow, Dr Alnis established links with national standardisation and measuring authorities in Germany, France, the UK and the USA.

For the time being, he is planning to stay in Garching. 'Since Professor Hänsch received the Nobel Prize, the group has doubled to 30 people,' Dr Alnis remarks. To him, this makes the MPQ with its current staff of 150 a very special place, because 'it is very easy to obtain advice and exchange knowledge'. And he has already submitted a proposal for a new grant, hoping that he will be able to continue his work there for another three years.

Excellence inspires excellence

Dr Alnis points out that his mentor worked with Arthur Schawlow, another Nobel Prize laureate, earlier in his career. 'Historically, it seems that *many famous scientists previously worked in the groups of other famous scientists. It's like a family tree.*' This is something that research in Latvia could not have offered him, he believes. 'The borders between the countries are not so strict any more and you can really feel that you are

in the European Union,' he says, adding that this provides opportunities to relocate as necessary.

Dr Alnis believes that being committed to excellence is the key to success when applying for a Marie Curie grant: finding a renowned research group or mentor and developing a good project idea might even be more important than all the small technical details of the proposal. With this emphasis on excellence, he concludes, 'you *know that those years of your life* are not lost, but *have helped you to gain valuable experience*'.

Project acronym ■ Hydrogen 1S-2S
Full project title ■ Precision laser spectroscopy of the 1S-2S optical clock transition in atomic hydrogen

Type of grant ■ Intra-European Fellowship
Budget ■ c. EUR 96 000
Duration of project ■ 01-11-2006 - 31-10-2008
Scientific discipline ■ Physics

Host institution ■ Prof. Theodor Hänsch
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RAPTOR ECOTOX

Fears over species loss and its impact on well-being and prosperity have led to global commitments aimed at halting the loss of biodiversity. Heads of state have met, legislation is being passed and reports issued. Everyone now recognises that knowing what is in store for the environment is vital. But who would have thought that birds such as falcons would be taking on this crucial monitoring role?

Birds of prey flying high

Dr Paola Movalli Duke realised early on that as biodiversity loss intensifies, so does the need to forecast ecosystem change. She knew too that raptors – also known as birds of prey – provide a window on the overall functioning of the environment. And she wanted to show how rare sedentary raptors, such as the lanner falcon in Sicily, Italy, can serve as sentinels of environmental health, contamination and ecosystem change. The lanner, too, might benefit from Dr Movalli Duke's idea that improved knowledge of threats could hatch recovery plans for the species.

'Species that function as sentinels of change can be critical monitors and predictors of successful climate-change mitigation and adaptation. Raptors are particularly suitable as sentinels. They are widespread, particularly sensitive to environmental change at various scales, and are among the first organisms to exhibit readily observable responses,' she says.

Dr Movalli Duke's Marie Curie Fellowship aimed at understanding chemical and other pressures on lanners and was based at the Natural Environment Research Council's (NERC) Centre for Ecology and Hydrology (CEH) at Monks Wood in the United Kingdom. The two-year fellowship saw her carry out field sampling in Sicily in collaboration with the University of Palermo (UNIPA) and laboratory analyses at Monks Wood. She also created an interdisciplinary network of raptor ecologists and ecotoxicologists across Europe.

Sampling on cliff tops

Dr Movalli Duke's field research focused on collecting samples of blood and feathers from lanner chicks and two of its prey species – magpies and doves. This was not as easy as it may sound. 'Sampling lanner chicks is particularly difficult,' she says. 'The nest sites are very sparsely distributed over thousands of square kilometres in Sicily's remote uplands, and built on high cliffs. Also, special care must be taken with such a rare species to avoid any risk of causing reproduction to fail.' Her solution was to ask the Department of Animal Biology at UNIPA to help provide a team of ornithologists familiar with lanner territories

in Sicily, as well as rock climbers willing to scale cliffs in the name of science. Dr Movalli Duke also benefited from a wide range of expertise at CEH in areas such as sampling design, laboratory analysis and biological statistics.

Her field research is already paying dividends. For example, she has published the first-ever paper on contaminants among lanners and their prey – a real breakthrough in this area. Additional papers are in preparation, providing important knowledge that could help the species' recovery, for example by identifying pollutant hazards.

Networker

Beyond her fieldwork, Dr Movalli Duke put special emphasis on network building. She organised an innovative interdisciplinary workshop in Sicily that brought together ecotoxicologists and ecologists working on raptor monitoring in Europe. Thanks not least to support from the Zingaro Nature Reserve, the regional government and UNIPA, the workshop was a resounding success with participants from top research and conservation groups across Europe attending.

The event resulted in the establishment of a European Network for Monitoring With and For Raptors and an outline proposal to develop this network. Building on this, Dr Movalli Duke coordinated (for NERC/CEH) the submission to the European Science Foundation (ESF) of a proposal for a five-year programme to strengthen the network. The relevant ESF Standing Committee has recently recommended the proposal for funding.

Guest editor

Inspired by the Sicily workshop presentations, Dr Movalli Duke conceived of and guest edited a special edition of the prestigious environment journal *Ambio*, entitled *Monitoring With and For Raptors in Europe*. She secured financial support for this from the institutes of contributing authors and from the Secretariat of the UN Convention on Migratory Species (CMS), which distributed copies to government parties to the Convention as a first European contribution to implementation of the recent CMS agreement on migratory raptors.

The future looks busy for Dr Movalli Duke. Her raptor research is expanding beyond Europe and, with her ongoing Marie Curie European Reintegration Fellowship at UNIPA's Department of Ecology and expected networking funding from the ESF, she intends to provide further insights into raptor ecotoxicology. She also wishes to strengthen collaboration between raptor ecologists and ecotoxicologists. The results will enhance understanding of the changing health of our environment. She is well aware of the power of networking, not only to foster collaboration and strengthen the awareness and application of scientific knowledge, but to also leverage funding and support in kind.

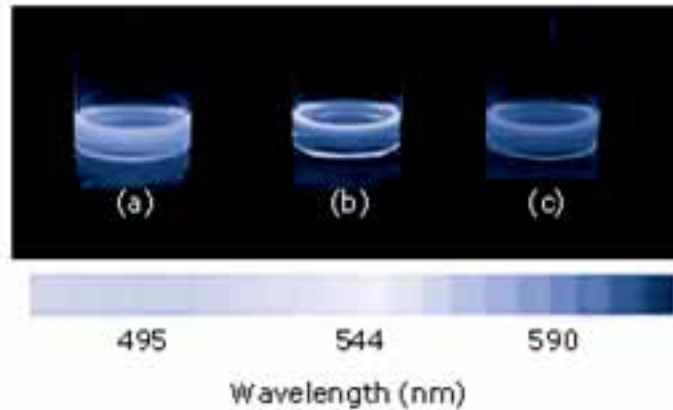
While much of Dr Movalli Duke's success must be attributed to hard work and determination, she is well aware that Marie Curie financial support and guidance are crucial. *'You should be able to call – as I happily was – on the generous support of a supervisor who is pre-eminent in his or her field, committed to supporting your development and located at a true centre of excellence,'* she says.

Her obvious research and networking skills, as well as the timely relevance of her field of work, mean that we are sure to hear more from Dr Movalli Duke in years to come.

Project acronym ■ Raptor Ecotox
Full project title ■ Understanding chemical and other pressures on lanners

Type of grant ■ Intra-European Fellowship
Budget ■ EUR 227 626 (EC contribution), plus additional funds (ca. EUR 30 000) raised for workshop, *Ambio*, attendance of CMS meeting.
Duration of project ■ 01-02-2005 - 31-01-2007
Scientific discipline ■ Environment

Host institution ■ Natural Environment Research Council (attn: Dr D Osborn)
Policy and Public Sector Liaison
Polaris House
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SMART

Everything about this material is exceptional: it is exceptionally thin, exceptionally conductive and exceptionally versatile. Molecular graphenes are honeycombed layers of carbon atoms. They are breaking new ground in the world of material science. Chemist Professor Sylvia Draper has been a graphene disciple for a long time. Her Smart project aimed to spread the word.

Molecular graphenes make their mark

Basically, graphenes have the same structure as graphite, the mineral that is used in pencils. 'Graphite contains hexagons of carbon atoms all touching each other, like a continental quilt,' describes Professor Draper of Trinity College Dublin in Ireland who initiated the Smart project. *'A graphene ideally comprises just one layer of hexagons which, because they're flat, can stack on top of one another – just like blankets thrown on a bed.'*

The graphenes that Professor Draper and her team of seven Marie Curie Fellows and eight indigenous researchers are investigating, however, are not merely made up of carbon. Instead, some of the carbon atoms have been replaced by others – nitrogen, for instance. What makes molecular graphenes so special is the atomic control the chemist can exert when making them, and their ability to interact with light. 'They fluoresce,' says Professor Draper. 'In addition, because they

are a flat one-dimensional sheet, they conduct electricity across the plane and along the stacks. So they are also very good for transporting electrons. This is why they could be used in optoelectronic devices – something like solar cells, for instance, where what you want is to capture photons of light, convert them into electrons and create a current. I believe that these materials can form an enhancement to what's currently used.'

Super-versatile and super-fast

Current solar cell technology has two problems: efficiency and production. Graphenes might be part of the solution, possibly replacing more expensive silicon in solar cells and computer chips. Their ability to conduct electricity efficiently also makes them interesting for other technologies: organic light-emitting diodes (OLEDs), touch screens, energy-storage devices, cell phones and, eventually, high-speed computer chips.

Professor Draper has been convinced of the potential of N-doped graphenes since she started working in the field about 10 years ago. She saw the Marie Curie Transfer of Knowledge

N-doped graphenes such as nitrogen heterosuperbenzenes show promise for use in sensor and photolytic applications; depending on pH and solvent type used, their fluorescence will vary in colour just like a traffic light.

© Dr Daniel Gregg

Development scheme as a chance to make a concerted, long-term effort to promote these special materials. 'I felt that I was ahead of the chemical competition, but wouldn't stay ahead if I couldn't put a sizeable team on this task,' she remembers. 'Also, when I have graduates, they rely on my expertise. These compounds have applications in so many areas that they need characterising and evaluating by many techniques. I am not an expert in all these techniques and areas. So, I needed to bring in people with new expertise which they could apply to our expanding range of systems.'

The human factor

And that is exactly what Professor Draper did: she recruited a total of seven experienced, postdoctoral research Fellows from various European countries and with various academic specialities to share their knowledge with her and her team. The collaboration worked out well, resulting in numerous publications, presentations and awards, although the human factor must always be taken into account. 'Some Fellows, by their personality, are more willing to share their knowledge than others,' Professor Draper acknowledges.

'It's quite hard on a human resource level to make it work properly, but when it does, it's fantastic. Several of my EU postdocs have integrated extremely well with the team and their expertise has become really embedded in it. It's tremendously rewarding. And I have learned a lot.'

Knowledge means confidence

The Fellows agree. For example, Dr Ania Selmi from France says: 'The fellowship has helped me to develop new knowledge and broaden my experience of chemistry, particularly in syntheses, coordination and organometallic chemistry and photophysics. It has also enhanced my ability to communicate technical information with experts in various scientific fields. I now have a better idea of which scientific specialities and skills industry requires and, ultimately, the fellowship has improved my career prospects.'

But the benefits go beyond what the individual researchers involved have taken home with them, Professor Draper adds: *'The profile of the group is now so much more enhanced and so much more immediate to the outside world.'* It's the

publicity and the recognition that the work that we're doing is really worthy and moving the area forward. That's been the greatest achievement.'

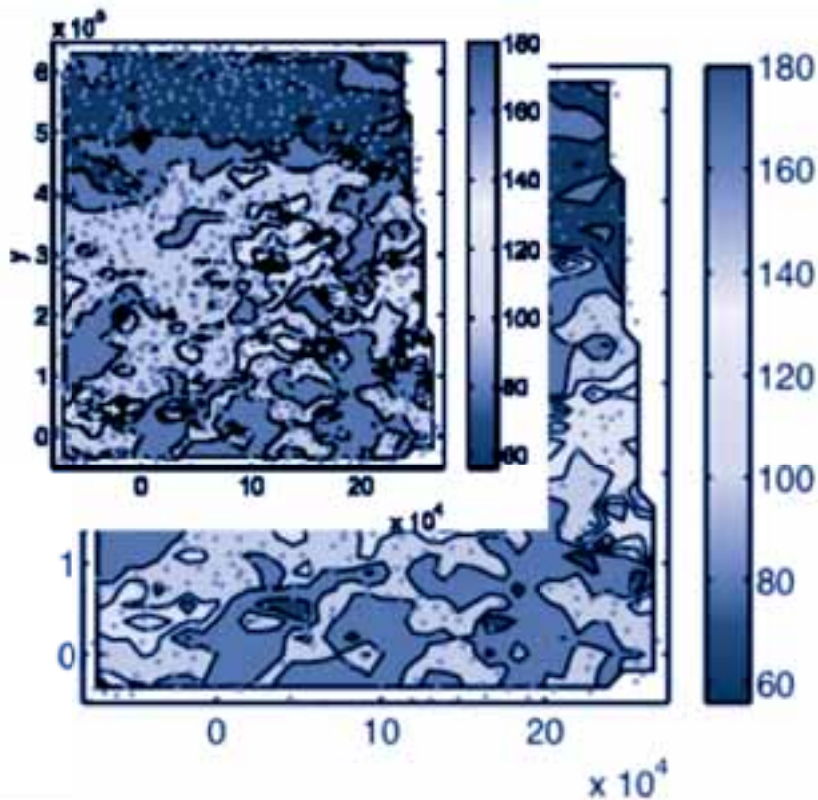
It is noticeable that Professor Draper feels confident about her research: 'I feel that we have a platform of research that I can present. I feel I've covered all the angles and I can go up and talk to an expert. There's nothing that he or she is going to suggest that I haven't already thought of. Or I can make a suggestion: you have this expertise, would you be interested in applying it to these systems?'

This confidence is, in part, the result of the Marie Curie project. And it has already borne fruit: new collaborations with scientists all over the world will surely be keeping Professor Draper's team busy beyond the completion of the Smart project. Electrocristallisation experiments on Professor Draper's graphenes in the USA, a study into the organometallic properties of her materials in the UK, and much more lies ahead. 'There are almost too many opportunities,' she says. 'Now, the thing is to try and target the best one.'

Project acronym ■ Smart
Full project title ■ Smart molecules for super materials

Type of grant ■ Transfer of Knowledge
Budget ■ EUR 961 704
Duration of project ■ 11-01-2006 - 10-01-2010
Scientific discipline ■ Chemistry

Lead partner ■ Trinity College Dublin
School of Chemistry
College Green
IE-Dublin 2
<http://www.tcd.ie>



SPATSTAT

How can statistical analysis help avoid major environmental disasters? This is the question that took four leading researchers from France, Greece, the Slovak Republic and the USA to the Technical University of Crete. There, the interdisciplinary team created a new tool that beats traditional methods hands down when it comes to analysing statistical variability quickly and reliably.

Danger ahead, statistics to the rescue

Earthquakes, tsunamis, landslides, floods, droughts – all of these natural disasters are likely to occur in some regions more than others, depending on environmental variables and risk factors. Statistical descriptions give us a picture of patterns displayed by environmental variables; they help us process and interpret information from satellites, for example. Ultimately, they can facilitate the prediction and prevention of major disasters, and hence save lives.

Engineers have various tools at their disposal to make a comprehensive analysis of the geophysical and environmental properties of a landscape. Understanding spatial variability is an essential part of their job when monitoring the environment. Computational tools have proven to be particularly useful in this type of analysis. However, because of the complexity involved, an expert usually needs to be on-site to operate the systems – something which may not always be possible for a variety of reasons.

New tools for non-experts

The Spatstat team took the study of variable statistics to a new level. Working together, and each using their own area of expertise, the Fellows created a flexible statistical model for spatial analysis. Their new approach could make a lot of headway in the field of computational models able to chart spatial variability. Stakeholders in associated industries may no longer need to employ on-site specialists. The computerised mapping tool itself could simply take over.

What makes the Spatstat system different from traditional methodologies? It relies on only a small set of physical parameters rather than many, making it easier to use. The model is based on Spartan Spatial Random Fields (SSRFs), a method inspired from the field of statistical physics. This method, applied in geostatistics, has overcome some of the shortcomings of classical analyses, principally because of progress in two areas: computational speed and model efficiency.

‘Usually, the information about environmental variables is scattered, and the measurements need to be interpolated to obtain smooth maps,’ explains Spatstat coordinator Professor Dionissios

Contour map of gamma dose rates (GDR) based on interpolated measurements from the German GDR network. The interpolated field is obtained using a Spartan spatial random field model developed during the Spatstat project. The colourbar scale refers to the values of the measured GDR in nanosievert per hour. The data are those used in the spatial interpolation comparison exercise in 2004 (SIC2004).

Hristopulos. There are two categories of spatial interpolation methods: the first is deterministic, assuming that every event, including natural disasters, is causally determined by an unbroken chain of prior occurrences. The second method is stochastic, an approach that takes into account predictable as well as random elements. 'The first [method] is simple and easy to implement but does not provide information about uncertainty,' Professor Hristopulos points out. 'The second is powerful, but human intervention is needed, making it necessary to employ a person who understands geostatistics.'

The SSRF method, however, provides an entirely new approach to spatial analysis. 'This analysis can be applied to a variety of scientific problems that involve filling data gaps, or constrained simulations. The power of the SSRF method stems from a sophisticated blending of spatial statistical methods with statistical physics,' Professor Hristopulos says.

At the crossroads between disciplines

At the Technical University of Crete in Chania, Professor Hristopulos established an ideal setting for the amalgamation of expertise on the subject. Assembled were: Professor Sujit K. Ghosh, Professor

in Statistics from North Carolina State University in the USA; Dr Milan Žukovič, an engineer who is now Assistant Professor at the Pavol Jozef Šafárik University in the Slovak Republic; and Dr Samuel Elogne, a mathematician from the University of Toulouse, currently at the University of Alberta, Canada.

'My focus is trying to get other researchers involved, to identify potential problems and percolate these ideas into the public sector and to convince the scientific community,' explains Professor Hristopulos. And the Spatstat project also gave him the means to attract significant talent to Crete, an island geographically positioned at the edge of the EU.

Attracting talented Fellows

'It is more difficult to do this with scientific projects than with others, especially because most postdocs want to focus on research, rather than teaching,' he explained. *'With Marie Curie funding, we were able to provide an attractive package. It was appealing and so drew the type of interest we wanted. In the seven years that I have been based in Crete, this was the best project both in terms of collaborations and because we were able to produce significant results.'*

For Dr Žukovič, the fellowship presented an opportunity to move back into academia following a number of years working in the private sector. He had previously conducted a study to model the thermodynamic properties of magnetic materials and was able to transfer this knowledge to the spatial prediction problem.

Dr Elogne, a national of the Ivory Coast, believes that the fellowship contributed significantly to his professional development. Following completion of his second post-doctoral appointment, he is planning to return to Europe to look for a more permanent position, in France. His fellowship was pivotal in the publication of numerous papers that he co-authored with the other Fellows. In particular, it allowed him to explore his interest in modelling petroleum reservoirs.

Professor Ghosh was appointed visiting professor in the Spatstat project. Funding for travel allowed him to combine his expertise with that of the other team members. 'The fellowship helped me to establish academic contacts and to learn new research methods in an area of mutual interest,' says Professor Ghosh. 'Since returning, I have continued to work with the team, and from my home institution we continue to work at achieving our long-term goal of providing automatic mapping functions.'

The truly interdisciplinary nature of this work is reflected in the collaborative publications which have been produced. Eight journal articles involving the Fellows and the coordinator have already been published in peer-reviewed journals in a range of different disciplines, including statistical physics, signal processing, environmental sciences and statistics. The team's findings have also been disseminated at international conferences. All of this attracted additional attention from outside the project, with the result that Professor Hristopulos received an invitation to present Spatstat's findings at the international statGis Summer School in Austria, and to the Department of Geography at the John Hopkins University in the USA.

Project acronym ■ **Spatstat**
Full project title ■ **Development of Spartan spatial random field models for geostatistical applications**

Type of grant ■ **Transfer of Knowledge**
Budget ■ **EUR 306 223**
Duration of project ■ **01-09-2005 - 31-08-2008**
Scientific discipline ■ **Engineering**

Lead partner ■ **Professor Dionissios T. Hristopulos**
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Department of Mineral Resources Engineering
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Tel. +30 28210 37688 // Fax +30 28210 37853

Other partners ■ **Samuel N'Dede Elogne, University of Alberta, Canada - Milan Žukovič, Pavol Jozef Šafárik University, Slovakia - Sujit Kumar Ghosh, NC State University, USA**



TRACKS

Research within the Tracks project could eventually result in new diagnostic tests and treatments for a range of diseases and conditions. The scientists are studying enzymes called transglutaminases (or TGases for short). Among other things, TGases play an important role in wound healing and skin and hair formation, and are therefore implicated in a number of health problems.

Getting to grips with protein glue

TGases are often referred to as 'protein biological glues' because of their ability to stick proteins together to form large, stable structures such as those found in skin, hair and during the healing of wounds. In addition, they are involved in signalling inside the cell and help to construct the cell's external support structures.

They also appear to play a role in the onset and progression of a range of health conditions, including coeliac disease (and associated complications such as diabetes), neurodegenerative diseases like Alzheimer's, Huntington's and Parkinson's, and tissue scarring.

Linking up Europe's TGases expertise

The Tracks Research Training Network (RTN) brings together six universities and two small and medium-sized enterprises

(SMEs) from across Europe. 'The overall objective of this programme is to bring together key groups in Europe, both in academia and industry, who are actively working in the field of TGases,' explains project coordinator Professor Martin Griffin of Aston University in the UK.

They are probing the role of TGases in neurodegenerative diseases, coeliac disease, wound healing and scarring with a view to developing new diagnostic tests and treatments. By sharing ideas and working together, the project partners ensure that the European TGases research community uses its resources both efficiently and effectively, while the involvement of industrial research partners will speed up the translation of research results into tangible medical products that will have a real impact on patients' lives.

The project partners are providing training to seven researchers who are just starting their careers and to seven more experienced researchers. As well as carrying out hands-on research alongside Europe's leading TGases researchers, the trainees receive top-level scientific education in state-of-the-art research methodologies and techniques. In addition, the SMEs in the project provide training in entrepreneurship,

intellectual property issues and the steps required to take a commercial product from the laboratory bench into the hands of health practitioners.

On track for scientific success

On the scientific front, Professor Griffin notes that the project has already helped to increase understanding at the cellular and molecular levels of many of the diseases linked to TGases. 'It has also opened up novel therapeutic avenues for people suffering from these disorders and the development of an early point-of-care test for coeliac sufferers,' he adds.

Among their achievements, the scientists count the creation of a number of molecules that are able to block the activity of TGases and so could be used in drugs to treat the diseases the partners are studying. Furthermore, these compounds appear to be more active than those produced in earlier research and are non toxic and easy to use in experiments.

Small batches of these compounds have been produced, and the project partners are now testing their potential to treat the different TGases-related diseases.

Tomorrow's experts

According to Professor Griffin, the trainee researchers have settled into their respective research groups well and gained considerable knowledge of how to work in a research consortium. 'The Fellows have widened their portfolio of research methodologies and technologies leading to both a deepening and a broadening of their scientific and commercial knowledge base,' he says. Furthermore, almost all of the early-stage researchers in the project have registered for postgraduate degrees in their partner universities, a step that will take them further along the path to a successful research career.

For the Fellows themselves, the benefits of participating in the project are clear. 'I have learned far more than just science. I have acquired abilities to manage my own project and integrate relevant findings and technology on new product development,' comments Mileidys Perez, an Italian early-stage researcher working at French SME Covalab.

She continues: 'It has been very exciting to extend research findings to the complete process of bringing a new product to market, and do so in a dynamic environment with the collaboration of so many colleagues from different countries.

This experience has made me aware of the additional benefits of collaborative research between scientists worldwide from both academia and enterprises.'

'The great advantage of a project like this is that it allows you to meet great people from all over Europe, share your knowledge with them, discuss problems that may occur during research, create new contacts that can be important for your future career and, most importantly I think, to make a lot of friends,' adds Kamila Pytel, a Polish early-stage researcher based at Aston University.

Match made in heaven?

One of the aims of the Marie Curie Actions is to promote long-lasting collaborations between research groups in different countries and sectors. Proof of their success in this comes in the form of Dr Said El Alaoui. Back in the 1990s, he was a Marie Curie Fellow under Professor Griffin. He subsequently moved to France where he founded the biotech SME (and Tracks project partner) Covalab. Over the years, he has continued to work extensively with many scientists, including Professor Griffin, across Europe.

'Dr El Alaoui is involved as a partner on this project and has an early-stage researcher in his employment, thus demonstrating the success of EC training programmes like Marie Curie and the longevity of network systems and collaboration,' states Professor Griffin.

Meanwhile, Professor Griffin is optimistic that the relationships established through Tracks will continue long after the project has ended. 'The partners have expressed a desire to continue their collaboration through applications for European research funding, including an application to set up a new research training network.'

Project acronym ■ Tracks

Full project title ■ Transglutaminases: role in pathogenesis, diagnosis and therapy

Type of grant ■ Training Network

Budget ■ EUR 2 945 000

Duration of project ■ 30-11-2006 - 29-11-2010

Scientific discipline ■ Life sciences

Lead partner ■ Professor Martin Griffin

School of Life and Health Sciences

Aston University

Aston Triangle

GB-Birmingham B4 7ET

Tel. +44 121 204 4096 // e-mail: m.griffin@aston.ac.uk

Other partners ■ University of Rome, Italy - University of Tampere, Finland - Covalab, France - University of Debrecen, Hungary - University of Oslo, Norway - XLINK Ltd, United Kingdom - University of Trieste, Italy



SEEDING CAREERS

Marie Curie Fellowships act as a springboard for a successful future in research. The Marie Curie Actions offer a helping hand, guiding Fellows through every stage of their career and providing practical support along the way.

Sowing the seeds for lifelong careers

Building a successful career in science is no mean feat. In addition to the general challenges faced in all walks of life in locating the right opportunities and acquiring a track record, science careers possess some peculiarities of their own.

One key feature is that there is rarely a clearly mapped out, or linear, career path to follow – the possibilities are potentially endless: private or public research facilities, at home or abroad, fundamental or applied R&D, teaching or no teaching, etc. While fewer sectors offer a linear career path today, this is doubly true for science: competition is constant.

This makes building a career in research a tough, ongoing and constant construction process, requiring foresight, good guidance and a network of contacts.

The Marie Curie programme is based on a keen awareness of this fact and has developed instruments to make it happen. Researchers are supported in both the early and later stages of their career: to launch themselves in the research sector, to build up teams and networks, and to advance science in a way that benefits society at large.

Stepping stones to success

Every career step a researcher makes can be the source of significant change and improvement – which makes it crucial that the right opportunities are available, and seized, at every stage.

In science, perhaps more than other fields, the foundations of a career are laid very early on, as researchers are judged on the quality of their previous research as graduates and postgraduates. This makes it essential that they find the best education and acquire excellent experience right from the very start.

The seeds of a budding career are planted at the very first stage, during the PhD, and researchers need to find a high-quality environment where they can learn the most and be exposed to potential future career paths, whether in academia or the private sector.

To help its Fellows get the best guidance, the Marie Curie programme provides researchers with opportunities to meet other researchers and potential employers, to attend conferences and seminars, and much more. In addition, a conference is held every two years for Marie Curie Fellows. Specialists from academia and private companies, consultants and Commission officials provide training, advice and the benefit of their experience. This regular gathering also allows Fellows to make contacts with potential colleagues from across Europe and beyond, which could lead to possible future career paths.

Later in their careers, researchers need to establish themselves more firmly by expanding their networks or creating new ones, choosing their future direction more independently, and eventually setting up and leading independent research teams of their own, where they

can make new breakthroughs and help seed the careers of the next generation.

Tools of the trade

Researchers are not only working in academic circles but in all other sectors, from hospitals and museums to high-tech companies. Scientists should be given the incentive and the skills to succeed on a long-term basis. In addition to scientific excellence, the new generation of scientists needs to hone skills as entrepreneurs, communicators and team players to make the most of this potential.

To do this, scientists need to acquire skills beyond those they have sharpened in academia. Marie Curie Fellows benefit from a specific allowance which they can spend as required to develop their careers. They also pick up a broad range of complementary skills, for example with regard to project management, communication and languages, as part of their involvement in a Marie Curie project. And many of the participating institutions



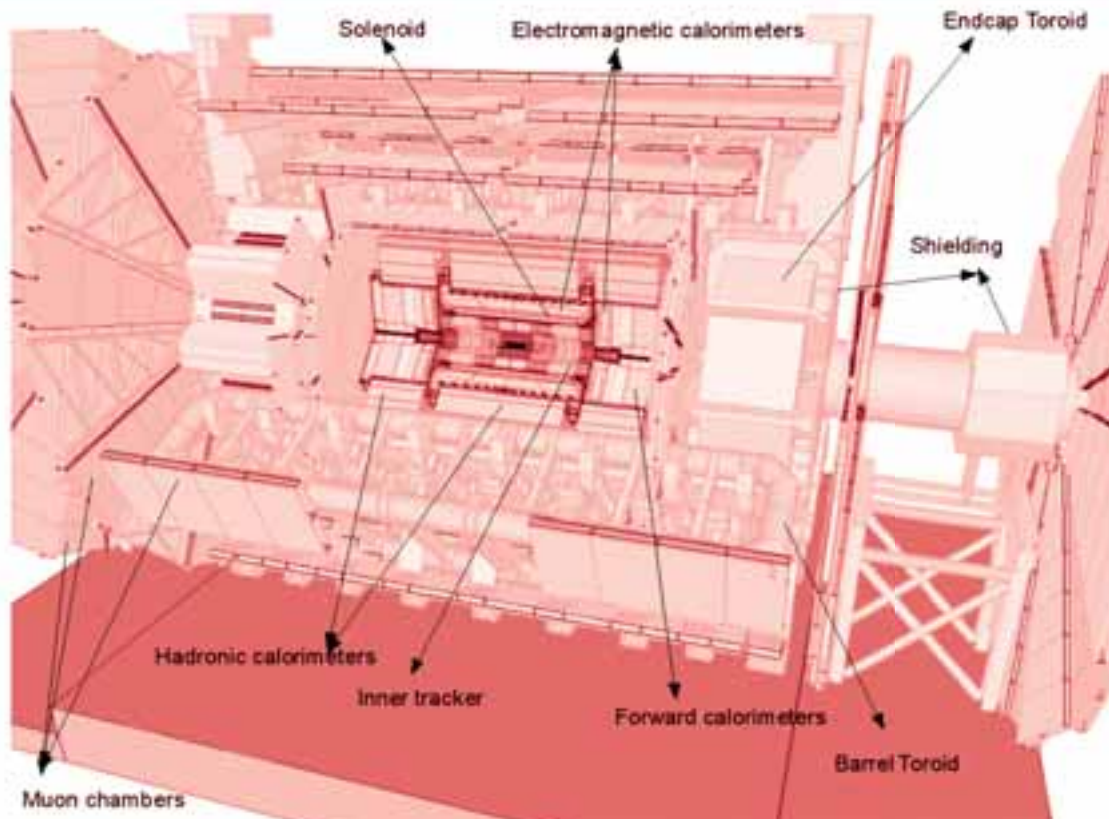


provide formal training to extend the Fellows' core competencies. When institutions receiving Marie Curie grants are evaluated, the training they offer is key.

Many researchers need to be able to capitalise on their research and turn abstract ideas into business solutions or practical applications that address societal or environmental challenges. With support from the Marie Curie Actions, Fellows can actually spend time in the private sector both to gather valuable new experience and to investigate the commercial potential of their science.

Marie Curie affiliations last much longer than actual fellowships. In addition, the Marie Curie Fellowship Association (MCFA) plays an important role in maintaining this link and in providing support. And for researchers wishing to return to their home countries after a period of mobility, the Marie Curie programme provides a reintegration grant.

This chapter shows some of the many ways in which Marie Curie helps its Fellows to go on to enjoy long, successful careers.



ARTEMIS

Understanding nature at its most fundamental level and shedding light on how the universe was formed have been on the minds of scientists for centuries. A Marie Curie-funded network is at the forefront of this research and is exercising its world-class expertise to find the answer. Enter Artemis...

Recreating the Big Bang

Artemis is a research training network that is exploring one of the most fundamental questions in modern science – the origin of mass of the elementary particles. The network has brought together the very best brains from several key areas in particle physics in order to exploit the physics potential of the ATLAS detector at CERN's Large Hadron Collider (LHC) – the world's largest and highest-energy particle accelerator, located 175 metres beneath the Franco-Swiss border near Geneva, Switzerland.

Big Bang bonanza

Artemis is expected to provide unprecedented data that will break new ground in our understanding of nature at its most fundamental level. It will recreate the exact conditions just after the Big Bang and thus show once and for all just how the universe was formed. This study has the potential to change our

perspective on the universe forever. In particular, the LHC data will allow for a definitive investigation of the mass-generation mechanism for elementary particles. This investigation could occur through the Higgs field (which permeates all of space) and the Higgs particle, or through another process. The Artemis researchers are at the forefront of this research within the ATLAS collaboration.

The four-year project is developing tools and methods for improving the reconstruction and identification of elementary particles in the ATLAS detector and optimising the data analyses for the all-elusive Higgs search. It will also measure well-known processes of particle physics and crucially, once enough data have been recorded by the ATLAS detector, will search for the Higgs boson – a colossal but so far elusive scalar elementary particle that particle physicists believe exists.

However, the project is not only about finding the keys to the universe. 'At the same time, an equally important Artemis goal is to form a strong platform for training European researchers and to push them to the front line of this high-profile research area,' says Rosy Nikolaidou, the French scientist in charge of the Artemis network. *'The strong links between the*

network institutes have allowed the young researchers to be in close contact with experts on several different research topics and have provided them with thorough training in key experimental and theoretical aspects of particle physics. This training and the visibility that the young researchers enjoy within a large international collaboration are essential ingredients for developing the profile of researchers who will take up leadership roles in European science in the decades to come.'

Fellows in demand

The Artemis scientists have made significant contributions to raising the Higgs discovery potential within the ATLAS experiment. The impressive positions and titles the Marie Curie Fellows have been given are just one indication of how highly they are valued. Equally remarkable are the novel techniques for detecting the Higgs boson put forward by the Artemis Fellows. They have already been recognised as unprecedented.

As a result of the Marie Curie project's success, invitations to give presentations at ATLAS meetings and international

conferences have been streaming into the inboxes of Artemis Fellows. This high-level exposure will certainly broaden career prospects. Indeed, this can already be seen: while many of the Fellows are still working under their original contracts, those whose contracts have expired have all continued in other high-level posts in particle physics.

Italian Bruno Lenzi, currently completing his PhD thesis with Artemis, may well follow a similar path. 'The subject of my PhD research was relevant to my previous experience and was also challenging given the huge quantity of new information. I gave a tutorial at the Paris meeting, and could also present my experience of the subject both in my home institute and in a general ATLAS meeting. I greatly appreciate the opportunities given by the network, in terms of training and interaction with other members, and also the possibility I had to present the work in an international conference,' he acknowledges.

Physicists of the future

The project's success has meant that the partners have decided to apply for a Marie Curie Network grant in order

to continue the network's fruitful collaboration. 'The Marie Curie Networks are very attractive to young scientists as they offer unique opportunities for training through research.

Many Fellows have immediately found employment in high-energy-physics laboratories in Europe. This allows them to stay in the field of particle physics and continue the challenging work they had started within Artemis,' says Ms Nikolaidou.

German researcher Sebastian Böser, who currently holds a postdoctoral position with Artemis, agrees: 'I have visited two schools, six workshops and one conference throughout my Artemis employment, providing me with a very good set of computing tools as well as the skills to critically analyse the first collision data. My experience in the Artemis framework has been very positive. I feel that I've been given excellent training and opportunities to quickly integrate myself in, for me, a completely new field of study.'

Rosy Nikolaidou is convinced of the need for patience and perseverance when starting a Marie Curie Network. 'There is quite a lot of preparation associated with running a research training network, which makes things quite complicated

for beginners, despite the helpfulness of the EU research officers in Brussels. However, in the end things work and the EU objective of bringing researchers from across Europe together is fulfilled.'

Let's hope this patience and perseverance will see the scientists finding the keys to the universe.

Project acronym ■ Artemis

Full project title ■ Investigation of the electroweak symmetry breaking and the origin of mass using the first data of the ATLAS detector at the LHC

Type of grant ■ Training Network

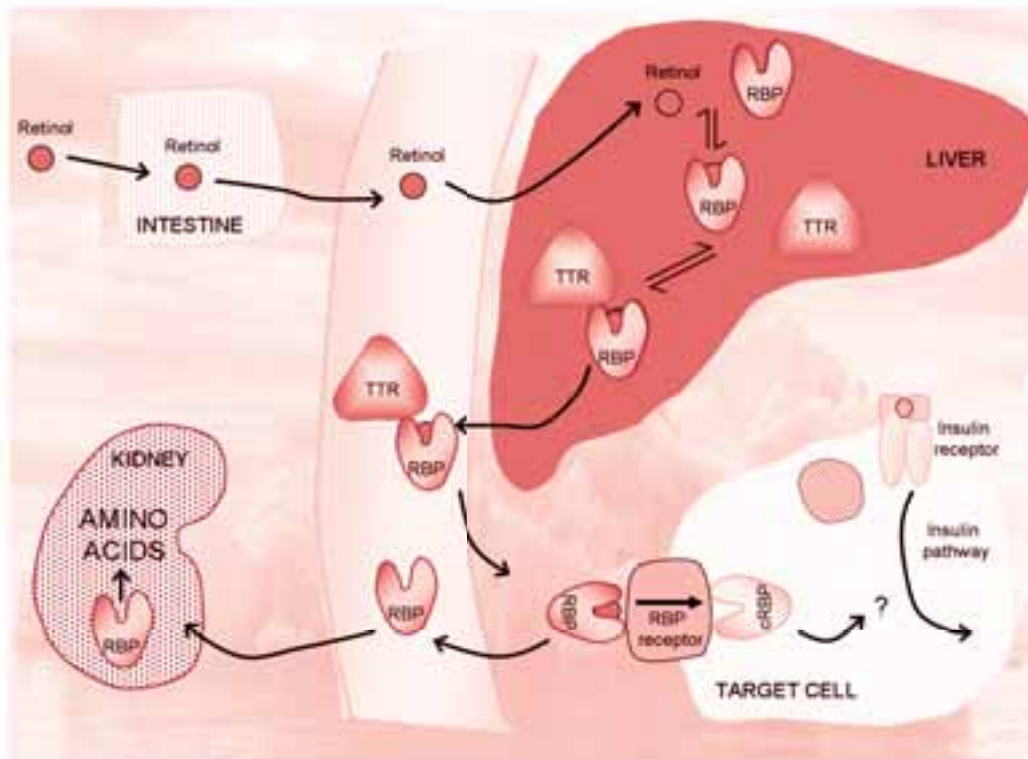
Budget ■ EUR 2.7 million

Duration of project ■ 01-10-2006 - 30-09-2010

Scientific discipline ■ Physics

Lead partner ■ Commissariat à l'Energie Atomique CEA Saclay
DSM/IRFU/SPP
FR-91191 Gif-sur-Yvette cedex

Other partners ■ University College London, United Kingdom - Aristotle University of Thessaloniki, Greece - University of Sheffield, United Kingdom - Istituto Nazionale di Fisica Nucleare (INFN) Pisa, Italy - Max Planck Institut für Physik (MPI), Germany - University of Durham, United Kingdom



BIOMEM

A membrane is a layer of material serving as a selective barrier within a biological system, which is impermeable to specific particles, molecules or substances. It regulates cell function and thus is an important target for many current and future therapeutic drugs. The Marie Curie-funded Biomem project strengthened Europe's expertise in this area by training 14 young researchers to a standard which attracted praise from external evaluators.

On the cutting edge of membrane research

The Biomem network brings together 30 research groups from across Europe, coordinated by John Findlay of the University of Leeds, with Antoinette Killian of the University of Utrecht as deputy. The motivation behind its formation was threefold: a number of research leaders were eager to collaborate on projects of mutual interest; the researchers had a strong desire to communicate their scientific passion to a new generation; and all involved in the project proposal knew that the field was critical to a better understanding of biology, as well as a cornerstone of improved diagnosis, drug development and therapies.

Network of natural allies

The goal was to create a generation of multi-skilled, flexible researchers ready to deal with the challenges ahead. 'It was relatively straightforward to come up with a research and training

programme, drawing on the integrated and varied research competences of the partners. The individual research projects involved meaningful collaborations and covered a wide skill base, including biochemical, biophysical and computational expertise,' says Professor Findlay.

Marie Curie funds supported 14 young scientists undertaking PhD degrees at 14 different institutions of higher education throughout Europe. Those selected came from all over Europe, India and North America.

The Fellows took part in a range of training programmes, starting with the nature, handling and manipulation of membranes and membrane proteins. Next came specialist and intensive workshops covering a variety of approaches to investigating the structure and function of membrane proteins. These included techniques in fluorescence and spectroscopy microscopy, as well as bioinformatics. Fellows also attended the two-week biophysics summer school as well as courses on structure.

All training courses were individually tailored and, where possible, carried out in collaboration with national training programmes as well as other EU-funded research initiatives.

'Life-history' of retinol-binding protein (RBP) from the time retinol is ingested until RBP is excreted in the kidney. RBP supplies retinol to tissues via a newly identified receptor vital to foetal development and possibly involved in type 2 diabetes.

Mighty Mini-MBA

But Biomem also stepped outside of the traditional training routine, introducing the innovative 'Mini-MBA – from Science to Business', which offered Fellows high-level exposure to commercial issues. Held at Donau University and taught by company executives, the course covered the skills needed to commercialise a scientific idea. Topics covered included scientific writing, project design, team construction and management, intellectual property issues and financial planning. Now open to any applicant, it continues as an annual exercise, making the Mini-MBA one of Biomem's lasting legacies.

Breaking through barriers

The Fellows and their science have advanced tremendously over the course of the programme. Their projects were all at the cutting edge of membrane research and led to new knowledge on topics such as the structural and functional characterisation of new receptors through to protein-lipid interactions (influence of membrane proteins on the lipid physical state or vice versa) and the structural properties

of well-known ones. New methodologies have also been developed as well as novel reagents such as the detergent-like 'amphipols'.

In general, the significance of these studies is that they characterise natural biological processes in ways that enhance our understanding of systems involved in human health. By directly targeting particular proteins and influencing human behaviour, our society is better equipped to combat disease and dysfunction.

Even before the four-year programme had ended, many papers had been published and several PhD degrees awarded. In *Nature Reviews on Microbiology*, particular emphasis was placed on the crystal structure of the OppA structure. Many more papers are due to be published in the coming months and years.

Finally, a common stake in the progress of the Fellows has intensified collaboration between several of the participating laboratories and is continuing beyond the end of the programme – to the benefit of the structure and efficacy of European science.

Stepping stone to a solid career

The training programme has already built up quite a reputation. Its external reviewers have remarked on the exceptional knowledge and confidence displayed by the Fellows, the maturity and independence they exhibit and the wide and considered perspective they have on the varied roles of science in society. Clearly, Biomem is well on its way to creating a new generation of scientists who are both better informed and balanced. The interdisciplinary nature of the project has also encouraged the researchers to look outside of their specialisation. These qualities will stand the Fellows in good stead to influence whatever fields they enter. Currently, all the Fellows are continuing in scientific research and many already have their first postdoctoral position.

Those responsible for the training are certainly optimistic regarding the future. *'It was a pleasure to train PhD candidates with a European and international perspective. This really was useful in opening our minds, getting to know in detail various European cultures, in a much deeper way,'* acknowledges Professor Alain Milon of the Institut de Pharmacologie et de Biologie Structurale at the University of Toulouse. 'Here, we really worked with our Fellows for three years and differences occurred. Hopefully we also gave them a feeling and knowledge of our own culture.'

The Fellows themselves are equally full of praise for the programme. For Florian Baumgart, Biomem was also a lesson in the importance of cooperation. *'The Marie Curie EST [early-stage training] programme showed the great potential of a network of collaborating laboratories that exchange experience and technical knowledge on a regular basis.* During the yearly reunions, there was much mutual discussion, exchange of experiences and propositions to tackle scientific problems from a distinct angle with different techniques.'

Project acronym ■ Biomem

Full project title ■ The biomembrane: the development of a multifaceted skills base for the new millennium

Type of grant ■ Training Network

Budget ■ EUR 2.55 million

Duration of project ■ 01-09-2005 - 31-08-2009

Scientific discipline ■ Life sciences

Lead partner ■ Prof. J. B. C. Findlay

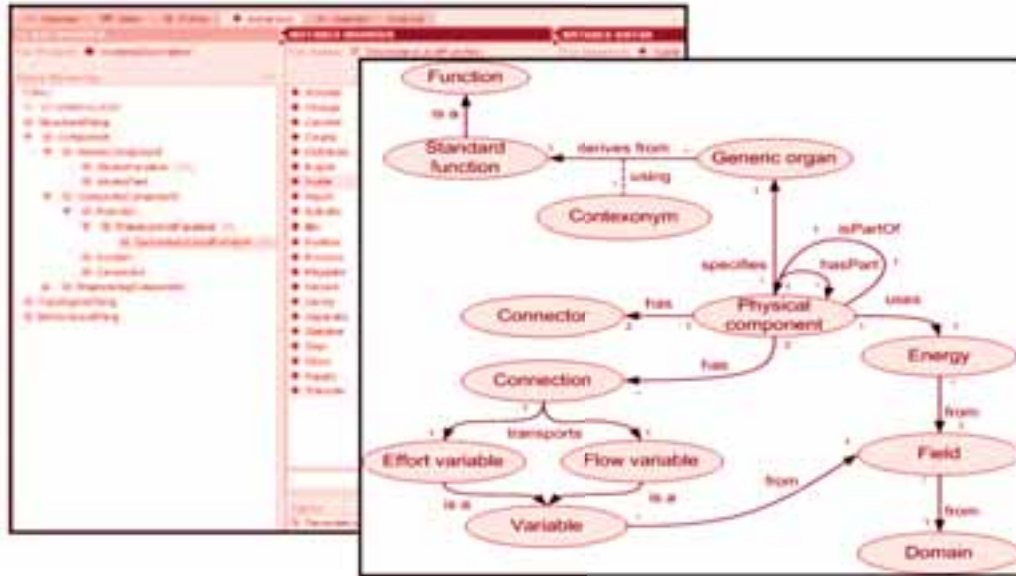
Biological Sciences

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Other partners ■ Humboldt University Berlin, Germany - University of Groningen, Netherlands - University of Southampton, United Kingdom - Instituto Superior Técnico, Portugal - Centre National de la Recherche Scientifique, France - Umeå Universitet, Sweden - Forschungszentrum Jülich, Germany - Universiteit Utrecht, Netherlands - Max Planck Gesellschaft zur Förderung der Wissenschaften, Germany - Universidad Complutense de Madrid, Spain - Université Libre de Bruxelles, Belgium - Université Paul Sabatier - Toulouse III, France - University of Helsinki, Finland - University of Aarhus, Denmark - University of Konstanz, Germany



COMODE

When consumers buy a new coffee machine, they think about the coffee it is going to make or imagine how it is going to look in their kitchen. When Professor Eric Coatanéa looks at a new coffee machine, he wonders how it was developed, how it affects the environment and how he can enhance the development process. The Comode project gave him an opportunity to pursue his research.

Starting from scratch in product design

Whether it is a coffee machine or a power plant, every product – in the broadest sense of the word – goes through a lengthy development process. During the Comode project at Helsinki University of Technology in Finland, French Marie Curie Fellow Eric Coatanéa focused on the all-important initial stages of this process. ‘The early design stage of the development process has long been considered as the strategic phase, where more than 75% of the cost of future products is constrained,’ he explains. At the same time, it is the key phase for other factors such as the environmental impact.

And this is where the Comode project comes in: taking a holistic, multidisciplinary approach, Professor Coatanéa aimed to reduce both environmental impact and the cost of product design processes, while at the same time improving performance, reliability and safety.

His research targets the period when the idea for a new product takes shape. ‘It’s based on the simple fact that the design process, like most human activities, can be seen as a decision process. The decisions we take at the beginning of a project have an extremely big impact later.’ The decision process for most kinds of products or services is driven by central considerations such as function or life cycle. ‘By defining these key concepts first, it’s easier to link them and support them with the help of mathematical tools later,’ he says.

Box + sand = mould

This approach may sound highly theoretical, and indeed it is, but it has led to tangible results. Together with a team of scientists, Professor Coatanéa has developed a prototype tool for the sand-casting process. The tool combines software with electronic and pure mechanical engineering, and revives an old method of the foundry industry. ‘It’s a bit like when kids play in the sand,’ the scientist jokes. ‘Basically, we tried to develop a tool that was able to automatically create three-dimensional (3D) shapes. These 3D shapes are first designed on the computer

with computer-aided design (CAD) tools, and after that they are transferred to a machine able to form a 3D shape in real time. There's a box with sand inside, which will be used as a negative for the mould part.' So, thanks to the use of sand, the process is cheap and highly versatile.

However, sandbox-assisted mould casting is just one aspect of Professor Coatanéa's research. During the Comode project, he and his colleagues also came up with a metric to measure the sustainability of a product or service, linking thermodynamic principles with a life-cycle perspective, and considering recycling aspects and the long-term effect of the substances released into the environment.

In the case of construction, for example, 'A house can be built in a forest, so I have to cut down the trees. People will live in this house for a while. And after maybe one or two centuries the house will be destroyed,' Professor Coatanéa explains. To complete the cycle, 'we need to rebuild the initial environment'. Taking into account the consumption of materials and other aspects, the metric provides a measure of the potential negative effect the product – in this case the house – will have.

Comparing unlike with unlike

What is new about this approach is that it manages to cover the early stages of a product, too, when few numerical data are available. In addition, Professor Coatanéa combined the metric with dimensional analysis. At the end of all of these considerations and calculations stand dimensionless numbers (without any physical dimension) that have two major advantages: they facilitate comparisons and similarity analysis. 'For example, if I build a bicycle or a car, I will be able to calculate dimensionless numbers for both and compare them because they share the same function – transport – and because they are compared in the same mathematic space which has been created via the dimensional analysis,' he explains. And thus it becomes possible to compare the potential negative impact of a bicycle and a car, in spite of all their obvious differences.

Professor Coatanéa's current research continues to focus on environmental and sustainability issues. One of the projects in which he is currently involved should facilitate the construction of ecological buildings. But whatever path he takes in his research, he always has to keep the bigger picture in mind. And this is also what he likes about engineering design. 'It's kind of a

never-ending story,' Professor Coatanéa finds. 'We can always try to integrate new approaches coming from different fields, from biology, from chemistry, from engineering to support the design purpose. And we are in a kind of transversal domain, so we can work with people from computer sciences, from electronic sciences and with artists, too.'

The road from teacher to scientist

Professor Coatanéa's own road to becoming a scientist was a little unusual, he reveals: for 11 years he worked as a manufacturing methods teacher in the French secondary school and university system. The decision to do a PhD in Finland was daunting at first. 'I have been interested in science all my life, but let's say I didn't have sufficient self-esteem to think there might be a career in research for me,' he admits.

But his self-esteem has been growing since he has taken the plunge – and with good reason. Professor Coatanéa's Marie Curie research took him to the internationally renowned Helsinki University of Technology, where he is now employed as Professor in Product Development.

'Marie Curie has given me the opportunity to pursue my own line of research.' This would probably have been much harder in another context, because we depend on money from industry to an extreme degree,' Professor Coatanéa believes. *'Some of my research topics are not necessarily very interesting to industry in the initial phase.'* Marie Curie, however, enabled him to develop his research and wait until a stable position at the university became available.

Project acronym ■ Comode
Full project title ■ Conceptual modelling design: experimentation and implementation of a new conceptual design method

Type of grant ■ Intra-European Fellowship
Budget ■ EUR 173 730
Duration of project ■ 01-11-2005 - 31-10-2007
Scientific discipline ■ Engineering

Host institution ■ Helsinki University of Technology
Department of Engineering, Design and Production
Otakaari 4
FIN-02015 Espoo



COOPERATIVE BREEDING

Can our siblings' actions affect how we develop? How does the death of a mother impact our development? And can our older siblings make up for such a loss? Over the years, Dr Charlotte Faurie has asked herself similar questions. Her focus is on 'cooperative breeding', a social system whereby individuals help care for young who are not their own.

Family fortunes

In her studies on pre-industrial people, Dr Faurie has set out to answer two key questions. Her first focuses on whether the size and composition of a family influences sibling survival and reproductive success, and if the so-called parental allocation of resources affects children. Her second question addresses the mechanisms of competition and cooperation between siblings and asks how they affect younger siblings' growth, health, hormones and education. In November 2005, she was given the chance to answer these questions when awarded a Marie Curie Fellowship. Dr Faurie packed her bags and left her native France for Sheffield in the United Kingdom.

'I have always been interested in understanding the evolution of cooperative behaviour, having studied paternal investment in children for several years, and I was especially fascinated by recent findings revealing the huge importance of a grandmother's role in the family unit. This led me to think how amazing it would be to study other sources of alloparental care. Studies on sibling care had focused on many species of birds and mammals, but up until this point had been rare in humans,' she says.

Researching our ancestors in Finland and Senegal

Dr Faurie's host university was in Sheffield, in the United Kingdom. It appears to have been a very successful posting, with her host university actively encouraging her to spread her wings – notably by sending her on field trips. In fact, much of Dr Faurie's research focused on old lineages of Finnish people recorded in church records, and her findings offer intriguing glimpses of family lives in bygone years. For example, she has established that in historical Finland, some 40% of children did not reach adulthood and the mortality percentage rose even higher if the mother died unexpectedly. However, older brothers and sisters compensated for the loss of the mother to some extent, confirming beyond a shadow of a doubt that older siblings can improve the chances of a younger sibling's survival.

She also spent some time in Senegal where her studies reveal a positive correlation between the degree of support provided by older siblings and their level of the stress hormone cortisol. This is consistent with the results from studies of other cooperative

mammals. Other analyses of cooperative behavioural impact on the success of younger siblings, as measured by growth, nutritional status, educational level and health status, are still in progress.

Finding the key to family dynamics

Parental investment is a limited resource, and is crucial for offspring survival and success in humans. Overall, Dr Faurie's studies underline how parents adjust their investment according to the biological and cultural factors characterising each specific environment. Those parental strategies evolved by natural selection because they maximise the representation of genes in future generations.

‘We all know that babies need a lot of care for an exceptionally long period of time to grow and develop optimally. Our research shows that it often takes more than just the mother and father to encourage development,’ says Dr Faurie. ‘I hope to further clarify the role of other family members in this task, and determine the consequences of variations in the amount of care received for children in the longer term.’

Dr Faurie believes her findings, made possible by the Marie Curie grant, will improve the understanding of the evolution of family living in humans and have relevance for several fields of science, including evolutionary biology, medical science, psychology and social science. She was also delighted to note that the general public finds her research of interest although, as she is quick to add, ‘This interest is hardly surprising because family dynamics affect us all on a daily basis.’

Dr Faurie's research is already bearing fruit with the release of several publications resulting from her close collaboration with the host team, especially its director, Dr Virpi Lummaa, during her 17 months with Marie Curie. She is still finding the answers to questions about the sibling's place in a human family and is currently analysing the effects of birth order on individual behaviour, growth and reproductive measures. In addition, she has broadened her research now to include the impact of sexual selection on the evolution of cooperative behaviour outside the family. A PhD on this topic will begin under her supervision.

It takes a whole world to raise a researcher

An avid believer in 'seeing the world outside the PhD lab', Dr Faurie recommends that all postgraduates travel abroad to experience different perspectives while conducting research. *'You always learn something new, and it puts things in perspective back home,'* she says. And, as a true networker, she also sees the value of establishing contacts, a key component of the Marie Curie experience, as a valued source of support and inspiration in any researcher's career.

Dr Faurie feels that the fellowship has given her *'the freedom and flexibility that is so important when you're still searching for your place and specialty in the world of science'*, and she is convinced that the Marie Curie grant has boosted her career, acting as a springboard towards a permanent research position in her home country. She was recruited by the National Scientific Research Centre (CNRS) in France following a very tough examination and feels that her status as a Marie Curie Fellow gave her a

distinct advantage over the competition. The support has also enabled her to work with a very dynamic research team at her host university, establishing connections with key collaborators which she hopes will endure well beyond her fellowship.

Project acronym ■ Cooperative Breeding
Full project title ■ Evolutionary and ecological causes and fitness consequences of dispersal strategies and cooperative breeding in pre-industrial people

Type of grant ■ Intra-European Fellowship
Budget ■ EUR 127 680
Duration of project ■ 01-11-2005 - 31-03-2007
Scientific discipline ■ Environment

Host institution ■ University of Sheffield
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CSIMHVALVES

Imagine being able to understand exactly how the human heart functions, every intricate detail – understanding it so well that you are able to create a computerised model of its tissues, the very fibre of the heart. Imagine being able, from this knowledge, to create a device which produces heart valves – real ones ...

The living heart of the matter

Heart defects are common; in fact they are some of the most common defects seen in newborns. Sadly, they are also one of the leading causes of deaths linked to birth defects.

It is unclear, at this stage, what causes these defects. Various genetic or environmental factors may contribute, but in the absence of conclusive evidence, prevention is very difficult and treatment remains the only option. This usually involves a succession of complicated, high-risk operations followed by ongoing treatment with medication – often for the entirety of the patient's life.

Better prospects for tiny patients

Advances in the treatment of this condition could help to improve the quality of life of babies born with heart defects,

and help to alleviate its lasting impact on sufferers in later life. In 2006, a Dutch Marie Curie Fellow set out to examine novel methods of replacing the defective valves in the heart. Combining knowledge of tissue engineering and computational modelling, Dr Raoul van Loon investigated the creation of a living prosthesis. Unlike the prostheses previously available, this one would have the ability to grow, adapt to new physiological situations, and even to fight disease. In effect, it would become a living, genuine part of the body.

This spectacular result is likely to bring new hope to many patients. In fact, as Dr van Loon explains, it 'implies that babies with congenital heart disease would not have to undergo several re-operations and that people with valve replacements would not have to take anticoagulants throughout their lives'.

Pumping ideas into action

Raoul van Loon studied mechanical engineering for his BSc and MSc at Eindhoven University of Technology in the Netherlands. Here he was able to look at the ways in which computer code

Bioreactor for tissue engineering of heart valves developed at the Heart Science Centre in Harefield, UK. The culturing medium is circulated through the bioreactor and provides mechanical stimuli and nutrients to the tissue constructs. A pulsatile pump connected to a left ventricular assist device ensures cyclic flow.

could be used to describe how cartilage behaves in certain conditions. This theory laid the foundations for his subsequent research, and he was awarded a PhD in bioengineering. His subject was the development of a computational method that could be used to simulate the interaction between blood and heart valves. Dr van Loon stresses that this was the study which triggered his passion for bioengineering research.

The two-year Marie Curie Fellowship was the opportunity he was waiting for, taking his research work to the next level. From his temporary base at Imperial College London, one of Europe's leading research institutes in biomedical engineering, he was able to broaden his horizons and hone his expertise in heart-valve modelling under the guidance of his supervisor, Professor Spencer Sherwin. He attended conferences and research meetings, joined workshops and lectured on the MSc course. And his papers began to appear in internationally renowned journals.

How to grow a valve

Determined to put his in-depth understanding of the intricacies of heart-valve modelling to good use, Dr van Loon began to look for researchers already making progress in this study area. Members of the Tissue Engineering Group, based at the Heart Science Centre in Harefield in the UK, are established as leading experts in this type of research. In cooperation with this team, he contributed to the development of a bioreactor, a potentially life-saving device designed to grow living prosthetic heart valves.

Dr van Loon explains the procedures and preconditions involved in this feat of bioengineering: 'First, the environment created inside the bioreactor must be kept sterile for a long time with sufficient nutrients for the cells. Secondly, well-controlled mechanical stimuli are needed for the artificial valves to grow; this requires knowledge about the pressure and flow. *I was able to provide the necessary engineering input for the design and testing of the bioreactor.*'

The development of the numerical techniques needed to model the heart valves was a vital part of the bioreactor design, the final stage of this project. It was here that the researcher called on the expertise of the aeronautics department at Imperial College. Together they tested and compared methodologies which Dr van Loon had previously developed at the PhD stage of his career. And, eventually, they were able to produce novel combinations of methodologies with significant potential for heart-valve modelling.

Branching out into diagnostics

The outcomes of the project were received with considerable interest and have opened up avenues for further study and new applications. In particular, the research on computational modelling of biological flows through diseased arteries and lungs has received much praise. Since finishing the fellowship, Dr van Loon has collaborated with cardiologists from nearby hospitals in Swansea, and his research has been adapted and applied to the diagnosis of aortic stenosis, a particular form of valve disease.

Impressive as they are, these achievements may just be the beginning for Dr van Loon, who is now a lecturer at the Civil and Computational Research Centre of the University of Swansea, one of the top engineering departments in the UK. He believes that his Marie Curie Fellowship has prepared him for this new challenge by enabling him to gain the necessary experience in research and teaching. Looking back on his time with Marie Curie, he recommends that future applicants 'employ their fellowship period not only for performing research, although this is clearly the important part, but *go one step further and organise seminars, explore new research ideas, teach, meet new people*, attend conferences and embrace the host country's culture'.

Project acronym ■ CSimHVValves
Full project title ■ Computational modelling of tissue-engineered heart valves

Type of grant ■ Intra-European Fellowship
Budget ■ EUR 167 665
Duration of project ■ 01-01-2006 - 22-10-2007
Scientific discipline ■ Engineering

Host institution ■ Prof. Spencer Sherwin
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GLUES

Dr Markus Reichstein is a 'rising star' in environment and ecology research, according to ScienceWatch.com – a well-deserved accolade for his work on the effect on ecosystems of changes to the climate. Now back in Germany after a two-year Marie Curie Fellowship in Italy, he has used a Marie Curie Reintegration Grant to establish an independent research group at one of the world's top biogeochemical research institutes.

Planet Earth and the carbon conundrum

Having moved straight from one Marie Curie grant to a second, Dr Reichstein is well aware of the career boost that the funding can give a young researcher. Between 2005 and 2006, he held a fellowship at the University of Tuscia's Department of Forest Ecology, where he worked on the Marie Curie Intermode fellowship project, developing expertise in processing and synthesising carbon, water and soil respiration data. The period in Italy set him in good stead to establish his own 10-member research team, and the Marie Curie reintegration grant sealed the deal: *'For sure, the Marie Curie grant was a great facilitator in the starting phase of the research group and helped my establishment at one of the top institutes of biogeochemical research in Europe* [the Max Planck Institute for Biogeochemistry in Jena, Germany],' he says.

Unearthing the mysteries of soil

Dr Reichstein's current research – a follow-on from the Marie Curie Glues project – focuses on the interactions within the Earth system. In particular, he is looking at the carbon and water exchange between the terrestrial biosphere (vegetation and soils) and atmosphere, and how this process is influenced by climate variations. Carbon is the major element in all organic material, both dead and alive. While carbon dioxide (CO₂) in the atmosphere is essential for plants, it is also a known greenhouse gas and too much is bad news. If we are to balance the global carbon cycle, an understanding of two long-term mysteries is needed: the flux between the atmosphere and the oceans, and the flux between the atmosphere and terrestrial ecosystems. Dr Reichstein is on a mission to tackle the latter.

What goes on below ground, Dr Reichstein says, is 'one big unknown and final frontier'. Soil contains around four times more carbon than the atmosphere. And surprisingly, for non-scientists, more CO₂ is released into the atmosphere each year by soils than by the burning of fossil fuels.

Image showing the fractions of absorbed photosynthetically active radiation, precipitation and air temperature during the summer of 2003

The carbon cycle begins with plants absorbing CO₂ from the atmosphere. Plant material, such as leaves and flowers, drops to the ground or makes its way into the soil as root litter. The circle is complete when soil micro-organisms and animals eat the decaying plant material – a process that releases CO₂ into the atmosphere. Soil organisms range in size from the microscopic cells that digest such decaying organic material to small mammals which live primarily on other soil organisms. Their role is frequently underestimated, and indeed current Earth system models tend to oversimplify this aspect.

Dr Reichstein intends to set the record straight. To do so he is using a combination of ‘data-oriented’ modelling techniques, which involve computers looking for patterns in the data, and ‘process-oriented’ modelling techniques, which are based on theoretical principles.

A summer of discontent

In the summer of 2003, temperatures soared to over 40°C in parts of Europe. The heatwave created a natural laboratory for Dr Reichstein and his Marie Curie colleagues to examine the

response of vegetation and soils to extreme weather events. As the sun beat down from one day to the next, it left thousands of human casualties in its wake – and undid five years of carbon absorption by Europe’s trees and plants as their productivity slowed and more carbon remained in the atmosphere.

The study also found that extreme climate events such as this may offset any benefits to vegetation productivity caused by global warming. With more hot weather predicted for the future, this knowledge is particularly valuable. *‘The study highlighted the importance of climate variability and extremes for ecosystem carbon balances, and showed a strong impact on ecosystems’ ability to take up CO₂ from the atmosphere,’* explains Dr Reichstein, adding that this effect was ‘caused by the drought rather than by high temperatures per se’.

The Marie Curie funding has also enabled Dr Reichstein to establish and maintain ties with groups working on similar topics, both within Europe and elsewhere. He has contributed to an EU project assessing terrestrial carbon balance and was also involved with an international project harmonising and standardising data on CO₂, water vapour and energy fluxes sent by members of regional networks from around the world.

Modelling climate change from the ground up

In addition to the knowledge gained and shared from these collaborations, they have also resulted in a concrete product: a global database of information on carbon-water fluxes between the ecosystem and the atmosphere. Dr Reichstein worked with previous Marie Curie Fellows and researchers in the USA to create it, and the data are currently being analysed for clues as to the impact of climate and vegetation on carbon dynamics. 'Overall, I hope that these and related studies can help us to get a better view of the effects of climate variability on the global carbon cycle and consequently lead us to improved model predictions of climate and its impacts on ecosystems,' says Dr Reichstein.

For this researcher, linking the Marie Curie funding to an EU-funded project has worked well, and he recommends that other Fellows do likewise. With one such EU project already behind him, he recently started to coordinate more than 20 research teams working on the Carbo-Extreme project – an attempt to improve models of terrestrial carbon dynamics in relation to climate. As satellite observation systems are applied to this area of science, more revelations about earth and biosphere

processes can be expected. One thing is certain: humans are changing the Earth system, predominantly in terms of climate.

Less certain is what this means for the dynamics within Planet Earth. Finding out could be key to our future welfare.

Project acronym ■ **Glues**

Full project title ■ **A model-data fusion system for global fusion of ecosystem observations, biogeochemical modelling and spatial data sets**

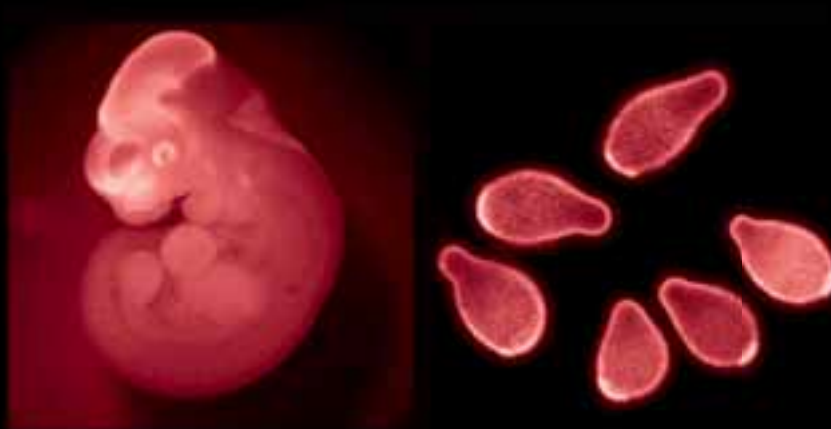
Type of grant ■ **European Reintegration Grant**

Budget ■ **EUR 40 000**

Duration of project ■ **01-04-2006 - 31-03-2008**

Scientific discipline ■ **Environment**

Host institution ■ **Max Planck Institute for Biogeochemistry
Hans-Knöll-Str. 10
DE-07745 Jena**



INTERDEC

How an organism develops depends on complex interactions between individual cells, particularly in the early stages of growth. Similarly, the decisions taken during the early stages of a career have long-term implications. The InterDeC project is helping young biologists find the right path to organic career development.

Organic career development

Organisms develop through a complex process which begins with the growth of the mother cell. This leads to cell differentiation, when general cells divide into specialised ones, and morphogenesis, which gives rise to tissues, organs and anatomical structure.

In fact, the development of an organism is driven by a range of tightly regulated decisions and processes at the cellular level. This implies that, in order to unravel and understand biological mechanisms and how they malfunction to cause disease, an in-depth knowledge of both developmental and cellular biology is required. For example, a detailed understanding of cell growth and its exquisite control mechanisms is critical for insight into the plethora of diseases in which cell and organismal growth goes awry, including congenital and developmental disorders and a range of different cancers. A strong foundation in both developmental and cellular biology is required to address such complex cellular processes.

Run by a consortium of high-calibre group leaders studying different aspects of biology in a range of model organisms at the University of Nice (France), InterDeC is an international PhD programme training top-level young researchers from Europe and partner countries to bridge the gap between developmental and cellular biology.

With nearly EUR 1.7 million in funding over four years from the Marie Curie programme, InterDeC comprises a complementary mixture of theoretical and practical courses, coupled with laboratory research. 'The Marie Curie InterDeC programme has been a fantastic way to obtain a PhD, providing a stimulating scientific environment and an excellent support network,' enthuses Hannah Hope, a Fellow from the UK.

Ms Hope has been examining polarised growth in the opportunistic pathogen *Candida albicans*. She is also the lead author of a 2008 paper in *Molecular Biology of the Cell* and has received a competitive Fondation pour la Recherche Médicale (FRM) fellowship to continue her thesis research for a fourth year – once her Marie Curie Fellowship comes to an end – in addition to a highly sought-after L'Oréal French Unesco fellowship.

The heart of the matter

The PhD Fellows receive well-structured scientific instruction. 'The broad training on a range of different biological systems, together with an emphasis on critical thinking, which InterDeC provides, is at the heart of seeding future careers in science,' explain InterDeC coordinators Dr Robert Arkowitz and Dr Andreas Schedl at the University of Nice.

The scientific training is personalised and customised to each individual PhD candidate's needs. 'I had the opportunity to get to know a few labs and model organisms during research rotations and, thus, choose the most suitable ones to carry out my thesis research,' states Majja Slaidina, a Fellow from Latvia. 'I was also very glad that I got the chance to broaden my scientific knowledge by participating in seminars on a wide variety of topics.'

Ms Slaidina has been studying the 'cross-talk' between the steroid hormone ecdysone and insulin signalling in the control of organismal growth in the fruit fly *Drosophila melanogaster*. In addition, she has been examining the role of insulin-like peptides in growth during non-feeding states. She has received a competitive Association pour la Recherche sur le Cancer (ARC) fellowship to continue her thesis research for a fourth year.

Talking science

But InterDeC is not just about science; it also focuses on communication, as today's scientists need to be able to get their message out. *'Research experience is critical but it's not the whole story. Researchers also need excellent communication skills.'* Moreover, they should be prepared to adapt to a new culture,' point out Dr Arkowitz and Dr Schedl.

In addition to helping Fellows hone their communication skills, the cutting-edge science is accompanied by training in a wide range of complementary areas, including language, data management, journal writing, as well as oral and written presentation. The Fellows also attend researchers' retreats and researcher-organised mini-symposia. 'The InterDeC programme provided us with intensive training in French, scientific writing and English presentation skills, as well as career guidance,' recalls Ms Slaidina.

Katie Ayers came all the way from New Zealand to do her PhD with the InterDeC programme. 'Being part of the InterDeC programme allowed us to meet and discuss science with internationally renowned researchers on a regular basis, and to use workshops and seminars to advance our knowledge in everything from scientific methods and presentation skills to career management,' she observes.

Ms Ayers has been investigating the regulation of the 'hedgehog' family of proteins, key signalling molecules that control pattern formation in invertebrates and vertebrates that are also involved in the predisposition for brain and skin cancer. She is first author of a 2009 paper in *Developmental Biology* and received a competitive ARC fellowship to continue her thesis research for a fourth year.

Broadened horizons

Katie Ayers feels that InterDeC has improved her future prospects considerably. 'I have had the pleasure of sharing my experiences with 10 other researchers from very different backgrounds and to create bonds that will endure into our future scientific careers. *I will leave the programme with a sense of pride at having been part of such a successful venture, and feeling adequately equipped for a future in academia,*' she concludes.

And how do Dr Arkowitz and Dr Schedl assess InterDeC's impact? 'Our project has just terminated and as such it is very difficult to draw firm conclusions regarding the impact of our programme on the Fellows' careers,' they note. 'However, we have already noticed our *Marie Curie Fellows have adopted a much more open attitude to their careers compared with other Fellows.*'

So, what caused this expansion of horizons? 'We believe this is due to the very broad training provided by our programme.' And the effects are already beginning to show. According to Dr Arkowitz and Dr Schedl, each Fellow has produced publications from their thesis research, eight out of nine Fellows were awarded competitive funding for the fourth year of their thesis research and, in most cases, the Fellows will go on to do postdoctoral research in academia or industry.

Project acronym ■ InterDeC
Full project title ■ International PhD program in developmental and cellular decisions

Type of grant ■ Training Network
Budget ■ EUR 1.7 million
Duration of project ■ 01-04-2005 - 31-03-2009
Scientific discipline ■ Life sciences

Lead partners ■ Robert Arkowitz
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<http://www.u636.org/index.php?page=team3&lang=en&type=webpgs>



KAPROW

The theory of democratic peace states that democracies rarely go to war with each other. An Italian researcher has taken a second look at the theory and offered up a more sophisticated definition through his studies of the renowned philosopher Immanuel Kant. His research is compelling and sets out a new philosophical view of democratic peace.

Contemplating peace

In *Toward Perpetual Peace* (1795), Immanuel Kant advocated three main institutional reforms to eliminate what Voltaire called 'the greatest self-inflicted tragedy of humanity'. The three reforms are: national governments must become liberal-democratic; an international federation of states should be established; and a certain degree of freedom of movement between states by foreigners should be secured. Should these three reforms be implemented, the result would be an ever-lasting peace among nations and an end to war. Dr Luigi Caranti delved deeper into this theory during his Marie Curie Fellowship.

The grant enabled Dr Caranti to move to Philipps-Universität Marburg in Germany, an institution with a long-standing tradition of Kant scholarship. During his time there he studied the most recent work on Kant as well as the latest contributions to democratic peace literature. 'I also presented several lectures presenting the first findings of my studies at the University's Institut für Philosophie,' he says.

Studying at Marburg – a good career move

Dr Caranti is certain his career has benefited as a result of the Marie Curie Actions. While at Marburg, he applied for a place on a brain gain programme initiated by the Italian government to encourage Italian researchers working abroad to return. This chain of events ultimately led to a position as associate professor at the University of Catania. '*I don't think I would have secured a place had it not been for the Marie Curie experience,*' he admits.

Dr Caranti also quickly realised the benefits of studying Kant at Marburg. He could easily access a myriad of relevant literature on the philosopher – and much faster than ever before. He also had close contact with experts in the field, regularly discussing the provisional results of his research with established scholars.

'I think that a more careful look at Kant's work offers a better understanding of the causal factors that lead to war and of the reforms necessary to secure peace worldwide,' says Dr Caranti. 'Put simply, *Kant still has something to teach us regarding the causes of war, as well as the reforms*

necessary to stop it.’ If we are patient enough to look at the details of his political thought, we will have a better chance of acting effectively to implement the national, international and global reforms necessary to decrease the likelihood of future conflicts, believes Dr Caranti.

Scholars misinterpreting Kant

While analysing Kant’s democratic theory, Dr Caranti identified a number of flaws in the way scholars were interpreting the German philosopher’s works. For example, many ‘internationalists’ (those who support cooperation between nations) claim that in the Kantian recipe for peace, the ingredient of the liberal-democratic government is significantly more important than the other two main institutional reforms – the international federation and freedom of movement. They believe that the problem of war can be reduced to a question of regime change at national level.

Dr Caranti thinks that scholars have not only exaggerated the importance of the national level, but also generally misinterpreted Kant’s views on it. He feels they missed the

cautious language Kant uses in describing the peaceful nature of republican peoples. Kant does not state that people living under a democratic rule will never go to war under any circumstance. Rather, he writes that they ‘will have great hesitation in embarking in so dangerous an enterprise [war]’. Taking these sentences as determinants rather than tendencies had led scholars to the false conclusion that combined democracy (democracy across borders) is a sufficient condition for peace and that democratic people who decide to go to war are exceptions to the rule.

Contrary to popular opinion, the federation of free states, the second pillar of Kant’s theory, is not limited to republics but open to all kinds of states, in the hope that they will reach the appropriate standards for accession.

Dr Caranti is also looking at Kant’s view of the interplay between the three pillars of his theory, asking: ‘Are we to expect that a world government of the kind Kant recommends will arise only when all states have turned liberal-democratic? How exactly does economic interdependence enter into the picture? And, is any kind of international trade conducive to peace or is it some form of *fair* trade that contains this potential?’

The above learnings proved invaluable for Dr Caranti when he edited a book entitled *Kant's Perpetual Peace. New Interpretative Essays*. This collection of essays was compiled by Kant scholars and helps to advance our understanding of democratic peace theory.

Appreciate the subtleties

One prominent scholar who inspired Dr Caranti into undertaking his current research and who he hopes to collaborate with in the future is Michael Doyle. He interpreted a 200-year absence of conflicts between democracies as striking evidence in favour of Kant's theory. Professor Doyle's claim sparked one of the most important research fields in the social sciences – Democratic Peace Theory (DPT) – which sits at the intersection of political philosophy, political science and international relations.

The current general consensus is that democracies have rarely fought between themselves. Fighting between scholars is still in full swing, however, as they are far from agreeing on an interpretation to account for this phenomenon. Those of a liberal orientation view it as evidence that Kant's project is

both sound and in the process of being implemented. Others deny or strongly play down the significance of each of the three Kantian claims.

'My research wants to cure these disparities through a better understanding of the subtleties of Kant's original insight,' says Dr Caranti.

Have no fear

Dr Caranti believes that being 100% clear on research objectives and a project's potential to be groundbreaking helps in the search for a good supervisor and host institution. 'One should not be scared to ask the most important scholars in your field,' he comments. 'They are likely to be happy to receive a new researcher at no cost.'

Project acronym ■ **Kaprow**

Full project title ■ **Kant and the problem of war**

Type of grant ■ **Intra-European Individual Fellowship**

Budget ■ **ca. EUR 170 000**

Duration of project ■ **15-02-2006 - 14-02-2008**

Scientific discipline ■ **Sociology**

Host institution ■ **Prof. Werner Stark**

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NASCENT

Although nanotechnology deals with the microscopic scale – at the level of the individual atoms or molecules – its potential applications are massive. The EU-backed Nascent network is helping European researchers build careers in this promising field.

Small beginnings

From falling apples to flying birds, nature has always been a great source of inspiration for science, and researchers are constantly working to understand new phenomena and improve our knowledge. In recent years, the new field of nanotechnology has attracted considerable attention. It focuses on the study of how atoms and molecules behave at the nano- or microscopic scale, where the properties of materials can differ significantly from how we know them at the macroscopic level. By harnessing these properties, scientists hope to develop new materials, including polymeric matrices, and devices with interesting applications in a range of different fields.

Just to give an idea of the scale, a nanometre is 1 billionth of a metre. Nanotechnology is a discipline which seeks to develop structures that are 100 nanometres or smaller, opening up exciting applications in a wide range of areas, from computing to medicine. It has already revealed mind-boggling possibilities, such as super-strong, lightweight fabrics, diodes that emit light and not heat, and a computer chip so small that you

could fit 400 on the head of a pin. 'Smart' materials, such as bandages that can detect the first signs of infection, are one promising avenue for research.

However, reproducing the natural processes at the nano-level is one of the greatest challenges facing contemporary science. But the ultimate prize is an alluring one. For example, such knowledge could stimulate the invention of novel non-biological systems and tailor-made biomolecules with new properties.

Nurturing new talent

The EU-backed Nascent research training network helps young European researchers build up careers in this fledgling science. 'Nascent provides a unique training platform featuring broad expertise, multi-sectoral environments and international experience in the nanomaterial field,' explains Marina Resmini, the network's coordinator. 'It enables young researchers to acquire a variety of skills, thus allowing them to become "European" professionals with excellent career perspectives.'

The network focuses on the development of polymeric materials that are able to act as catalysts and sensors for novel technological applications, by using the imprinting approach.

Molecular imprinting is a technique which has largely been developed by European researchers over the past three decades. It allows the creation of artificial receptors by using a target molecule as a 'template' around which functional monomers are arranged. Following the polymerisation process, cavities with specific recognition characteristics are obtained, and these novel materials can be used for a variety of applications.

This promising field has now reached a crossroads where further advances will require closer collaboration between academia and industry, as well as among different disciplines, such as chemistry, biology, physics and materials science. Bringing about such a transformation requires providing young scientists with advanced training – and that is exactly what Nascent has been doing for the past three years. The network provides both early-stage and experienced researchers with fellowships, training programmes, workshops and conferences.

'Working in Nascent allowed me to grow and develop both as a researcher and as a person,' believes Kevin Flavin, an experienced researcher at Queen Mary, University of London (UK). 'This fellowship was an invaluable experience in my pursuit of a successful academic career, which gave me the opportunity to return to Ireland and take up a research position in one of the top research institutes in the country, the Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN), Trinity College, Dublin.'

Growing space

According to some of its members, the Nascent network has something of the familiar about it. 'Nascent has been an incredible success, since bonds have been created between people from the different corners of the continent (and even a bit further), bonds that surpass to a large extent the scientific barrier,' describes Artur Moro, an early-stage researcher of Friedrich Schiller University in Jena, Germany.

Sharing knowledge and experience has also been a great plus.
'Nascent has been more than a scientific family for me

over the past three years. All the participating institutes have great mentoring skills which results in a positive ripple effect across the early-stage researchers,’ says Rita Jorge, an early-stage researcher who is based at Queen Mary, University of London.

This laid-back environment and quality mentoring has encouraged Fellows to think ‘out of the box’. She believes that: ‘This has given us a space to grow, but most importantly *a friendly space to fall and fail, and to learn why and how we did it* and how to overcome it in the future.’

The network has organised four training schools, three international meetings, as well as a workshop on enterprise and innovation and another on molecular modelling. Additional training events are planned for the last year of the network. In addition, network members have participated in other conferences and workshops to disseminate their scientific results and information on Nascent.

The network supports and encourages female Fellows to pursue a full and fulfilling career in science. One of the interesting outcomes has been the creation of a ‘Women in Science’

society, based at Queen Mary, where one of the founders is a member of Nascent. This society, supported by the network coordinator, has successfully secured independent funding and organises monthly meetings. Visit the society’s blog at: <http://wiseqmul.wordpress.com>

Project acronym ■ Nascent
Full project title ■ Nanomaterials for application in sensors, catalysis and emerging technologies

Type of grant ■ Training Network
Budget ■ EUR 2.7 million
Duration of project ■ 01-09-2006 - 31-08-2010
Scientific discipline ■ Chemistry

Lead partner ■ Dr Marina Resmini
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Other partners ■ Ben Gurion University of the Negev, Israel - Centre National de Recherche Scientifique, France - CiS Institut für Mikrosensorik GmbH, Germany - Friedrich Schiller University of Jena, Germany - Kodak Limited, United Kingdom - Polish Academy of Sciences, Poland - PolyIntell S.A.R.L., France - Universidad Complutense de Madrid, Spain - Università di Padova, Italy



NEUROEMPATHY

Ever sense a chill running down your spine when watching a gripping film? Do you ever cry when the hero loses, or feel elation when he or she wins? If so, you are probably a normal human being. But do we really know how this happens?

The neuroscience of empathy: can you feel it?

When people watch movies, they share the experiences of the actors they observe: hearts beat faster when we see someone slip from a rooftop or when onscreen lovers come together in a romantic clinch.

And this does not just apply to the big screen. We experience similar reactions when we watch our fellow humans and even animals in the real world. None of this may seem surprising – after all, surely that is why we go to the movies? But how does it happen? What makes us respond emotionally to other people's situations?

Getting to the heart of human feeling

'Specific brain areas are involved when we perform certain actions or have certain emotions or sensations,' explains Christian Keysers of the University Medical Center, Groningen's School of Behavioural and Cognitive Neurosciences (BCN). 'Interestingly,

some of these same areas are also recruited when we simply observe someone else performing these actions, experiencing similar sensations or emotions.'

BCN carries out research and provides scientific training for graduate and PhD Fellows. The central question is: 'How does the brain enable us to interact with the environment?' Its members are looking for insights into brain functions, applying multidisciplinary approaches at different levels: the behavioural, the cognitive and the neural.

'The brain areas we are talking about are called "shared circuits",' continues Professor Keysers. 'They transform the sensations we observe in others into sensations that we can feel ourselves.' Because of these shared circuits, understanding other people is not an effort of explicit thought but rather an intuitive sharing of their experience. 'In other words, we feel empathy.'

Through the investigation of shared circuits, Professor Keysers' group is seeking to understand the neural basis of empathy and its dysfunctions. The Social Brain Laboratory comprises a young, multicultural band that investigates empathy using psychophysiological methods, patient studies and a powerful new tool called functional magnetic resonance imaging (fMRI).

Mapping empathy

Since the 1890s, it has been known that changes in blood flow and blood oxygenation in the brain, collectively known as haemodynamics, are closely linked to neural activity. When nerve cells are active their oxygen consumption increases. The local response to this oxygen utilisation is to increase blood flow to regions of increased neural activity, which occurs after a delay of about one to five seconds.

The recent discovery that magnetic resonance imaging can be used to map these changes in brain haemodynamics that correspond to mental operations has extended traditional anatomical imaging to include maps of human brain function.

‘This new tool, fMRI’, explains Professor Keyzers, ‘gives us the ability to map brain structures, but also to observe which structures participate in specific functions, providing high-resolution, non-invasive reports of neural activity.’

The ability to directly observe what the brain is doing in real time opens an array of new opportunities to advance the understanding of neural functioning and organisation, and it presents a potential new standard for assessing neurological status and neurosurgical risk.

Putting excellent Fellows in touch with their feelings

Currently comprising five postdoctoral researchers, five PhD Fellows and one Master’s student, Professor Keyzers’ Social Brain Laboratory is rapidly expanding. Generously financed by the European Union’s Marie Curie Actions and the Dutch Science Foundation, its ‘NeuroEmpathy’ project (Towards a neuroscience of empathy: shared circuits for actions, emotions and sensations) is creating some very exciting opportunities for young researchers.

Among other things, the Marie Curie programme supports excellence in team building, providing funding that enables promising researchers to establish their own group.

Marleen Schippers is a PhD Fellow from the Netherlands who says, *‘The Marie Curie programme has allowed me to do wonderful research under a well-paid contract, in an international environment that has been very stimulating for me.’*

Ms Schippers says the travel budget associated with the grant has allowed her to go to a number of very interesting international conferences that would have been out of reach otherwise. ‘This will provide an ideal basis for my scientific career,’ she concludes.

Marie Curie Fellows working on the NeuroEmpathy project have published key papers on shared circuits and social cognition. The project has also drawn Fellows from abroad, adding to Europe's knowledge base.

Jo Etzel, a postdoc from the US, says, *'As a non-European researcher, I greatly appreciate the mechanisms in the Marie Curie programme aimed at encouraging international teams. The travel funding is particularly generous and helpful, and I also appreciate the longer contract period that is possible because of the grant.'*

Ms Etzel explains that postdoctoral appointments in this field are often short term, making it difficult to develop a set of interrelated projects. 'This kind of in-depth work is only possible with a longer contract like this.'

Soldiers of science march on

Professor Keysers says empathy is a concept central to psychiatry, psychotherapy and clinical psychology, and the lack of ability to empathise is central to many psychiatric conditions. Schizophrenia patients, for example, can show severe empathy dysfunction.

Several factors influencing empathetic response have already been identified, such as neurodevelopmental problems, brain damage and the onset of psychiatric illness. The work being carried out by Professor Keysers' group under the NeuroEmpathy project promises to provide new insights into these and other mechanisms underlying an important aspect of human social interaction.

Project acronym ■ **NeuroEmpathy**
Full project title ■ **Towards a neuroscience of empathy: shared circuits for actions, emotions and sensations**

Type of grant ■ **Excellence Team**
Budget ■ **EUR 1.34 million**
Duration of project ■ **01-06-2006 - 31-05-2010**
Scientific discipline ■ **Life sciences**

Lead partner ■ **Prof. Christian Keysers, PhD**
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OESTROGEN RECEPTOR

The average European dairy cow produces 6 000 kg of milk per year. The substantial increase in milk yield over the past few decades is, however, an achievement that comes with a price: dairy cows all too often succumb to reproductive disorders. Marie Curie Fellow Dr Manel López-Béjar suspects that certain growth factors have a role to play here.

Food, feed and fertility

Since a cow only produces milk after calving, fertility is important to dairy farmers. Usually, cows are bred at intervals of 12 to 14 months to keep the milk production level at an optimum – about 305 days after calving, the cow will stop giving milk. As the cow will give birth again around 60 days later, the intermediate, non-lactating period is very short.

The quest for ever-higher yields through selective breeding and other techniques may be profitable in the short term, but in the long run it can have a number of negative effects that will cost the farmer money and, of course, endanger the animal's health and welfare. The European Food Safety Authority (EFSA) has called for changes in the criteria used for genetic selection in the dairy industry.

The costs of the quest for higher yield

Persistent and possibly fatal infection of the cow's mammary glands (mastitis), lameness due to 'high-performance' feeds containing high levels of carbohydrates, and sinking production levels are just some of the adverse impacts of focusing on nothing but yield. The farmer's response is often to send the cow to the slaughterhouse. Infertility, too, is among these side effects: a cow is most fertile between 60 and 80 days after calving. If it has not conceived by the end of this period, it becomes more and more difficult to breed from it.

'The decline in fertility can largely be attributed to ovarian disorders which may be produced by an inadequate response to the high nutritional demands of the lactation period,' explains veterinary scientist Dr López-Béjar of the Autonomous University of Barcelona in Spain. 'Nutritional status is a major factor in controlling fertility in cattle during their reproductive years.'

This applies to cattle and humans alike. 'Over-nutrition is generally associated with poor reproductive performance, in addition to other anomalies such as metabolic disorders,'

says Dr López-Béjar. Underlining how his findings might have implications for human medicine, he adds, 'Under-nutrition, on the other hand, can lead to anovulatory infertility in women, where the ovaries fail to release a germ cell. Similarly, a prolonged negative energy balance in cows affects follicular growth and development.'

The regime of a ruminant

While many dietary factors can impact upon fertility-related matters in cows, the Oestrogen Receptor project focused on the link between growth factors and fertility. Usually, the term 'growth factor' refers to a protein or hormone that stimulates cellular growth. Some growth factors, first and foremost the insulin-like growth factor (IGF), play a role in regulating ovarian function, uterine and placental growth and early foetal growth during pregnancy. 'The IGF system is related to nutritional and metabolic processes in both animals and humans,' Dr López-Béjar says. 'Our hypothesis is that the IGF system regulates ovarian function throughout activation of the oestrogen receptor. Therefore, the oestrogen receptor could be an indirect marker of fertility.'

Using the research conducted during a previous Marie Curie Fellowship at the University of Nottingham in the UK as a starting point, Dr López-Béjar found further evidence of the intricate link between fertility and the insulin-like growth factor system. His findings indicate that an animal's feed might indeed be part of the solution to infertility in dairy cows, and that by adapting nutritional content, farmers may be able to bring the problem under control. What is more, *'the results are directly relevant to other species'*, including certain human ovarian pathologies involving abnormal follicular maturation,' Dr López-Béjar stresses.

A smooth start back at home

Excellent research conditions, direct collaboration with outstanding institutions and exceptional scientists have all contributed to this outcome, which may be of interest outside the dairy industry in light of the possible solutions to human infertility problems that could surface as research progresses.

These ideal work conditions might not have been as easy to set up without support from the Marie Curie programme, Dr López-

Béjar believes. 'The Marie Curie grant allowed me to develop an outstanding research project with excellent financial support when I came back to my original university,' he explains. 'It was a determining factor for me being professionally reintegrated into my country of origin after my stay in the UK, and that reintegration included transnational mobility.' This is a point that can be particularly trying in many scientists' careers. The attempt to build and make further progress on research started abroad as part of Marie Curie or other programmes may often be suppressed by everyday tasks back home, where teaching or other projects might take priority.

In addition, he says that the grant allowed him to improve his skills for managing research projects. His new, enhanced skill set surely improved his standing when he returned to Spain, where he is now dean of the Faculty of Veterinary Medicine at the Autonomous University of Barcelona. 'At present, I have a permanent position at the university,' Dr López-Béjar adds. 'For that, I am in debt to the Marie Curie Actions that I was able to enjoy.'

Speaking as a researcher who has twice been successful in applying for Marie Curie grants, Dr López-Béjar advises any

peers who attempt to secure one for themselves should be well prepared, 'because it is a very exigent call.' As a last piece of advice, he adds: 'Do not choose your host institution on the basis of its scientific excellence alone, but also take human and educational values into consideration. And finally: *enjoy the work, research is a fascinating profession.*'

Project acronym ■ Oestrogen Receptor
Full project title ■ Growth factors and ovarian function in cattle.
The IGF system and the oestrogen receptor

Type of grant ■ European Reintegration Grant
Budget ■ EUR 40 000
Duration of project ■ 01-09-2004 - 31-08-2005
Scientific discipline ■ Life sciences

Host institution ■ Universitat Autònoma de Barcelona
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PAPHOS

In 1870, Jules Verne wrote about the mysteries of the deep ocean, but almost 140 years later, what goes on beneath the waves remains a puzzle. Dr Hélène Agogué dived into the depths of this little-known world to find out more about one particular aspect of sea life – microbes and their impact on ecology.

Up close with plankton, 20 000 leagues under the sea

The esteemed Netherlands Institute for Sea Research was the setting for Dr Agogu  s Marie Curie project, known as Paphos. Her mentor was microbial oceanography expert Professor Gerhard Herndl. She arrived in the Netherlands from her native France fresh from her PhD in sea surface bacteria at the University of Lyon I. There she joined a team investigating the role and make-up of microbial communities in the depths of the North Atlantic waters.

Replenishing Earth

The movement of matter within or between ecosystems, whether it is caused by living organisms, geological forces or chemical reactions, is known as the biogeochemical cycle.

The cycle allows all elements, such as nitrogen and oxygen, to be recycled. In this way, the Earth replenishes itself time and time again.

Knowledge about how these processes work will help scientists to understand the entire Earth system better and to keep an eye on the delicate balances that keep it functioning. A wealth of literature is available on the levels of carbon dioxide in the atmosphere. But since the same amount of organic carbon is stored in the deep ocean, the mysteries of the deep deserve a little more attention.

‘Only when we have an improved knowledge of deep ocean carbon cycling will we be able to make educated predictions on the role of the deep ocean in the carbon budget of the Earth system,’ says Dr Agogu  . A better understanding of the components which make up the carbon balance may help policy-makers take the decisions needed to sustain it.

Marine life, and specifically microbe behaviour, is the scientist’s secret weapon in measuring both the underwater production and consumption of carbon.

Minuscule communities under the sea

Prokaryotic plankton, sometimes known as the 'drifter', lives in our oceans and is an important ingredient in the diet of many fish. This wandering organism is also recognised as a major player in the ocean's biogeochemical cycles. Much was already known about the abundance and diversity of the plankton communities in surface waters, but what they get up to in deeper waters – the remaining 80 % of the ocean – remained a mystery, until now. Paphos focused on the mesopelagic (200 to 1 000 m below the surface) and bathypelagic (1 000 to 5 000 m) zones of the Atlantic.

'It has been shown that planktonic archaea, consisting of two major groups, might actually account for about one-third of all prokaryotic cells [organisms without a cell nucleus] in the global ocean. However, we still do not know the diversity and functional importance of this archaeal community in deep waters and whether [the plankton] are important players in the biogeochemical cycles of the open ocean system,' explains Dr Agogué.

To find out, samples were collected from a range of stations and depths in the eastern North Atlantic Ocean. The expeditions, named

after the Greek mathematician Archimedes, took place between 2005 and 2008. Dr Agogué used advanced techniques including cloning to get a clear picture of what exactly was included in this archaeal community.

At home with plankton

One key finding was that the location of the water from which the sample was taken significantly changed its plankton content. Indeed, the location had more influence on the types of planktonic archaea found in it than did the depth at which it was collected.

The team found evidence of a pronounced stratification of the plankton communities, with distinct sub-surface, meso- and bathypelagic clusters. And the microbial community was also found to be metabolically active, meaning that they release their enzymes into the ambient water and utilise organic matter for growth.

'The findings we have made indicate that our knowledge of deep-ocean carbon cycling is still in its infancy,' says

Dr Agogu . The new insights gained from the project were presented to the world in an article written by Dr Agogu  and published in the prestigious journal *Evolution*. She considers this one of her key achievements during the Marie Curie Fellowship.

Returning to familiar shores

After finishing her postdoc in the Netherlands, Dr Agogu  returned to France where she completed a one-year fellowship at the University of La Rochelle. She has also been offered a permanent position in the Institute for Coastal and Environmental Science. The position will be financed by the French National Centre for Scientific Research, the largest government research organisation in France.

Dr Agogu  believes that the Marie Curie Fellowship was instrumental in her current career success.

'This project with the Herndl group allowed me to obtain experience in project management and to present the results of my research at international meetings, since the project

supervisor and his entire group were very international, with researchers coming from five different European nations. Also, the time I spent in this laboratory allowed for an exchange of knowledge and techniques beneficial for both the Netherlands and the French marine microbiology community.'

Of course, much of her success can also be attributed to her hard work and positive attitude. *'Science must be a passion; a career in science is built on perseverance and patience but also the willingness to "leave home" and learn new things.* Don't be afraid of asking to be supervised by a famous professor – working within such a group will allow you the opportunity to expand your professional network,' she advises.

Project acronym ■ Paphos
Full project title ■ Prokaryotic activity and phylogeny of oceanic systems

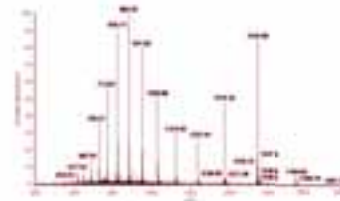
Type of grant ■ Intra-European Fellowship
Budget ■ EUR 149 926.22
Duration of project ■ 01-05-2006 - 30-04-2008
Scientific discipline ■ Environment

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STRUCTURAL BIOLOGY



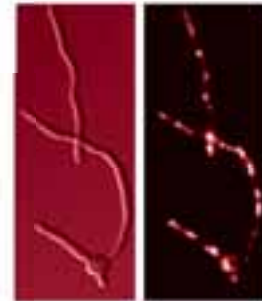
IN VITRO ANALYSIS



BIOINFORMATICS



CELLULAR BIOLOGY



PENELOPE

Penelope, the wife of Ulysses in Homer's *Odyssey*, wove and unwove a shroud while awaiting the return of her husband. Taking inspiration from the Greek epic, researchers in the Penelope project are unravelling the complicated web of protein interactions that make up the cells of living things. They want to understand the basic principles of life and the underlying causes of diseases like cancer.

Unravelling the basic principles of life

The focus for the Penelope team is the study of protein interactions in yeast strains and how these evolved over time as a means of shedding light on the fundamental molecular mechanisms of cellular networks. 'Nowadays, after the deciphering of the human genome, we know the components,' says Michela Bertero, the project manager. 'The next challenge is to understand their interactions.'

Penelope received Marie Curie funding as a research training network. This allowed the project to recruit 16 young researchers for whom the work marks a first plunge into basic research.

A network of proteins

Proteins, lipids, DNA, RNA and small molecules that make up cellular components interact through what Dr Bertero calls the 'interactome network'. Diseases such as cancer occur when

these cellular components malfunction, changing how they interact. Comprehension of protein-to-protein interactions will take scientists some way towards understanding cellular health, she says.

Penelope focuses firmly on four yeast species whose cellular structures have evolved over one thousand million years. The researchers are characterising their known protein interactions whilst looking out for any previously undetected ones. Using the four yeast genomes, they are unravelling networks mediated by so-called 'SH3 domains'. Commonly found in the eukaryotic genomes (membrane-covered cells) of animals, SH3 domains are small 'pieces' within a protein that are involved in many protein-to-protein interactions relevant for different biological processes.

'Comparative analysis across the four genomes will allow us to investigate how new interactions were added to their networks as well as how others were lost over time,' says Dr Bertero. 'By understanding SH3-mediated protein-to-protein interactions in a model eukaryotic organism, Penelope will greatly contribute in giving unprecedented insights into important biological processes.'

Training and travel

For the Fellows, Penelope is a means of gaining extensive interdisciplinary experience. A fellowship really can boost a career, as attested to by Penelope coordinator, Professor Luis Serrano.

Early on in his career, Professor Serrano wanted to change his specialisation from population genetics to the study of protein engineering. A Marie Curie Training and Mobility Fellowship award allowed him, a Spaniard, to move to London for one year to work at the laboratory of Professor A. R. Fehrst, a pioneer in the field. He then followed Professor Fehrst to the University of Cambridge for three years.

During his fellowship, Professor Serrano wrote eight ground-breaking papers, leading to numerous citations by other researchers. Recognition of his work included a Marie Curie Excellence Award.

After founding a number of successful start-up companies, he is now back in Spain as head of systems biology for a joint programme of the European Molecular Biology Laboratory (EMBL) and the Centre for Genomic Regulation (CRG).

Sharing wisdom

Professor Serrano is now ready to pass on his experience. Penelope's senior scientists organised various workshops, combining

hands-on sessions with open discussions and theoretical lectures. The young researchers have also received on-the-job training in genetics and genomics, and training in the use of software tools to simulate how cell networks operate.

In addition, the network's training programme has included sessions on the 'soft' skills the young researchers will need to advance professionally. One such session helped them to write their first scientific paper; it was co-organised with Holger Breithaupt, an editor working for the scientific journal *EMBO Reports*.

Many of the Fellows have found one of the most rewarding aspects of the project to be the opportunity to travel to the various research centres involved. PhD Fellow Erik Verschuere from Belgium has taken up a post at the Centre for Genomic Regulation in Barcelona, Spain. He cites the opportunity to work with researchers from different countries and with different scientific backgrounds as a major benefit.

'Working on such a large interdisciplinary project is not always easy,' he acknowledges. 'But it makes me aware of how ambitious goals can be achieved by combining efforts and complementary skills.'

Coordinating research across Europe...

Sia Jorde from Sweden moved to the Carlsberg Laboratory in Copenhagen, Denmark. 'The Marie Curie programme has offered

me the possibility of working in a variety of countries within the EU and has given me the opportunity to make valuable connections and friends at other institutions,' she says.

Fellow Swede Patrick Reijntj, also at the Carlsberg Laboratory, agrees and adds: 'The Marie Curie programme has built bridges and opened doors to a number of new opportunities.'

Swiss PhD Fellow Matthias Spiess moved to the Centre National de la Recherche Scientifique in Strasbourg, France. 'The Penelope project ... gave me the opportunity to learn new laboratory techniques and to discuss scientific problems and possibilities with a broad range of interesting and qualified people,' he explains. 'This helped me a lot with my own thesis and led to the formation of networks and new friends who might be my scientific collaborators in the future.'

...and beyond

Avula Tejakalyan from India took up a Marie Curie Fellowship at the Academic Medical Centre in Amsterdam, the Netherlands. 'The Penelope project is very dynamic, international and multidisciplinary in different areas of molecular sciences and it has provided me with a unique opportunity to train for being a future scientist,' he says.

Scientific achievements have already moved Penelope closer to the final goal of mapping protein interactions in cellular networks. And new collaborations have been established within and outside of the project, says Jürgen Wendland of Carlsberg Laboratory.

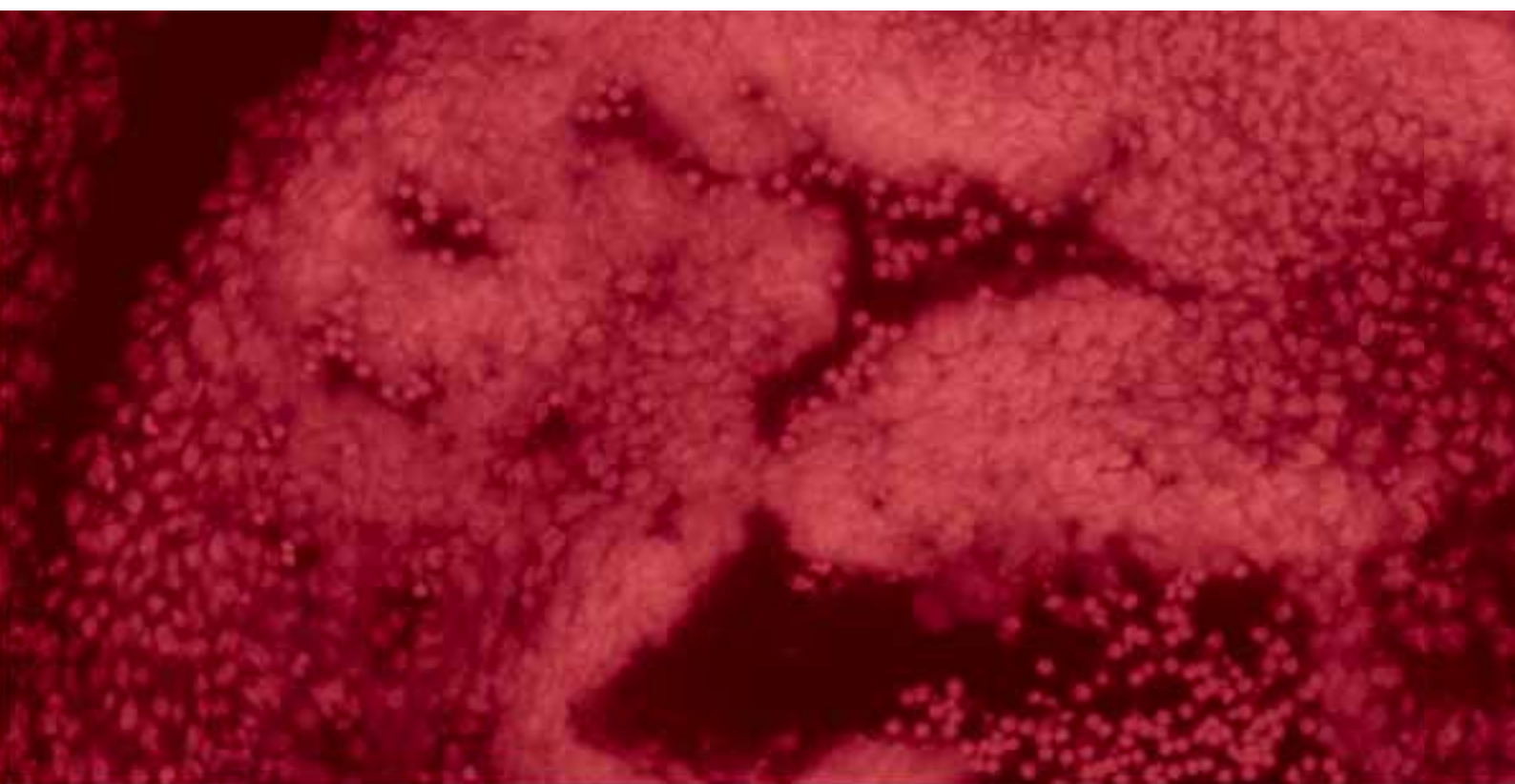
'The Marie Curie research network provides a platform for international collaboration on topics that no individual group could accomplish itself,' he says. *'Encouraging secondments and travel between the groups helps to forge a new generation of scientists who think internationally, and thus helps to reduce the boundaries in a future Europe.'*

Project acronym ■ Penelope
Full project title ■ Evolution of protein-interaction networks: the SH3 network in yeast species

Type of grant ■ Training Network
Budget ■ EUR 2 900 000 (maximum European Commission contribution)
Duration of project ■ 1-04-2007 - 31-03-2011
Scientific discipline ■ Life sciences

Lead partner ■ Prof. Luis Serrano (coordinator, luis.serrano@crg.es)
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Other partners ■ Academisch Ziekenhuis bij de Universiteit van Amsterdam, Netherlands - Instytut Biochemii i Biofizyki Polskiej Akademii Nauk, Poland - Centre National de la Recherche Scientifique, France - Carlsberg Laboratory, Denmark - Biozentrum University of Basel, Switzerland - European Molecular Biology Laboratory, Germany



PUMPING UP THE HEART

Many researchers dream of running their own laboratory. Dr Daniele Catalucci, a specialist in biomedicine, has achieved this and more. Collaborating with scientists in hospitals and laboratories in Europe and the USA, he has been deciphering the secrets of heart function on the molecular level. In particular, he and his colleagues are developing non-invasive treatments for heart failure, which remains a major killer in Western societies.

Unlocking the secrets of heart function

Heart failure, not to be confused with a heart attack, happens when a person's heart can no longer supply enough blood flow to meet the body's needs. According to Dr Catalucci, the condition affects more people than you would expect in Western societies – between 5 and 10 people in 1 000 experience heart failure every year.

Often attributed to lifestyle and diet, heart failure affects a disturbingly high number of people over the age of 50 and is the leading cause of hospitalisation for this age group. It is therefore regarded as placing a heavy burden on the healthcare systems of Europe and the United States and, accordingly, a lot of time and money has been put into researching its causes.

In past decades, thousands of peer-reviewed studies of the condition have shown that heart failure is not brought on by a single mechanism, lifestyle factor or sequence of events. At the

moment, the understanding is that something triggers a chain of events that makes the chambers of the heart lose their ability to pump blood efficiently. The body then tries to compensate, increasing the actual size of the heart; this temporarily restores the heart's function. But while this enlargement gets the blood moving again, in the long run it causes secondary heart damage.

Dr Catalucci and his lab are trying to answer questions about what happens at a molecular level between the triggering event and heart enlargement (called the 'asymptomatic' phase), and the secondary damage that leads directly to heart failure (called the 'symptomatic' phase). His hope is that understanding the molecular mechanisms involved in these transitions will provide key knowledge that may unlock new, more effective therapies than heart transplant. At the moment, getting a new heart is the only viable treatment for heart failure.

Pathways of discovery

The molecular mechanisms behind the heart's function are controlled by signalling pathways. In a signalling pathway,

biochemical reactions take place in cells that change one kind of stimulus, or signal, into another very rapidly. These reactions are often carried out by enzymes. Dr Catalucci uses protein and enzyme analysis together with computer-based modelling and *in vivo* models to see what is going on in the heart.

His recent research focused on the signals involved in the insulin/IGF-1 pathway. This pathway routes signals that regulate the physiological contraction of the heart and is crucial for cell division and growth, gene and protein synthesis, and cell death. Damage to this is a major cause of heart failure. Dr Catalucci looked specifically at the importance of this pathway and small RNA molecules (microRNAs) in modulating heart function; past studies have shown that microRNAs, whose signal controls protein production, are involved in the regulation of cardiac development.

Dr Catalucci's studies in the US and Italy shed light on what can happen when there is intervention within this pathway. The results led him to believe that correct cardiac function may be re-established if appropriate molecules can be developed.

'So far, results from my studies have provided strong potential for the development of novel therapeutic approaches that have

also resulted in patent applications, thus highlighting the very high relevance that scientific research can have,' says Dr Catalucci.

Creating a common research ground

Thanks to a Marie Curie Fellowship, Dr Catalucci was able to complete his postdoctoral training in the USA after obtaining his doctorate from the University of Rome in Italy. Working at the University of California in San Diego, under the supervision of Dr Kenneth Chien, his postdoc research in cardiology provided him with the invaluable technical expertise that made his current research possible. The learning was by no means one way: he managed and coordinated the lab while, at the same time, tutoring students in laboratory techniques.

'I gained extensive experience with several *in vitro* and *in vivo* techniques used in molecular cardiology, including cellular and molecular biology, biochemistry, physiology and bioinformatics amongst others,' he explains.

Supported by a community of leading experts in cardiology and biomedicine, the post also offered him the opportunity to

co-author scientific papers in important journals (the *Journal of Cell Biology* and *Nature Medicine*, for example). In terms of career development, this is essential, as publications such as these can provide a great opportunity to stake a claim in the academic research community. Perhaps more importantly for Dr Catalucci, the access he gained to this community and the network-building opportunities provided also led to several fruitful collaborations.

'I have had the great opportunity to develop a network of collaborations that goes beyond a specific project and aims to improve the understanding of the principal mechanisms in cardiovascular development, physiology, and medicine,' he says. *'The sum of this has been to establish a strong basis that led my own line of research back in Europe.* These collaborations have not been lost, but form a solid network base for me back in Italy.'

In addition to the support he received in the USA, Dr Catalucci stresses the importance of the mentoring he had back home in Italy, in particular the fruitful working relationship he continues to have with Professor Condorelli.

Since 2007, Dr Catalucci has been a researcher at the Institute of Biomedical Technology of the National Council of Research (CNR) in Milan, Italy, and has built his own research group in collaboration with the private hospital MultiMedica in Milan.

'The experience has allowed me to develop a critical mind for investigation and given me the confidence to become an independent investigator as well as to develop my own line of research in a new and challenging scientific environment,' he says, referring to the opportunity afforded him by the Marie Curie Fellowship.

Dr Catalucci's group relies on a combination of public and private funding to investigate new ways of looking at heart failure that could well lead to life-saving interventions.

Project acronym ■ Pumping up the Heart

Full project title ■ Molecular mechanism of Akt-induced myocardial contraction

Type of grant ■ Outgoing International Fellowship

Budget ■ EUR 245 652.68

Duration of project ■ 01-11-2004 - 31-10-2007

Scientific discipline ■ Life sciences

Host institution ■ Prof. Gianluigi Condorelli

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SEMEAI

Outside the obvious green job sectors, such as recycling or renewable energy, business and the environment may not seem like areas with a lot of common ground. Environmental initiatives cost money, they do not make money, or so the thinking goes. Renato J. Orsato believes that this is where many people are wrong. In his Marie Curie project, he asked: 'When does it pay to be green?'

Let's get down to green business

Dr Orsato collected more than 30 industry case studies from Australia, Brazil, Europe and New Zealand for his research in the Semeai project. These include both successful examples of environment-related investments, and less successful ones. His analyses clearly showed that it does pay to be green – but only under certain conditions.

Define 'green'?

'You have to be very clear about what you mean by "green",' Dr Orsato emphasises. 'What is the type of eco-investment you're talking about? Are you talking about reducing the emissions of your factory by doing some eco-efficiency, obtaining a certified environmental management system for your processes, developing an eco-brand, investing in bio-polymers?'

In addition, there is the small matter of defining 'pay'. Depending on whether a company only counts financial returns as adequate payment or whether it also takes intangible aspects into consideration, such as reputation or the value of a brand, it will, or will not, perceive an investment as worthwhile. These aspects all play a role in answering the green question, as do time frame and location.

In the early 1990s, a Scandinavian supermarket chain found a positive answer to the question: the company successfully established one of the first eco-brands worldwide. The brand, covering over 250 eco-friendly products, is one of the case studies that fuelled Dr Orsato's research. He concluded the key to success of that ecological differentiation was the difficulty for competitors to imitate the eco-brand. At the same time, 'the information about the products was not controversial', Dr Orsato adds. 'You cannot sell Argentinian honey in Sweden and think that that's environmentally friendly.' Finally, the consumer must be willing to pay a price premium for ecological differentiation. All conditions were fulfilled by the Scandinavian eco-brand and contributed to its success. But, of course, as Dr Orsato explains, eco-branding is only part of the answer, as it is better

suited to some companies than to others, depending on the inherent nature of their products or services.

Sustainability strategies are choices

This is why Dr Orsato's theoretical framework builds on a total of five sustainability strategies: eco-efficiency, beyond-compliance leadership, eco-branding, environmental cost leadership and sustainable value innovation. While 'eco-efficiency' essentially entails optimising the overall use of resources, 'beyond-compliance leadership' implies that a company is willing to do more than the industry average to promote green operations. 'Eco-branding' strategies are applied to niche markets, in which consumers are willing to pay price premiums for eco-differentiation. 'Environmental cost leadership' ultimately means selling a product leader in environmental performance, but competing on low price only. Finally, 'sustainable value innovation' allows companies to bypass competition altogether by creating products and services that present both low environmental impact and cost while giving customers and society good value. For a company to obtain returns from eco-investments, managers

need to consciously choose the strategy best suited to the business context and its internal capabilities.

Dr Orsato has now compiled this theoretical framework, backed up by a number of cases he studied during his Marie Curie Fellowship at the University of Technology Sydney in Australia, into a book. While his current employer, the business school INSEAD in Fontainebleau, France, supported him in the final stages of the writing and publication process, it was his Marie Curie grant that facilitated the bulk of the work.

He hopes that *Sustainability Strategies: when does it pay to be green?* will also serve as a textbook in an MBA course he is developing for INSEAD, as well as in other programmes in America and Scandinavia. ***'There was a lack of studies and, consequently, materials to teach the relationship between business and the environment,'*** he explains. ***'Hence, the rationale for my research.'***

His is a multidisciplinary approach to the world of business, situated at the intersection between business and the environment. The Marie Curie grant enabled Dr Orsato to follow through with his unusual, multidisciplinary approach and demonstrate how

being green can become an asset for a company, rather than a burden. *Marie Curie 'enabled me to immerse myself in the study of a subject without the hassle of having to look for money in the short term,'* he says. 'Having these three years to reflect and collect the case studies and do the whole process was really helpful. In the end, I was able to dig deeper than I would have been able to if I had had to teach to support myself and my research the entire time.'

He was able to take his research much further than even he had thought possible when he submitted the proposal. Although initially his study's scope had been limited to Europe and Australia, his fellowship and contacts enabled him to collect valuable data from companies in New Zealand as well as Brazil.

It's all about making a difference

After his break from the classroom, he is keen to return to the world of education. He hopes that the MBA course and teaching materials he is working on will ultimately help 'bring sustainability issues to the mainstream of business schools'. This scientist, with mixed Italian and Brazilian heritage, wants

to catalyse changes in the business community where, from his experience, sustainability issues are still rarely more than a note in the margin.

But this, of course, is just one aspect of Dr Orsato's personal bid to make a difference for the sake of environmental protection. 'I'm always preoccupied with the impact of what I do,' he says. 'Maybe it's because I'm Brazilian. I'm preoccupied with the Amazon or other parts of that country, its environment. I think that was my departure point for this journey. My main concern is how you can really use knowledge to make a difference in terms of creating a truly sustainable global society, reducing poverty, and helping development in general. We are running out of time here.'

Project acronym ■ Semeai

Full project title ■ Strategic environmental management at European and Australian industries: 'when does it pay to be green?'

Type of grant ■ Outgoing International Fellowship

Budget ■ EUR 287 488

Duration of project ■ 01-07-2004 - 30-06-2007

Scientific discipline ■ Economy

Host institution ■ INSEAD


Boulevard de Constance

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A background image of an industrial landscape at sunset. On the right, a large, curved, metallic structure, possibly a cooling tower or part of a power plant, is visible. In the center, a tall, thin tower with a lattice structure stands against the sky. The sky is a mix of blue, orange, and yellow, with some clouds. In the foreground, there are some industrial structures and a fence.

INDUSTRY IMPORTANCE

Increasing our knowledge of the universe, nature or humankind is probably the noblest endeavour researchers can have. Exploiting that knowledge to improve everyone's life and make the outcomes of science accessible to all is equally important. Marie Curie Actions recognise the important role commercial exploitation plays in the research community. That is why the Actions recognise the importance of both the public and private sectors.



Building bridges between academia and industry

Imagine the loss for humankind if Denis Papin's invention, the piston steam engine, had remained unknown to Thomas Savery and Thomas Newcomen. It is unlikely they would have commercialised their first steam machine in 1712, and we would not have benefited from one of the major inventions to shape the modern world.

A free flow of knowledge

What was true then is even truer today: any advance in technology or medicine is the result of the commercialisation of scientific results, also known as transfer of knowledge. And that is not all – exploitation of research results benefits society not just because of the end product, but also because it creates new jobs.

Knowledge transfer is about transmitting knowledge, expertise and skills to where they can be best exploited to the benefit of society or the economy. It can take a number of forms, including patents, licensing agreements, publications, the creation of spin-off companies and researcher mobility.

The flow of knowledge is not limited to one direction. Traditionally, knowledge transfer involved researchers in universities passing knowledge to industry partners who could then use it to make a profitable product. Everyone is a winner in this 'game'.

For universities, the benefits are more than financial. For example, working closely with private companies helps them to ensure their research meets the needs of industry and society. Research collaborations with the business world can also lead to a rise in the quantity and quality of research carried out in universities.

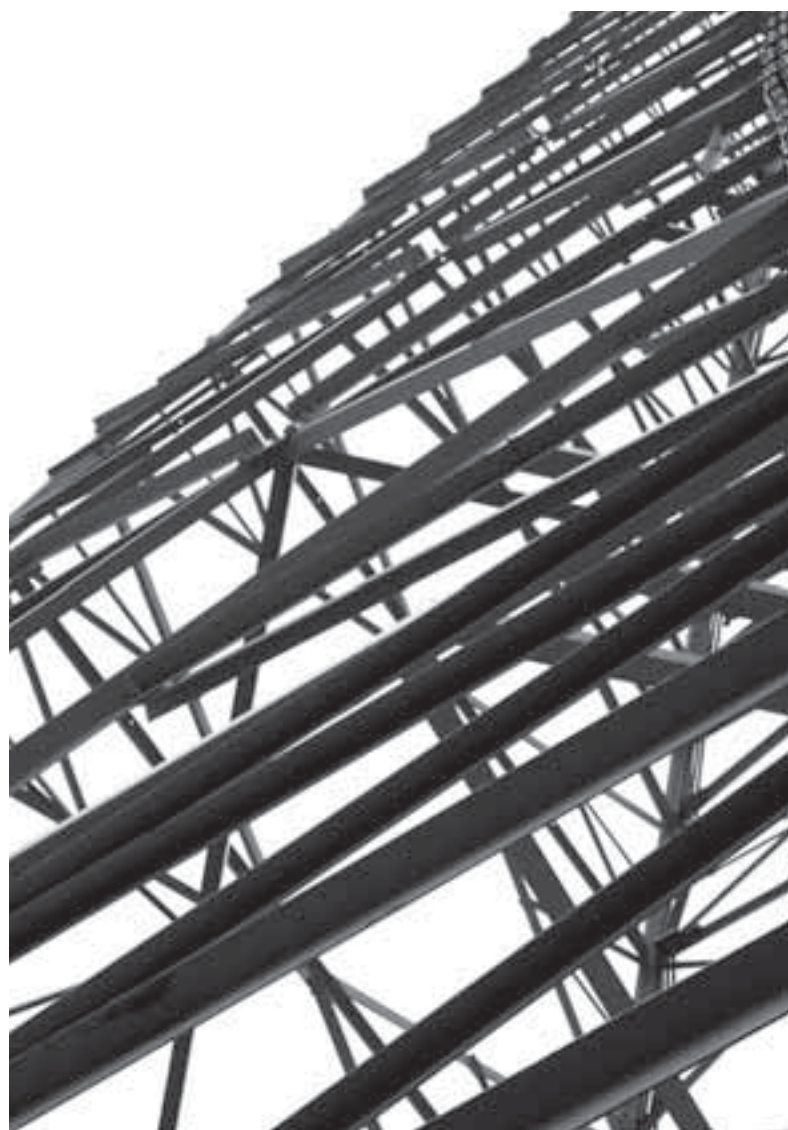
For industry, developing a more systematic way of transferring knowledge helps companies to tap into the knowledge generated in universities more efficiently.

Everybody benefits from knowledge transfer: as well as speeding up the introduction of new products and services to the market, it creates new jobs and companies and helps to boost development at both local and regional levels.

Marie Curie, the matchmaker

Marie Curie Actions are boosting knowledge transfer in Europe in a number of ways. A dedicated Action forges strong links between universities and businesses through the exchange of research staff and the organisation of networking events such as workshops and conferences.

In addition, all Marie Curie Fellows are encouraged to engage with industry during their fellowship. Even those carrying out fundamental research must be open to considering the possible economic and societal applications of their work. Raising young researchers' awareness of industry also gives them the opportunity to consider a career in private sector research.



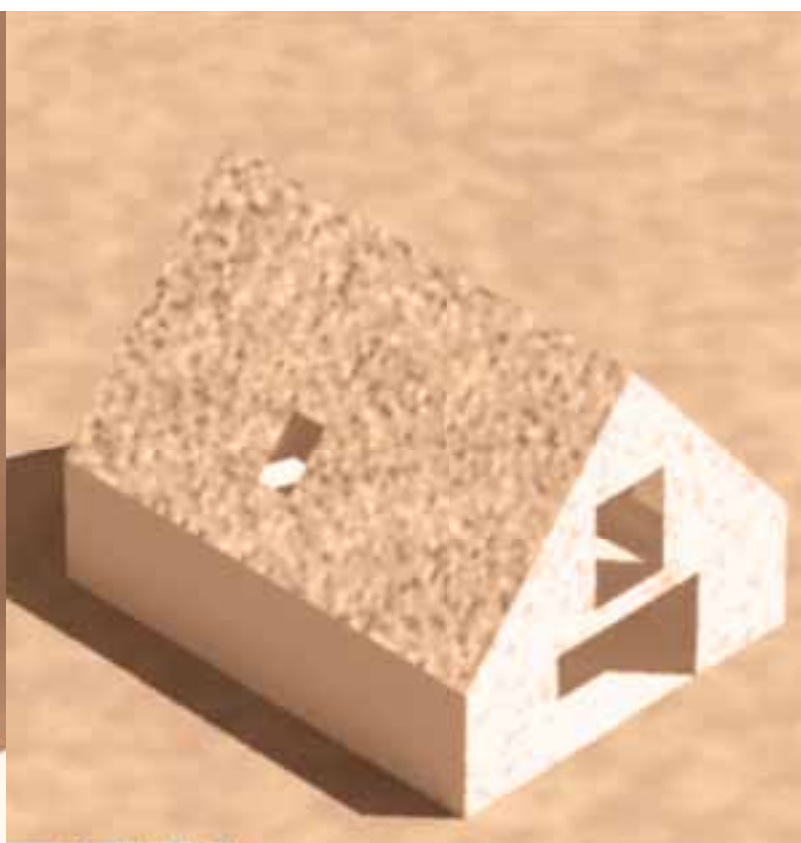


Fellows study complementary subjects such as entrepreneurship, intellectual property and research management, all of which will help them to improve their interactions with industry. Furthermore, many Fellows opt to spend it within a private company.

In recognising the important role industry plays, the Marie Curie Actions also include industry representatives on the panels that evaluate project proposals.

All of these activities serve to both raise researchers' awareness of industry's needs and, crucially, create personal links between researchers in academia and industry. Marie Curie Actions mainly take care of the human factor of knowledge transfer. Other aspects need improvement, too, such as the amount of money available for investment in the transfer of knowledge.

The following pages feature projects in which industry plays a full and active role, to the benefit of all involved.



CAB

Marie Curie Fellows working under a remarkable architectural design and construction project have made important advances in the area of computer modelling and simulation, bringing together crucial but often separate expert and industrial communities to improve environmental performance in the building process.

All join hands, new software helps streamline building

The EU now boasts the largest single economy in the world, but tough economic times and stiff competition mean companies, including builders, must keep costs low and productivity high in order to survive. More can still be done to streamline the building process and, ultimately, to make it more environmentally friendly – from early design phases straight through to construction and maintenance.

‘Computer-aided simulation in the construction industry is used increasingly by building physicists, and heating, ventilating and air-conditioning professionals,’ explains Roman Rabenseifer of the Slovak University of Technology in Bratislava. ‘Here at the Department of Building Structures in the Civil Engineering Faculty’, he says, ‘we have experts with knowledge that could make a big difference in the building industry.’ But powerful tools like computer models and simulation software, he adds, are still largely ignored

by architects and designers in the initial phases of building design, when many of the most important decisions are made.

Getting architects to use the latest software-based tools could make a big difference in the construction industry as a whole, allowing time and cost savings, and increasing overall European competitiveness.

Helping architects to help themselves

Under the ‘Computer-aided building physical modelling’ project, the Marie Curie programme funded eight Fellows working to create new software tools that would help in the application of existing knowledge to the renovation of buildings.

‘We wanted to take the kind of information generated by very technically oriented people, such as thermal physicists, and put it in the hands of architects and designers who tend to work in a more intuitive way,’ says Dr Rabenseifer. ‘Doing so would provide *a strong boost in terms of knowledge transfer, helping these important communities understand each other and work more in concert.*’

The project achieved some major milestones. Cooperating with several project partners, including academic bodies, city planners and a number of architectural and consulting companies, the team developed a generic model for the assessment and optimisation of home design and renovation. The intention was to reduce the distance between architects and existing complex software tools, making the manipulation of vital design data easier and more understandable. Basic physical laws represent boundaries that are programmed into the modelling software. Then, users can input design parameters, including volume and area, climate data, construction type and quality, heating and cooling system characteristics and operational features.

And there's more

The team also developed two detailed reference building physical models, simulating a typical building targeted for renovation in the city of Stuttgart. 'These models will be extremely useful to designers during the building energy certification process,' says Dr Rabenseifer. 'The result should be a significant improvement in the quality of renovation proposals and a reduction in the time necessary for the preparation of energy certificates.' Meanwhile, he affirms, computational accuracy will be maintained, or even improved.

Finally, the project team developed a similar simulation model to aid in the renovation of a large grammar school in Slovakia. This particular model enables designers to assess the renovation process from a broad variety of viewpoints. This includes the ability to calculate daylight availability, summer overheating and shading effects, heating and cooling energy demand, the effects of natural ventilation and fire safety parameters. One of the key achievements for the project was to see this simulation tool used in a demonstration of best practices in the renovation design of public buildings.

'Our new models make it possible to perform a high number of calculations very quickly, while easily, even automatically, varying any number of selected parameters,' Dr Rabenseifer adds.

Boosting careers, winning contracts

During the project, all Marie Curie Fellows obtained extensive training in computer-aided modelling and programming, significantly improving their skill bases and solidifying their future prospects in an important research field.

After they returned to their home institutions, the Fellows took part in the development of physical models and templates in

cooperation with appointed researchers. Training was capped by a two-week final seminar at STU Bratislava's Faculty of Civil Engineering at the end of the project. The purpose of this seminar, says Dr Rabenseifer, was the improvement and refinement of Fellows' skills after they had gained some practical experience.

Aside from the development of new software tools, some key observations were reported during the project. For example, project partners used the new optimisation models to demonstrate the extent to which thermal insulation thickness influences the reduction of heating-energy demand in low-energy and passive houses, a very important finding of this project.

Opening new doors

'Importantly, the newly developed generic model for assessing home renovation has been a key asset for the university', says Dr Rabenseifer, 'allowing us to win a new industrial research contract with a major European manufacturer of double façades and curtain walls.'

In addition, knowledge and experience gained during the project helped the Slovak academic research partner to successfully implement several European standards, including EN ISO 10456 on the hygrothermal properties of building materials and products.

Dr Rabenseifer says he is now deeply involved in follow-up research on double-skin façades and curtain walls. Meanwhile, Marie Curie Fellows Enikő Sallai and Milan Janak have been engaged by industrial partners.

'These researchers are specialists in computer-aided building physical modelling with extensive experience and knowledge of relevant standards. *They [MC Fellows] are now helping their companies to develop tailored computer models of particular building types and templates of building details,*' says Dr Rabenseifer, emphasising how the Marie Curie Fellowships have helped the researchers get ahead.

Project acronym ■ CAB

Full project title ■ International computer-aided building physical modelling

Type of grant ■ Industry Academia Partnership

Budget ■ EUR 235 000

Duration of project ■ 01-09-2006 - 31-08-2008

Scientific discipline ■ Engineering

Lead partner ■ Dr Roman Rabenseifer

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Other partners ■ APLAN, Slovakia - EEB, Slovakia - Konieczny Architekten und Stadtplaner, Germany - Physibel, Belgium



ENZYMAT

Enzymes are biomolecules that catalyse many chemical reactions in living organisms. The chemical industry, too, has discovered their catalyst nature. They are used in contact lens cleaners, for example, and even baby foods. But Marie Curie Fellow Chris Duxbury has chosen to take his studies down a different road: smart plastics that can change their properties thanks to an enzymatic reaction.

Cooking up new materials for biomedical applications

Enzyme-responsive materials (ERMs) are what Chris Duxbury's Enzymat project is all about – materials into which enzymes are mixed to trigger a specific reaction. For instance, ERMs can swell or collapse or turn from a solution into a gel. One advantage of enzymes as catalysts is that they are very specific: they fit the reaction they were designed for like a key fits into a lock. Moreover, they are environmentally friendly and can replace potentially toxic catalysts based on heavy metals.

Smart and even smarter plastic

Dr Duxbury's research resulted in a plastic with different degrees of hardness: 'The material that I made softens when you heat

it,' the Englishman explains. 'You can change the temperature it softens at depending on the initial programming you put in the material.'

Basically, the 'programming' determines how far the reaction proceeds: 'The degree of the response produced by the material was encoded into the material during its synthesis, in a similar way to the binary code used throughout information technology,' Dr Duxbury explains. 'You can programme it so that a lot of the reaction occurs and then you get a material that softens at a low temperature. If the reaction only proceeds to a small extent, then you get a material at the end that softens at a higher temperature.' And how will it be used? It is all still rather theoretical, he admits, but it opens up exciting possibilities for biomedical applications.

The shape of things to come

And the theory itself is already causing quite a stir. 'The results of this research have led to several patent applications, book chapters, journal articles, presentations at international conferences and further grant applications,' Dr Duxbury

reports. And the industry seems to see the value of his research, too. There was actually a link with industry from the start, since the host institution that took Dr Duxbury in was the research branch of Dutch chemical company DSM. Dr Duxbury joined the group of Dr Andreas Heise who was supervising research activities at the interface of enzyme and polymer chemistry. At DSM, Dr Duxbury, 29, had access to state-of-the-art technology, and possibly even more importantly to a large network of experts from different scientific avenues.

'This research project was highly interdisciplinary, positioned between the areas of life science and materials science,' Dr Duxbury recalls. 'As such, it involved a high degree of collaboration between different research groups within DSM. This has allowed me to learn a great deal from colleagues in my research area as well as expanding my knowledge in other related fields.'

Enzymat also enabled him to present his work at international conferences and meetings, valuable networking opportunities that not only helped increase Dr Duxbury's visibility in the

scientific community, but also made it easier to establish collaborations with other researchers. Out of the Enzymat project alone came cooperation with the University of Eindhoven in the Netherlands, the Swedish Royal Institute of Technology, a research group just across the border in Aachen, Germany, and Dr Duxbury's former research group at the University of Nottingham in the UK.

'With the academic group of Dr Heise at the University of Eindhoven, we started a collaboration on the basis of the work I was doing in the framework of Marie Curie, the enzyme-responsive materials,' Dr Duxbury says. 'We've also taken it a bit further and there's still work being carried out there at the moment.'

'The Royal Institute of Technology in Sweden gave us advice on enzymes, as experts in the field, and we tried to apply their expert knowledge to what I was doing here,' he summarises. 'And we did the same kind of thing in Germany, but on the materials side. With my old group in Nottingham, we were again looking at ERMs and seeing whether we could apply them in supercritical fluids.'

The world of private research

Clearly, ERM theory thrives on cooperation, which also offers *'a fantastic opportunity to travel and develop networks whilst gaining exposure to different areas of research'*, Dr Duxbury notes. In addition, Enzymat has been a resounding success for the young polymer chemist in terms of career development: Dr Duxbury has taken up a permanent position at DSM, a world very different from the university environment he is familiar with.

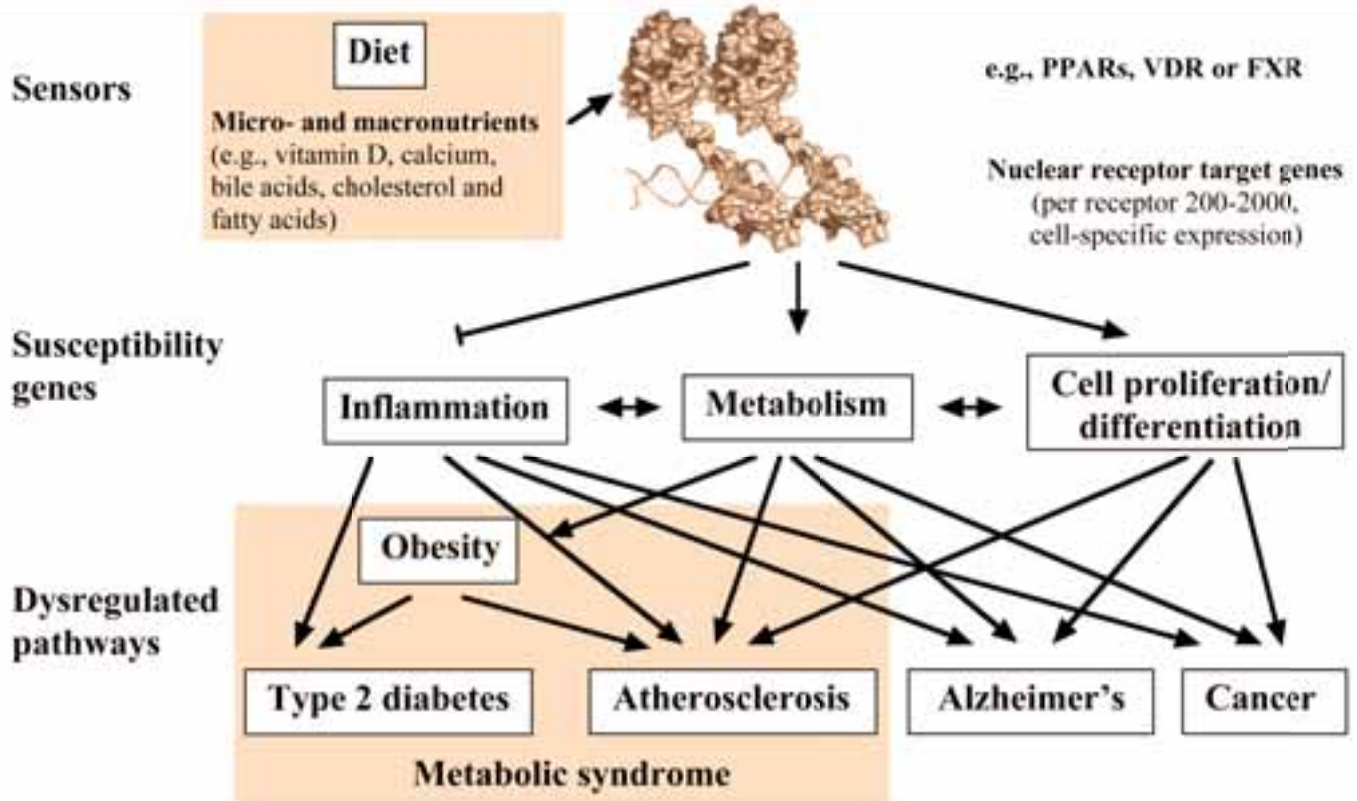
'When you're in university doing research like this, then you're basically doing research for the sake of research, because it's interesting, because there's some challenge there,' Dr Duxbury explains. 'When you're based in a company like this, on the other hand, this concept still applies to some extent, but you also have to pay a lot more attention to the end product having some kind of application. The science is driven in a slightly different direction. It's more product-based, rather than just doing things because they're interesting and cool. They expect you to have a product at the end of the day, which you can go off and sell.'

But in the end, this should be to Dr Duxbury's liking, since his love of making things is what drew him to materials chemistry: 'I like the fact that you actually make something physical that you can touch and feel the difference between the materials you make. That's probably one of the main reasons.'

Project acronym ■ Enzymat
Full project title ■ Enzymatic approach to chiral multifunctional materials for advanced applications

Type of grant ■ Intra-European Fellowship
Budget ■ EUR 148 141
Duration of project ■ 01-12-2006 - 30-11-2008
Scientific discipline ■ Chemistry

Host institution ■ DSM Research B.V.
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NUCSYS

Complex organisms such as human beings are made up of tens of trillions of individual cells – quite a complicated set-up, by any standard. When communication between these various parts fails, system-wide breakdown can follow. The academic and industrial partners within the NucSys research training network have set themselves the task of understanding how to avoid such a scenario.

Broadening cooperation to tackle diet and disease

The network includes leading academic and industrial partners from nine EU countries. Its success provides clear evidence of the importance of cooperation and exchange between all of those working in the wider medical research community.

Cells perceive and respond to their environment. They trigger physical development, enable wounds to heal and kick-start the immune system into action when the body is under attack from a virus. NucSys is seeking to understand the influence of nutrients contained in the food we eat on the behaviour of cells in the human body.

The starting point for NucSys is one of the key players in intercellular communication – nuclear receptors. These can

be found within the cells that mediate the activity of hormones and other substances, including certain vitamins.

‘Nuclear receptors constitute a large network in the human body,’ explains Dr Carsten Carlberg of the University of Luxembourg. ‘They sense lipids, carbohydrates and cholesterol compounds, and assess overall energetic status. They also prompt a multitude of responses.’ Nuclear receptors, in concert with other proteins, regulate how genes work, he explains. ‘They trigger cell growth, changes in metabolic rate and homeostasis, among other things.’

As with many physiological processes, the ways in which the genes respond are subtle, affected by other biological functions and given conditions. But when disease strikes, the normal working relationship between the sensors and the response networks is disrupted. Dr Carlberg says a better understanding of these processes could lead to novel insights into how to improve health.

Integrating the ‘-omics’

Nuclear receptors help regulate physiology. Dr Carlberg says the NucSys network aims to bring together a diverse range of data on their activities, ultimately generating a unified paradigm capable of describing and predicting complex processes in living cells and organisms. The next steps will be to describe gene-nutrient interactions mathematically and to model the impact of diet on health and the development of disease. Eventually this will help doctors to treat diseases more effectively.

The power to predict first ‘requires the integration and interpretation of large amounts of data from “-omics”-based studies’, explains Dr Carlberg, ‘i.e. genomics, transcriptomics, proteomics, metabolomics and physiomics’.

The NucSys consortium does just that. Comprising 14 academic and two active industrial partners, it brings together researchers from disciplines that have not traditionally sat side by side. Molecular, cellular and developmental biologists, pharmacologists, physiologists, systems mathematicians and bio-informaticians are all working together, and with the same goal in their sights.

The excellence of the science performed by NucSys is reflected in the publication of a paper in August 2009 in the prestigious journal *Cell*.

More than science

‘Any research scientist’s academic experience should also include the presentation and publication of their work,’ says Dr Carlberg. ‘Our ESRs [early-stage researchers] are no exception.’ NucSys Marie Curie Fellows have participated in a number of high-level meetings and conferences, he continues, distinguishing themselves among their peers.

NucSys Fellow Pedro Velica explains: ‘I presented my work on muscle development and redevelopment at the European Muscle Conference in Oxford in 2008. My abstract was selected for a talk and was even awarded with the meeting’s “Young Investigator Prize”.’ His abstract will be published in the *Journal of Muscle Research and Cell Motility* and, for winning the award, he has been invited to write a short report for the same journal.

United in diversity

‘One of the things that makes the NucSys consortium so unique is its multi-sector structure’, says Dr Carlberg, ‘bringing together basic and clinical scientists, working in both academic and commercial settings.’ Initial industrial partners included Unilever, a well-known multinational company with significant expertise

in food products, and Biozell, an SME in Milan with expertise in vitamin D analogues. In July 2008, the Marie Curie Fellow working at Biozell moved to Intercept, another SME, based in the United States and Italy.

The contribution of these companies, in terms of research and training their respective Fellows, has been crucial to the success of the NucSys network, believes Dr Carlberg. 'It's all part of creating a truly interdisciplinary team approach to biomedical research,' he says. *'This galvanisation of a powerful set of consortium members with knowledge in diverse areas means excellent science and excellent training for our Marie Curie researchers.'*

In a very real way, NucSys is a network of young researchers who act like the biological phenomena they are studying: in molecular networks, various signalling routes engage in 'conversations', exchanging information and producing a unique output which depends on many factors.

'Like elements in these molecular networks', says Dr Carlberg, 'our young researchers are positioned strategically, each studying a particular group of molecules.' They then engage in conversations, he says, exchanging data and producing conclusions based on many factors.

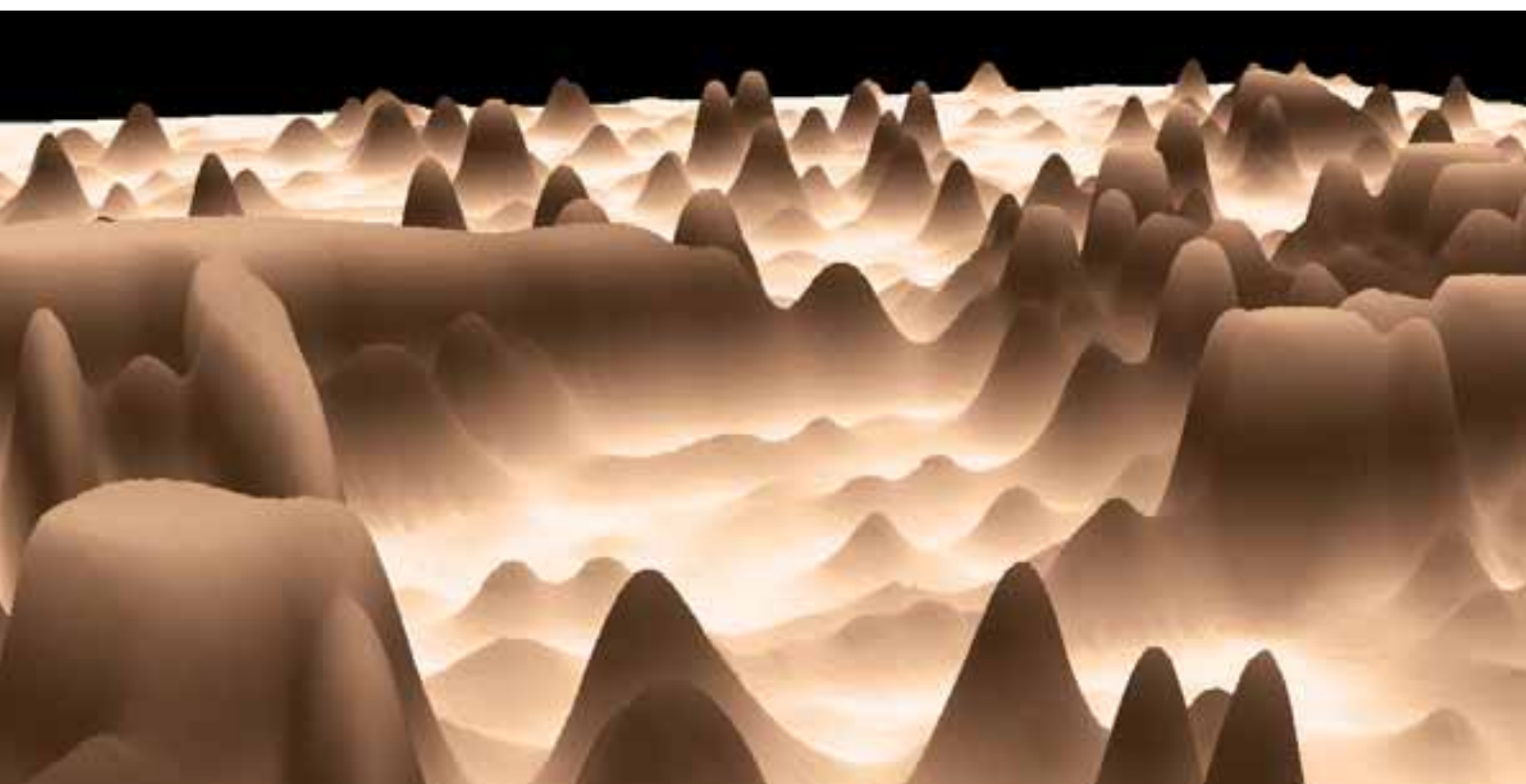
'This parallel networking approach is without precedent in the history of biology', claims Dr Carlberg, 'perhaps only rivalled by the collaborations seen among nuclear particle physicists. In this way, we hope to generate the beginnings of a comprehensive understanding of the entire nuclear receptor network.'

Project acronym ■ NucSys
Full project title ■ Systems biology of nuclear receptors:
a nutrigenomic approach to aging-related diseases

Type of grant ■ Training Network
Budget ■ EUR 3.9 million
Duration of project ■ 01-07-2006 - 31-12-2009
Scientific discipline ■ Life sciences

Lead partner ■ Carsten Carlberg, PhD
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Other partners ■ University of Kuopio, Finland - University of Birmingham, United Kingdom - Erasmus Medical Center, Netherlands - The University of Surrey, United Kingdom - Free University of Amsterdam, Netherlands - Wageningen University, Netherlands - University of Oulu, Finland - Catholic University of Leuven, Belgium - Unilever UK Central Resources Ltd, United Kingdom - Instituto de Investigaciones Biomédicas, Spain - Max-Planck-Institute for Molecular Genetics, Germany - St George's Hospital Medical School, United Kingdom - Medical University of Vienna, Austria - Biozell, Italy - Intercept, Italy - University of Manchester, United Kingdom



TARGET-BREAST

The emotional turmoil that breast cancer patients and their families go through cannot be overstated. In addition to human suffering, the disease causes social, economic and clinical difficulties. Effective targeted therapies and marker systems are urgently needed to combat this killer, and the work of the Marie Curie-funded Target-Breast consortium is making a welcome impact. It could lead to novel diagnostics and treatments.

Catching the killer

If science is to prevent breast cancer, it must first be able to predict its occurrence. For the Target-Breast consortium, the strategy was initially to identify novel marker systems for predicting the progression and therapeutic response of human breast tumours. The team would then be able to detect new pathways for preventing disease progression and treatment resistance. A major component focused on refining the existing complex datasets that have been generated from screening human breast tumour tissues.

‘Knowledge of the gene or protein expression profile of a particular patient’s tumour can, for example, either be used to predict the ability of an individual tumour to spread or to predict its response to anti-cancer drugs. In addition to providing new insight into patient stratification, the research performed under *the Target-Breast project has shed some light on possible targets for therapeutic intervention to treat individuals with breast cancer*,’ says project coordinator William Gallagher.

Knowledge was shared throughout Target-Breast with the training of nine researchers by academic and industrial partners. The project enabled close collaboration between three academic centres (University College Dublin, Lund University and Netherlands Cancer Institute) and two industrial partners (SlidePath and Agendia). This made possible secondments of key staff from both sectors, enabling them to acquire valuable new technological skills in the biotechnology and biomedical diagnostics sphere. The academic partners benefited by taking their work closer to commercial application, while for the industrial partners, the arrangement facilitated access to key clinical and other experimental resources, advancing internal research activities.

The project’s achievements are numerous. Agendia, a cutting-edge molecular diagnostics company, further extended its examination of breast tumours via the identification of a gene expression signature that could predict response to tamoxifen, a standard hormonal therapy used in breast cancer treatment. A bioinformatics researcher from University College Dublin visited Agendia for nine months to acquire experience of molecular

A panoramic view of the breast cancer proteome. Abstracted representation of two-dimensional gel showing a spectrum of proteins (represented by peaks) that present in a human breast cancer cell line.

© Thomas Lau (PhD researcher in Prof. William Gallagher’s laboratory)

diagnostics within an industrial environment and to transfer his own skills on using sophisticated computational approaches.

Meanwhile, SlidePath, a life sciences informatics company with headquarters based in Ireland, expanded its digital slide management software portfolio by interacting with Lund University and University College Dublin. In particular, several researchers from SlidePath worked with Lund University to develop a novel image management system – opTMA – that analyses complex breast cancer image datasets derived from tissue microarray studies. opTMA is now being developed as a new commercial product by SlidePath.

In addition, both University College Dublin and SlidePath have spent significant time both developing and applying automated image analysis tools to fast-track biomarker quantification. Such tissue-based imaging approaches allowed the team to make progress on a selection of candidate breast cancer biomarkers in terms of validation, and to publish papers on their findings. Of particular note, University College Dublin was able to road-test an in-house novel approach for quantifying nuclear biomarker expression on over 1 000 breast cancer patient samples, including a cohort of over 500 patients from

a randomised control tamoxifen trial. This provided the key data needed to consolidate a prior patent filing on this novel image analysis approach. This research has now received national funding for further developmental work to turn it into a commercially applicable diagnostic tool.

Professor Gallagher is certainly convinced of the benefits of this particular Marie Curie scheme. ‘I gained invaluable experience in respect to managing a medium-scale multi-institutional grant. Indeed, I particularly benefited from learning how to maximise collaborations across the academic-industrial interface,’ he says. ‘At a personal level, I would acknowledge my recent rapid promotion from Lecturer to Associate Professor to Vice-Principal of Research and Innovation in the space of a few short years has been, in a very substantial way, due to my participation in the Target-Breast project.’

The project has provided substantial training opportunities for junior and experienced researchers, giving each of them a highly valuable perspective of work within a sector different from their own. A key component of this training was to engender independence within the more junior researchers, while providing an environment for efficient transfer of knowledge in

both directions for the more experienced researchers. Each of the researchers involved has expanded their research career horizons as a result of Target-Breast.

For future applicants, Professor Gallagher offers some words of wisdom: for principal investigators and future coordinators, *Marie Curie is an excellent bottom-up programme to initiate new collaborations between academic and industrial partners, as well as consolidate pre-existing interactions.* Given the complexity of reporting, he would encourage applicants to ensure that all partners are fully committed for the duration of the project, and will contribute in an active way to progress the research. 'In our case, we were lucky to have excellent partners in this respect, but certainly problems can arise if applicants are not sufficiently aware of the potential pitfalls along the way. I was also fortunate to have a close colleague, Mr Steve Penney, who provided significant support in terms of project management, particularly in respect to financial matters and reporting.'

What lies ahead for Professor Gallagher? He is 'very keen' on bringing the outcomes of the research closer to clinical utility over the coming years. One key focus will be a unique

approach for automatically quantifying cancer biomarkers via the sophisticated image analysis approach further advanced by Target-Breast. It now requires further validation on multiple cancer and marker types, as well as building into a framework that is convenient to use for pathologists and other researchers.

Project acronym ■ Target-Breast

Full project title ■ Target-Breast – Breast cancer biomarkers and functional mediators: harnessing the new wealth of –omic data

Type of grant ■ Industry Academia Partnership

Budget ■ EUR 622 995

Duration of project ■ 13-02-2006 - 13-02-2010

Scientific discipline ■ Life Sciences

Host institution ■ University College Dublin

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TEAMOHOLIC

Although it deals with animal clones, Teamoholic has little to do with duplication. In fact, it is a truly original project designed to bring Hungary into the mainstream of the European genetic-engineering community and to strengthen links between academia and industry. It has even resulted in a spin-off company.

Teeming with life

The words 'animal cloning' put most people immediately in mind of Dolly which was the first mammal to be cloned from an adult cell, and was described by *Scientific American* as the 'world's most famous sheep'. The technique used to clone Dolly was known as 'somatic cell nuclear transfer'. This method involves replacing the nucleus of an egg cell with that of an adult or foetal cell.

Examples of beneficial future applications are the multiplication of high-value farm animals and the preservation of endangered species. The potential applications of cloning include the creation of customised stem cells that can be used in human regenerative therapy, while any attempts to clone human beings are strictly prohibited across the world.

A more down-to-earth and practical current application is to use cloning to create transgenic animal models, such as mice or rabbits, which can be used for medical research. The advantage of somatic cell nuclear transfer is that it allows specific genetic modifications in several species, including rabbits, pigs or cattle. The cloned animals can then be used as models to understand human diseases and develop treatments for serious illnesses, such as Alzheimer's and atherosclerosis.

Hungary for science

With Marie Curie funding, Andras Dinnyes, a specialist in embryology, cloning and stem cell biology, was able to assemble a top-notch international research team in Hungary. Teamoholic, as the project was known, scored numerous groundbreaking successes and created the first cloned mice and rabbits in central Europe, transforming Hungary into a leading centre in the field.

'This breakthrough has provided a very relevant tool for further biomedical research for human disease models, and for genetic reprogramming in regenerative medicine,' explains Dr Dinnyes.

Marie Curie Excellence Grants aim to help researchers better anchor their careers by providing funding to establish their own group – which is exactly what occurred. During the project, Dr Dinnyes – whose past achievements include the production of gene knock-out lambs and the first cloned piglet in Europe, while working at the Roslin Institute in the UK – received a permanent full professorship at Szent Istvan University in Gödöllő, Hungary. Since then, he has also been awarded a visiting professor's chair at the Veterinary Faculty of the University of Utrecht in the Netherlands.

Dream team

As its name suggests, Teamoholic had a passionate commitment to teamwork. In fact, many of the scientists involved in the project see that as one of the main ingredients of its success.

Over its four-year duration, Teamoholic recruited more than 40 scientists from across Europe and beyond. The project helped these young researchers to gain valuable scientific experience and acquire additional skills through training, with a special emphasis on industry-related issues.

'My postdoctoral experience in Hungary, as an Ethiopian-born scientist finishing a PhD in Germany, was very rewarding both culturally and scientifically. I have gained many friends, published good scientific papers, participated in scientific training and enjoyed scientific collaborations with other teams working nationally and internationally,' acknowledges Solomon Mamo, an Ethiopian biologist on the project who has since moved to take on a senior research position in Ireland, at Lyons Research Farm, University College, Dublin.

In fact, Teamoholic has proved to be an excellent career springboard for many of the scientists involved. *'Many of our*

researchers have capitalised on the training they received and moved on to pursue industrial career paths with SMEs or the pharmaceutical industry,' notes Dr Dinnyes.

The project has also done its bit to reverse the brain drain and turn it into a brain gain. 'I left Hungary for several years to work in the United States. Teamoholic helped me tremendously to reverse the brain drain and to secure a long-term position back home,' says Krisztina Tar, a Hungarian molecular biologist whose career has taken her to John Hopkins University in Baltimore, the University of Chicago and the Medical University of Vienna.

Innovative clones

Unlike in some sectors, such as computing, cloning in biology is at the absolute cutting edge. And in true keeping with its mandate to build bridges between industry and academia, Teamoholic has resulted in a spin-off.

BioTalentum Ltd, which was founded by Dr Dinnyes in 2005, is a research-based start-up focusing on biotechnologies to build on the scientific results of Teamoholic, along with several EU-funded projects.

The firm carries out stem cell research and develops transgenic cellular and animal models. It is very active in EU-backed collaborative research efforts and is a full research partner in several projects funded by the Union's Sixth and Seventh Framework Programmes, including five in which it is the coordinator. BioTalentum has a branch specialising in the management of biomedical research projects and provides such services to national and European projects.

Teamoholic has also helped researchers in the corporate world renew their links with academia and then take advantage of that experience in the business world. One Fellow in this position was Ildiko Nagy, a teacher of biology and chemistry from Hungary who is now vice-president of BioTalentum. 'After I got my PhD, I continued my career in the business world, with General Electric, HSBC and other multinational companies,' she recounts. 'The biggest reward of the Teamoholic project for me was the wonderful opportunity to modify my career path back to science, and combine that with my experience in business.'

People power

The success of Teamoholic and its spin-offs, Dr Dinnyes insists, is down to the quality of the researchers involved – and that

is why Marie Curie Fellowships are so important. 'Marie Curie Actions provide something which is even more important than state-of-the-art equipment: well-trained, motivated researchers,' he believes. 'Once you have found a good young scientist, it is important to keep them on a self-development path. Combining the different Marie Curie Actions which are best suited for the specific career stage of the researchers can enhance the lasting impact on their careers.'

It is no surprise then that Dr Dinnyes has set up and become involved in new Marie Curie projects, including a research training network called Clonet which helps early-stage and experienced researchers to acquire sound basic knowledge and technological experience to tackle the increasing complexity of transgenic animal model research for biomedical applications.

Project acronym ■ Teamoholic
Full project title ■ Team on advanced transgenic animal technologies

Type of grant ■ Excellence Team
Budget ■ EUR 1.8 million
Duration of project ■ 01-05-2004 - 30-04-2008
Scientific discipline ■ Life sciences

Lead partner ■ Prof. Andras Dinnyes
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GENDER BALANCE



Women researchers have brought major contributions to science. Notable examples include Hypathia, the great philosopher and mathematician at the Library of Alexandria; Marie Curie, who explained radioactivity; and Rosalind Franklin, the first person to uncover the structure of DNA. The search for brilliant minds cannot be restricted to a pool of only half the population. This is why Marie Curie Actions make sure that the best researchers are not hindered in their career because of their gender.

Encouraging gender balance in science

It is a basic human right – no one can be discriminated against on the basis of gender. Less than 10% of senior scientists are women, yet half of the science student population are female. This shortfall must be corrected. R&D has been recognised as an important driver of Europe's development and future prosperity and to achieve this Europe needs all its excellent researchers.

Jobs for the girls *and* the boys

In line with all EU policies, the Marie Curie programme is committed to removing any discrimination based on gender. It strives to tackle preconceived ideas both within the research world and beyond, by empowering women to rise to the heights of a research career and by increasing awareness of the mechanisms of gender inequality throughout the sector.

Fostering equality from the start

All too often, academic recruitment practices draw staff from traditional networks that overlook potential female applicants. The European Commission's *Code of Conduct for the Recruitment of Researchers* requires complete transparency during recruiting to prevent the possibility of unjust appointments. It aims to overcome gender bias by promoting equality from the outset.

The Marie Curie programme fully endorses the code of conduct and has adopted internal procedures introducing further equality-enhancing steps. Evaluation panels for Marie Curie project proposals, for example, must be made up of at least 40% women, and proposals must address the issue of gender balance explicitly.

Why do women leave?

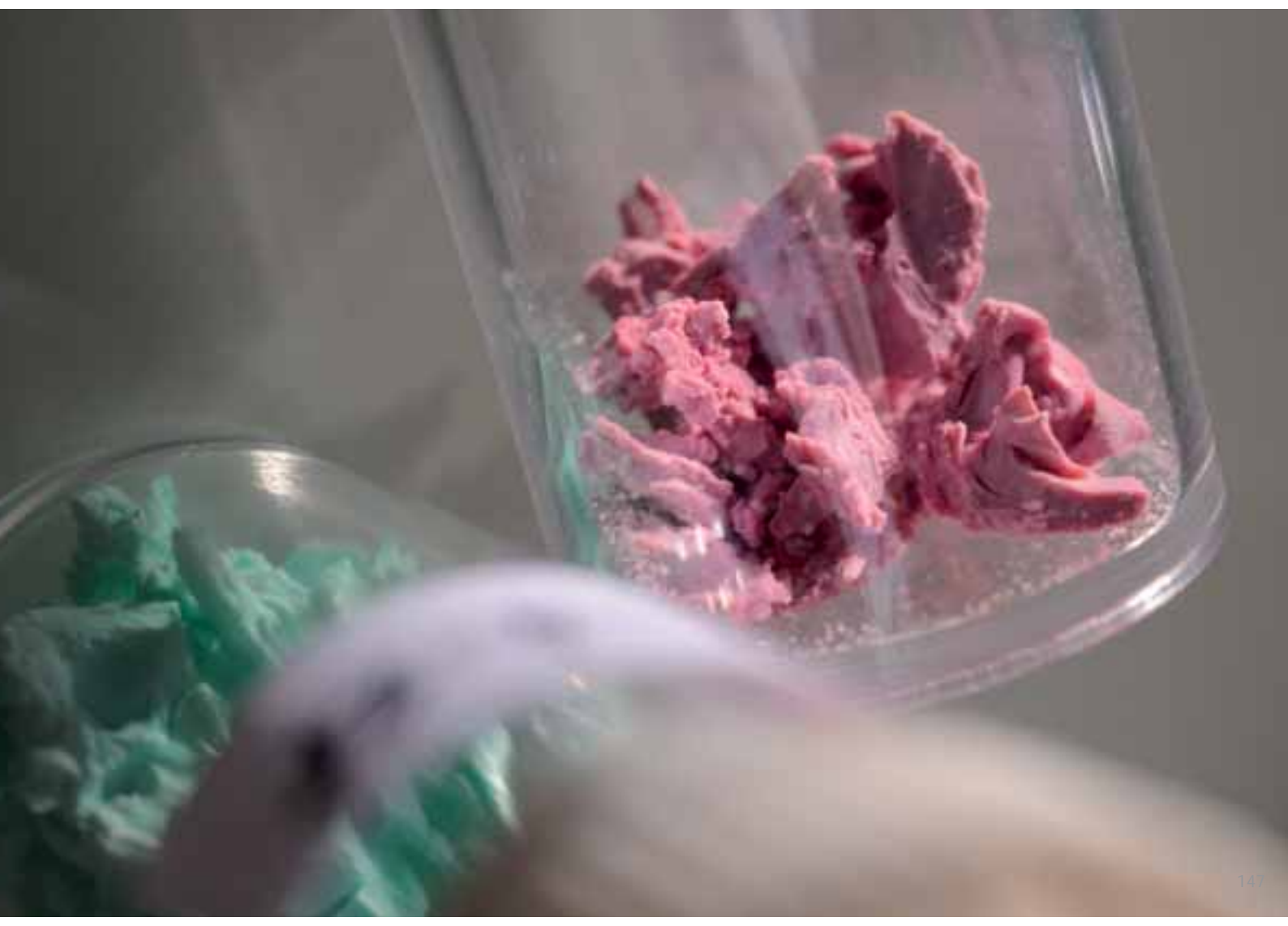
However, low levels of initial recruitment are just one hurdle to overcome. Not only are women not employed in the sciences as frequently as men, but they are also

more likely to leave once they are in. The research sector suffers from abnormally high attrition rates – the so-called leaking pipeline effect.

In order to stem this exodus, action must be taken to make scientific research a less biased profession. The Marie Curie Actions work to encourage Europe to professionalise the field and thus make it more appealing to promising applicants. Efforts to tackle the instability of research careers, which is linked to the fact that researchers often subsist on grants rather than benefiting from salaries with perks comparable to those offered by other sectors, are expected to go a long way in this respect. Increased financial stability, relevant social security provision and greater flexibility, for example on parental leave and working time arrangements, will help to make research careers more attractive to men and women alike.

Still a way to go

There is still a lot of work to be done to make scientific research a gender-balanced sector. However, this is vitally important if women are to participate fully in helping Europe to become the world's leading knowledge-based economy. Research needs more women like those featured in this chapter.





AQUABASE

Today, an increasingly complex cocktail of chemicals is finding its way into the environment, and from there into our drinking water. These so-called micro-pollutants do not respect national boundaries and are thus a global issue. Dealing with the problem means harnessing all available resources, including the best European researchers, regardless of their gender.

Touching base on micro-pollutants

The term 'micro-pollutants' covers a variety of both natural and man-made substances, including a wide range of industrial chemicals, endocrine-disrupting or pharmaceutically active compounds, antibiotics and pesticides. They are discharged deliberately or inadvertently, or may be present as a result of degradation processes. Crucially, many of these substances can persist despite treatment and some of them can affect aquatic organisms and possibly human health.

The effects of micro-pollutants are the particular concern of the Marie Curie-funded Aquabase project, managed by Rita Hochstrat, a biologist, and coordinated by Professor Thomas Melin, a chemical engineer, both from RWTH Aachen University. 'The programme's focus is endocrine disrupters, but also a broader group of micro-pollutants, including antibiotics, other pharmaceuticals and residues of personal-care products,' explains Professor Melin. 'The goal is a better understanding of the fate of civilisation-related chemicals in our water and finding ways to control them.'

The problem of quantifying the occurrence, analysing the distribution pathways and evaluating the various effects of micro-pollutants represents a set of truly interdisciplinary tasks, he adds. To meet the challenge, Aquabase has put together a consortium comprising several departments within the Natural Sciences, Medical and Engineering Faculties of RWTH Aachen University.

Team members say the results have been very promising, leading to some important new insights of value to other researchers and potentially the general public.

A sense of accomplishment

Rita Hochstrat looks back on five years of planning and guiding the Fellows' progress: 'This project lends itself perfectly to the training of Fellows of varied backgrounds. Thanks to the Marie Curie programme, these young researchers are benefiting from a strong and coherent structure, where complementary topics and methods are the core of the programme.'

All Fellows received training in using powerful analytical techniques, indispensable tools for investigating micro-pollutants. These include the use of radio-labelled substances.

'With C14 isotopes, we can track various materials to better understand what is going on in the systems in question,' explains Ms Hochstrat. 'The technique was successfully applied to membrane bioreactors, soil systems and water-sediment-biota systems.'

Further work was carried out, she says, on the separation and identification of pollutants and their degradation products using chromatographic techniques and mass spectrometry. 'But our Fellows also developed individual analytical methods for their target compounds using high-performance liquid chromatography.'

In addition to key experimental work in the participating laboratories, a full range of activities is maximising the effectiveness of training. They include internal and open workshops on current scientific issues, and tailor-made courses to strengthen fundamental knowledge and highlight particular aspects of the research performed.

Striking the right balance...

'Aquabase, which has a strong engineering component, recruited a total of 14 Fellows', says Professor Melin, '10 of whom were female.' In two application rounds, with subsequent selection workshops, candidates were given the opportunity to present

themselves to the consortium. Overall excellence and fit for the proposed tasks were primary criteria, but striking the appropriate gender balance was also a consideration.

'In the course of the project, the group developed a sense of equality, common purpose and cohesion', continues Professor Melin, *'with female members often taking leading roles.'* Indeed, he notes, the project was managed by a woman, Rita Hochstrat.

For her part, Ms Hochstrat says the relationships between Fellows were characterised by critical openness as well as respect for each other's achievements – whether male or female.

...and making a difference

Marie Curie Fellow Hanna Maes of Belgium says, 'This fellowship has been the basis of my scientific career. The work I did and the experiences I had allowed me to move forward and eventually take up a postdoc position at the same institution. I came into contact with important scientists in my field, as well as policy-makers and people from industry, establishing a strong network of professional contacts.'

'Increased mobility and excellent networking opportunities helped all of our Fellows to develop a sense of independence,'

says Ms Hochstrat. Of the seven Fellows trained for three years within Aquabase, five have now taken up positions in research institutions or as researchers in the industrial sector. The others have chosen careers in industry or with the European Chemicals Agency. Short-term appointments, comprising seven posts of six months each, stimulated graduates to look for PhD programmes at other institutions, she adds.

Candida Shinn is a British PhD candidate now studying at the Université Paul Sabatier in Toulouse. She notes that the Marie Curie Aquabase project provided her with a refreshing look at the research world. 'Participating in a multi-disciplinary, EU-funded research programme showed me the importance of collaborative research in science. I hope the Union's framework programmes will continue granting such great opportunities to young scientists!'

Lubomira Kovalova of Slovakia agrees. Now working at the prestigious Eawag Research Institute in Dübendorf, Switzerland, she says, '*The Marie Curie programme is an excellent way to explore science without borders – geographical as well as between the scientific disciplines. For me it was a chance to grow professionally*, use state-of-the-art instrumentation, work in well-equipped labs, attend international conferences and meet the people who write the best publications in the field.'

Micro-pollutants, macro-achievements

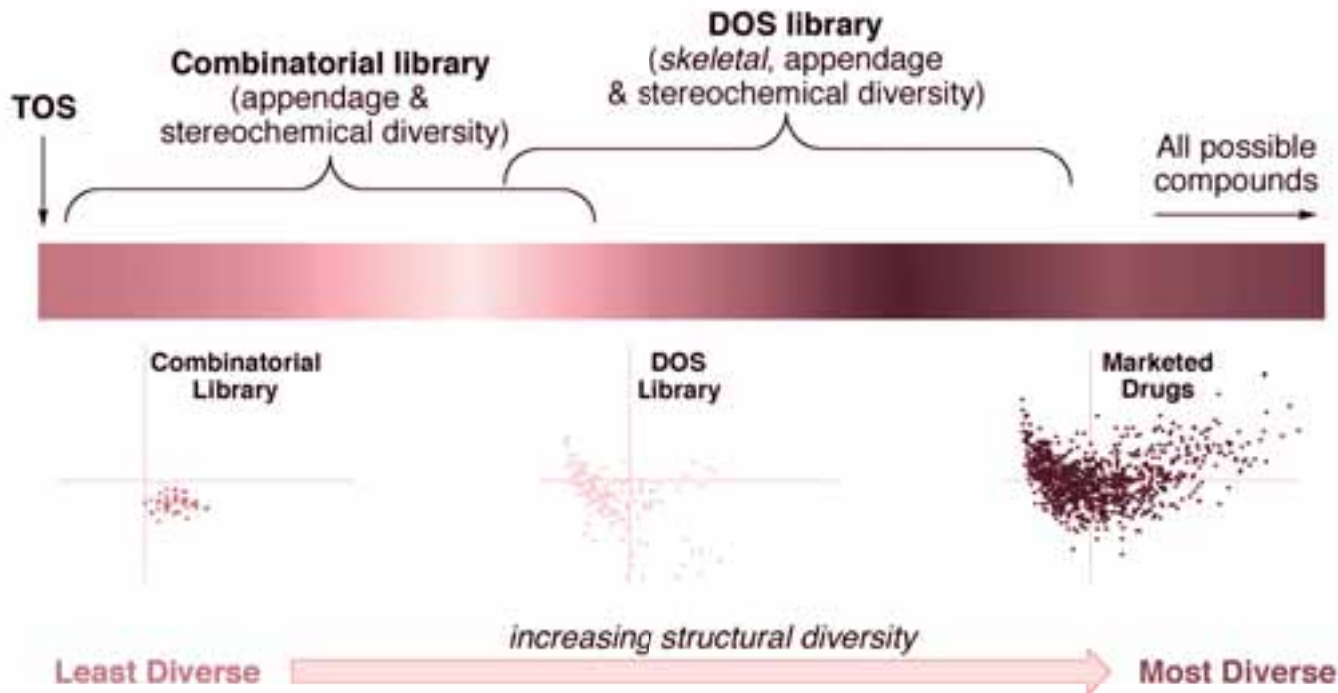
Professor Melin remarks that the analytical results of the project have been particularly significant. The team has developed and improved methods to detect trace substances in wastewater. It has identified new compounds as metabolites from biodegradation and reaction products of treatment processes.

But also, the results on the fate of micro-pollutants in various treatment systems, their transport in environmental compartments, and their eco-toxicological effects 'represent important contributions to the wider understanding of micro-pollutants in the aquatic environment,' he concludes.

Project acronym ■ Aquabase
Full project title ■ Organic micro-pollutants in aquatic environment – interdisciplinary concepts for assessment and removal

Type of grant ■ Training Network
Budget ■ EUR 1.3 million
Duration of project ■ 01-04-2004 - 31-03-2008
Scientific discipline ■ Environment

Lead partner ■ Thomas Melin
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DRUG-DISCOVERY

During her two-year Marie Curie Fellowship at the University of Cambridge in the UK, Mónica Díaz Gavilán created an impressive collection of new chemical compounds, many of which could have antibacterial properties. In addition, she improved the techniques used to study these novel compounds. By offering her the opportunity to work with some of Europe's best scientists, the fellowship also gave Dr Díaz Gavilán's career a major boost.

From ladybirds to pest control

The rise in antibiotic resistance means the hunt is on for new chemical compounds that could kill disease-causing bacteria. The first stage in the drug-discovery process entails screening large numbers of compounds for potential antibacterial properties. But where do these compounds come from? Older techniques for generating new molecules tended to generate large numbers of similar compounds.

Spanish chemist Mónica Díaz Gavilán's work involves a newer technique called Diversity-Oriented Synthesis (DOS). As its name suggests, it allows researchers to create large numbers of very diverse molecules that look and behave very differently to one another. The DOS method has contributed a great deal to the advancement of research in organic synthesis.

Dr Díaz Gavilán's Marie Curie Fellowship allowed her to spend two years in the lab of Professor David Spring, one of the world's leading researchers in DOS.

Professor Spring's group offers young researchers a fertile training ground on which to learn their craft. The research staff is gathered from across Europe and beyond. His team maintains close ties with both academic researchers and industrial partners, including AZ, Bayer Schering, GSK, Lilly, Pfizer, Syngenta and UCB.

Crucially, working in Cambridge gave Dr Díaz Gavilán access to top-of-the-range technical equipment and laboratory materials, along with the chance to work side by side with some of the best researchers in Europe.

A molecular librarian

In DOS, researchers use simple, readily available molecules as building blocks. By triggering the right series of reactions, they can encourage these building blocks to combine in lots of different ways, leading to the creation of a diverse 'molecular library'.

Dr Díaz Gavilán used amino-alkenes as her starting materials. Although they are simple molecules, they can be modified

chemically in various fashions. The molecules she created using DOS are known as ring systems. Excitingly, similar molecules have been found in nature, and some of these naturally occurring chemicals have been shown to have useful properties. The many and diverse molecules in Dr Díaz Gavilán's library are now being tested for antibacterial activity.

Meanwhile, the young researcher succeeded in transforming one of her molecules into a chemical called myrrhine. Myrrhine is secreted by ladybirds to repel predators. As such, it could turn out to be extremely useful for agricultural pest control. The myrrhine acquired by Dr Díaz Gavilán was produced using fewer steps and in larger quantities than other attempts to produce the substance synthetically.

Contributing to the field

A particular focus of Mónica Díaz Gavilán's research at Cambridge was how DOS could be used to examine the chains of chemical reactions through which the small, complex molecules in the library are generated. Crucially, she contributed to her field of study by improving upon the methodology used in these

experiments. Most notably, she invented a new process that enhances the technique used to prepare for the testing of different-sized structures. This new process can be applied to different studies in the future.

During her time in Cambridge, Dr Díaz Gavilán also developed a powerful biotechnology tool capable of screening compounds for the chemical properties relevant to the drug-discovery process.

A steep learning curve

Dr Díaz Gavilán describes her experience of working in the team as feeling like part of a family: *'Everyone was very friendly and helpful. Not speaking the language perfectly was not a problem; there was always support and I never felt stuck*, even at the beginning,' she says. Her work at the Department of Chemistry enabled her to benefit from the university's outstanding level of knowledge and infrastructure. Describing the scientific library at the centre, she adds, 'it is second to none; straight away I was impressed by it. It was not just a "normal" scientific library, but truly excellent.'

Nonetheless, she describes the experience that her Marie Curie Fellowship awarded her as the steepest learning curve she has ever experienced – and the one which made the greatest contribution to her knowledge of the subject and helped her to advance her career. Since completing the fellowship, Dr Díaz Gavilán has taken up the position of Assistant Lecturer in the Department of Medicinal and Organic Chemistry at the University of Granada. There she works in a group devoted to the study of carbohydrates in the synthesis of bioactive molecules.

The power of perseverance

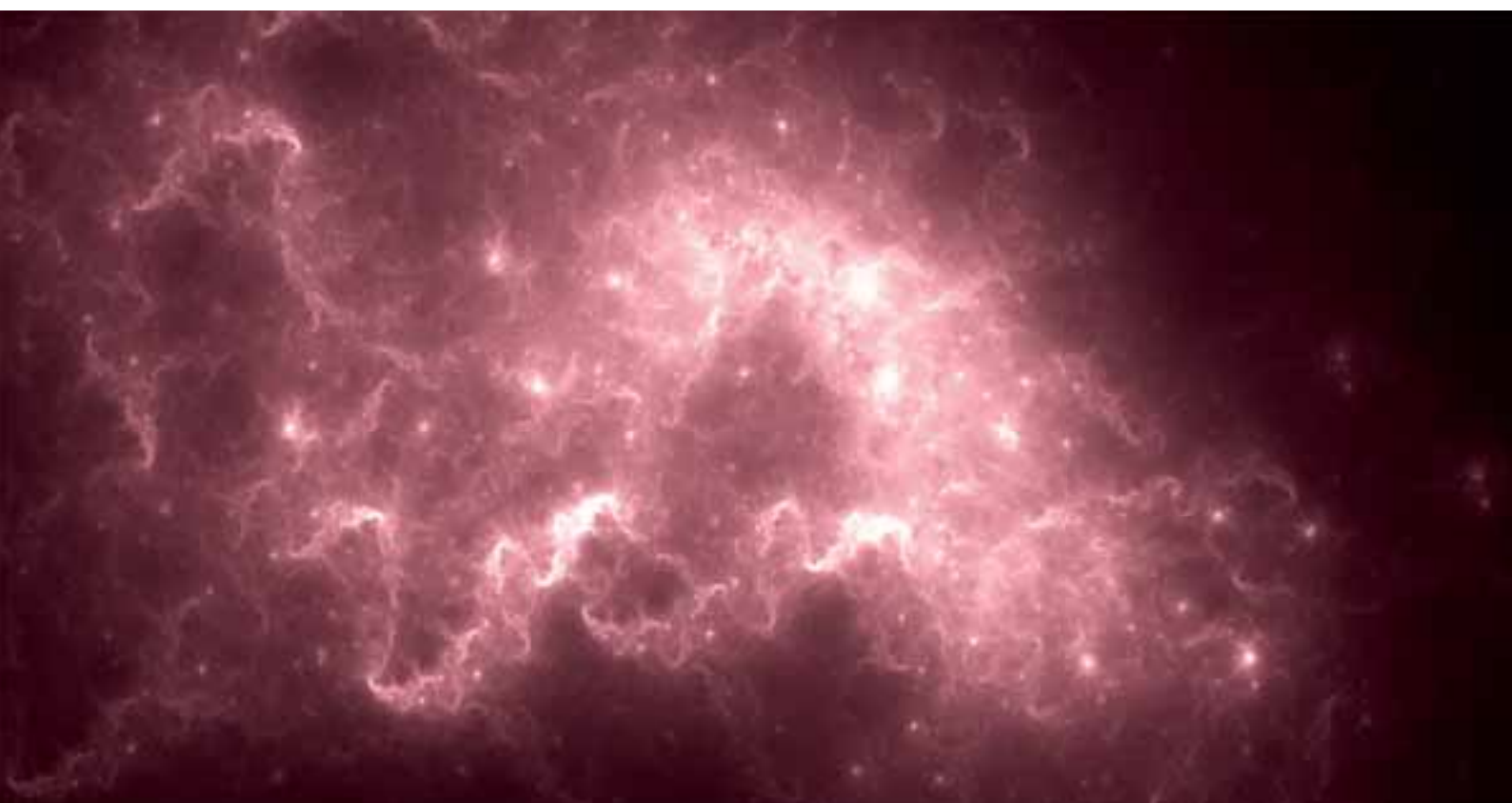
Dr Díaz Gavilán is one of a growing number of women pursuing highly successful careers in the hard sciences. However, she observes that many women still appear to abandon research careers shortly after completing their PhDs – an issue which the Marie Curie programme has specifically set out to address. 'A scientific career is a difficult one; it requires that you make sacrifices,' Dr Díaz Gavilán concedes. And, she adds, 'In many ways it is especially difficult for women, particularly when you want to start a family.'

But she is quick to encourage budding female scientists. 'My advice to women embarking on a career in the sciences is that they persevere, and I would encourage them to try for a Marie Curie Fellowship. It will give them a chance to go to leading research institutes and to meet renowned scientists. My main message to them is: *Don't give up! Things are better for women in the sciences than they used to be.*'

Project acronym ■ Drug-Discovery
Full project title ■ Synthesis and screening of new small molecules with antibacterial activity: discovery of novel biological targets

Type of grant ■ Intra-European Fellowship
Budget ■ EUR 169 367
Duration of project ■ 01-01-2007 - 31-12-2008
Scientific discipline ■ Chemistry

Host institution ■ Prof. David Spring
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EARA-EST

The European Association for Research in Astronomy (EARA) launched its own Marie Curie Network, EARA-EST, which sought to even the gender balance in astronomy and harness the under-exploited potential of female astronomers.

Helping women astronomers reach for the stars

More than two centuries ago, the Hanoverian Caroline Lucretia Herschel became the first European woman to be recognised as an astronomer – and the first woman to draw a salary from her science. Along with her brother, William, who discovered Uranus in 1781 and became royal astronomer to the British crown, she searched the sky for comets, discovering eight of them between 1786 and 1797. In 1835, she even became an honorary member of the Royal Astronomical Society.

We have come a long way since then. Women have been the authors of major astronomical breakthroughs and make up a substantial proportion of the staff at astronomical research bodies and observatories. Nevertheless, despite a strong commitment to promoting gender equality, astronomy is one science in which the gender gap is still quite large.

According to the International Astronomical Union, only a quarter of all astronomy professionals are women, although this global

figure masks a huge gap between countries: in some, there are almost no female astronomers, while in others as many as half are women.

Astronomical progress

In astronomy, the sky is quite literally the limit, and this should be the case regardless of gender; after all, women represent half of the talent pool from which research institutes can draw. However, in the longer term, this requires action early on, to attract more girls to become interested in and study astronomy in order to bridge the gender divide in graduate numbers.

In the shorter term and in recognition of the fact that women need an early opportunity in order to launch a successful career in science, the European Association for Research in Astronomy (EARA) launched its own Marie Curie Network, EARA-EST, to provide young female and male astronomers with truly equal opportunities.

EARA's six leading European laboratories in theoretical and observational astronomy – from Germany, Spain, France, Italy, the Netherlands and the UK – offered early-stage training fellowships to astronomers and astrophysicists from across Asia, Europe, Latin America and the United States.

‘Our programme is founded on the notion of equal opportunities regardless of gender (and nationality),’ explains Robert Mochkovitch of the Institut d’Astrophysique de Paris, the network’s coordinator. ‘Some 36 % of our 70 Fellows were women, which is much more than the proportion of woman astronomers in Europe and the United States. The majority of our women Fellows came from southern Europe (mainly Italy and Spain).’

While it is impossible to detail all the research carried out by the 70 Fellows, here is a brief taster. In cosmology, EARA-EST Fellows explored the large-scale structure of the universe using both observational techniques and numerical simulations to study, among other things, the nature of the mysterious dark matter and dark energy. They also investigated in detail the dynamical, photometric and chemical evolution of galaxies.

Research projects on the physics of star and planet formation addressed different phases of the process from the early evolution of a proto-planetary disc containing dust and ice particles to the properties of the proto-star which eventually forms at the centre. In addition, the work of Fellows searching for exoplanets – also known as extra-solar planets – led to the discovery of several new objects.

Everyone a star

In addition to access to Europe’s top astronomy facilities, Fellows also received training in complementary skills, such as languages,

living and working in international environments, software training, project management, and more.

‘The Marie Curie programme gave me the possibility to receive high-level scientific training at a top institute, together with complementary skills, such as research management and languages, which are important to enhancing one’s job prospects in the world of modern research,’ recalls Elisabetta Micelotta, a Fellow from Italy.

EARA-EST scored some impressive successes. Fellows who took part in the programme published 93 papers in peer-reviewed journals, including 61 as lead authors. ‘[EARA-EST] was a challenging experience that strongly motivated me and it had a remarkable impact on my PhD thesis, which was also published as a paper and presented at different international conferences,’ notes Susanna Vergani, also from Italy.

The nine Fellows on longer fellowships successfully completed nine PhD theses: five on cosmology, three on star and planet formation, and one on exoplanets.

The programme helped the young Fellows who took part in it to go on to do further work at an EARA institute or to seed their careers elsewhere.

Pathfinder

EARA-EST helped its Fellows develop their skills and chart their career path. 'The three months I spent at the IAP in Paris, thanks to the Marie Curie EARA-EST programme, were a great opportunity for my PhD and the future of my research career,' says Ms Vergani. 'During this period, I worked with very experienced and capable people, learning a lot and developing my research skills. I managed to extend my knowledge to other research fields and I established links with people working in several different domains.'

She adds: 'The fruitful collaboration built with the people I worked with at the Institut d'Astrophysique de Paris (IAP) is still going on. It is also thanks to this experience that I obtained my present postdoc position in Paris.'

Yuliana Goranova's Fellowship, which took her to Germany and the Netherlands, helped her gain valuable experience back home in her native Bulgaria and then land a good position in France. 'I spent a year in my home country, Bulgaria, where I had a shared position between two of the institutes of the Bulgarian Academy of Sciences in Sofia. *The experience in proposal writing I had gained in both Munich and Leiden helped me to become a member of a successful ongoing collaborative project supported by the Bulgarian Science Foundation,*' she describes.

How was it for you?

All in all, the EARA-EST Fellows came away with a sense of fruitful gain from their Marie Curie experience. 'It is difficult to say in just a few words what the EARA-EST programme means to me,' Ms Goranova admits. 'But if I have to summarise it, it would be: top-level professional training and new research experience at one of the leading astronomical centres in Europe. This is coupled with an excellent opportunity to extend and further develop my communication and project management skills, to meet new people, and it had a great impact on my future career.'

Dr Micelotta sums it up as 'pleasant and fruitful, and I think that the programme significantly increased my future career prospects in scientific research'.

Project acronym ■ EARA-EST
Full project title ■ European Association for Research in Astronomy – Early-Stage Training

Type of grant ■ Training Network
Budget ■ EUR 2 765 617
Duration of project ■ 01-09-2004 - 31-08-2008
Scientific discipline ■ Physics

Lead partner ■ Robert Mochkovitch/Chantal Le Vaillant
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Other partners ■ Institute of Astronomy, United Kingdom -
Instituto di Astronomia de Canarias (IAC), Spain - Leiden Observatory,
Netherlands - Max-Planck-Institut für Astrophysik (MPA), Germany



GLADNET

Accurate data about the quality of metals and machinery they produce are essential if Europe's manufacturers are to produce the kind of world-class products needed to compete in the global market place.

Material collaboration

The EU-funded Gladnet project is rising to the challenge, designing more accurate spectroscopic methods that will help industry to develop new materials and surface coatings.

Gladnet sees collaboration between 16 industrial and research teams working on new glow-discharge spectroscopy techniques for analysing materials such as steel. A glowing gas plasma (analogous to those in household fluorescent lamps) is used to erode the surface of the material under investigation, allowing a researcher to determine the concentration of the chemical elements below the surface quickly and accurately.

Glow-discharge spectroscopic analysis enables manufacturers to quantify and identify the bulk composition of materials such as alloys, semiconductors and glass. The technology also provides information on the layer-by-layer composition of surfaces and coatings, making it useful for analysing the materials used for

computer hard disks, paint layers, car bodies, tools, human body implants, nuclear materials and nanowires, for example.

The partners continue to develop glow-discharge spectroscopy as a more competitive alternative to typical analytical techniques. They have taken great strides towards improving the understanding, performance and analytical capabilities of the procedure.

Finding the best brains

The project responds to European industry's need for skilled researchers and new knowledge on rapid, accurate methods to analyse solids, says Johann Michler, project coordinator and head of the Laboratory for Mechanics of Materials and Nanostructures at Switzerland's Federal Laboratories for Materials Testing and Research (Empa).

Dr Michler notes that the Marie Curie funding for the training network allowed the project to recruit some of the best young minds in the field. As a result, 8 of the 16 Fellows are women.

Working with industry

In addition to the support, the young researchers welcomed the chance to work in collaboration with industry on a project that combines training, pure research and the possible practical application of that research.

‘The training networks are a great opportunity to establish long-term collaborative ventures,’ notes Dr Michler. ‘Team-working across national boundaries is much more intensive if a research Fellow spends time at different places under joint supervision.’

Varvara Efimova, an early-stage researcher, is one of several Fellows who moved from their home country to take up a position with Gladnet. The Russian scientist was posted to IFW Dresden in Germany where she worked on adapting an existing device for characterising the electrical behaviour of pulsed discharges. She says the project helped her develop and improve her skills as an experimental scientist. She also gained experience in presenting her work to large audiences.

‘The Marie Curie programme changed my life in the best way,’ she admits. ‘Now I am working on a topic I am interested in. I have a lot of friendly colleagues, competent people around

me in case I need some advice, an opportunity to present and discuss my results, and a good perspective for my future work. In addition, I travel a lot, learn foreign cultures and languages and find all this very exciting.’

She encourages other young researchers to apply for Marie Curie funding as a means of furthering their careers in science. ‘Do not hesitate to join similar European projects like Gladnet,’ she says. ‘You get to see a lot of new places, meet interesting people, make good friends and can obtain very important skills which you will need in the future.’

Belgian Deborah Alberts, another early-stage researcher with the project, agrees. She was posted to the University of Oviedo in Spain and believes one of the project’s achievements was to attract more women researchers to the field of glow-discharge spectroscopy.

‘It clearly shows there are a lot of women who want to do this research and are ready to leave their home countries to work and establish a new life in other places,’ she says.

She found the experience allowed her to explore the various research career opportunities available in her chosen field.

‘The Marie Curie programme provides the possibility of combining training courses with active research, as well as getting a broad insight into both industry and education,’ Ms Alberts says. ‘The possibility of coming into contact with researchers from a variety of study areas and collaborating with them opens the mind to the future career choices available in life.’

A family affair

For other Fellows it was the flexibility of the Marie Curie support that helped them in the early stages of their research career. Research Fellows with families receive additional financial support as a supplement to the mobility allowances already provided through the Marie Curie programme. The allowances help a researcher and his or her family move to a new country and help pay for regular visits home.

Petr Šmíd moved from his home country, the Czech Republic, to take up a position with Gladnet, first in London and then Germany. His wife and child moved with him, and during his 14-month fellowship in London he received two weeks of paternity leave when his second child was born.

‘Thus I was able to help my wife directly after the birth,’ he says. ‘This was particularly helpful since our parents were not able to come to us immediately after the birth to support us as is normal when a family lives in their country of origin.’

Project acronym ■ Gladnet
Full project title ■ Analytical glow discharge network

Type of grant ■ Training Network
Budget ■ EUR 2 863 542
Duration of project ■ 01-02-2007 - 31-01-2011
Scientific discipline ■ Chemistry

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Other partners ■ Leibniz-Institut für Festkörper- und Werkstoffforschung Dresden e.V., Germany - Research Institute for Solid State Physics and Optics, Hungarian Academy of Sciences, Hungary - Korrosions- och Metallforskningsinstitutet AB, Sweden - Imperial College London, Space and Atmospheric Physics Group, Blackett Laboratory, Physics Department, United Kingdom - London Metropolitan University, DCCTM, United Kingdom - Universiteit Antwerpen, Department of Chemistry, Plasmant, Belgium - University of Oviedo, Department of Analytical and Physical Chemistry, Faculty of Chemistry, Spain - Saint-Petersburg State University, Chemical Research Institute, Russian Federation - Faculty of Physics Belgrade, Serbia - AQura GmbH, Department Inorganic Analyses, GDMS Laboratory, Germany - LECO Instrumente Plzeň, Czech Republic - ThyssenKrupp Steel AG, Center of Materials Excellence - Auto Division, Germany - Shiva Technologies Europe SARL, France - Tofwerk AG, Switzerland



MIGRANT CHILDREN

Immigration has become a fact of life across Europe. Even countries that were previously major sources of emigration, such as Italy and Ireland, have become net recipients of migrants. A project studying the impact of immigration on children in Ireland is helping female academics migrate upwards in their research careers while giving returnees a voice.

Cross-border career paths for women

In Ireland, from the Great Famine of 1845-47 to the 1950s, the natural increase in the population was, in fact, continually offset by out-migration on a scale higher than in any other European country, according to the Irish Centre for Migration Studies. This led to an almost continuous decline in the population for more than a century.

Economic reforms in the 1950s and Irish entry in 1973 into what later became the EU contributed to a brief period of net in-migration, mainly of returning Irish migrants, in the 1970s, which was followed by mass emigration again in the 1980s and early 1990s. However, the recent economic boom of the late 1990s and 2000s has been accompanied by net in-migration on an unprecedented scale involving immigration from many parts of the world, particularly eastern Europe.

Ireland's levels of emigration were once well above the European norm, and its recent levels of immigration have also been higher than average. In the period 1995-2000, approximately a

quarter of a million people migrated to Ireland, of whom about half were returning Irish. This represents an astonishing 7% of the 1996 population (3.6 million). Before the recent recession, it was forecast that by 2020 the population of Ireland would have grown to 5.3 million, of which 1 million, or about a fifth, would have been immigrants.

Many Irish people believe that their country's history of migration means they have a duty to extend a warm welcome to people coming to settle in Ireland. Despite this attitude, Ireland experiences similar challenges to other European countries in dealing with new immigrants, such as controversies over asylum seekers, integration and competition for jobs.

Home away from home

Although rewarding in many ways, migration can be difficult for children. Moving away from their friends and family and having the routines of their short lives disrupted can make the early days extremely traumatic. They frequently face challenges in adapting to new circumstances, making new friends and negotiating cultural differences, and they become highly competent in dealing with the social and cultural demands of diverse settings.

Ireland possesses a category of migrant children that is peculiar to emigrant countries: the children of returning émigrés. 'A significant number of the 1980s generation of emigrants have been returning to Ireland in recent years, many of them with children who were born elsewhere, reflecting a strong desire among return migrants to bring up their children in Ireland,' describes Caitriona Ní Laoire of University College Cork, whose research interests lie in the areas of migration, childhood, identities, rural issues and gender. She has published widely in these areas, including papers in *Social and Cultural Geography*, *Journal of Rural Studies* and *Translocations*.

'For them, the notion of "coming home" raises many issues of identity and belonging. On the one hand, they are likely to share similar experiences with other migrant children, associated with moving from a familiar to an unfamiliar place, and with possible experiences of dislocation, loss and exclusion. On the other hand, their familial ties and support structures in Ireland, and their pre-migration knowledge of Ireland, are likely to be stronger or more complex than for other immigrant children,' she adds.

Despite their large number, the children of returning Irish émigrés are an under-researched subject, explains Dr Ní Laoire. With funding from a Marie Curie Excellence Grant, she is investigating the subject with a view to improving understanding of the experiences of these 'returnee' children and, in so doing, to give these kids voice.

The research is part of a larger team project on children's experiences of migration to Ireland. The research has been exploring the young migrants' experiences, everyday lives and social worlds, their family, kin and intergenerational relations; and how they negotiate and form their identities upon moving to Ireland. The project was due to publish its findings in September 2009 and a book drawing on the research is due out in 2010.

Dr Ní Laoire values the leadership role that the Marie Curie Fellowship afforded her: ***'Being team leader has been a wonderful opportunity to establish my research career, to develop expertise in an exciting and newly emerging area and to develop skills in research leadership and management,'*** she acknowledges.

Focusing the gender lens

The 'Migrant Children' project did not only focus on an under-studied field of research; it also provided a boost to a relatively neglected researcher population: women. The team was made up of a female team leader, Dr Ni Laoire, two female team members and one male team member. 'This represents a considerable female presence in light of the general under-representation of women in research in Europe,' notes Dr Ni Laoire.

The rationale behind this, she explains, was 'for reasons of equal opportunities as well as to achieve gender balance in the conduct of the research, as gender is a core dimension to the experiences of migrant children and youth'.

In addition to regular statutory requirements and the university's own equal opportunities policies, a 'gender lens' was used in the recruitment process, from the way applications were processed to the selection panel. 'In effect, this meant recognising and taking account of the different impacts of the structuring characteristics of research careers on males and females,' sums up Dr Ni Laoire.

And the experience of working on the project has been invaluable to her team. *'Being part of a Marie Curie Excellence Team has given me valuable experience of conducting research in another national context from where I gained my education,'* asserts Naomi Bushin, a Marie Curie Fellow who worked on the Migrant Children project. 'I have developed strong international research links, acquired new skills, contributed to knowledge in an under-researched area and enhanced my research profile.'

Dr Bushin, who graduated from the University of Wales, is currently focusing her research efforts on the experiences of children and young people who have moved from central and eastern European countries to Ireland.

Project acronym ■ Migrant Children
Full project title ■ Children's and young people's experiences of immigration and integration in Irish society

Type of grant ■ Excellence Team
Budget ■ EUR 1.2 million
Duration of project ■ 01-10-2005 - 30-09-2009
Scientific discipline ■ Sociology

Lead partner ■ Dr Caitriona Ní Laoire
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NANBIOPTIC

One of the most exciting developments in science and innovation in recent years has been the advent of nanotechnology, an area with the potential to create new materials and devices with wide-ranging applications. It could revolutionise fields as diverse as medicine, electronics, and energy production. The Marie Curie programme supports the men and women making new discoveries in this important field.

Big ideas of the smallest kind

Nanotechnology is the study of how matter is controlled on an atomic and molecular scale. Generally, it deals with structures of 100 nanometres or smaller, and involves developing materials or devices within that size range. Nanotechnology crosses the traditional boundaries between scientific disciplines – it has already spearheaded extensions to conventional physics, led to completely new approaches based upon molecular self-assembly and sparked the development of new materials with dimensions on the nanoscale.

‘Small’ is the new ‘big’

Marie Curie Fellow Beatriz Hernandez Juárez moved from Spain to Germany for her project on semiconductor nanoparticles, known to some as ‘quantum dots’. Her focus was the use of quantum dots to build up hybrid materials (materials containing

two different components) that can be used in applications from biomedicine to photovoltaics or photonics.

A quantum dot is a particle of matter so minute that adding or removing an electron changes its properties in some useful way, giving it the potential to improve lives and boost the economy.

Researchers have studied quantum dots in transistors, solar cells, LEDs and diode lasers, and they have also investigated quantum dots as agents for medical imaging.

A fantastic opportunity

‘The support I received through my Marie Curie Fellowship gave me the opportunity to join a recognised expert group devoted to nanoparticles,’ says Dr H. Juárez. She worked with Professor Horst Weller’s group at the Institute of Physical Chemistry at Hamburg University.

‘The atmosphere was fantastic’, says Dr H. Juárez, ‘and I had a chance to become part of a wider European research scheme.

Marie Curie support allowed me, among other things, to attend conferences, workshops and scientific meetings, and this was truly essential. I really appreciated that.'

Today, Dr H. Juárez works at IMDEA Nanoscience, a foundation created by the regional Government of the Community of Madrid and Spain's Ministry of Education and Science, to manage the Madrid Institute of Advanced Research in Nanoscience. 'Our institute promotes the creation of new research groups by bringing together scientists from different areas and from relevant international research establishments,' explains Dr H. Juárez.

IMDEA Nanoscience fosters effective collaboration on ambitious interdisciplinary research programmes, she explains, which is work that surpasses the capacity of individual groups. Training of new scientific and technical personnel is another key priority, and there has been a major push to create spin-off companies.

Just the beginning

Dr H. Juárez has proved that gender need no longer be a barrier to success in the hard sciences. In 2009, she was awarded the AGeNT-D Nanoscience Prize, honouring her for research done with Professor Weller in Hamburg. Clearly, her presence as a Marie Curie Fellow added a new dimension to his group, and she has shown herself to be a positive role model for other women looking to make a career in the development of leading-edge technologies.

The results of Dr H. Juárez' research have been crucial to her current work. 'Working with Professor Weller at the Institute of Physical Chemistry, I gained a high level of understanding in the synthesis and characterisation of these fascinating "quantum dot" nanomaterials,' she says of her Marie Curie Fellowship. 'At the end of the project we had completed the fabrication of novel hybrid materials combining semiconductor nanoparticles and carbon nanotubes with potential applications in photovoltaics and solar cells.'

Carbon nanotubes are cylindrical carbon molecules with novel properties that make them potentially useful in many applications in nanotechnology, electronics, optics and other fields of materials science, as well as potential uses in architectural fields.

The results of her efforts have been published in peer-reviewed international journals and formed part of a new patent application. 'This work has been essential for my current and future research projects', confirms Dr H. Juárez, 'a starting point for a series of new studies that are being carried out at IMDEA Nanoscience.'

Project acronym ■ Nanbiptic

Full project title ■ Semiconductor nanoparticles: from biomedicine to optics

Type of grant ■ Intra-European Fellowship

Budget ■ EUR 476 000

Duration of project ■ 01-12-2006 - 31-08-2008

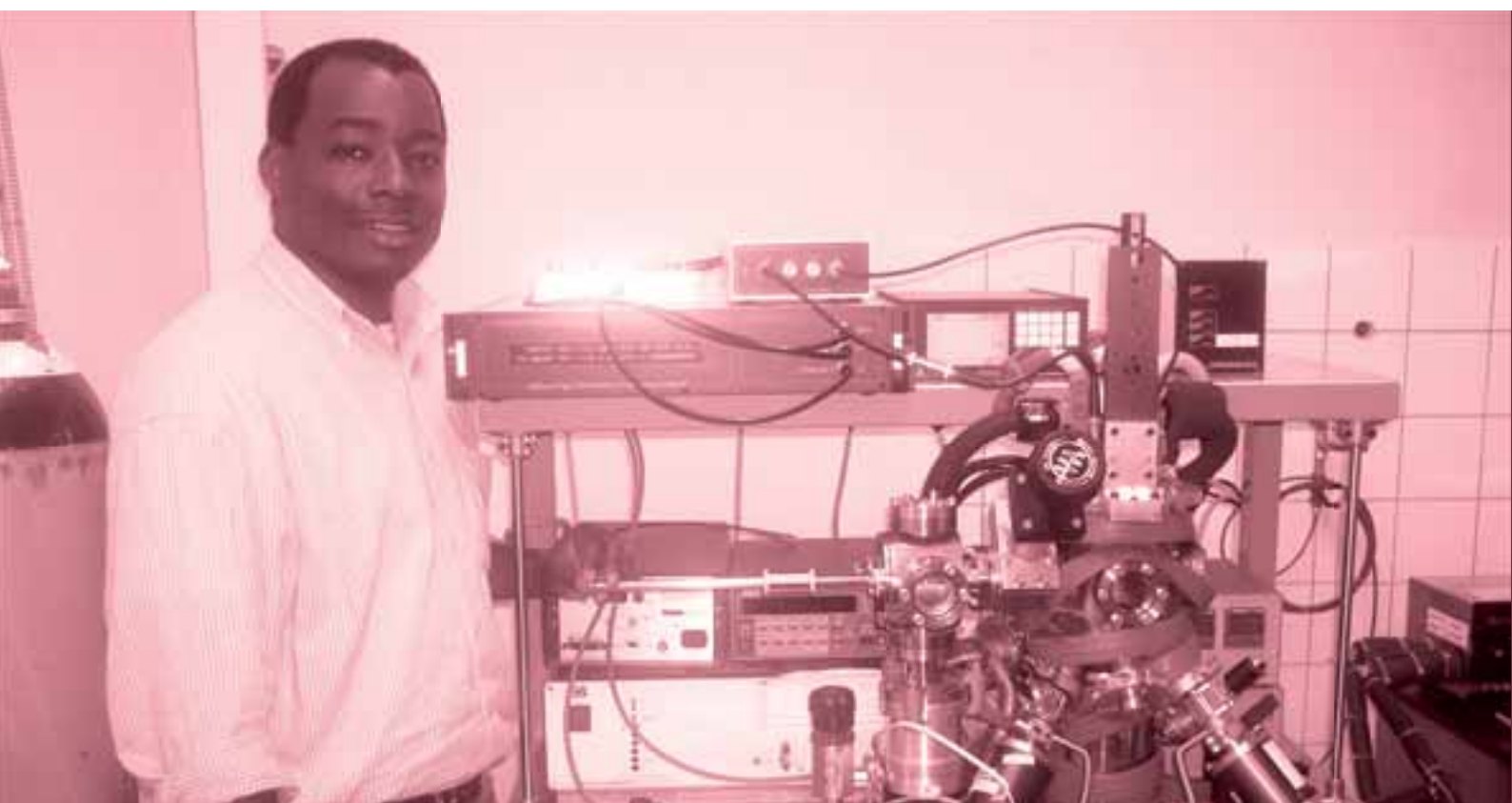
Scientific discipline ■ Chemistry

Lead partner ■ Beatriz Hernandez Juárez

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NANOMATCH

Developing new and more efficient lighting will reduce Europe's energy needs and address the environmental challenges posed by climate change. The EU-funded Nanomatch project is at the cutting edge of a scientific domain with answers.

Making light work at the nanolevel

The lamps and fluorescent tubes currently lighting up homes and offices around the world are highly inefficient, turning only a small fraction of the energy they use into visible light. The rest of the energy is wasted as heat.

Nanomatch's researchers are laying the scientific foundations for new and more efficient lighting by manipulating organic and inorganic lighting materials at the nanoscale level. The goal? New types of photovoltaic cells and light-emitting diodes (LEDs) should result.

The project received Marie Curie funding as a training network, helping it to recruit the best minds from across Europe. The 22 young researchers are receiving extensive interdisciplinary training in structural biology.

Matching women with nano

Attracting more women to this groundbreaking work is a priority, say Nanomatch joint coordinators Dr Hans-Joachim Egelhaaf and

Dr Johannes Gierschner. Indeed, 13 of the project's contingent of young researchers are women, and they also make up one-third of the project's principal investigators.

Dr Egelhaaf attributes the project's successful recruitment policy to a number of factors. Job advertisements proactively encouraged applications from women, and whenever possible, potential Marie Curie Fellows are offered day-care facilities for their children. All of this was made clear in the job advertisements.

These are the kinds of benefits needed to attract promising postdoctoral scientists or PhD Fellows, and entice them to relocate to join a team of researchers in their field. 'We can look for quite a while to find young researchers to fill places. But funding such as that provided by Marie Curie can make moving to another country more attractive to doctoral Fellows,' believes Dr Egelhaaf.

Ensuring that having family or moving abroad did not discourage the best structural biologists from joining the team, the project appointed a special ombudswoman to help participants deal with any family-related issues. She was elected by the women on the team from one of their number in the network.

'The ombudswoman is used quite frequently,' says Dr Egelhaaf. 'She has been helpful in many situations, including the easing of tensions. It's not only about family-related problems. Many of the problems are bureaucratic issues, which occur frequently. These are issues that affect both genders.'

Bright prospects for tailor-made molecules

Dr Egelhaaf says the experience gained in the project has helped the young researchers gain valuable experience which will further their careers in the science of optoelectronic devices – for example LEDs or solar cells – using nanoscale technologies.

The Nanomatch approach – exploring the advantages of hybrid organic and inorganic materials by tailoring the molecules to emit light in specific ways – is unique. And the control achieved by this approach has opened up the way for new possibilities in device technologies. The findings have also deepened understanding of elementary processes, such as energy and electron transfer in three-dimensional molecular arrangements, and at the organic and inorganic interface, Dr Egelhaaf explains.

Since the project started, the researchers have published 15 joint papers and have given an impressive 30 conference presentations. The young researchers themselves have made

15 oral and poster presentations at international conferences. Gaining experience in communicating the fruits of their labour, five principal investigators and seven of the young researchers stepped on to the stage to give presentations at the European Materials Research Society's Spring Meeting 2008, which was also used as a platform to present the network as a whole to a scientific audience.

And there is more: one commercially available product was launched and one patent application is on the way, plus, 'our lecture series *Aspects of Nanoscience & Nanotechnology* is being considered as the basis for a book at the end of the project'.

Dr Aurélie Guenet, a French researcher participating in the project at Germany's University of Münster, said she gained enormous experience from participating in the training network. She found the interdisciplinary approach of Nanomatch a good opportunity to broaden her knowledge in chemistry, as well as to discover new topics in physics and physical chemistry.

'It was also a nice way of meeting people – young researchers, principal investigators and professors – from different countries, and to discuss and exchange ideas with them,' Dr Guenet says. 'It enabled me to have a better overview of the science being developed nowadays across Europe while attending the different workshops organised by Nanomatch or by conferences.'

Networking for the future

Nanomatch is actually the follow-up to the Nanochannel project, another network funded by Marie Curie. And when Nanomatch's funding ends in 2010, the project's coordinators are preparing to apply for funding for a new follow-up project.

'The long-term outcome of a network is hard to forecast,' Dr Egelhaaf admits. 'In any case, the experience with the two Nanomatch summer schools [in Wrocław Technical University, Poland, and the University of Valencia, Spain], which were organised by two young researchers of the former Nanochannel network, is very positive, strongly promoting the young researchers' careers in their home institutions.'

Those involved in both networks have already gone far. One of Nanochannel's young researchers is now a Nanomatch principal investigator, and several of the other Nanochannel young researchers have already received permanent positions at academic institutions.

'In general, the participation in European Commission projects is, in our experience, highly regarded by the scientific community because of their strong collaborative, international and interdisciplinary character which helps a lot in the promotion of the young researchers' careers,' explains Dr Egelhaaf.

Anna Chizhik, a young researcher from Russia who moved to the University of Tübingen in Germany for the project, says the experience she is gaining through Nanomatch will help her develop her career as a scientist.

'Work in Nanomatch has brought me a lot of exceptionally fruitful collaborations, which will undoubtedly develop in future,' she says. *'Extensive exchange of research experience strongly increased my scientific skills.* Moreover, Nanomatch allowed me to integrate into the European system of research and education.'

Project acronym ■ Nanomatch

Full project title ■ Supramolecular nanostructured organic/inorganic hybrid systems

Type of grant ■ Training Network

Budget ■ EUR 3 682 047

Duration of project ■ 01-09-2006 - 31-08-2010

Scientific discipline ■ Life sciences

Lead partner ■ Institute for Physical Chemistry

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Other partners ■ Evonik Degussa GmbH, Germany - Ecole Normale Supérieure de Cachan, France - Università degli Studi di Cagliari, Italy - University Mons-Hainaut, Belgium - University of Groningen, Netherlands - Universität Bern, Switzerland - Eindhoven University of Technology, Netherlands - University of Münster, Germany - Centro Ricerche Fiat - Società Consortile per Azioni, Italy - University of Zurich, Switzerland - Consiglio Nazionale Delle Ricerche, Italy

BRAIN GAIN



Europe is increasingly retaining its brightest and its best talents, regaining many that have emigrated, and acting as a magnet for some of the world's top scientific brains.



Brain gain through circulation

European culture and vision of the world is largely based on science. Ancient Greek philosophers such as Epicure reflected 2000 years ago that the universe should be composed of atoms. Renaissance humanists led the way to new techniques. And in the Enlightenment period, Reason developed as a source of knowledge and allowed for the scientific and technological developments we know today.

Scientific education and research have always played a central role in Europe. Although education has remained of high quality and has become increasingly accessible over the years, post-World War II Europe has suffered from a brain drain due to the lack of career opportunities for skilled researchers. But those days are over, and the Marie Curie Actions are deploying every effort to make Europe attractive for researchers, entice them to Europe and ensure that they enjoy promising careers.

Returning European researchers and researchers from third countries also culturally enrich the European scientific landscape by bringing new approaches and attitudes with them. Likewise, brain circulation facilitates the formation of international networks, catalyses new collaborations, helps foster new ideas and promotes the dissemination of breakthrough technologies.

Knowledge without borders

Plugging and reversing the brain drain have become top priorities for both the EU and its Member States. And there are signs that not only is the tide being turned, but that Europe is becoming a major destination for its own returning talent, as well as top talent from other parts of the world.

A major and recent breakthrough was the creation of a 'scientific visa', allowing researchers from outside the EU to receive a residence permit. Accredited research organisations certify the status of the researcher and acknowledge the existence of a valid research project, as

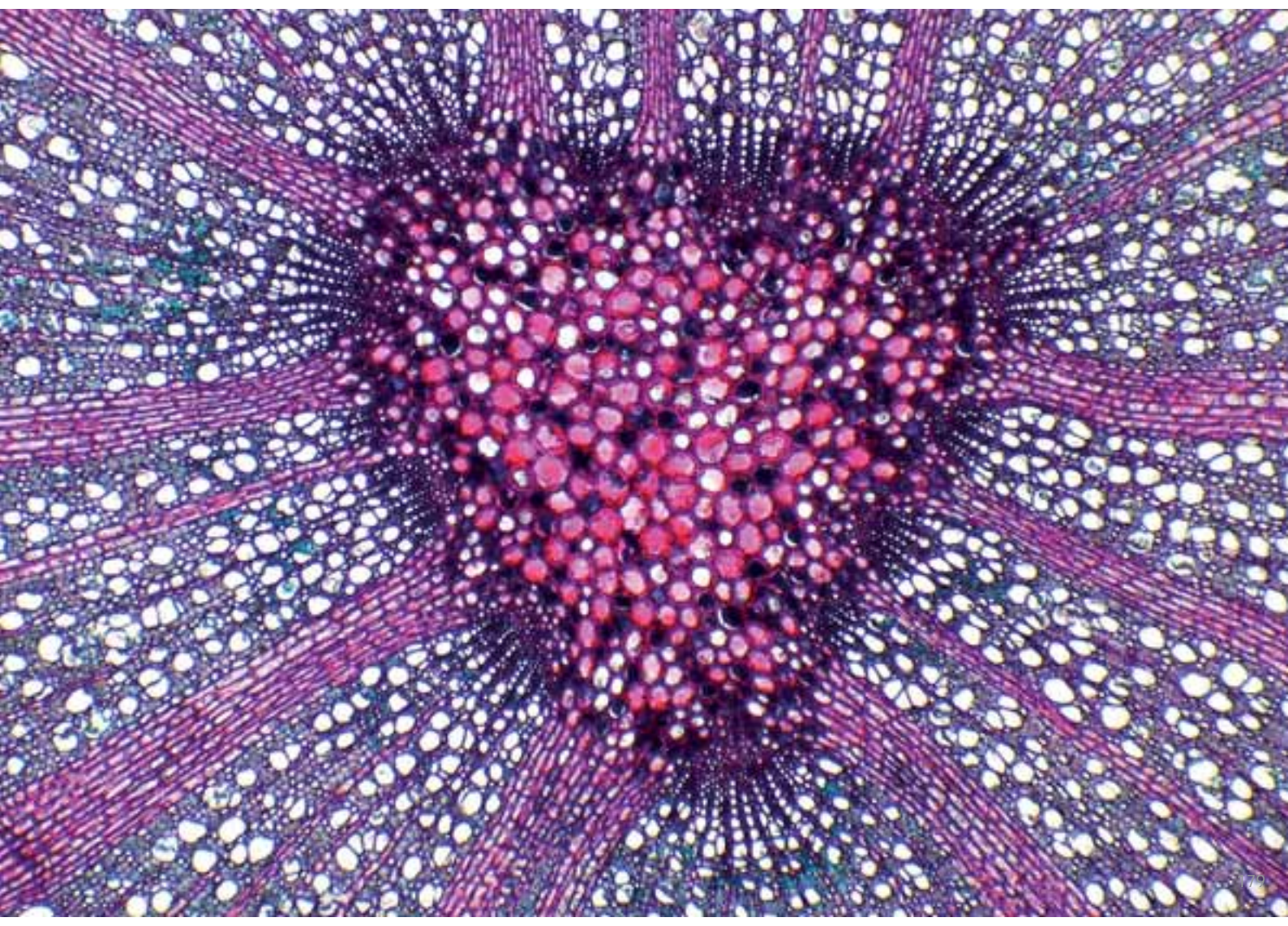
well as the researcher's scientific skills, financial means and health insurance. National immigration authorities must fast-track applications, delivering the residence permit within 30 days. And once the researcher is in possession of the permit, she or he is free to move between all EU Member States for the purpose of the project.

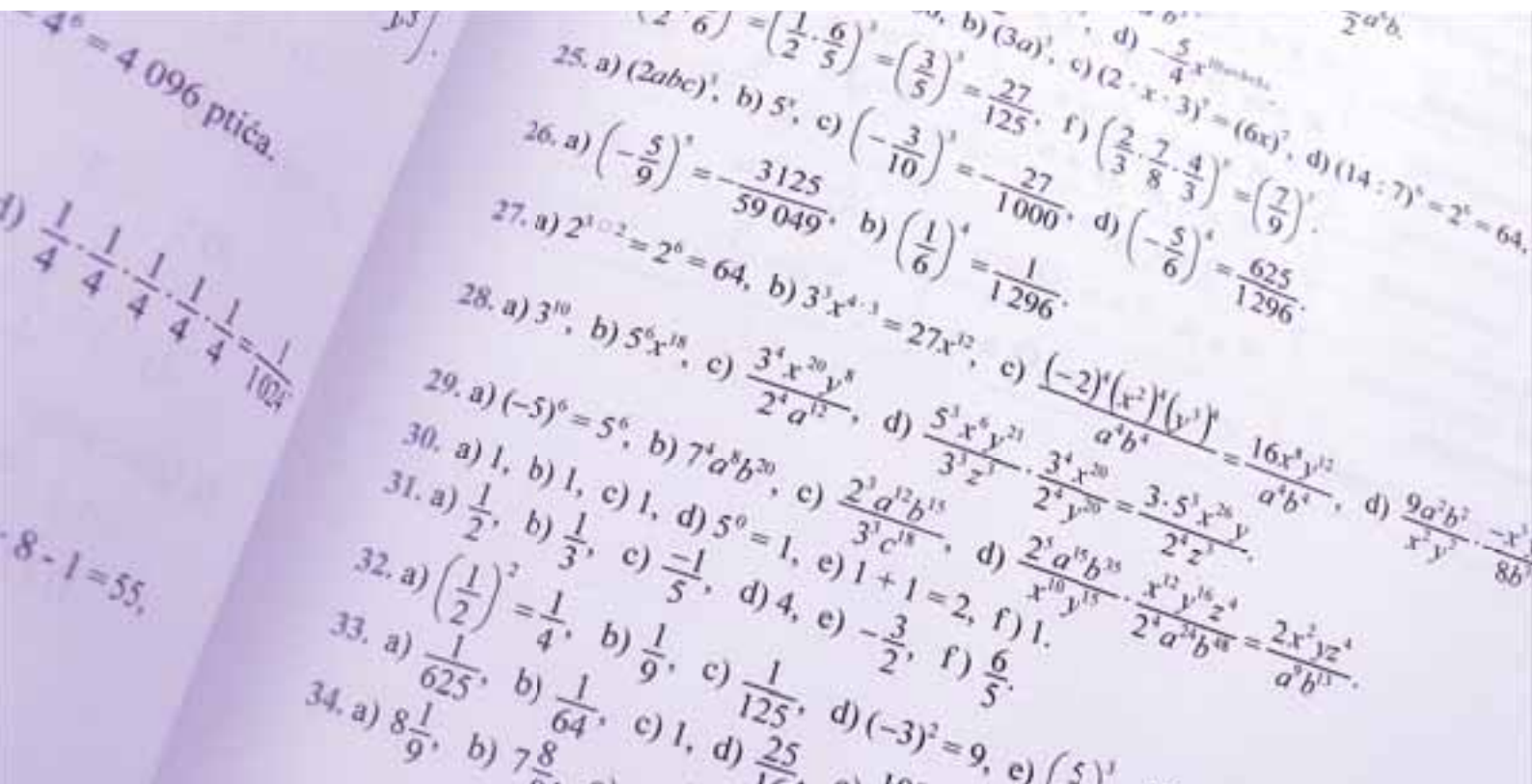
Circulating brains

Marie Curie Actions have played a pivotal role in attracting top-notch researchers to Europe and encouraging and helping expatriate European researchers to return. The Actions are based on the emerging notion of 'brain circulation', which recognises that European researchers based outside Europe can be a brain gain for the EU, as can third-country scientists based in the EU, for their home countries.

Incoming fellowships are attracting world-class researchers from outside the EU to Europe's shores, while outgoing fellowships help European researchers gain valuable experience abroad which they can later use to advance their research and careers back home. In addition, reintegration grants help European researchers based abroad – either within Europe or in a third country – to return home and reintegrate into the scientific community there.

With real-life case studies, this chapter showcases just how Marie Curie promotes brain circulation and how it is helping to turn the EU into a brain magnet.





ADAPTUNPREDICT

The Marie Curie programme aims to support and promote excellence among European scientists and researchers. Sometimes that means bringing them back home from distant lands. Peter J. Hammond returned from the United States to take up a Marie Curie Excellence Chair at the University of Warwick, where he now collaborates with other European scholars in developing and applying mathematical models in economic contexts.

Excellence Chair brings top-level mathematical economist back home

Single-person decision theory is a branch of applied mathematics which, following Savage's classic work *The Foundation of Statistics*, is concerned with identifying and modelling: what 'acts' or 'strategies' a single agent can choose; what 'consequences' can result from those acts; and what 'states of the world' represent uncertainty about the possible consequences of any act. When several agents with different objectives interact, it becomes multi-person decision theory – more often called game theory because it was first applied to games like chess.

Although the fields of decision and game theory may seem a bit removed from our everyday lives, they provide an important tool commonly used in biology, engineering, computer science and the social sciences, including political science, international relations, philosophy, and, most notably, economics.

'In essence, game theory uses mathematical models to analyse behaviour in strategic situations, where one "player's" success in making choices depends on the other players' choices,' explains Peter Hammond of the University of Warwick's Department of Economics. 'But we need to recognise that the models we use in statistics, decision or game theory and economics can only have temporary validity. In fact, the most appropriate model for analysing any challenging problem is bound to change in ways that cannot be predicted within that model.'

This is especially true, says Professor Hammond, because of limits on the complexity of useful models. So far, nearly all normative or prescriptive models used in applied decision science are 'myopic' or even 'hubristic', in the sense that they fail to recognise their unavoidable built-in obsolescence. One especially damaging recent example is the statistical models used by large financial institutions to determine their trading activities. Another illustration is climate change, where standard decision analysis makes it hard to understand the idea of the 'precautionary principle'. This can be interpreted as suggesting that humanity should be reluctant to change the composition of the Earth's atmosphere too drastically until

we understand the consequences better, or as showing what can be done to mitigate them and to abate harmful emissions.

'Moreover, descriptive decision models that heed psychological limitations are usually treated as fixed. It is important, however, to try to understand and even estimate what potential benefits may emerge if those making important decisions can, for example, receive expert professional advice.' Furthermore, economists usually estimate the benefit of professional services based on a consumer's subjective and inexperienced 'willingness to pay', rather than on the true benefits arising from better decisions.

A model of teamwork

Recognising and exploring the implications of these fundamental defects in applied decision models has been a key aim of the Adaptunpredict project, which brought Professor Peter J. Hammond back to his home country after many years in the United States. Thanks to support from the Marie Curie programme, *'Peter became our Marie Curie Excellence Chair holder upon his return to England,'* says Mark Harrison,

who became the lead partner in 2007 while he was Head of the Department of Economics. 'He immediately undertook some important collaborative work with European scholars, some based here at the University of Warwick, but also with others elsewhere within the EU.' His research achievements were honoured in July 2009 when he was elected as a Fellow of the British Academy.

The Chair holder has been employing a research assistant to consider fundamental mathematical issues connected to economic models involving games with a large number of players. There is also some related collaborative work being developed with members of the mathematics department through their programme in interdisciplinary mathematical research.

More to come

'The Adaptunpredict project has resulted in three published papers so far, together with a wide-ranging variety of conference and seminar presentations on topics ranging from game and decision theory to the design of market institutions,' reports Professor Hammond.

'Apart from some work on the limitations of existing normative models,' he says, 'there are other papers in progress that stem from a pilot study last year of how far student participants in an experiment made decisions that adhere to the standard rationality axioms that economists impose, and how their decisions relate to the attention they appear to give to each of the alternative decisions they could have made.' This pilot study was conducted in collaboration with Professor Stefan Traub of the University of Bremen.

In general, however, the first two years of this three-year project have been devoted to rather extensive exploration; it is during the third and final year that the Chair holder expects to convert the results of these explorations into working papers to be submitted for eventual publication.

After what amounts to an extended pilot study funded by the Marie Curie Excellence Chair, Professor Hammond is now planning to apply for further funding through the Economic and Social Research Council of the UK to further understanding of some of the implications for regulating financial markets. Indeed, this seems to be one of many cases where the evident modelling failures really could and should have been better predicted.

In the long run, almost everybody could benefit from more robustly designed markets based on a model which, unlike most of those used currently, explicitly treats the possibility that borrowers may default.

Project acronym ■ Adaptunpredict

Full project title ■ Adapting to the entirely unpredictable, and other aspects of dynamic behaviour: beyond the von Neumann standard paradigm in games and economics

Type of grant ■ Excellence Chair

Budget ■ EUR 493 237

Duration of project ■ 01-04-2007 - 31-03-2010

Scientific discipline ■ Economics

Lead partner ■ Prof. Mark Harrison

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CSS-OMICS

Stress is a part of daily life for many. But while it means agitation or the odd sleepless night for most, in others it can lead to clinical depression. The illness affects up to one in six Europeans during their lifetime.

Hunting for depression genes

A major obstacle to discovering successful treatments for depression is the lack of scientific knowledge about what makes some people less able to cope with the pressures of life. Our genes may hold some of the answers. A few seem to protect us while others appear to make us more vulnerable to depression in the face of adversity.

Cathy Fernandes, a British psycho-pharmacologist, took up the challenge of finding out to what extent genes can play an active role in depression. Stimulated by recent research that found genes can interact with the environment, she decided to delve further into the subject. Her work could help identify new methods for treating depression.

‘We still know very little about what causes depression, which genes and brain systems are involved and how to successfully treat this illness,’ says Dr Fernandes. ‘Depression is likely influenced by many different genes in different people and is closely related to stressful life events, but some people are much more vulnerable to emotional stresses and adverse life events than others.’

Dr Fernandes received a Marie Curie Fellowship that allowed her to move from the UK to the Rudolf Magnus Institute in Utrecht, the Netherlands, to conduct studies involving mice. The aim of her research was to hunt down genes responsible for conferring either resilience or susceptibility to social stresses.

The Marie Curie Fellowships are an important component of the EU's programmes to keep European scientists active in ground-breaking research within the bloc's borders. In addition to gaining access to the resources at the Rudolf Magnus Institute, Dr Fernandes was later able to take up a post as a Research Councils UK Fellow at the University of London's Institute of Psychiatry, King's College, after her 14 months in the Netherlands.

Mobility, resources, training

‘The Marie Curie Fellowship created the opportunity to work with a precious genetic resource – a specific mouse reference population – only available in Europe at the Rudolf Magnus Institute,’ she explains. ‘This mouse population is a critical component of my research, proving the “gene” factor.’ Without access to the Institute's mouse population, Dr Fernandes would have needed to consider taking her research outside of Europe.

A key part of her research was to find a way to measure both the physiological and behavioural results of stress at the same time. The fellowship gave her the opportunity to obtain valuable training on physiological techniques for such analyses from a research institute with years of experience in the field.

'I had many active collaborations at the time of my fellowship and due to the generous mobility allowance granted with the fellowship, I was able to continue these active collaborations – one of which resulted in my current post,' she says.

Identifying the factors of depression

Her research at the Institute focused on chromosome substitution and how studying the effects of stress on the young could help build understanding of the interplay between genes and environment in depressive illness.

'Early life events are most important in shaping our behaviour as we develop into adults, and there is a strong link between exposure to stress in children and the development of depression in adults,' she says.

She looked for genes in the mice that may be activated or influenced by stressful environments. Mice are considered

as excellent model organisms for this type of research as scientists can influence their genes and alter their environments in many ways. Working with the models she developed from the mouse tests, Dr Fernandes tried to determine how they might be used to indicate whether human genes could also interact with their environments.

Lonely mice

Three key results arose from her project. One was her discovery of specific interactions between the environment and genes that led to reactions in the brain. One set of mice was deprived of social interaction through isolated housing. These mice generally became more hyperactive and anxious compared to mice that were housed in a social setting.

However, another set of mice deprived of social interaction appeared to be resilient to the effects of social stress as they did not exhibit any increase in their activity. This result suggests that there are specific genes that confer either susceptibility or resilience to social stress, says Dr Fernandes.

The second major finding of her research was a higher level of corticosterone, a stress hormone, in those mice stressed through isolated housing than in those housed socially. The

finding provides evidence of an interaction between genes and environment at the level of the stress response system.

Dr Fernandes regards her third major result as the discovery that differences in gene activity due to stress can be detected in mice, and that such activity could be a useful measure of the interaction between genes and environment.

‘At this stage, there are no direct socioeconomic implications of my research, which is at the level of basic science,’ Dr Fernandes acknowledges. ‘However, my research has provided evidence for a direct link between our genetic make-up and our environment. It is a first step towards identifying specific genes that either put people at risk of, or protect against, developing depression.’

Biological mediation

The next phase of the work will be to identify specific genes involved in depression – and hence the biological processes mediating their response to environmental factors. Research is currently under way to identify specific genetic regions and the genes underlying the interaction discovered during Dr Fernandes’ Marie Curie Fellowship.

‘The long-term aim of my research is to show the value of positive social support in certain at-risk individuals with the aim of improving the treatment of depressive illness, a severely debilitating disorder placing a high burden on society,’ she says.

In addition to the personal satisfaction gained from rewarding research, Dr Fernandes claims the funding and the project helped her to make the transition to an independent researcher.

‘In addition to professional rewards, I have greatly benefited from working and living abroad with all the challenges and experiences that provides,’ she says. ‘I gained many new colleagues and friends, with whom I still regularly interact.’

Project acronym ■ CSS-Omics

Full project title ■ Chromosome substitution strains: a powerful tool to study the stress response in mouse

Type of grant ■ Intra-European Individual Fellowship

Budget ■ EUR 92 546

Duration of project ■ 05-06-2007 - 04-08-2007

Scientific discipline ■ Life sciences

Host institution ■ Rudolf Magnus Institute of Neuroscience, University Medical Centre Utrecht

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ELSAQUINTANA-NCSCS

For Spanish pharmacologist Elsa Quintana, a Marie Curie Fellowship has provided the perfect opportunity to continue research into cancer in the United States and then return to Spain, equipped with new knowledge and experience.

Brain gain in Spain

Dr Quintana has a passion for science. 'After finishing my PhD at the University of Valencia's Department of Pharmacology, I was sure I wanted to do science for the rest of my life. This was because of the wonderful experience I had under Dr Juan Vicente Esplugues and Dr Maria Dolores Barrachina at Valencia. They really reinforced my passion for science and always encouraged me to have my own ideas,' she recalls.

Given her interest in cancer stem cells, Dr Quintana decided that the next step would be to study stem cell biology. 'It was a risky change since my background was not in that area. However, in my opinion, postdoctoral training provides a good opportunity to change fields. In that way, by the time you are ready to start your own group you have really doubled your scientific training,' she remarks.

Thanks to a Marie Curie Fellowship, which allows Fellows to explore new career paths, Dr Quintana was able to join the laboratory of Dr Sean Morrison at the University of Michigan in the United States for two years. This allowed her to work with a world leader in stem cell biology and gain the necessary

experience. In her return year at the University of Valencia she is further developing her new skills.

Detecting sleeper cells

Given the groundbreaking nature of the cancer research in which Elsa Quintana is involved, her love of science could prove invaluable to millions of people. The research she is conducting for her fellowship involves studying the tumorigenic potential of human melanoma cells, in other words, looking at the potential for skin cancer to develop.

'We have increased the ability to detect tumour formation by several orders of magnitude, making it possible for the first time to detect efficient tumorigenesis from single cells,' the researcher explains. So far, her research suggests that melanoma cells with the potential to turn into tumours are far more common than had previously been thought.

'The question of whether cells with tumorigenic potential are common or rare within human cancers has fundamental implications for therapy,' she says.

The cancer stem cell hypothesis predicts that only a tiny subpopulation of cancer cells has a tumorigenic potential, as opposed to the more traditional view, according to which all cancer cells can develop into tumours. Identifying the right scenario is, therefore, essential, as Dr Quintana points out. 'It is extremely important to know whether we need to target *all* cancer cells or a rare subpopulation.'

If all cancer cells have the potential to develop into tumours, then it is essential that therapy does not leave a single cancer cell alive. If it is only a tiny minority of cancer cells that develop into tumours as the cancer stem cell hypothesis predicts, then the challenge is to identify that rare population in order to specifically target and eliminate it. 'Both scenarios are challenging, but anti-cancer therapy will be addressed in a very different way depending on which one holds to be true. Our work suggests that to cure human melanoma we need to eliminate *all* cancer cells,' notes Dr Quintana.

Research on an international stage

Dr Quintana wishes to use her Marie Curie Fellowship as an opportunity to gain valuable knowledge and experience that she can use back in Europe for the remaining year of her fellowship to help build up her career back in Europe. She will spend the final year at the University of Valencia.

'Dr Morrison is a bright, young, enthusiastic scientist who has taught me how to think critically and work extremely carefully. It is a big lab full of talented postdocs and graduate researchers,' she enthuses. 'One of the goals of my postdoc was to build up a competitive CV and I think I am accomplishing it.'

One major new addition to her CV was an article on her work published in the prestigious journal *Nature*. 'The article was selected by the editor for the front cover of the 4 December 2008 issue and has been highlighted in many other scientific journals. Consequently, this work has drawn a great deal of attention from the international and national press,' she points out.

The extra visibility and exposure has also led to invitations to address scientific gatherings in the United States and Europe.

'I have had the opportunity to interact with other scientists, gain recognition in the cancer and stem cell fields, and create connections that I hope will be beneficial in the near future.'

Although Dr Quintana still has a full 12 months left in her fellowship, she is already planning for her post-Marie Curie career. 'I am currently generating new preliminary data that supports the continuity of the project and reflects the progress I am making towards my consolidation as an independent junior researcher.'

Project acronym ■ ElsaQuintana-NCSCs
Full project title ■ Characterisation of melanoma-initiating cells

Type of grant ■ Outgoing Individual Fellowship
Budget ■ EUR 244 000
Duration of project ■ 01-02-2007 - 31-01-2009. Remaining 12 months will be resumed after one-year leave has expired.
Scientific discipline ■ Life sciences

Host institution ■ Professor Juan Esplugues Mota
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EXNER_BORISOV

Many modern devices and technologies rely on waveguides when it comes to transmitting power or signals from the point of generation to the point of application. Optical fibres are one common example of a waveguide. But what if there is a gap in the guiding material or some other perturbation? Over to Marie Curie Fellow Dr Denis Borisov...

Guiding waves towards their destination

Waveguides are conduits for electromagnetic, sound and other waves, used for transferring power as well as communication signals. They can be made of various materials, depending on the field of application, and take different forms: slab waveguides, fibre or channel waveguides. They can be hollow or solid. However, what unites them all is that whatever wave they guide – be it electromagnetic or acoustic – the power loss during the progress of the wave should be kept to a minimum. Other features, once again, depend on what the waveguide is used for.

Russian researcher Dr Denis Borisov joined forces and brains with renowned waveguide expert Professor Pavel Exner at the Czech Academy of Sciences in an attempt to develop a model that can predict how the features of waveguides will change under certain conditions. 'If you have a cable through which

you send the waves and modify something inside – add a gap inside or just some other material or you make some other modifications – it changes its properties,' Dr Borisov explains.

A mathematical model

Dr Borisov did not take a practical approach to these so-called 'distant perturbations', but rather a theoretical one: using his mathematical skills, he unified theories that had been developed in various papers by different authors dealing with a variety of very specific problems. 'I wanted to create a blend of possible models. And I succeeded,' he says, not without pride. 'I developed a new technique which gave me a chance to solve this problem in its very general form. And it means that all the results known before are brought together in my general solution.'

Since waveguides can be found in many fields, including nanotechnologies or information technologies, the ability to better predict how a waveguide's properties will change might help to improve performance of different devices – computer

chips, for instance. 'Of course, it's not as if our results will make it possible to build new computers,' Dr Borisov adds modestly. 'There is still a very big distance. But in a sense, we can understand the effects that happen in those chips and we can help engineers with it. We can explain the effects that will occur under certain circumstances, so that they can be taken into account when they're making the chips.'

Time for a change

Despite a fascination that becomes tangible when Dr Borisov talks about the subject, waveguides had not been his speciality to begin with. Initially, the young mathematician had specialised – and excelled – in homogenisation. It was only after his colleague, mentor and friend Professor Exner had suggested a change that he ventured into the new field. And there he excelled, just as before. 'In mathematics, it's not such a great idea to limit yourself to just one field,' Dr Borisov firmly believes. 'From time to time you should change your field. Instead of dealing just with one subject, you should learn new things every now and then.'

When Dr Borisov left his home institute, the Faculty of Physics and Mathematics at Bashkir State Pedagogical University in Ufa, heading to his fellowship in Prague, he was 'just a PhD', he says about himself. His thesis had been on the subject of homogenisation and had yielded a medal from the Russian Academy of Sciences for the best young mathematicians in the country, as well as an Academia Europaea Prize. But that was before he delved into waveguides. 'Waveguides was a new subject, so I really worked hard,' Dr Borisov remembers. 'Then, finally, based on the results that I obtained in Prague and some additional ones, I defended a second thesis in Russia.

'So, I obtained a second scientific degree in Russia; it's called "Doctor of Science" and it's equivalent to the professor level. This means that I have now taken up a professor position at my university,' he says, adding that the Marie Curie Fellowship helped a lot in speeding up the process. 'I reached this level rather fast. I mean, I was just 30 then. And without this fellowship, I don't think I would have succeeded, because *Marie Curie enabled me to devote one and a half years to science and nothing but science*. I didn't have any other duties. It was great that I was able just to work on writing papers and solving problems.'

Learning from each other

Dr Borisov feels that the fellowship has benefited him greatly in more ways than one: it has given him the opportunity to broaden his horizons scientifically and personally, to establish new links with colleagues from all over Europe that have engendered new collaborations. 'And it was really useful for my colleagues, too,' he is sure. 'In all collaborations I had and I have now, I have worked and am still working with people who are not so familiar with the methods I know. So, they learn new things from me, just like I learn new things from them.'

Dr Borisov makes it very clear: the Marie Curie Fellowship was a complete and utter success for him. Maybe most of all because it gave him the freedom to do what he loves: *'Maths is exciting. You learn something new every time you start working on a new problem.* And when you're successful, you feel like you're on top of the world,' Dr Borisov enthuses. 'It's like my soul wants me to do maths. This is just a part of my life. I can't even imagine doing anything else. I'm glad that I'm a mathematician. I've obtained all I wanted when I decided to go into maths a little over 15 years ago.'

Project acronym ■ Exner_Borisov
Full project title ■ Spectral properties of perturbed quantum waveguides

Type of grant ■ Incoming International Fellowship
Budget ■ EUR 102 184
Duration of project ■ 01-10-2005 - 30-04-2007
Scientific discipline ■ Mathematics

Host institution ■ Czech Academy of Sciences
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HIVOXFORD

In late 2006, five Bulgarian nurses and a Palestinian doctor stood trial in Libya charged with the hideous crime of deliberately infecting over 400 children with HIV. A guilty sentence meant death by firing squad. Even as the court deliberated, science came to their rescue, as Marie Curie Fellow Tulio de Oliveira published the results of research that proved the medics' innocence and helped to secure their release.

Life-saving science

Portuguese scientist Dr Tulio de Oliveira has lived all over the world. For over two years, his home was Oxford in the UK where he was a Marie Curie Fellow at the city's famous university. His project – HIVOxford – distinguishes between the factors that shape the evolution of HIV (Human Immunodeficiency Virus) within an infected individual, such as the immune system and antiretroviral drugs, and the forces driving the evolution of the virus in the population. In December 2006, the fruits of his labour were published in a groundbreaking article in *Nature* magazine, saving six lives and making headlines across the globe in the process.

Back to December 2004 in Oxford – Dr de Oliveira's project was ambitious. It aimed to shed light on the evolution of HIV and, in effect, map the progress of the disease in an infected individual. This entailed analysing the genetic sequence of the virus in one individual and comparing it to HIV sequences from other individuals from the same population group living in the same area.

By running the data through powerful computer programs, including some software he had developed himself, Dr de Oliveira was able to calculate the origin and temporal distribution of HIV-1 strains responsible for localised epidemics.

Renowned scientists as teachers

Dr de Oliveira was supervised by virus evolution experts Andrew Rambaut and Oliver Pybus. *'The time spent in Oxford was very productive, instructive and exciting. I learned many new scientific techniques but, crucially, I learned how to identify and solve complex scientific problems,'* says Dr de Oliveira. 'By the end of the fellowship, I was in a better position to identify scientific questions, learn new analysis techniques and use them to find the answers.'

His two-year fellowship saw him publish nine research papers, produce two bioinformatics software applications, and collaborate in the creation of a genetic database for over 900 RNA viruses. However, the highlight was the publication of his research in *Nature*. The results concluded without a shadow of a doubt

that the accused medical personnel were not responsible for the HIV and hepatitis C virus (HCV) outbreak at the Al-Fateh Hospital in Libya.

The path to *Nature*

The path to the *Nature* paper began in October 2006 when Dr Giovanni Rezza and Dr Massimo Ciccozzi from the Istituto Superiore di Sanità (ISS) invited Dr de Oliveira to Rome to discuss the potential analysis of HIV-1 sequence data isolated from 37 of the 418 children who were infected in an outbreak of the virus at the Libyan hospital. There he met Professor Vittorio Colizzi who gave him access to the genetic sequences of the HIV and HCV genetic sequences from the Libyan children.

Dr de Oliveira's goal was to determine the origins of the outbreaks. He began by analysing the HIV and HCV sequences using evolutionary techniques developed in Oxford. Initial results showed that one HIV-1 strain and three HCV strains were responsible for the infections. The origin of the HIV strain was mapped to West Africa and the HCV strains to West Africa and Egypt. A worldwide HCV strain was also detected.

The next, crucial step was to apply molecular-clock techniques to determine when the outbreaks started. Together with Dr Pybus, Dr Rambaut and Italian researchers, he applied various models of evolution to the data. The results revealed that both outbreaks began before March 1998 – the date the accused medical staff arrived in Libya. The findings were submitted to *Nature* and underwent a rigorous peer review process. In December 2006, the paper was published and, along with international pressure from human rights and medical organisations and interventions from high-ranking politicians, it eventually helped to secure the release of the medics in July 2007.

To Africa, where it all started

'In many respects, Marie Curie contributed to my career development. It gave me the opportunity to receive in-depth training on virus evolution, establish a solid network of collaborators and publish papers and software applications,' explains Dr de Oliveira. *'It also showed me how scientists can work together to answer questions that are important for everyday life. The fellowship and its results allowed my career to advance to a more senior academic position.'*

Dr de Oliveira's story does not end there. He is now working in South Africa where he is investigating the use of genetic analysis to identify networks of HIV-1 transmission. Specifically, he is studying how HIV-1 strains are transmitted in northern KwaZulu-Natal in South Africa. The findings will be integrated with geographic and demographic data gathered over the past 12 years and will help to enhance understanding of the causes and consequences of high-level HIV transmission in the area. He is also developing computer applications with Belgian and French researchers to classify HIV-1 strains and to support the clinical antiretroviral treatment of HIV-infected individuals.

Dr de Oliveira has some words of wisdom for prospective Marie Curie Fellows, saying: 'The identification of the research group is a crucial step and I advise prospective students to visit the group before and during the preparation of the project proposal.' His reasoning for this is that 'The two-year duration of an academic research project is a short time for an academic research project and in order to be productive the research project must be well defined in advance and the Fellow must work hard and stay focused.'

Project acronym ■ HIVOxford
Full project title ■ The intra- and inter-evolutionary dynamics of HIV

Type of grant ■ Intra-European Individual Fellowship
Budget ■ EUR 162 448
Duration of project ■ 01-12-2004 - 30-11-2006
Scientific discipline ■ Life sciences

Host institution ■ Zoology Department
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MARINE MAGNETISM

Isn't it just awful having to dust? Most people hate dealing with it, which is why the more fortunate among us hire home helps, while others simply avoid the chore and hope it goes away. A young scientist from China begs to differ. His work depends on dust – aeolian dust signals, to be precise. These signals can paint a picture of environmental variations thousands of years ago and quantify the effects of human activity.

Just a pile of dust?

Dr Qingsong Liu's international career began at the National Oceanography Centre in Southampton (NOCS), in the UK, renowned for carrying out a wide range of research on marine science. He is convinced that it greatly improved his background knowledge in marine sciences, notably how to link dust signals to palaeoclimatic variations. *'Marie Curie support has enabled me to focus on a hot area in my research field. For me, freedom is one of the most important factors that ensured the success of my fellowship,'* he says. The researcher also participated in several important international scientific meetings which enabled him to exchange valuable information and experience with other researchers.

New insights

Dr Liu's studies cover palaeoceanography – the study of the history of oceans – and environmental magnetism, which can increase understanding of the complexity of aeolian magnetic minerals such as haematite and goethite. His research traces variations in aeolian dust signals recorded

in marine sediments from the North Pacific Ocean and investigates the driving mechanisms of the East Asian Monsoon. Dr Liu published over 10 international peer-reviewed papers during his two-year fellowship and has more in the pipeline. The papers have, he says, provided new insights into environmental magnetism.

Basing a career on dust may seem surprising to many. But it is less surprising when you realise the huge role it plays in influencing our climate. 'Dust reflects the sunlight which, in turn, cools the earth. It also fertilises the oceans making up for loss of nutrients,' explains Dr Liu. 'Isn't it therefore important to understand how rates of dust emissions fluctuated in the past, which led to changes in vegetation, hydrology and precipitation? Of even more importance is understanding the inherent fluctuations in dust flux, which helps to correctly quantify the effects of human activity.'

Dr Liu's work is divided into three phases. The first focuses on the aluminous iron oxides, goethite and haematite which are ubiquitous in soils. They provide crucial information for deciphering dust signals in both terrestrial and marine sediments and thus carry important information concerning

aeolian dust. The second traces dust signals from the Chinese loess to marine sediments in the North Pacific, and the third investigates how dust signals from different regions of the world might be connected.

Making a big impression

The results are impressive. For instance, Dr Liu found that the magnetic properties of haematite and goethite vary largely with respect to aluminium content. He also discovered that the magnetic enhancement of samples crossing a palaeoclimatic transition at the intensification of major Northern Hemisphere glaciation (2.7 million years ago) was not due to variations in the abundance of ice-rafted debris deposited. Rather, it resulted from a higher concentration of fine-grained particles caused by increased aridity of the Asian continent and intensified global atmospheric circulation during the late Pliocene epoch.

The results highlight the important role of dust deposition in controlling the magnetic characteristics of sediment in the sub-Arctic Northwest and central North Pacific Ocean. Finally, to better understand palaeoclimate variations and how the

sediment magnetic signal varies between Asian interior dust sources and their eventual deposition in the North Pacific, the team has worked on the origin of magnetic signatures in soil environments.

Moving on

Dr Liu believes his career prospects have definitely been given a boost by the Marie Curie programme. Thanks to the active support of host professors Andrew P. Roberts and Eelco Rohling, his background in rock magnetism combined with the knowledge of marine science gleaned from his fellowship mean he has now become a specialist in marine magnetism.

Much has happened to the doctor since his fellowship ended. 'As a result of Marie Curie, I obtained a replacement teaching position at NOCS, and later a permanent position as professor at the Institute of Geology and Geophysics at the Chinese Academy of Sciences. *Since returning home, I have established a "rock and environmental magnetism" laboratory and my own research group,*' he acknowledges.

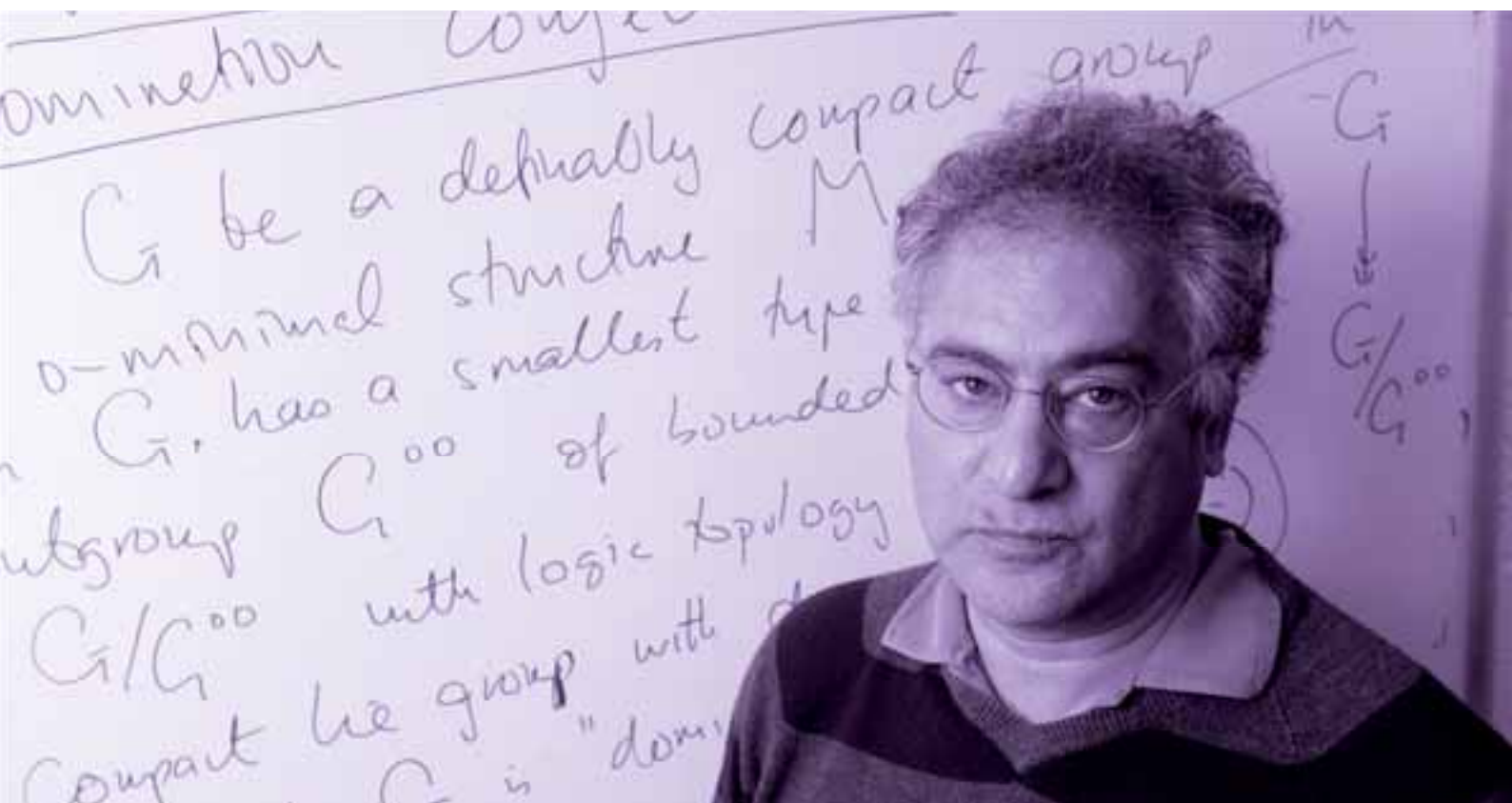
The young research team in Beijing is currently studying synthetic magnetic minerals and sediments from cores near the Chinese coastline and the North Pacific region. 'Undoubtedly, the Marie Curie programme has opened the most important window for my future career. It has earned me a reputation in science. This is the main reason I have secured my current position in my homeland,' he says.

The National Oceanography Centre certainly worked for Dr Liu, who swears by having the right host institute that meets your needs, expands your horizons and enables you to learn more about your subject field. He also sees the importance of doing your utmost to establish a good rapport with those in charge of the institution and indeed your fellow Fellows. For Dr Liu, all the indications are that what he has gained during his Marie Curie experience will be put to even more good use in Beijing. And, of course, Europe gains from the knowledge he shared while here, alongside his close links with European researchers.

Project acronym ■ Marine Magnetism
Full project title ■ Probing the long-term forcing mechanisms of the Asian Monsoon by magnetic analysis of aeolian dust in sediments from the North Pacific Ocean

Type of grant ■ International Incoming Fellowship
Budget ■ EUR 139 385
Duration of project ■ 01-09-2005 - 31-08-2007
Scientific discipline ■ Environment

Host institution ■ School of Ocean and Earth Science
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MODPAP

The Modpap project has delivered key findings in advanced mathematics and, with support from Marie Curie, it has also returned an outstanding European researcher to the EU after a long stint in the United States.

Increasing the sum total of Europe's maths expertise

Model theory is a branch of mathematical logic which has developed some close relationships to other parts of mathematics. Modern mathematical logic, conceived at the beginning of the 20th century, sought solutions to problems at the very foundation of mathematics, such as the nature of infinity, the nature of proofs, and also the nature of computations.

Today's model theorists study relations between mathematical objects and the language in which we talk about them. Back in the 1950s, Abraham Robinson had already used these ideas to show that Leibniz's use of infinitesimals in his presentation of calculus could be put on a rigorous footing. Model theory currently has close ties with other areas of mathematics, including algebra and geometry.

Project coordinator Dugald Macpherson of the University of Leeds, UK, says the aim of Modpap (Model theory, pure and

applied) has been to support and promote research activities on model theory and its applications in Europe, while contributing to the training of young researchers, both in Leeds and elsewhere in the EU.

Powerful answers to advanced mathematical questions

'The research objectives of the project had several aspects,' Dr Macpherson explains. 'A certain machinery – stability theory – has been developed in model theory to study restricted classes of structures, such as the field of complex numbers. First, we wanted to extend the methods to a wider class of structures. Secondly, we wanted to strengthen applications of model theory to parts of mathematics, such as differential equations, which are fundamental for modern science and technology.'

'The project has been very successful and has led to major breakthroughs and advances in these areas,' acknowledges Dr Macpherson. 'Highlights include a series of papers by our Marie Curie Chair holder, Dr Anand Pillay, together with collaborators such as Ehud Hrushovski.'

According to Dr Macpherson, Dr Pillay has been instrumental in some exciting new work on 'first-order theories without the independence property'. The group has come up with some important ideas on measure and developed new solutions to conjectures linking model theory and 'Lie groups'.

Lie groups, named after the 19th century Norwegian mathematician Sophus Lie, represent the best-developed theory of continuous symmetry of mathematical objects and structures, which makes them indispensable tools in many areas of contemporary mathematics.

'Another highlight', says Dr Macpherson, 'has been a new round of collaboration between Dr Pillay and the number theorist Daniel Bertrand from Paris on the application of model theory and differential algebra to problems of transcendence theory for function fields.' The resulting papers, he confirms, have either appeared or are expected to appear in top mathematical journals.

Dr Pillay and Dr Macpherson are the editors, together with Drs Chatzidakis and Wilkie, of a two-volume book on model theory with applications to algebra and analysis, published by Cambridge University Press in 2008. Several of their own contributions appear in the two volumes.

'In general, direct research output from the Modpap project has been considerable, with nearly 20 research papers written by Dr Pillay, in addition to papers by myself and Fellows,' says Dr Macpherson.

Marie Curie adds up

Statistics show that highly skilled people are more mobile than the rest of the population. One of the key actions of the EU's Research Framework Programmes (FPs) has been to make Europe more attractive to the best and brightest from other countries and, in some cases, to bring its own best and brightest back home after stays abroad.

One of the main benefits of the Marie Curie-funded Modpap project, continues Dr Macpherson, was that it made possible Dr Pillay's return to Europe. Originally from the UK, Dr Pillay moved to the United States in the early 1980s. The Marie Curie-funded 'Excellence Chair' facilitated his return.

'During my time as Marie Curie Chair holder', says Dr Pillay, 'I organised three international workshops in Leeds, using Marie Curie Chair funding.' The topics were o-minimality (March 2006), differential algebra (May 2007) and classification theory (June 2008).

'Each meeting saw the participation of leading researchers and had a significant impact on the field,' he affirms.

'The three-year Marie Curie Excellence Chair was a very nice experience,' he adds. *'I was able to devote all of my time to some very interesting and fruitful research. Indeed, I can say it has been among the most productive and enjoyable periods in my professional life.'* I am grateful both to the European Union and to the project coordinator Dugald Macpherson, for having made it possible.'

Dr Pillay's tenure as Marie Curie Chair holder has ended but, according to Dr Macpherson, he has now been granted a permanent chair in the School of Mathematics at the University of Leeds.

A brain gained and brains gain

Dr Pillay's Marie Curie Excellence Chair coincided with two networks in mathematical logic in which Leeds was involved, namely the early-stage training network Mathlogaps (Mathematical logic and applications), coordinated by Leeds University, and the research training network Modnet (Model Theory), coordinated by the University of East Anglia.

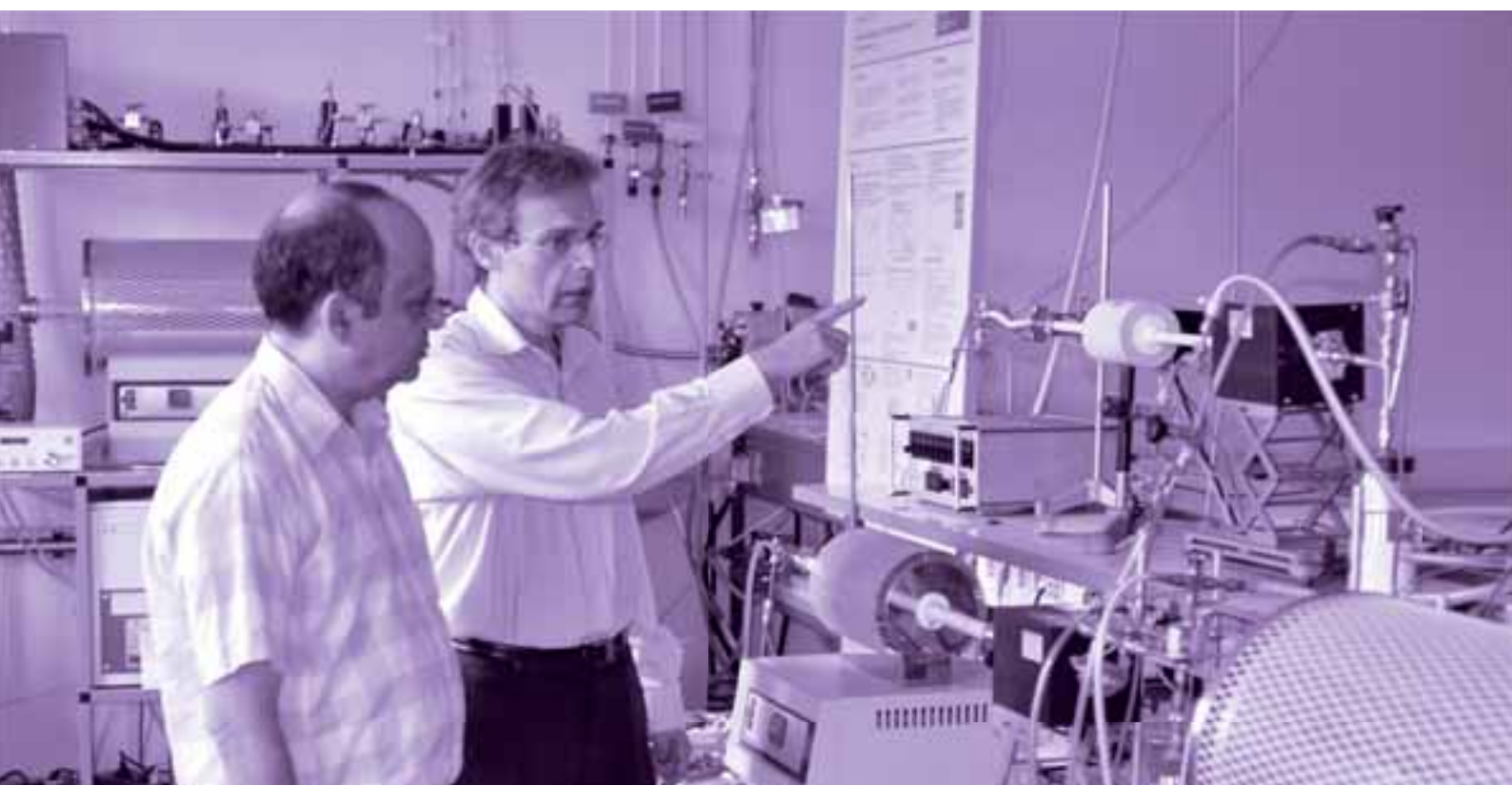
Dr Pillay played a substantial role in both of these initiatives. For example, one of his PhD Fellows, G. Boxall, was initially funded by Mathlogaps, and Dr Pillay delivered a course of lectures on 'continuous model theory' at a Mathlogaps training workshop in Leeds in the summer of 2005. Meanwhile, Modnet funding allowed a postdoc, Dr F. Benoist, to work in Leeds from 2007 to 2008. Dr Pillay delivered lectures and short courses at several Modnet training events and conferences.

'Through it all, we have managed to develop a very strong research group in model theory here in Leeds,' concludes Dr Pillay. 'I now have five PhD Fellows, one of whom is about to submit his thesis. I also hold, with Dr Macpherson as co-investigator, an Engineering and Physical Sciences Research Council grant which is funding a three-year postdoctoral research assistant, a PhD Fellow, travel, and three research visitors, one from Jerusalem, one from Wroclaw, and one from Vassar College in New York.'

Project acronym ■ **Modpap**
Full project title ■ **Model theory, pure and applied**

Type of grant ■ **Excellence Chair**
Budget ■ **EUR 479 372**
Duration of project ■ **01-09-2005 - 31-08-2008**
Scientific discipline ■ **Mathematics**

Lead partner ■ **Anand Pillay (Chair-holder)**
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NANOSWITCH

It calls to mind a scene from a science fiction film: a pane of transparent glass becomes an opaque mirror surface at the flick of a switch. Despite the futuristic appearance, switchable mirrors are far from being a mere vision. Smart glasses can be used in different applications. Marie Curie Fellow Bodh Raj Mehta came to Europe to take the technology one nano-step further.

Mirror, mirror on the wall

The technology is based on the phenomenon that hydrogen can trigger changes in structural, optical and electric properties of rare earth metals such as gadolinium, an element used in a variety of applications ranging from nuclear reactors to compact disks. For the switch to occur, the inner side of two glass panes must be coated with a thin film containing gadolinium or a similar substance. When a gas with small amounts of hydrogen is introduced between them, the properties will change and turn the material's status from transparent to reflective. Why is this useful? Switchable mirrors have applications as windows in buildings, cars and planes, and can help save energy or simply act as a screen.

Professor Mehta's Nanoswitch vision was to improve the quality of such switchable mirrors with the help of innovative nanotechnology. The physicist from the Indian Institute of Technology Delhi and his colleagues at the Marie Curie host, the Faculty of Engineering at the University of Duisburg-Essen

in Germany, had mapped out a route to better switchable mirrors. Most importantly, the professor aimed to develop a new deposition technique for the thin film that would make sure that the rare earth metal nanoparticles would be perfectly spherical and stay within a well-defined size range of 10 to 30 nanometres (nm). This, Professor Mehta surmised, would improve the switchable mirror and sensing characteristics of the material.

More control for greater efficiency

And this is exactly what the researchers achieved. They came up with a sophisticated technique to deposit the thin-film composites – made up of rare earth metals and palladium (Pd) nanoparticles – in an even, defect-free way, substantially improving the material's quality. The novelty of the set-up lies in the extreme control it allows over the material, Professor Mehta explains. The particles that are irregular in size and shape at the beginning of the process are transformed into uniform, spherical, single-crystal nanoparticles before they are finally deposited on the devices.

‘Throughout their journey, the nanoparticles float in carrier gas at a well-defined concentration level and are maintained at constant flow conditions, which also allow particle movement from one step to another without exposure to the ambient,’ Professor Mehta specifies.

All in all, this extraordinary degree of control over both the change of electrical properties during the hydrogenation process and the size of the Pd nanoparticles has contributed to greater control over the extent and timing of the reaction. Thanks to this improvement, Professor Mehta has been able to develop a new type of hydrogen sensor, a gas-sensing device which will help detect hydrogen leaks at concentrations well below safety limits.

Compared with common systems, his sensor represents a major improvement, Professor Mehta says: ‘This new type of sensor has higher sensitivity, fast response time and ... it can function in the presence of background noise. Our initial research has shown that this sensor works better in comparison to other devices at a lower temperature. This is especially useful in space and fuel-cell applications.’

Win-win situation for host and fellow

This development has only been made possible by bringing together the complementary areas of know-how of Professor Mehta, on the one hand, and Professor F. Einar Kruis’ team at the University of Duisburg-Essen, Professor Mehta believes. ‘The host group of Nano Structure and Technology (NST) at the University of Duisburg-Essen has the expertise and experience in synthesising well-defined particles; I have experience in using rare earth and palladium thin films for switchable mirror and sensing applications,’ Professor Mehta concludes, adding, ‘it’s a win-win situation’.

The collaboration and experience abroad have had a lasting effect on Professor Mehta’s professional and personal development. While the host group gained new insights into thin-film and material science, Professor Mehta deepened his understanding of nanotechnological concepts and improved his skills in synthesising nanoparticles.

‘This experience was a sort of “training on the job” in international and large collaborative research groups,’

he says. 'This international experience and visibility for my research activities was quite useful in my career development at the parent institute. For example, I am presently the convenor and principal investigator of the Nanoscience and Technology Programme at the Indian Institute of Technology Delhi, New Delhi, India.' Besides coordinating and participating in various multinational, collaborative and international projects, Professor Mehta became a member of the Scientific Advisory Committee of the Department of Science and Technology, India, and the Nanotechnology Committee of the Bureau of Indian Standards on returning to his native India.

Insights beyond science

At the same time as making scientific progress, Professor Mehta continues to draw on some of his more mundane European experiences. 'One of the distinct features of European ways of working seems to be that you aim to have strict time slots for work, family, friends and oneself. I will always like to implement these when I am in India.

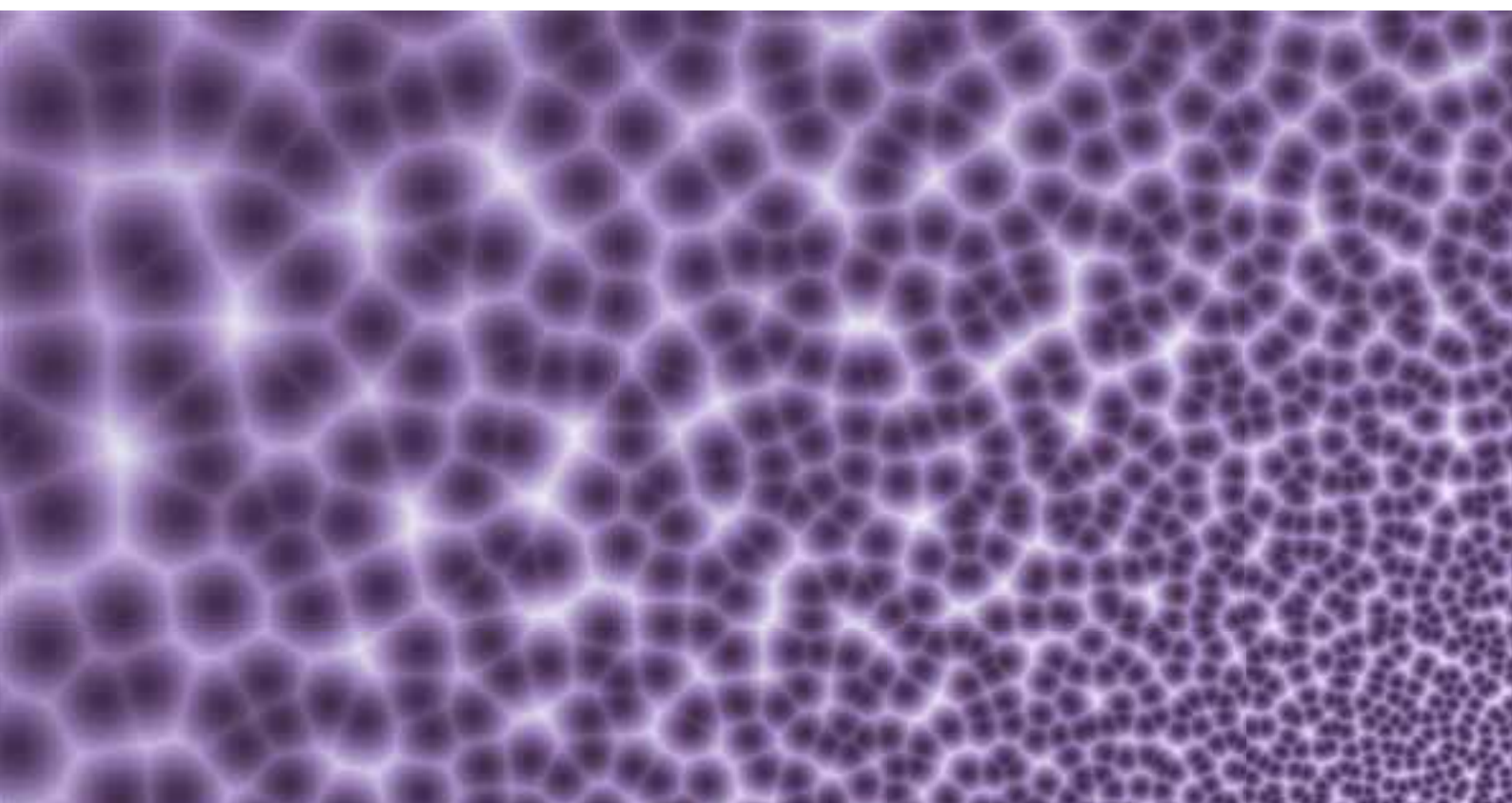
'After seeing the science management system and laboratory culture in Europe, I now make special efforts to find ways to improve my efficiency and that of my research group,' he explains further. 'What is more, close interaction with the research group, host and his family gave rare glimpses of German and European working habits and culture. These memories of my stay in Duisburg will always prompt me to have some serious hobbies and to do some sports during weekends.'

Project acronym ■ Nanoswitch
Full project title ■ Size-selected Pd and rare earth nanoparticles for hydrogen-induced switching

Type of grant ■ Incoming International Fellowship
Budget ■ EUR 86 509
Duration of project ■ 23-06-2006 - 30-07-2007
Scientific discipline ■ Materials science

Host institution ■ Institute of Nano Structure and Technology (NST) and Centre for Nanointegration Duisburg-Essen (CeNIDE)
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Prof. Dr F. E. Kruis
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PIPKIGKO

One in every 700 babies born worldwide has a cleft palate, a condition which often impacts the individual's self-esteem, social skills and behaviour. The Marie Curie project PIPKigko has made progress on therapies for this and other developmental disorders such as spina bifida, bleeding maladies and even certain forms of cancer.

When cells *don't* stick together

Dr Kyle Legate, a Canadian scientist with a PhD in biochemistry, was lured to Europe by means of an Incoming International Fellowship under the Marie Curie programme. While here, he made significant strides towards understanding the mechanism and consequences of cell adhesion using the mouse as a model for the biological system. He spent his two-year fellowship at Dr Reinhard Fässler's laboratory in the Department of Molecular Medicine at the Max Planck Institute of Biochemistry, Martinsried in Germany.

'Cell adhesion', the focus of Pipkigko, can be defined as the binding of a cell to a surface, extracellular matrix or another cell using cell-adhesion molecules. Put simply, it involves cells coming together and bonding.

The Pipkigko project examined the function of a particular enzyme that is present in specialised cell-adhesion structures called 'focal adhesions'. These adhesions are specific types

of large macromolecular assemblies through which both mechanical force and regulatory signals are transmitted. The enzyme Dr Legate examined is known as phosphatidylinositol 4-phosphate 5 kinase Type I gamma (PIP $\text{K}\text{I}\gamma$). It makes a membrane lipid (the cell membrane is a flat sheet that forms a continuous barrier around a cell), called PIP 2 , of high importance for many cell functions, including cell adhesion.

Location, location, location

'PIP $\text{K}\text{I}\gamma$ is of particular interest because its location within the cell makes it well placed to regulate the functions of many cell-adhesion proteins. My work involved examining the consequences of disturbing the location of PIP $\text{K}\text{I}\gamma$ within the cell so that it is unable to perform its function,' says Dr Legate. 'The research shows that mice develop normally when the localisation of PIP $\text{K}\text{I}\gamma$ to focal adhesions is disrupted. However, cells derived from these mice are significantly affected,' he continues.

Several parameters linked to adhesion are sluggish in cells lacking PIP $\text{K}\text{I}\gamma$, compared to cells in which the enzyme is localised normally. This is due to the reduced attraction to

focal adhesions of specific proteins which activate integrins. Integrins are the transmembrane receptors that recognise and bind to extracellular matrix, and are the main receptors in focal adhesions. This research shows that the rate of cell adhesion is not important to the normal development and functioning of organisms. Dr Legate says that the role of adhesion rate in disease is currently under investigation.

Crucially, Dr Legate's work is leading to new knowledge on how quickly adhesions can be formed. The recruitment of integrin-activating molecules to adhesion sites is a rate-determining step for adhesion formation, and PIPK1 γ accelerates the recruitment of some of these molecules to adhesion sites. These findings raise the possibility that PIPK1 γ may be exploited as a therapeutic target and may slow the rate of adhesion in disease states, thus allowing more time for additional therapies to be effective. The fact that genetically modified mice that cannot localise PIPK1 γ to adhesion sites develop and function normally suggests that such a manipulation of the adhesive machinery of the cell may be well tolerated. 'Additional research will nevertheless be required to explore these possibilities,' maintains Dr Legate.

Beyond cleft palate

It is not only cleft palate that can be treated by understanding cell adhesion. Examining the processes governing how cells sense and interact with their environment holds major importance for many conditions that arise from defective cell adhesion, such as bleeding disorders and skin-blistering diseases. Discovering how all of this fits together could enable scientists to step in and change the way that dysregulated (impaired) cell adhesion takes place during the disease progression seen in metastatic cancer. Dr Legate's research should also provide the groundwork for effective therapies for other developmental disorders that arise due to defects in cell adhesion, such as, for example, spina bifida and muscular dystrophies. In addition, Dr Legate's research is giving new insight into how certain dangerous bacteria can gain entry to our cells by hijacking the adhesion apparatus, raising the possibility that new approaches to fighting infection may be on the horizon.

Connecting Europe and North America

Dr Legate has spread his wings and gained invaluable knowledge during his Marie Curie experience. 'I have had the opportunity to examine questions of fundamental biological and medical importance in a vibrant and stimulating international environment.

By studying abroad, I have made connections to the European scientific community that I will carry forward into the next stages of my career. These relationships represent a brain gain for both Europe and North America, as transatlantic collaborations will be maintained for future mutual gain once I return to Canada,' he acknowledges.

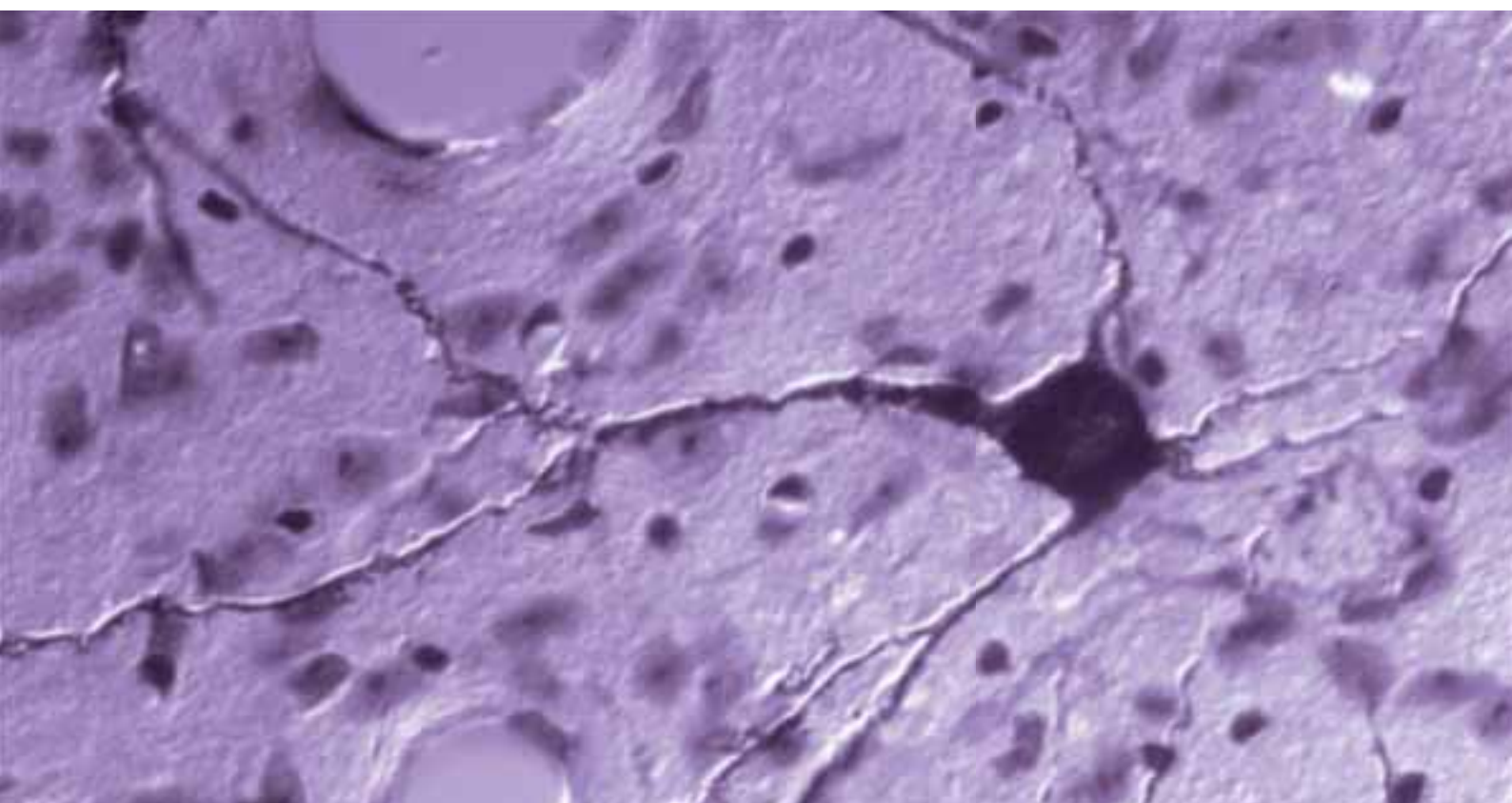
'My Marie Curie Incoming International Fellowship has allowed me to pursue my scientific career abroad, broadening my professional experience and enabling me to interact with a scientific community to which I did not have access in the past. My exposure to a variety of experimental approaches and different ways of considering scientific questions will allow me to be a more effective researcher and teacher of tomorrow's generation of life scientists.'

These future generations of scientists will benefit not only from Dr Legate's experience and knowledge, but from the way understanding of cell adhesion has been boosted in Europe and North America alike, thanks to a new closeness between the scientific communities in both continents forged by Pipkigko.

Project acronym ■ Pipkigko
Full project title ■ Targeted disruption of the type I phosphatidylinositol phosphate kinase gamma gene and the effect of focal-adhesion formation in a mouse genetic background

Type of grant ■ Incoming International Fellowship
Budget ■ EUR 158 197.69
Duration of project ■ 01-10-2004 - 30-09-2006
Scientific discipline ■ Life sciences

Host institution ■ Max Planck Institute of Biochemistry
Am Klopferspitz 18
DE-82152 Martinsried



TARGETING PCD IN PD

A Marie Curie grant lured Miquel Vila back to Europe from the United States. He is now in Spain investigating new therapies for Parkinson's disease, one of the most serious degenerative conditions affecting the brain. And he has established his own research group to help him.

Brain gain to fight brain drain

A neurodegenerative disease is a condition in which the vital, and for now irreplaceable, cells of the brain and spinal cord, known as neurons, die. The two most common are Alzheimer's and Parkinson's disease, both of which share a common trait: proteins collect and form deposits in internal organs, interfering with normal cellular function, sometimes lethally.

Parkinson's disease is the second most common neurodegenerative disorder after Alzheimer's dementia. More than 1.2 million Europeans – mostly aged between 55 and 75 – live with the consequences of this progressive disease, according to the European Parkinson's Disease Association (EPDA). The disease is not only devastating for the sufferer, who gradually loses control of his or her body, but also for friends and family who watch this happen.

Scientists do not yet know what causes the condition, although it has been established that genetic factors, toxins and head traumas are the cause in a minority of cases.

Parkinson's is very difficult to diagnose in its early stages – something that is not helped by the way in which symptoms vary from person to person. The development and progression of the disease also hinder diagnosis. Many patients will suffer tremors, slowness of movement, rigidity and poor balance, not to mention cognitive and mood disturbances. These symptoms can be explained by a dramatic loss of dopamine-producing neurons, which in turn leads to a shortage of this neurotransmitter in the brain of affected patients.

Seeking a cure

Despite long years of research, there remains no known cure for Parkinson's. Instead, treatment focuses on alleviating the symptoms, which doctors do by compensating for the dopamine deficiencies in the brain. As dopamine cannot cross

the blood-brain barrier, the precursor levodopa (L-DOPA), which is able to enter the brain to form dopamine, is usually administered.

With time, however, the therapeutic benefits of L-DOPA treatment diminish. 'Treatment with L-DOPA remains palliative and symptomatic. It does not impede the progressive death of dopamine neurons,' points out Miquel Vila, who heads the Neurodegenerative Diseases Research Group at the Research Institute of the University Hospital Vall d'Hebron in Barcelona, Spain.

This raises the urgent need to acquire a deeper understanding of the pathogenesis, the underlying causes, of Parkinson's disease. Only with this understanding will scientists be able to identify new molecular targets for more effective treatments.

With the help of a Marie Curie grant, Professor Vila is heading an ambitious project to identify the underlying molecular mechanisms that cause dopamine neuron death in Parkinson's sufferers. *'We expect our results to lay the ground for the development of novel therapeutic strategies for this devastating, currently incurable, neurodegenerative disorder,'* he explains.

Genetic detective work

Over the past decade or so, genetic research has led to major breakthroughs in our understanding of Parkinson's disease. Several hereditary forms of the disease have been discovered and the gene defects that cause them have been identified and studied.

Although only a tiny minority of people with Parkinson's have the hereditary form, the genetic defects that cause it can shed light on the root causes and mechanisms of the disease. 'Using gene-targeting approaches, we have identified some of the key molecules that contribute to dopamine neurodegeneration,' describes Professor Vila. 'We have also identified pharmacological compounds able to interfere with the affected molecular pathways and to provide neuroprotection in experimental animal models of the disease.'

Based on their results, Dr Vila's team is currently collaborating with a leading pharmaceutical company to test new compounds that could slow down or even arrest dopamine neuron cell death.

Brain circulation

In 1998, Miquel Vila packed his bags, waved goodbye to Spain and moved to the United States to take up a position as a postdoctoral research Fellow in the University of Columbia's Department of Neurology. Here he specialised in the neuroscience of movement disorders. The move worked out well, and by 2001 he was assistant professor of neurology at the same institution. For four years, he built up his own research work funded by the National Institutes of Health (NIH) of the USA.

Despite being awarded permanent residency in the United States under the 'outstanding researcher' category, Professor Vila was keen to return to Europe and pursue a research career on this side of the Atlantic. And so he turned to Marie Curie. *'The Marie Curie grant allowed me to return to Europe to develop a new research group on neurodegeneration,'* he recalls. 'In addition, I obtained a permanent position as a research professor at the Catalan Institution for Research and Advanced Studies (ICREA), which guarantees my long-term professional integration in Europe beyond the Marie Curie Action.'

Catalonia is one of the country's leading R&D hubs and is a well-known biotechnology cluster. It is home to 400 life-science research groups and with its 12 universities producing 32 000 students in the life sciences, new cadres are emerging all the time. This means that Dr Vila's return home will have a large multiplier effect.

Project acronym ■ Targeting PCD in PD
Full project title ■ Targeting programmed cell death in Parkinson's disease

Type of grant ■ Excellence Team
Budget ■ EUR 1.2 million
Duration of project ■ 01-12-2005 - 30-11-2009
Scientific discipline ■ Life sciences

Lead partner ■ Miquel Vila, MD, PhD
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COMMUNICATING SCIENCE

The background of the slide is a photograph of the Singapore Science Centre dome, a large, curved, glass-enclosed structure. The dome is illuminated from within, and its reflection is visible in the water in the foreground. The sky is a mix of blue and orange, suggesting a sunset or sunrise. The title 'COMMUNICATING SCIENCE' is overlaid in large, white, bold, sans-serif capital letters.

Science completely shapes the way we live. Invention, new ideas and products continue to revolutionise every aspect of modern life. Science affects everyone – and, hence, is everyone's business. It is essential that researchers communicate their research to enable citizens to influence how our lives will be in the future.



Science for the people

The results of scientific research have filtered through into every aspect of day-to-day life and played a major role in shaping how we live our lives: from medical discoveries which dramatically improved sanitation, and domestic robots which enable us to have more leisure time, to the revolution in how people relate to one another thanks to the internet and social networking technologies. In fact, there hardly remains a human activity that is not profoundly touched by science – from the food we eat to the modern gadgets with which we stay ‘connected’. In European culture, which is based on Reason, our vision of the universe and the origin of life is naturally based on scientific discoveries.

Knowing this, it is no wonder that we as citizens want to be more involved in how and for what purpose research is undertaken. This attitude should of course be encouraged by researchers themselves. Transparent communication

should be the rule both for the ethical issues concerned and the possible negative outcomes of scientific discoveries. This is not intended to hinder scientific advancement, but to better predict and manage any unexpected negative side effects.

Communicating science is not just about informing. Science also has the power to inspire. Forty years ago, the Apollo missions to the moon made science ‘cool’ and inspired many of today’s scientists to take up their calling. In their own way, current scientific frontiers are no less awe-inspiring. Greater awareness of science can inspire young minds to aspire to become scientists and researchers, helping fill future shortages – and researchers have a special part to play as role models and mentors.

Turning the tide

It is abundantly clear that how we will live in the future will be shaped by the frontier and emerging scientific disciplines of today. With our collective future at stake, communication and dialogue are becoming as essential

as labs and microscopes in order to prepare for and channel these changes in a way that maximises society's interests.

Communicating science ensures that citizens are informed about and aware of the latest developments. It helps us to become partners in the scientific process, to participate in the ethical debate surrounding new discoveries and technologies, and to better assimilate these advances in society.

At a time of apparent growing public apathy and underinvestment in science, this greater awareness and involvement is not only good for society, but it is also good for science. In highlighting the important role of research, it ensures continued public commitment to investing in R&D – which can help the EU remain competitive globally and address the socioeconomic challenges it faces.





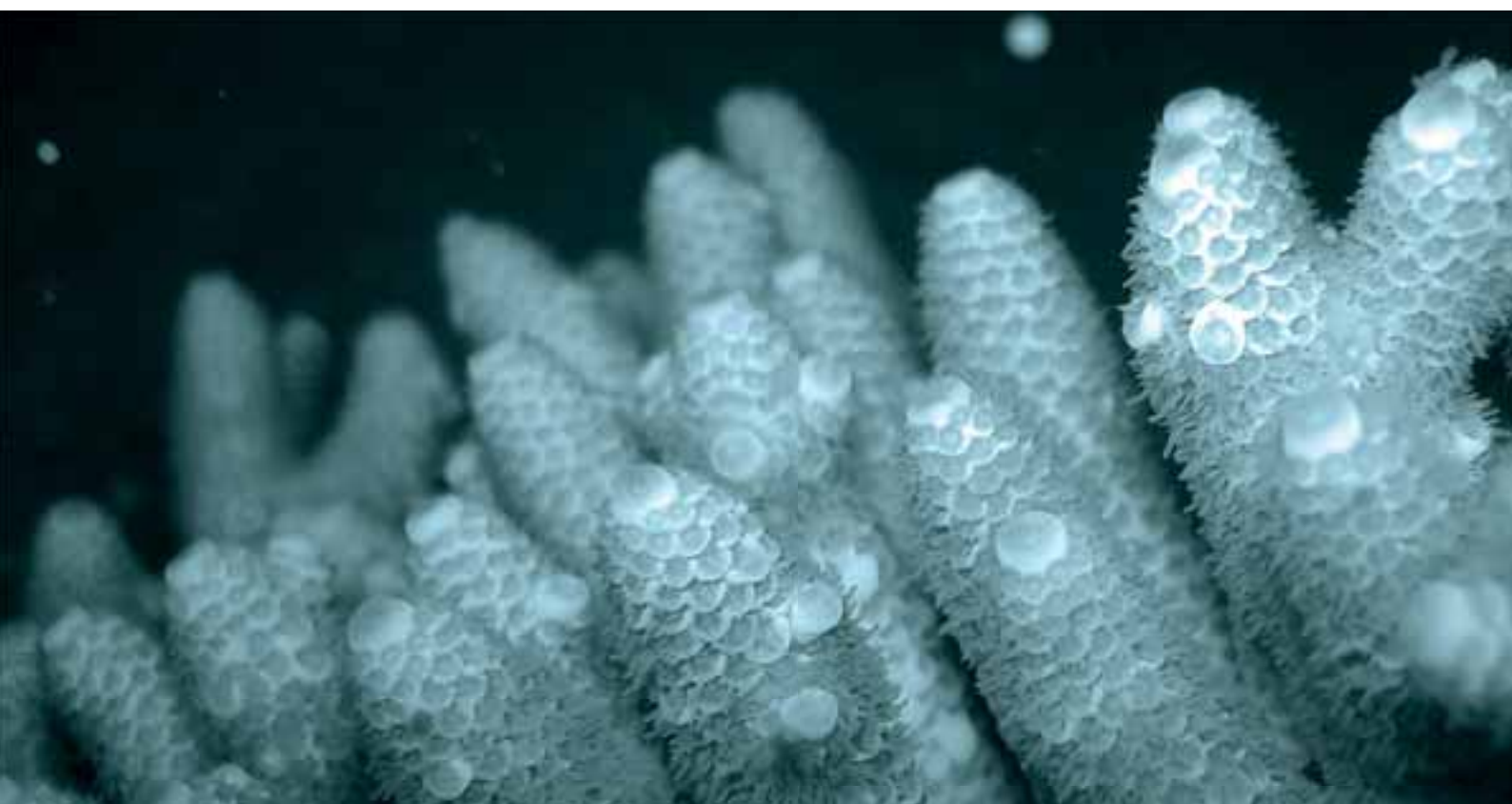
Moreover, certain areas of modern science, such as bio- and nanotechnology, can be considered controversial. Some of that controversy is due to popular misperceptions and can be cleared up if scientists engage more closely in the public debate.

To engage with the general public effectively, scientists have to abandon their 'ivory tower' and recognise that communication is a two-way street, and that they cannot simply expect the public to fall into line, but must address and respond to their concerns. In order to be heard, scientists also have to listen.

Message in a beaker

Communication is a vital component of all European research activities. EU-funded projects are expected not only to disseminate their results but to communicate with the broader public in order to promote understanding of their work and its significance for society.

Marie Curie Fellows are in a prime position to act as ambassadors for science and to communicate its benefits. In addition, they are well placed to promote the attractiveness of careers in science and research. This chapter shows what Marie Curie Fellows and Networks are doing to highlight the benefits of their work, raise the profile of science, and attract more young people to pursue careers in research and academia.



BCR

The moon holds a strange fascination. However, its pale face not only entices human senses – corals, too, feel its call. Once a year, hundreds of coral species spawn synchronously, and the cue comes from the moon. Dr Oren Levy dived deep into the blue waters around Australia's Great Barrier Reef to reveal how these eyeless organisms detect the light.

Once in a blue moon

Every year in November, the sea around the Great Barrier Reef is awash with the coral spawn. In a matter of a few days after the full moon, hundreds of coral species release their eggs and sperm more or less simultaneously. Why all at the same time? Mass spawning has one clear advantage: predators are unable to gobble up all of the spawn when they are swamped with it. Some of it is sure to get away to blossom into a new generation. This explains why corals spawn en masse. However, exactly how they do this has continued to puzzle scientists.

For three years, Dr Levy conducted his studies under the Marie Curie 'The blues of coral reefs' (BCR) project, spending some of his time in the laboratories of the University of Queensland in Brisbane, Australia, and the rest in the field lab on Heron Island off the Australian coast. There he collected samples during different phases of the moon's cycle, in new moonlight and full moonlight, which he then analysed using sophisticated lab equipment in Brisbane. 'What's unique about this work is that it was done in ambient conditions and not under controlled laboratory conditions like it is usually done with all the model

animals: they usually don't see the ambient light anymore, just fluorescent lab lights,' Dr Levy notes.

Up and down the evolutionary ladder

This was how he found part of the solution to the coral-spawning puzzle and discovered two specific genes in the corals, called CRY1 and CRY2. 'These two genes are known as cryptochromes,' comments the biologist, who is now back at Bar-Ilan University in Ramat Gan, Israel. 'Cryptochromes are blue-light photoreceptors found in many organisms from cyanobacteria to humans.'

Cryptochromes are involved in the circadian rhythm: they steer many organisms' biochemical, physiological and behavioural processes according to environmental cues, such as light and dark. 'In humans, these genes are part of the circadian oscillator', Dr Levy explains, 'but in other organisms, like drosophila [fruit flies] for instance, these genes entrain the circadian clocks to the environment, acting as photoreceptors. So, this is probably the way that corals are synchronising the circadian clock with the environment.'

A new perspective on chronobiology

The discovery was particularly exciting because it was the first time that these genes had been found in organisms that are lower on the evolutionary ladder than *Drosophila*. *'The same components that you find in humans, you find in this very early basal evolutionary group,'* Dr Levy reports enthusiastically. 'I think from this perspective this is amazing. I also think that this gives researchers working with model animals like *Drosophila* or zebrafish a different perspective on chronobiology and the evolution of the circadian clock. Even for our community, the coral reef community or the people working with other cnidarians, we start seeing how it all fits together, how genes are expressed and how they affect the physiology, behaviour and the biology of these animals.'

Unfortunately, scientific problems are rarely as simple as that: the mass spawning is very likely triggered by a far more complex series of signals and processes. Hence, the cryptochromes are only one piece in the puzzle. Dr Levy and three PhDs under his supervision at Bar-Ilan University are attempting to unravel more of the underwater mystery. 'We have started investigating more in order to find the other components of the circadian

clock chain,' Dr Levy says. 'Because corals have a symbiotic relationship with the algae inside them, we are studying the algae's circadian mechanism as well as that of the coral itself.'

And the lines of communication between Israel and Australia established during the Marie Curie Fellowship remain open: Dr Levy's PhDs might be able to benefit from his link with leading coral expert Professor Ove Hoegh-Guldberg in Brisbane and may get a chance to do some more fieldwork on the Great Barrier Reef.

The need to communicate

Communication on the BCR project, however, has not been restricted to the scientific world and the network of experts. First published in *Science*, the subject was soon picked up by major non-scientific media like the *New York Times* which, in turn, attracted the attention of other newspapers in Israel and elsewhere, as well as that of the general public. Dr Levy jumped at the chance to talk about his research – a natural reaction from his point of view, although he acknowledges that some scientists find it hard to describe their research to the general

public. *'I think if you know your stories and your work, you can deliver it in simple words that the general public, too, will understand,'* he says. 'You want everybody to understand. What is more, *if you ignore the need to communicate your science,* you lose a lot of credit with time, because *people just see you sitting in your ivory tower.'*

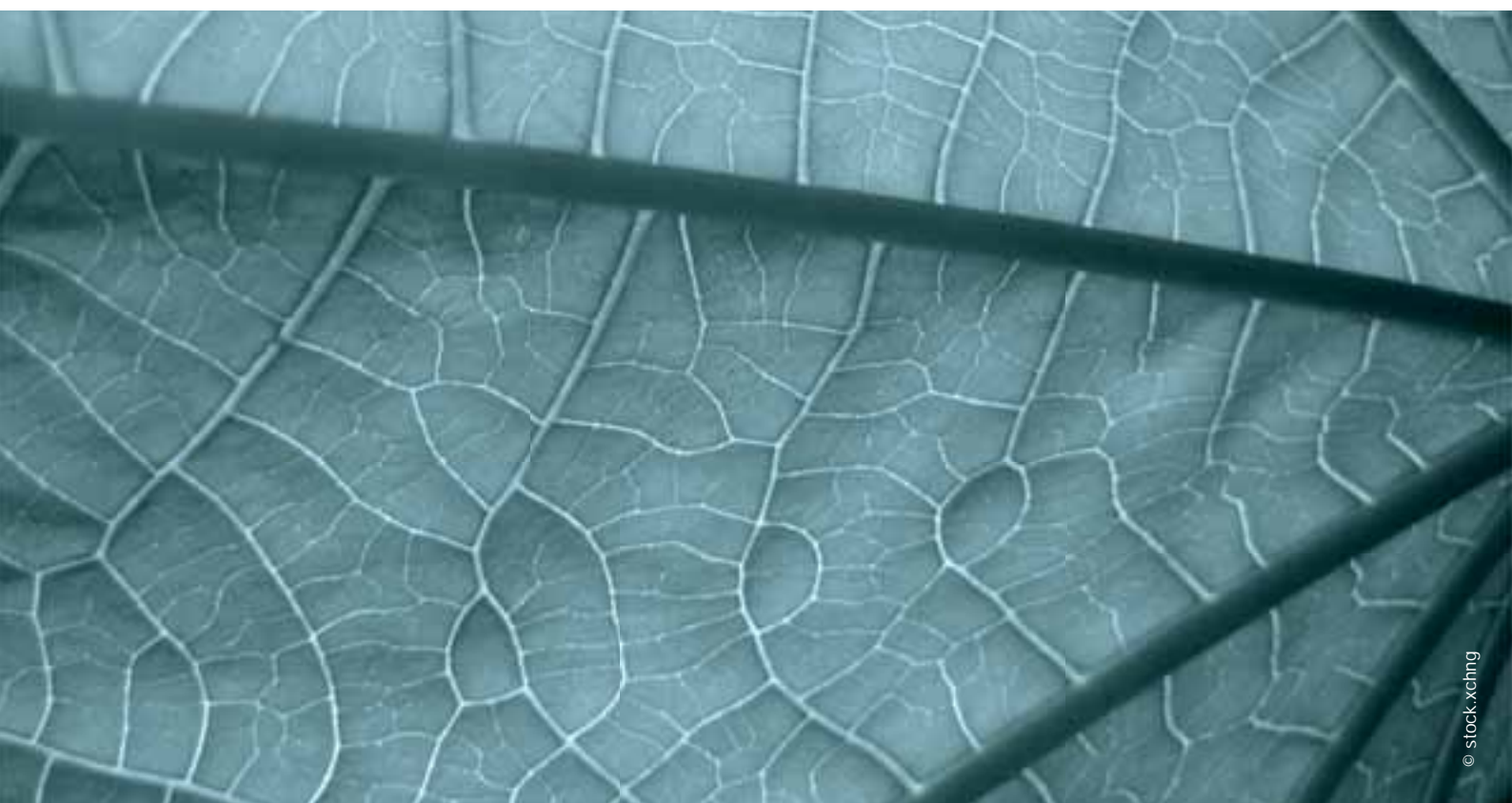
Nevertheless, he believes that putting across new insights in biology might be easier than presenting recent discoveries in physics or maths. 'Maybe people know more biology than they do maths; maybe there are higher requirements,' Dr Levy acknowledges. 'But in the end, I think a good scientist can tell a story and should be able to tell a story in his specific area – it doesn't matter what he's working on. Of course, it also depends on what kind of person you are.'

Project acronym ■ BCR
Full project title ■ The blues of coral reefs

Type of grant ■ Outgoing International Fellowship
Budget ■ EUR 221 641
Duration of project ■ 15-09-2004 - 14-09-2007
Scientific discipline ■ Environment

Host institution ■ The Mina and Everard Goodman Faculty of Life Sciences
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BIMORE

Solar energy is abundant, and harvesting it could take the pressure off the world's dwindling supplies of traditional sources of energy. The Bimore project is investigating how nature has perfected the art of using the sun to fuel growth. By replicating the process, the team hopes to provide an alternative to petrol that will make travel more sustainable.

Mother Nature's molecules

Bimore 'solves problems of great societal relevance,' says project coordinator Larry Luer of the Madrid Institute of Advanced Studies. Take energy sources. The oil needed to produce petrol is in short supply. While an alternative has been developed – biofuels – this option also has limitations. The production of biofuels is in direct competition with food production, and can lead to hunger among poor populations if it is given priority.

Artificial photosynthesis offers a solution. The process makes possible the production of fuels from sunlight. And making some sit up and take notice is the fact that the system can be set up in deserts, avoiding competition with agriculture. Bimore is investigating the elementary processes needed to construct such an artificial photosynthetic system.

Bimore's research field is molecular electronics – an interdisciplinary theme that spans physics, chemistry and materials science.

Its unifying feature is its use of molecular building blocks to power electronic components, both passive (e.g. resistive wires) and active (e.g. transistors). One of its ultimate visions is the 'molecular computer' in which the computing is done by single molecules, at a higher speed than today's processors by orders of magnitude.

The concept of molecular electronics has caused excitement among both science fiction readers and writers, and scientists. The prospect of size reduction in electronics, down to the scale of a single molecule, has sparked imagination in both quarters. On these extremely small length scales, materials have vastly different properties than in the everyday world. These properties need to be known and understood in order to fully exploit their potential. Bimore is contributing to this understanding on a molecular scale. 'This brings us closer to the molecular computer, but also tells us how an artificial light-harvesting device should be built,' explains Dr Luer.

In nature, sunlight is absorbed by chlorophyll and then travels through a photosynthetic complex until it finds the 'reaction centre', where light energy generates electron gradient to

convert CO₂ into a reduced carbon based-fuel (sugar). ‘We want to integrate natural working principles into devices so they are as efficient as nature but produce an output which is adapted for humans, such as electricity and fuels,’ says Dr Luer.

International interdisciplinary involvement

The interdisciplinary nature of Bimore makes collaboration a key feature of the project. But cooperation is not limited to university departments – researchers are also working together across geographical borders. A typical project involves biologists in countries around the globe analysing the journey of a photosynthetic complex and ultimately deciding whether the molecules function in an electrical device.

Some 30% of Bimore’s Marie Curie Fellows come from non-EU countries such as India, Indonesia, Iran, Russia and the United States. ‘The international dimension is crucial for our research field. Bearing in mind that some countries have strong industries while others are strong in fundamental research, bringing together these different research cultures is at the heart of the international dimension.’

‘The main asset is the consortium,’ continues Dr Luer. *‘Only an international consortium with leading groups is able to tackle the problem at hand.’* This is also a strong benefit for the Fellows who receive highly interdisciplinary training, enabling them to solve problems that are interdisciplinary by nature.’

Fellow Tatas Brotosudarmo from Indonesia agrees. ‘Marie Curie Fellowships are demanding and require high personal involvement. You are not only expected to be an excellent researcher, but also a research manager. That involves organising a summer school and setting up new research projects. If this is what you want to do, *Marie Curie provides an excellent platform for the impact you wish to make,*’ he acknowledges.

Exciting excitons

The consortium has discovered how a morphological modification in a photosynthetic complex influences the way light is transported. Findings on the size and mobility of ‘excitons’ (light energy travelling in condensed matter, in tiny carbon nanotubes) have furthered understanding of how fast light energy can move in such nanotubes, and how far it can reach. Crucially, the team is

now able to trace the movement of light energy in real time. New knowledge on electrical conductivity across a single molecule in the presence of irradiation will also assist in the development of new molecular-electronic devices.

The project results are so exciting that the team has not been able to keep them to itself. A golden opportunity to communicate the science and share the team's enthusiasm with the public came along with the 'Researchers' Night' in Italy, where Marie Curie Fellows used animations, games and even a song to explain their attempts to watch how energy 'jumps' from molecule to molecule. Their audience included experts, non-experts, students and young children. Such was the demand that a team of 4 was run off its feet for 11 hours.

The team's fun and engaging approach to communication was very successful in raising awareness among the general public of the energy options for the future, and they encourage other researchers to seek similar opportunities: it is fun, useful and ultimately very rewarding.

And the communication drive did not end with the closing of the team's show: Dr Luer followed this with interviews for Italian national radio and the Italian Research Council's television channel.

Dr Luer's career path has clearly benefited from Marie Curie involvement. 'After my PhD in photoconductivity, my research interests required a new technique with higher temporal resolution. I began my career as a Marie Curie Fellow in femtosecond spectroscopy. After the fellowship, I was offered the position as senior researcher at the femtosecond lab at Politecnico di Milano,' he says.

Dr Luer now cooperates with leading European groups in molecular biology, device technology and supramolecular chemistry, this time as a Marie Curie project coordinator.

Bimore may be working at the molecular level, but its impacts are expected to be huge. The consortium will be expanding into microscopic and nanopatterning techniques that have the potential to control the morphology of artificial systems at the nanoscale.

Project acronym ■ Bimore
Full project title ■ Bio-inspired approaches for molecular electronics

Type of grant ■ Training Network
Budget ■ EUR 2 773 000
Duration of project ■ 01-10-2006 - 30-09-2010
Scientific discipline ■ Engineering

Host institution ■ Coordinated by Larry Luer
Madrid Institute of Advanced Studies
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CENS-CMA

As the Estonian coastline continues to attract more tourists, increasing numbers of scientists are trying to understand its complex environment. The country's coastline represents a new frontier in scientific research, being the focus of several new collaborations. A Marie Curie-sponsored project between the Centre for Nonlinear Studies in Tallinn and the Centre of Mathematics for Applications in Oslo is taking forward the science of coastal engineering.

Coastal research on the crest of a wave

The extensive Estonian coastline is home to more than a thousand islands, many of which host nature reserves and draw in visitors from all over the world. Understanding the impact of construction in the coastal zone and of heavy shipping traffic is crucial for the preservation of the region's natural resources and for ensuring that efforts to develop the area are sustainable. Little is known of the region's particular coastal environment because, in the past, Soviet policy kept civilians from accessing the coastline for military reasons. For decades, coastal research and education were discouraged, and science stagnated.

When Estonia regained its independence in 1991, researchers got back to work building a comprehensive knowledge base in an effort to better understand the complex interactions between ship wakes, waves, beach erosion and other factors along Estonia's vast coastlines.

Rebuilding coastal engineering knowledge, research and education is a monumental task, but researchers at the Centre for Nonlinear Studies (CENS), founded in 1999 within the Institute of Cybernetics at Tallinn University of Technology, took up the challenge.

Internationalising wave science

Supported by a Marie Curie Transfer of Knowledge scheme, CENS joined forces with the University of Oslo's Centre of Mathematics for Applications (CMA) in Norway for a research programme in applied wave mathematics.

The Transfer of Knowledge scheme financially supported visiting Fellows' extended research stays at both CENS in Tallinn and the CMA in Oslo. These fellowships could last anywhere between two months and two years, and were granted to either 'experienced' researchers (usually postdocs with between 4 and 9 years of research experience) or 'senior' researchers (with 10 years of research experience or more).

The research visitors provided valuable contributions to CENS and CMA wave studies. The collaborations were characterised by strong teamwork and a readiness to share experience and resources.

Coastal research in the limelight

Research on marine waves and coastal processes became one of the focal points of the CENS-CMA project, covering about one-third of the fellowship months, and resulting in the establishment of the Wave Engineering Laboratory in January 2009.

Dr Tarmo Soomere, a member of the Estonian Academy of Sciences, was one of the first CENS Fellows to study at the CMA in Oslo. During the project he was elected 'Estonia's Person of the Year 2005' by the newspaper *Postimees* for predicting and explaining the effects of the storm Gudrun, one of the most severe storms to hit the Baltic Sea in recent history. The Marie Curie project, he says, opened up the scientific community in Estonia and helped scientists to communicate with the public about their research.

'Longer stays in such centres are an almost mandatory experience for everybody who wishes to be successful in cutting-edge science,' asserts Dr Soomere. 'This is particularly important for the younger generation of researchers who tend to focus on a narrow range of problems or a single object of study.'

The benefits of communicating effectively with the public can be reaped when lead researchers are able to organise research in their own communities, explains Dr Soomere. 'This is exactly my case: *the experience gathered as a CENS-CMA Fellow turned out to be indispensable in launching both the teaching and research of port and coastal engineering in Tallinn,*' he adds, referring to the new Laboratory of Wave Engineering in the Institute of Cybernetics, of which he took on the task of leader.

Good news travels fast ... and far

The project enjoyed the attention of the press: some of the Fellows' work was covered in newspaper articles. Other grant recipients gave public lectures, which were well received, and the partners conducted a summer school on coastal processes.

The school was covered in a 15-minute feature on the popular science television programme *Bionina*, produced by the Estonian national broadcasting company ETV.

The CENS-CMA research collaboration also welcomed scientists from further afield: Dr Kevin Parnell, based at the James Cook University in Australia, spent three months as a Senior Fellow in Tallinn.

‘The time I spent at the CENS department in Tallinn enabled me to research vessel wakes and their environmental effects,’ says Dr Parnell. *‘I was able to foster collaborations in a part of the world where it is uncommon for Australians to conduct research.’* I am now applying the knowledge I gained to projects in Australia and New Zealand, where issues related to vessel wakes in confined coastal waters remain. It also led to my undertaking further collaborative projects in Estonia.’

Project acronym ■ CENS-CMA
Full project title ■ Cooperation of Estonian and Norwegian scientific centers within mathematics and its applications

Type of grant ■ Transfer of Knowledge
Budget ■ EUR 853 333
Duration of project ■ 01-05-2005 - 30-04-2009
Scientific discipline ■ Mathematics

Lead partner ■ Tallinn University of Technology
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Tel. +372 620 4160
<http://cens.ioc.ee/cens>

Other partners ■ Training partner
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FLOODS

Very few of us now question that climate change is actually happening. Many of the consequences will be beyond our control, but if we know what to expect, making changes now could save lives and our way of life in the future. South Korean researcher Kim Jung-Hyun is investigating new ways of predicting what is in store, using clues buried in the ocean floor. And she has been making sure that as many people as possible know about them.

Seeing the future through the oceanic past

A changing climate increases the likelihood of extreme weather events such as droughts and floods. No country will be immune to the changes, but some will be more vulnerable than others because of their geographical location. Those in coastal areas will be particularly at risk as water levels rise.

What we can expect, and when, are questions which are too important to be left to guesswork. Scientists are taking a variety of approaches to predicting what the future holds, and many are looking to the past for clues.

Missing pieces of the puzzle

Records of palaeofloods (floods in the past) do not go back far enough to be useful indicators – they only date back to the

18th century. Beyond that, data are rare or too brief to give a clear picture of variations in natural flood occurrence that can be linked to climate change.

Dr Kim came to the problem with a background in geology. Originally from South Korea, she had already completed her undergraduate studies there at Chungnam National University. She then moved to Europe to undertake MSc and PhD degrees at Bremen University in Germany.

Continuing her tour of Europe, a Marie Curie Fellowship took her from the Centre de Formation et de Recherche sur l'Environnement Marin in France, where she was working as an invited researcher, to the Royal Netherlands Institute of Sea Research, which has one of the world's leading research groups in organic biogeochemistry. Her goal was to understand the fate of organic matter in coastal zones, as knowing this would help scientists to predict the results of future water levels on coastal regions.

Her strategy involved first testing the applicability of a newly developed index which could provide clues on past and future floods. She also examined variations in marine organic matter.

The hunting ground for this precious organic matter was to be the soils and sediments from the Gulf of Lions, a wide inlet in the Mediterranean Sea on the southern coast of France.

The project lasted two years. During the first she conducted a geochemical analysis. This involved looking at the total nitrogen, organic carbon concentrations and stable carbon isotopic composition of terrestrial and marine samples. In the second year, analysis focused on the spatial distribution patterns of the Branched and Isoprenoid Tetraether (BIT) index, which was tested for appropriateness as a tool to indicate palaeoflood events.

‘Our results from the Têt watershed (France) and the Gulf of Lions (NW Mediterranean) showed that the BIT index, indicator of soil input from land into the ocean, has a potential for tracing flood events that occurred in the past and thus for providing palaeoflood records on geological scales. Such palaeoflood records as responses to past global climate changes can provide valuable information to indicate the potential impact of the present greenhouse global climate change and therefore contribute to the design of strategies for water and risk management,’ explains Dr Kim.

Speaking science

During her fellowship, Dr Kim was interviewed for an article in *Nature* on high-calibre foreign researchers working in the Netherlands. This was an excellent opportunity for her to communicate to a wider audience the importance of her research as well as her experience and contribution to the field of physical science in her host country. Being selected for such an article was no doubt a great honour.

Dr Kim describes the Netherlands as an ideal training ground for young researchers. She explains that although finding a permanent position in the country is a fiercely competitive venture, ideally her next career objective is to build up an independent research team of her own.

Dr Kim has also been communicating science through other mediums. She has presented her findings to the media as well as academics and government representatives. And in the first year of her fellowship alone, she published papers in numerous acclaimed journals, including *Organic Geochemistry*, *Paleogeography Paleoclimatology Paleoecology* and *Geochimica et Cosmochimica Acta*, three journals renowned for publishing articles on cutting-

edge research. Furthermore, the results of the Flood project have been published in the 2009 NIOZ annual report, which is read by policy-makers and those with a keen interest in maritime research.

Worldly ambitions

‘As a non-European citizen, *the Marie Curie Fellowship was an opportunity for me to share experience with leading scientists and to achieve my research ambitions in a European interdisciplinary landscape*,’ says Dr Kim.

Indeed, it was not only researchers in the Netherlands who got to see her in action – she also collaborated with the Norwegian Polar Institute, too. The coalition between these two prestigious institutes made possible a comparative study of two different climatic zones. Dr Kim braved the elements in a cruise expedition around Svalbard, which involved 10 days in the Arctic near the North Pole, working in difficult conditions.

‘I have been on other expeditions and worked in tropical environmental conditions; the limitations you face working in the Arctic make carrying out research so much harder. My

research involved filtering water samples; this depended on the right weather conditions being available, which meant that I needed to be available to carry out my research 24 hours a day which was exhausting at times.

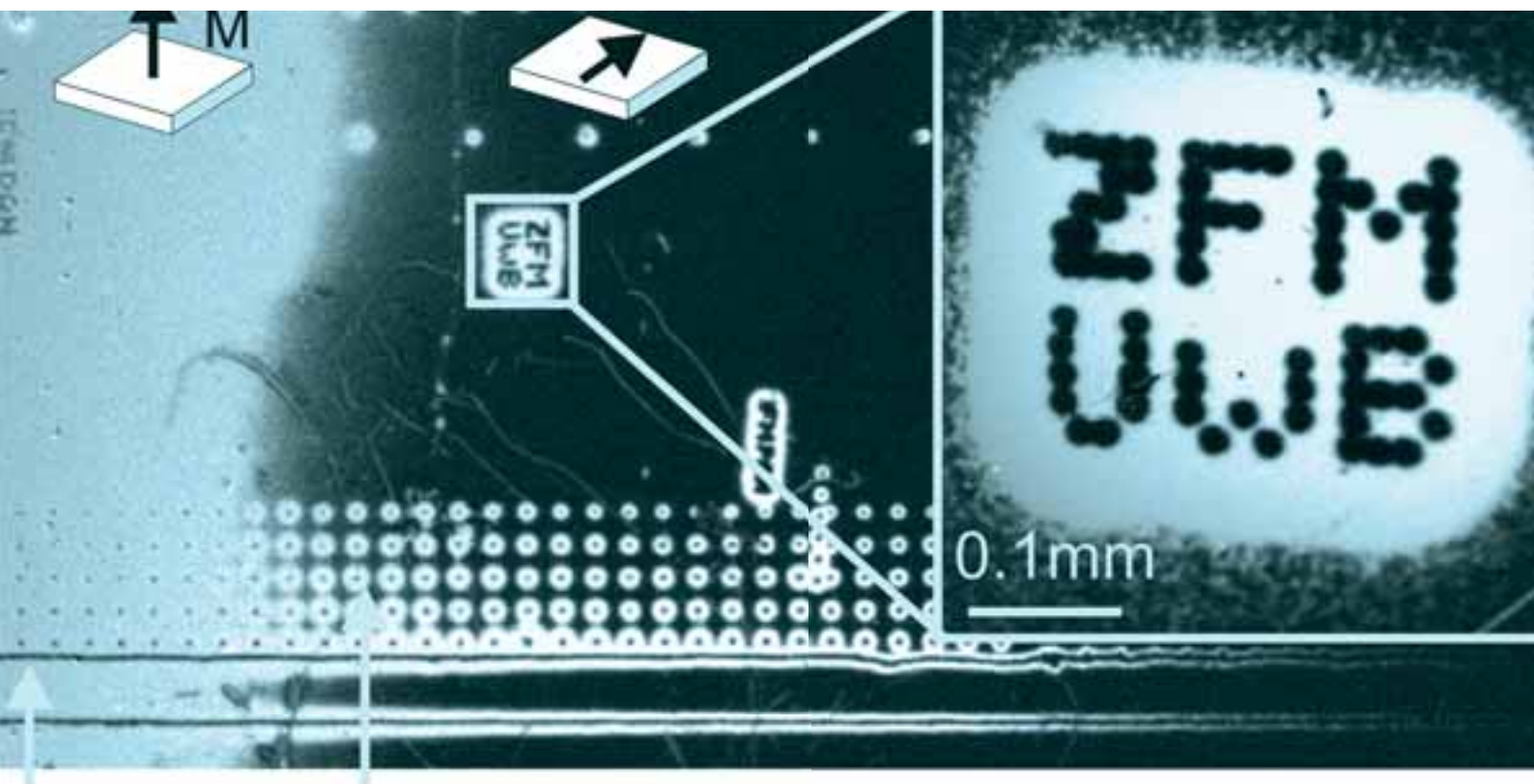
‘For researchers interested in climate change the Arctic is a hotspot right now, therefore I was lucky to be involved in this expedition.’ The expedition received a lot of media attention.

Dr Kim has now been hired as a postdoctoral Fellow and is based in the Marine Organic Biogeochemistry department at the Royal Netherlands Institute for Sea Research. Her fellowship supervisor Professor Jaap Sinninghe Damsté has won a grant from the European Research Council to continue research into methods for reconstructing past climates using the fossil molecules in sediments.

Project acronym ■ Floods
Full project title ■ Fate of land-derived organic compounds in the coastal ocean

Type of grant ■ Intra-European Fellowships
Budget ■ EUR 155 000
Duration of project ■ 01-11-2006 - 31-10-2008
Scientific discipline ■ Environment

Host institution ■ Professor Sinninghe Damsté
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NANOMAG-LAB

These days, the average personal computer has hundreds of gigabytes of storage space, and the future looks practically limitless. Progress made in the study of nanomagnetism is partially responsible for bigger and better hard drives. The Marie Curie Network Nanomag-Lab is spreading the news about this exciting new scientific domain that has put a new spin on materials science.

A tiny bit of attraction: magnetism at nanoscale

Magnetism at nanoscale makes it possible to develop new materials in a completely new way: previously, it was necessary to apply time-consuming chemical, mechanical or heat treatments to all of the material to stimulate specific desired properties, including magnetism. Now, however, scientists can change the structure of the material at nanometre-atomic level, providing greater accuracy as well as opening up a whole range of new exciting possibilities. The result: new materials with properties that did not exist before in nature.

For instance, scientists are now able to alter magnetic orientation on this small scale, a modification that has an impact of much larger proportions. It is only thanks to a technology called perpendicular recording that personal computers are what they are today. Perpendicular recording – as opposed to traditional longitudinal recording – increases the storage density threefold on hard disks. The technology depends on

aligning the poles of magnetic elements – they represent the data bits – in the material at right angles to the disk. In this way, more bits can be squeezed into the same space. Doing this requires nanomagnetic know-how. Thanks to knowledge of this kind, scientists like Professor Andrzej Maziewski, head of the Laboratory of Magnetism at the University of Białystok in Poland (the network host) can create regions with different magnetic orientation, a magnetic pattern that can be adapted as needed for specific applications.

Small changes, but a huge leap in progress

This knowledge is not only essential to modern storage media, but also to innovative sensor applications and other technologies. In short, nanomagnetism has helped shape the modern world. 'It's an exciting new area,' says Professor Maziewski. As the Nanomag-Lab coordinator, he has played his part in introducing 14 Marie Curie Fellows and many more researchers to this area. Their study of metallic and semiconducting sub-micrometre thick films within the Nanomag-Lab network has created great interest: 78 papers in internationally recognised journals and more than 100 presentations at conferences in Europe, Japan and the United States.

Creation of the out-of-plane magnetisation state after irradiation of a Co nano-wedge by laser light. This is a new type of magnetic writing – different designs were created by laser: paths, spots in both array and inscription. The image was registered by optical microscopy using the polar Kerr effect.

What is more, Nanomag-Lab fostered new collaborations. For instance, on the EU-funded Fantomas project, the University of Bialystok has joined forces with 10 organisations across Europe to start a training network in nano-opto-magnetism. Moreover, Nanomag-Lab helped obtain additional funding to set up a state-of-the-art lab in Bialystok. 'As a result of Marie Curie, we obtained support from the Polish government and we created a new, unique lab,' Professor Maziewski says. 'Now we can support projects on nanomagnetism not only in Poland, but in other parts of Europe. You can see it from the number of papers we have published.'

Too good to keep to themselves

But the network did not want to limit its efforts to the scientific community. The general public should also benefit, the consortium thought. However, 'physics is not simple', as Professor Maziewski knows. 'For many scientists, it's hard to discuss their area of research with the public.' Even the exchange and transfer of knowledge from scientist to scientist is usually not quite as easy as one might believe. *'Every university has some unique knowledge. And that can be very interesting to share,'* Professor Maziewski believes. 'Yet, *sharing only*

through publication of articles in different journals is not good enough, because only a limited number of people will read the articles, even in popular journals.'

And how did they solve both of these problems? First, the Nanomag-Lab team helped produce a film entitled *Nanomagnets* in an attempt to explain the science and its applications to a broader public. 'This film could be used for different people, in schools, for instance,' Professor Maziewski thinks. Currently, it is available in Polish.

On a more wide-reaching scale, the internet was the obvious choice: 'We started making experiments available to different people with different levels of scientific understanding through the web,' says Professor Maziewski, explaining the strategy. 'In our online experiment, we have a tutorial for different levels, high school or university students, for instance. So, they can learn about magnetism on different levels. And after this, people can start to learn more about nanomagnetism.' The material – experiments and scientific texts – is available to everybody online and has already attracted thousands of users who wanted to learn about the Faraday effect – the interaction between light and a magnetic field in a medium – or to observe magnetic domains, to name just two examples.

Visions of a global lab

‘Computer-aided experiments or experiments on the internet, though, cannot replace hands-on experience,’ Professor Maziewski underlines. ‘It’s only a first step. I also find it is extremely important to give researchers the room to experiment directly, to give them the opportunity to measure things in real life.’

But the benefits of the internet are undeniable. ‘It is a powerful tool. And maybe in the future, we could create a sort of global laboratory with the participation of different universities. If everybody put in only a small effort, the education of researchers could be much more efficient,’ Professor Maziewski enthuses.

He believes that science is in dire need of fresh blood and is always looking to make the natural sciences more popular among young people: ‘We need students,’ he says. ‘On a scientific team, there can’t only be professors. You also have to develop good relations between researchers, professors and PhDs. So you have to awaken young people’s interest and teach them. This is very important for Europe, too, because only then can we expect progress in research.’

Project acronym ■ Nanomag-Lab
Full project title ■ Combined study of nanostructured magnetic materials

Type of grant ■ Transfer of Knowledge
Budget ■ EUR 852 842
Duration of project ■ 01-09-2004 - 28-02-2009
Scientific discipline ■ Physics

Host institution and lead partner ■ University of Białystok
Department of Physics
Laboratory of Magnetism
41 Lipowa street
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Other partners ■ **EU partners:** Institut d'Electronique Fondamentale, Université Paris-Sud, France - Laboratoire de Physique des Solides, Université Paris-Sud, France - Leibniz-Institut für Festkörper- und Werkstoffforschung Dresden, Germany - Magnetism Group, Technische Universität Kaiserslautern, Germany - VSB Technical University of Ostrava, Czech Republic - Charles University, Czech Republic - Institute of Physics, Academy of Sciences of the Czech Republic - Hahn-Meitner-Institut, Germany - Research Institute for Technical Physics and Materials Science, Hungarian Academy of Sciences
Supporting partners: Donetsk National University, Ukraine - United Institute of Informatics Problems, National Academy of Sciences of Belarus - Research Center on Resources Saving, Belarus National Academy of Sciences



NEPHILID SPIDERS

Slovenian scientist Matjaž Kuntner spends his days studying sex – spider sex, to be precise. He used his Marie Curie grant to delve further into the bizarre world of the nephilid spider, where tiny males and gigantic females are locked in an epic battle of the sexes that has resulted in some rather peculiar mating behaviour. His research has captured the imagination of the media.

Castration, cannibalism and conflict: the battle of the sexes, spider-style

There are about 40 species of nephilid spider scattered across the tropical and sub-tropical regions of the Americas, Africa, Asia and Australia. They include the golden orb weavers whose webs can reach 1.5 metres in diameter. However, what really makes the nephilids stand out is the massive size difference between the sexes; the females are 10 to 100 times heavier than the males. This means that males vastly outnumber females, because few females survive long enough to reach truly gigantic proportions.

Although many aspects of nephilid biology have been studied extensively in the past, little was known about their mating habits – until Matjaž Kuntner came along, that is. Originally from Slovenia, he spent six years working at the prestigious Smithsonian

Institution in the US before a Marie Curie Reintegration Grant gave him the opportunity to come back to Europe and set up his own research laboratory in his homeland.

The traditional view of sexual selection involves males competing with each other for access to females and females choosing the best males. However, Dr Kuntner's research is turning this idea on its head. In the nephilid world, the conflict is between male and female, as the females want to mate with lots of males, while the males want to stop the females from mating with other males.

'Classically, sexual selection is viewed as a female choice and females taken as the monogamous gender. Often, however, this is entirely mistaken,' explains Dr Kuntner. 'In spiders, the females are highly polygamous, which is certainly not in the interest of the males which strive to monopolise the females, thus forcing monogamy. Sexual conflict over mating then triggers antagonism between the sexes.'

Dr Kuntner's research has revealed the lengths that male spiders will go to control access to females, as well as the tricks employed by females to get round the males' ploys.

One simple strategy involves the males simply guarding a female they have mated with, fighting off any other males that attempt to get near her.

Kinky stuff

In many species, the males 'plug' the female's sexual orifices by breaking off all or part of their own sex organs during intercourse and leaving them behind in the female. The males of some species actually castrate themselves entirely during this process, becoming eunuchs. By sacrificing a body part in this way, the males hope to stop the females from being able to mate with other males. However, the story does not end there, because the females have changed the size and shape of their own sex organs to allow them to accommodate these plugs while still mating with other males!

The spiders are now engaged in an evolutionary 'arms race'. Dr Kuntner's research shows that in some species the males have the upper hand as the plugs seem to be completely effective at stopping the females from mating. However, in other nephilids, the females have retained control over their sex lives,

and can mate a number of times despite having several plugs embedded in their sexual organs.

Dr Kuntner has even observed cases of post-coital cannibalism. The females of the species involved, *Herennia multipuncta*, are notoriously sexually aggressive. In these cases, the male may plug an aggressive female in a bid to monopolise her sex organs before he is either evicted or eaten.

This research has challenged and altered the mainstream views of the scientific community. Prior to this project, sexually antagonistic co-evolution had been demonstrated in insects but not in spiders. The results are an important contribution to the understanding of sexual selection mechanisms.

Let's talk it over

Encouraged by a receptive public, Dr Kuntner has enthusiastically invested time and energy into communicating the results of his work. He gives regular talks on spiders, and has set up a website devoted to his favourite arachnids. In addition to details of both past and current research projects, it features many

of Dr Kuntner's striking photos of nephilid spiders and other wildlife, as well as a detailed glossary of evolutionary terms.

His work has featured in a number of prestigious scientific journals, such as *Scientific American*, and has even caught the eye of the wider media.

Dr Kuntner comments: 'Although I cannot judge the relevance of my work in the long run, *several media seem eager to present my research to the public and my lectures worldwide are usually well attended and well received.*'

Dr Kuntner's Marie Curie grant helped him to secure a permanent position in his native Slovenia and allowed him to establish his own research laboratory at the Scientific Research Centre at the Slovenian Academy of Arts and Sciences based in Ljubljana. As well as enabling him to fit out his new laboratory with high-quality equipment and materials, the funding provided Dr Kuntner with the resources to embark on two expeditions and travel to conferences.

'The grant facilitated my career in my home country, even in my home town, which is a rare commodity in science.

I now train students in the Slovenian language. And do not think that it is impossible to conduct world-class science in your home town, however small it is,' he advises.

Together with colleagues in other parts of the world, Matjaž Kuntner is continuing his work, probing the sex lives of nephilid spiders, as well as studying broader aspects of the biology of the nephilids and related spiders. Who knows what weird and wonderful mating habits his investigations will uncover in the future?

Project acronym ■ Nephilid Spiders
Full project title ■ Nephilid spider phylogenetics as a test for antagonistic co-evolution of sexes

Type of grant ■ International Reintegration Grant
Budget ■ EUR 76 651
Duration of project ■ 15-03-2006 - 15-03-2008
Scientific discipline ■ Life sciences

Host institution ■ Professor Dr Oto Luthar
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WISE

The 32 countries within the European Environment Agency produce four tonnes of waste per capita every year, while the average European throws away 520 kilogrammes of household waste annually. A new generation of waste managers was required, and the 'Waste in a social environment' (Wise) project has gone some way towards creating one.

Winning the waste battle

Waste is not only unsightly but poses a health and safety hazard for those living or working near it. There is now question: it has to go somewhere, although waste disposal can have a significant impact on the environment.

It is usually the job of the local or regional authorities to pick up and dispose of municipal rubbish. Landfills, where the waste is buried, and incinerators, which burn the waste at high temperatures, are used for waste that does not break down. A combination of these and recycling centres are used by most local authorities.

But the complexity of waste management requires competent and well-informed planners and decision-makers who understand that one solution will not fit all of Europe's waste problems. The Marie Curie-funded Wise network, developed and coordinated by the Department of Processing and Recycling at Aachen

University in Germany, has trained Europe's waste managers of tomorrow. A series of interdisciplinary seminars in several EU countries have prepared them to tackle the world of waste.

Calling all waste specialists

Wise held specialist seminars on waste management in different locations across Europe, including Germany, Spain, Malta, Austria and Poland. The courses addressed environmental education as well as technology and policy.

Today's waste managers are dependent on technology, as well as the support of waste-producers in households and businesses. Technology opens up new options for waste disposal and the unavoidable logistics involved in the process. And while those making waste decisions must be fully clued up on these technologies, political issues are no less important. 'Effective implementation of waste legislation can only be achieved when a common level of understanding and education about key waste issues and problems is realised,' explains project manager Catherine Hornsby. The training programme's tried-

and-tested methodology also included courses on sustainable technologies, barriers to waste management, social factors, technology transfer and best practices.

Recycling ideas across Europe

The seminars brought together young researchers and postdoctoral Fellows with a common scientific interest. Their backgrounds ranged from economics to industrial psychology and technology development, and they hailed from all over Europe, including countries whose waste management strategy is still in the early stages of development. The training capitalised on their collected expertise, encouraging them to look at the same issues from several perspectives.

Viviana Cigolotti, a doctoral candidate at the University of Naples Federico II in Italy, participated in the seminars. She remarks: 'The Wise courses were an extraordinary experience as it was possible to meet people from all over Europe and beyond. I learned how to work with other PhD Fellows and after four courses, *I feel myself more European than Italian.*'

Alexandre Duran-I-Grant, a doctoral candidate from the University of Versailles Saint Quentin-en-Yvelines in France, agrees: 'This course allowed me to integrate into an international community and, moreover, to take part in a working team [that was] widely multinational and multilingual.'

A doctoral candidate at the Helsinki University of Technology in Finland, Maaria Kriistina Wierink particularly appreciated the multidisciplinary nature of the Wise seminars. 'The participants and experts came from several fields and it gave me a good overview of the field of waste management. I managed to make several excellent contacts. I learned a lot of management skills, since it was my first time [being a] team leader,' she says.

Professor Helmut Seifert of Karlsruhe University in Germany was one of the experts giving the seminar. He explains the thinking behind the initiative: '*The idea to mix up groups from different disciplines was very helpful in finding new, sometimes even unexpected, wonderful solutions for the given problems.* I think both the well-harmonised selection of the participants as well as the very good organisation of the course in general were the preconditions for the best result of the event.'

Hands-on

However, the courses were not only about theory. A trip to Malta and Poland ensured that the Fellows learned how to apply knowledge to practical scenarios. And a visit to fully functional integrated waste-management complexes in Spain, Germany and Austria exposed the participants to the most advanced waste-management set-ups in Europe.

In Malta, the participants learned about organic waste composting and 'digestion' methods, as well as legislation issues affecting these technologies. They also looked into how relevant industrial by-products accumulate, transform and are released into the environment, and went on technical visits to Maltese waste-processing plants.

Each researcher took a look at some of the most important questions facing waste managers in Malta. For example, they were asked whether it would be possible to capture methane from waste streams, and what type of collection and sorting systems work best for a small island.

According to Klaus Kögler, head of the European Commission's Unit for Sustainable Production and Consumption, the Marie Curie-funded Wise project was not only a professional investment for the participants but also an investment in the future well-being of society as a whole.

Project acronym ■ Wise
Full project title ■ Waste in a social environment

Type of grant ■ Conference
Budget ■ EUR 319 358.64
Duration of project ■ 01-01-2007 - 31-12-2009
Scientific discipline ■ Environment

Lead partner ■ RWTH Aachen University
Templergraben 55
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A high-resolution image of the Earth from space, showing the Western Hemisphere. The Americas are visible, with North and South America in shades of green and brown, and the surrounding oceans in deep blue. The title 'WORLDWIDE RESEARCH' is superimposed in large, white, bold, sans-serif capital letters. The word 'WORLDWIDE' is on the top line, and 'RESEARCH' is on the bottom line. A faint, semi-transparent version of the same text is visible behind the main title.

WORLDWIDE RESEARCH

The quest for knowledge is a universal endeavour. Humanity is facing many common challenges – from preserving the environment to protecting against pandemics – that require international cooperation. In addition, as a responsible global citizen and scientific powerhouse, the EU works together with less-endowed countries to help them deal with local issues, such as droughts and neglected diseases.

Unlocking a world of learning through international cooperation

From understanding climate change to unlocking the secrets of the human genome, there are certain scientific questions and issues which concern the entire world. As an international scientific hub with a long-standing tradition of research excellence, the EU is well placed to play a vital and pivotal role in such global undertakings.

For many years, the European Union has nurtured international scientific cooperation to address the needs and opportunities of an interconnected world and to contribute to the peace and prosperity of Europeans, as well as to that of citizens around the world.

Global warming is just one example where the EU has taken the lead in promoting international collaboration. Not only has Europe been a trailblazer in the political sphere – playing a major role in the Kyoto Protocol, for example – but it has also been a major investor in ‘green’ technologies and eco-innovation, and cooperates with partners across the world in these fields.

But it is not all about down-to-earth subjects – in fact, the sky is quite literally the limit. Through the European Space Agency (ESA), Europe joined the global team building the International Space Station (ISS), which is increasing our knowledge of the ‘final frontier’.

Then there is the galaxy within. The sequencing of the human genome was another notable – and groundbreaking – example of the EU’s participation in international science. Labs in Europe, Japan, the United States and other countries shared the painstaking quest to identify the more than 3 billion nucleotide ‘letters’ making up the DNA macromolecule.

Global partnerships

By opening up European research to the world, the Union aims to make Europe a more attractive destination for world-class talent and a major global scientific reference point. It also seeks to enable European public research institutes and industry to access knowledge available elsewhere in the world.

Just as the European Research Area is working to combine European research infrastructures to create a synergy in which the sum of the whole is greater than its individual parts, the EU is aiming to maximise that critical mass through international cooperation. It is also striving to build capacity in and with developing countries to help them tackle their unique scientific needs. In addition, it is developing science and technology activities that can help implement EU foreign and development aid policy, such as EU-backed research into communicable diseases.

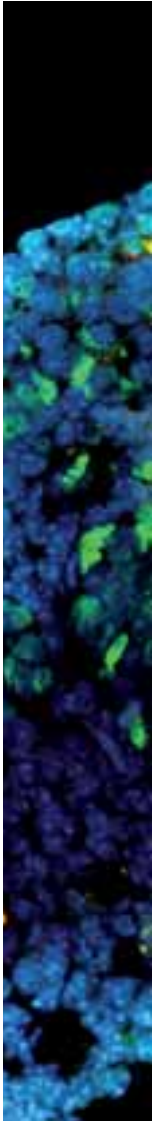
European research programmes seek to make a world of difference both to the EU and its international partners.

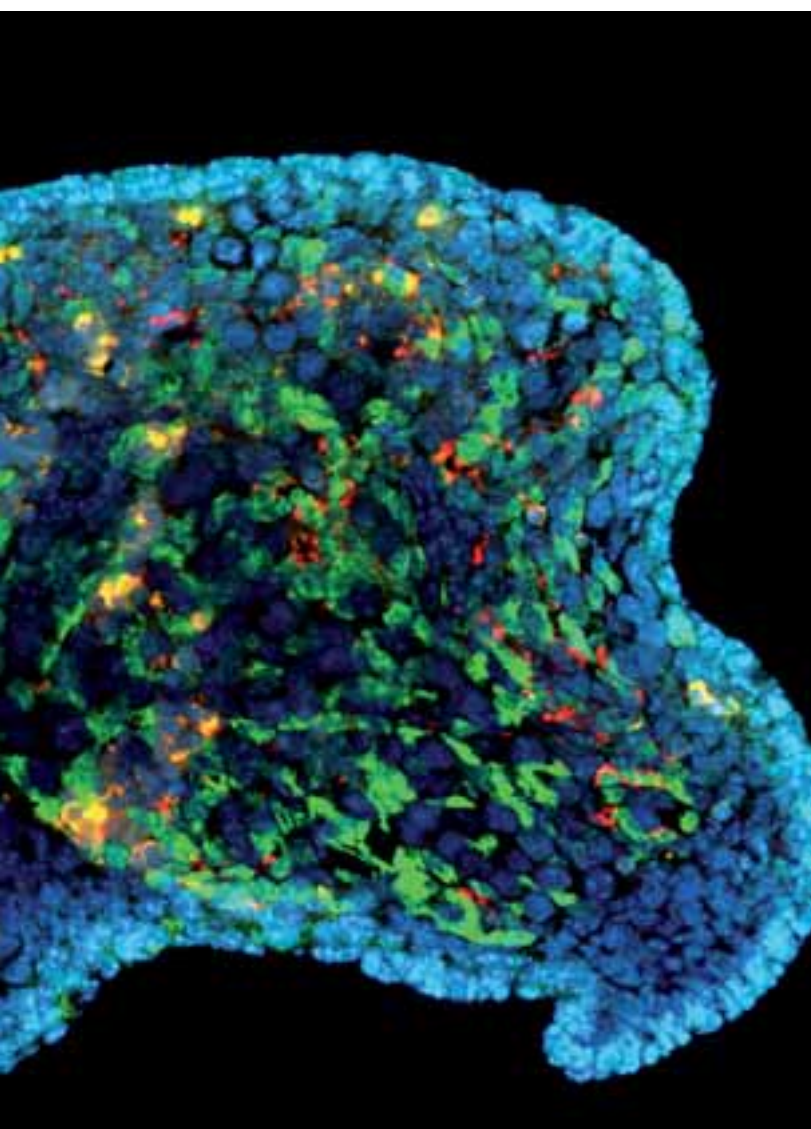
That is why global collaboration is an integral part of every aspect and priority of EU research programmes.

Marie Curie's international face

In keeping with the EU's goal to promote international cooperation, the Marie Curie Actions have their own specific international dimension. They seek to bolster the quality of European research by attracting research talent from outside Europe and by fostering mutually beneficial research collaborations with non-European researchers.

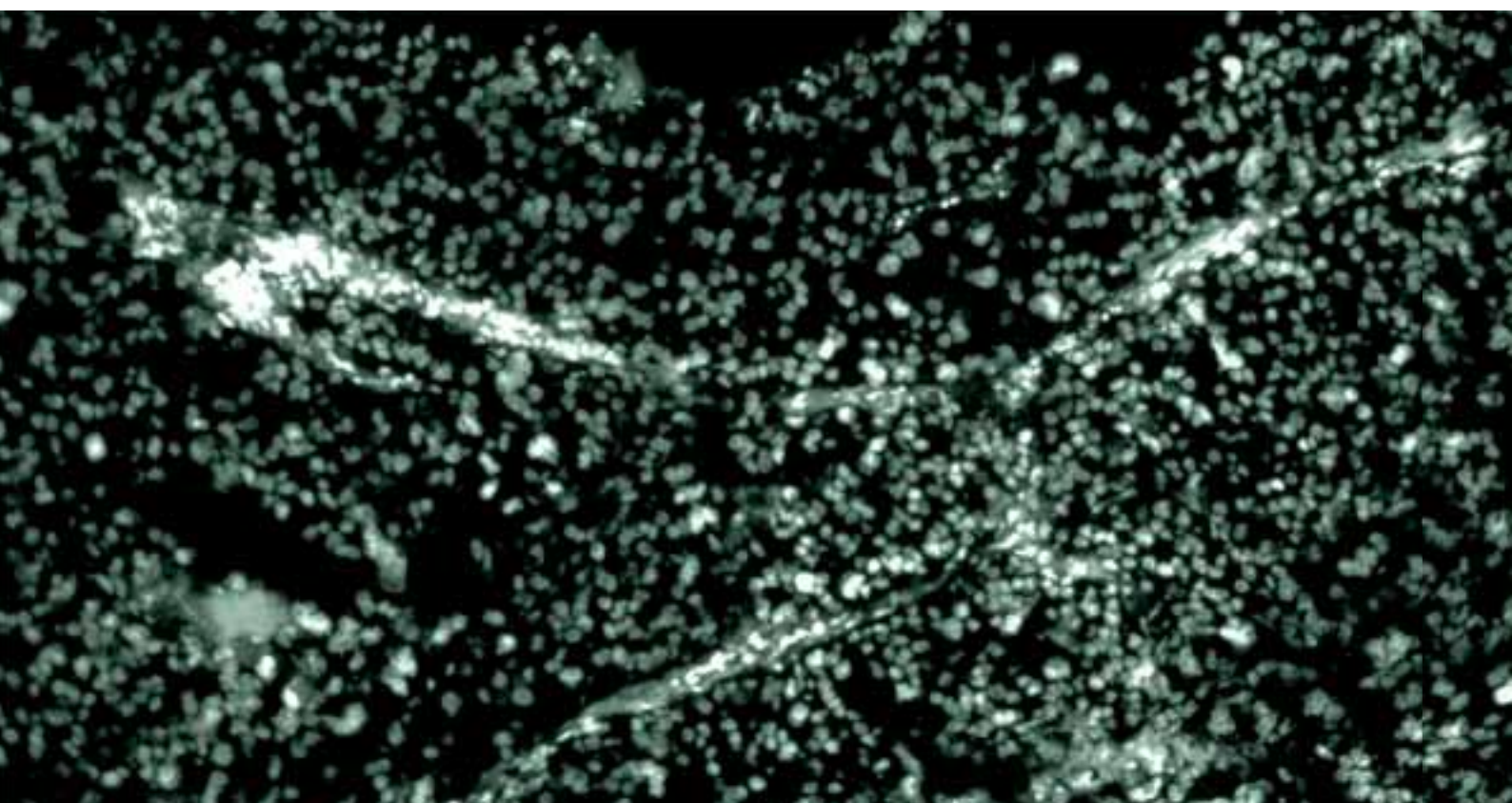
There are numerous mechanisms to promote this international dimension. Specific international funding schemes allow experienced European researchers to spend time in an institution in a non-EU country, or bring experienced researchers from outside the EU into Europe. In addition, support is available for staff exchanges between European research organisations and their counterparts in third countries, creating tighter collaboration which in turn generates new projects. But





the global dimension does not stop there: international research teams can collaborate with European teams in any of the networks and non-EU researchers are recruited to these networks.

Concrete examples featured in this chapter show what a world of difference these Marie Curie Actions are making.



ATTACC

Only one in a million is affected, but the prognosis for these sufferers is far from good. Five years after the initial diagnosis, 60 % of those with adrenocortical carcinoma lose their battle with the illness. Marie Curie Fellow Martin Fassnacht sought to improve the chances of survival for people with this highly malignant adrenal cancer – and succeeded.

Attacking the tumour from within

Adrenocortical carcinoma – or ACC – affects the adrenal gland, a small organ close to the kidneys. It produces a variety of hormones, including the stress hormone cortisol. Many ACC patients – 60 to 70% – show exceedingly high levels of particular hormones. In female patients this can lead to the development of male features, or in children, precocious puberty, among other symptoms. 'This is often the reason why they go to the doctor, and then the disease is detected,' says Dr Fassnacht. 'In other patients, it's just the sheer size of the tumour. The medium size is about 12 cm, but the organ itself is only 2 or 3 cm in size. And some of our patients have tumours that grow to be 20, 30 or even 40 cm, which certainly causes problems by itself. But the majority have hormonal problems.'

But what comes after the diagnosis? Unlike many other, more common cancers, ACC did not have an established diagnostic or therapeutic approach until a few years ago. And

there was no great interest from the pharmaceutical industry in studying the disease either because it is too rare. Attitudes seem to be changing now, thanks in part to the work done by Dr Fassnacht during the ATTACC project, as well as his counterparts worldwide.

Cutting off the tumour's lifelines

Dr Fassnacht took a two-fold approach in his studies at Duke University in the United States and his home institution, the Bayerische Julius-Maximilians-Universität in Würzburg, Germany: immunotherapy, on the one hand, and targeting the tumour stroma on the other. In immunotherapy, doctors try to stimulate the patient's immune system and make it attack and destroy the cancer cells, much like it would a virus.

The antistromal strategy attempts to cut the tumour's lifeline: 'Tumour stroma are the cells in a tumour which aren't actually tumour cells – the benign, normal cells,' Dr Fassnacht explains. The stroma cells form the interface between malignant tumour cells and the normal host tissue; this provides the tumour with

nutrients and ensures blood supply and other vital functions. 'Today, it is well known that the tumour cannot grow without these normal cells,' Dr Fassnacht adds. 'Therefore, targeting these cells is an important and interesting concept for cancer therapy, and we tried to combine the use of immunotherapy with antistromal therapy.'

Immune system to the rescue

The question at the beginning of the project was: is it possible to make the human immune system target those normal cells that are so essential to the tumour? 'It was thought that our immune system does not detect its own normal cells and that you cannot stimulate an immune response against those cells,' the endocrinologist from Germany says. 'But our team, as well as other research groups, have been able to demonstrate clearly that it is possible and feasible to raise an immune response in humans against these cells.'

In fact, Dr Fassnacht was able to vaccinate mice against the Fibroblast Activation Protein (FAP), which can be found in the stromal tissue of some tumours. This elicited the desired

immune response against the stroma, marking a milestone for cancer therapy.

The importance of independence

The Marie Curie Fellowship was key to this success because it granted Dr Fassnacht independence. While this was important at his American host university, he believes it was even more so when he returned to Germany: 'Many of my colleagues come back to their original institutions and then they just have to do 100% clinical duties. That makes it very difficult to continue your own research. *Thanks to the Marie Curie Fellowship, I was able to start my own research group and mainly focus on research* during the first 12 months in Würzburg.'

His cutting-edge research continues. Dr Fassnacht is still building on the results that came out of the Marie Curie Fellowship now, years after it came to an end. All possible avenues are being investigated, be they immunotherapy, chemotherapies, or so-called targeted therapies. Some studies are still in the realm of basic research, while several clinical trials are in progress.

Dr Fassnacht is now International Study Coordinator for the first-ever randomised phase III trial in ACC. 'While this study is performed just with public funding, now more and more companies are actually contacting us for trials in ACC,' Dr Fassnacht is happy to report. 'In Germany, we started another clinical study two years ago, supported in part by a pharmaceutical company. And just now we are negotiating with a company that wants to sponsor an entire international trial, so that is another sign of progress. *Through our research and our networking we awakened their [pharmaceutical companies'] interest.*'

Hopes for a new drug

Nevertheless, Dr Fassnacht and his collaborators in Europe and the United States still have a fair bit of work ahead of them, if they really want to give more ACC patients a chance of survival. 'Considering the basic research that we're doing, I fear it will take at least 5 or even 10 years to put this in clinical trials and then maybe commercial output,' Dr Fassnacht estimates. 'But these other trials, hopefully with the help of companies we are negotiating with at the moment, may lead to approval for new drugs in four or maybe five years.'

All of this development from no established therapy to having a new drug within scientists' reach has happened in the last few years. And Dr Fassnacht has been one of the agents of this development, something of which he has every reason to be proud: 'Our group, alongside five or six other groups worldwide, has helped this progress along. I realise only when I look back now that we were part of it. Certainly, we didn't achieve it on our own, but together with some other groups, we have managed to at least make things a little more established. That's a great feeling.'

Project acronym ■ ATTACC
Full project title ■ Dendritic cell-based cancer immunotherapy targeting the tumour stroma

Type of grant ■ Outgoing International Fellowship
Budget ■ EUR 163 051
Duration of project ■ 01-01-2005 - 31-12-2006
Scientific discipline ■ Life sciences

Host institution ■ Bayerische Julius-Maximilians-Universität
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Duke University Medical Center
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BIOSEB

Out in the middle of nowhere, at eye level with wolves and lynxes, the Marie Curie Training Course Bioseb brings promising young scientists face to face with Europe's distant past and sets them on a course for a brilliant future. Using a multidisciplinary approach, famous scientists from around the world give participants insights into the hot issues affecting state-of-the-art ecology.

A summer in Europe's last primeval forest

Bialowieza Primeval Forest in Eastern Poland is one of the last and largest remaining fragments of the immense primeval forest that once spread across the European Plain. This ancient woodland, straddling the border between Belarus and Poland, is home to populations of many species. For some, it is the last refuge – they are rare or extinct elsewhere on the European continent.

The wildlife highlights in Bialowieza Primeval Forest include wolves, lynxes and otters – mammals that are rare in Europe – as well as some 800 European bison, a successfully reintroduced species. All are being studied by those lucky enough to be selected for the Bioseb Summer Schools.

'It is a perfect place for PhD Fellows to learn about biodiversity and ecology,' says Bioseb administrative coordinator Tomasz

Samojlik of the Polish Academy of Sciences' Mammal Research Institute (MRI PAS).

Into the wild

Every year at the end of May, the MRI PAS, an EU Centre of Excellence in Bialowieza, takes between 60 and 70 young scientists out into the wild for a Summer School in Ecology and Biodiversity. 'Apart from our own researchers,' says Dr Samojlik, 'eminent scientists from other European countries and throughout the world are invited as keynote speakers and tutors.'

The Bioseb Marie Curie Conferences and Training Courses provide short-term training opportunities and allow researchers to network and keep abreast of the latest scientific developments in their fields. The action targets primarily early-stage researchers and researchers with up to 10 years of experience, all supported with Marie Curie funding. 'Our Bialowieza Primeval Forest Summer Schools are intensive, diverse, one-week courses combining various methods of training,' Dr Samojlik explains. 'This includes lectures, field work, hands-on laboratory classes,

free discussion evenings, and staff-guided excursions to Bialowieza and Biebrza National Parks.'

All things ecological

Dr Samojlik says course work emphasises a strongly multidisciplinary approach, with lectures and training sessions on ecological and conservation genetics, population and evolutionary ecology, biogeography and macroecology, physiological ecology, conservation of biodiversity, geographic information systems (GIS) in ecology, and methods of ecological research on animals.

'The main objective is to provide state-of-the-art knowledge, but we also want to give young researchers an opportunity for direct interaction with leading scientists,' Dr Samojlik says. *'The Summer Schools are also an excellent platform for contact building and networking among the young researchers themselves.'*

Over three summers from 2007 to 2009, nearly 200 PhD Fellows from 40 countries participated in the Bialowieza Primeval Forest Summer Schools. The majority of these have been citizens of EU Member States, but 11 % came from other countries far

and wide, including Canada, Georgia, India, Israel, Kyrgyzstan, Russia, Serbia, South Africa, Thailand, Turkey and Uganda.

At the same time, the Bioseb project has successfully recruited renowned researchers from around the world to speak at the Summer Schools. 'We have been particularly pleased with the quality of the keynote speakers,' Dr Samojlik adds. 'All are eminent scientists active in ecology, biodiversity, genetics, conservation biology, and related fields all over the world.' These have included Robert E. Ricklefs (USA), John Fryxell (Canada), Pierre Taberlet (France), Kevin Gaston (UK), Norman Owen-Smith and Graham Kerley (South Africa), John R. Speakman (UK), Heribert Hofer (Germany) and many others. In total, 25 % of the invited speakers came from outside Europe.

Uniting theory and practice

'We hope that these Summer Schools will play an important role in fostering our participants' scientific careers,' says Dr Samojlik. 'Even at this early stage, the signs are promising. In the post-event evaluation forms, 64 % of participants have expressed their wish to work in research for more than 10 years, and only 6 % said they expected to quit research after obtaining a doctoral degree.'

But no matter what the future may bring for the young participants, both they and the invited speakers have shared very positive opinions with the organisers. 'As a trainee researcher in biological conservation, I found that the experience of attending the school improved substantially both my knowledge and practical skills in the area of applied research, while my admiration for our continent's natural heritage was significantly enhanced,' acknowledges Charilaos Pilidis of the University of Bristol, UK.

José Ricardo Teixeira Rocha of the University of Lisbon, Portugal, agrees, appreciating most of all the hands-on experience he gained during the Summer School: 'In the six days that I spent in Poland, I had the chance to put into practice some of the most useful things I had been learning about in academic studies. *I also gained a wealth of new knowledge and experiences that definitely allowed me to broaden my horizons, both professionally and individually.*'

Vincent A. Viblanc of the Département d'Ecologie, Centre National de la Recherche Scientifique (CNRS), France, also has nothing but praise for the course. He participated in 2009: 'Based on my attendance ... I can personally certify that the teaching I received there was of outstanding quality

and covered an extensive range of topics from conservation ecology to quantitative genetics.'

Looking back on experiences so far, the wealth of positive feedback and the great interest that the Białowieża Primeval Forest Summer Schools have generated, Dr Samojlik believes that this form of training for early-stage researchers should be a permanent component of the Marie Curie scheme in future European Commission research framework programmes.

Project acronym ■ Bioseb
Full project title ■ Summer Schools in ecology and biodiversity - understanding patterns and processes

Type of grant ■ Conference
Budget ■ EUR 476 000
Duration of project ■ 01-12- 2006 - 30-11-2010
Scientific discipline ■ Environment

Lead partner ■ Scientific coordinator of the project:
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Administrative coordinator: Dr Tomasz Samojlik
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E-mail: samojlik@zbs.bialowieza.pl



CAUSE KIDNEY DAMAGE

A potentially deadly disease of the kidneys is plaguing the Balkans, where it currently affects more than 100 000 people. The precise causes of this condition, which also occurs in farm animals, are unclear. A researcher from Bulgaria is determined to clear up this mystery, helping not only Europeans but also African communities afflicted by similar diseases.

The invisible enemy

Ochratoxin A (OTA), penicillic acid (PA) and fumonisin B1 (FB1) are just three of the fiends Professor Stoycho Stoev of Trakia University, Bulgaria, is pursuing. These are so-called mycotoxins – toxic by-products of the metabolism of fungi such as moulds or yeasts. OTA is one of the most common mycotoxins in the world and will contaminate foods like grain, coffee or grapes if they are not stored properly. It is a known fact that OTA can cause kidney damage and disease in humans as well as pigs and chickens: kidneys will grow abnormally and subsequently diminish, and may also develop a motley surface, fibrosis, cysts or other lesions. In such an important organ, this can prove fatal.

Both Scandinavia and the Balkans have been hit by severe outbreaks of OTA-related nephropathies in the past. But while the concentration of OTA found in food and feed in Scandinavia was enough to explain the outbreaks there, this was not so in the Balkans, more specifically in Professor Stoev's native Bulgaria. There were more people and animals affected there, but the concentration of OTA was lower. This

led the experienced veterinary pathologist to believe that several toxins might be at play here. His suspicion: OTA, PA and FB1 interact and create a stronger effect together than they would on their own.

On the trail of the culprit

Like a detective visiting the scenes of similar crimes, Professor Stoev is sure that comparing 'the same kind of pathology under different geographical, environmental and agricultural conditions gives us some knowledge about a possible polyaetiological [having multiple causes] nature of this nephropathy'. Hence, he is studying tissue samples from Bulgaria, on the one hand, and from South Africa on the other, hoping to shed light on the complex triggers of such kidney diseases.

His tests have already substantiated one of his suspicions: OTA and PA have a strong synergistic effect and do create more damage together. In addition, he and his colleagues from the University of Johannesburg's Food, Environment and Health Research Group (FEHRG) have discovered a new mycotoxin that

might contribute to the effect. 'Now, we are trying to evaluate the possible toxic potential and the chemical structure of the mycotoxic substance with the help of research collaborators and PhD Fellows from various African countries,' Professor Stoev remarks. Ultimately, he says, a better understanding of mycotoxins' action will make it possible 'to undertake various preventive measures, assuming that we are clear about the causes of these nephropathies'.

Help for the poorest of the poor

Thus, Professor Stoev is continuing his struggle against a potentially deadly foe, increasing understanding of the causes of kidney damage as he goes. This will not only benefit fellow citizens of the Balkans or of the European Union, but sufferers around the world – which include disadvantaged populations in South Africa: 'From the South African perspective, the investigation of the role of environmental agents in chronic diseases, which are rampant in the black rural areas, is of paramount importance to the country.' But why are such studies so essential?

The cause of many cancers and diseases is still a mystery. However, it has been proven time and again that they are 'at least in part linked to diet and mycotoxins', Professor Stoev makes clear. For this reason, the poor are often the most vulnerable: many are malnourished to begin with and do not have the means to store food properly. Professor Stoev adds that other factors, such as alcoholism, heavy smoking, HIV or tuberculosis, which are more frequent in poorer areas, further compound the risk, and emphasises that international cooperation is key to helping those most vulnerable communities. 'Any effort to understand such diseases is a priority, so that effective interventions can be made.'

The work of a pioneer

Professor Stoev has been pushing back the boundaries in more ways than one, being the first Marie Curie Fellow to take his research to the African continent. And this pioneering work has already gained broad recognition. Professor Stoev is in great demand as a speaker at scientific events across South Africa, and numerous prestigious journals have published his articles. But the Marie Curie grant has also helped him to establish

new contacts with policy-makers from South Africa and other countries and researchers alike.

However, his challenge is not over yet. Together with Professor Mike Dutton of the University of Johannesburg he has managed to establish new collaborations to pursue the work begun in the 'Cause Kidney Damage' project. As a result, the FEHRG has formed new research bonds with the State Veterinary Service in Pretoria, the University of KwaZulu in Durban and other South African research organisations. On the international level, Professor Stoev's academic home, Trakia University, has expanded its collaboration with the University of Johannesburg to take on-board the Institute for Medical Research and Occupational Health in Zagreb, Croatia, and Imperial College London, UK. This is a resounding success for Professor Stoev and his project. Marie Curie, he says, has helped to take his career one step further by enabling him to acquire new skills and establish key contacts.

Against this background, Professor Stoev has one key piece of advice for future Marie Curie applicants: be persistent! *'If they are persistent in pursuing their scientific ideas and research goals, they will eventually be successful, despite*

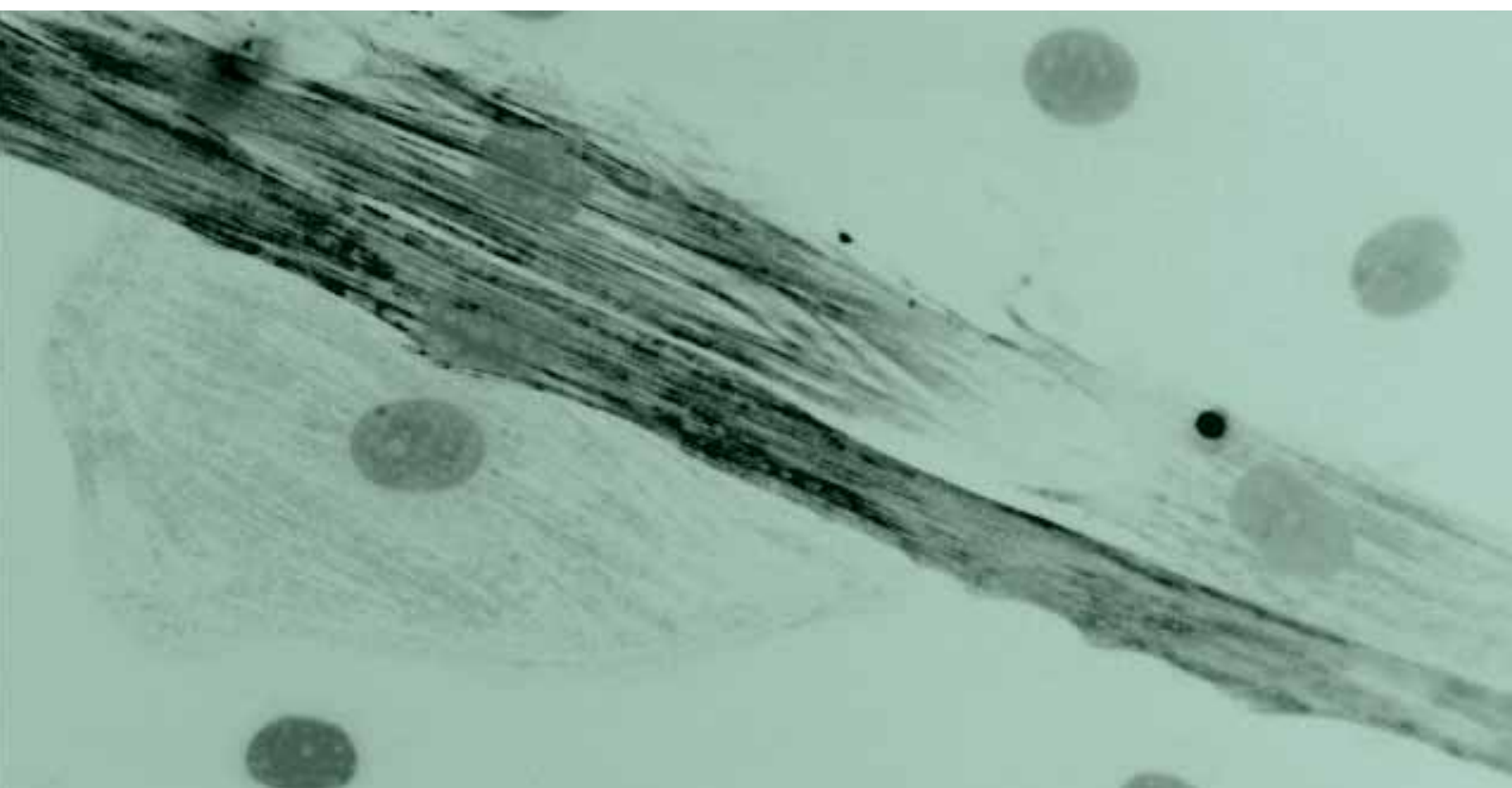
difficulties and obstacles at the beginning. The Marie Curie Fellowships are excellent tools to this end and will allow them to meet a lot of new researchers devoted to science, just like them. This is extremely important for them because *in this day and age of high tech, new discoveries depend largely on the collective efforts of like-minded people.'*

Project acronym ■ Cause Kidney Damage
Full project title ■ An expected multi-causal nature of spontaneous animal and human nephropathy in Bulgaria and South Africa

Type of grant ■ Outgoing International Fellowship
Budget ■ EUR 184 968
Duration of project ■ 05-01-2007 - 04-01-2010
Scientific discipline ■ Environment

Host institutions ■ Food, Environment and Health Research Group
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CAVEOLINS

Every breath becomes a wheeze. A cough starts and will not stop. Panic sets in as the muscles around the airways tighten their stranglehold. All of these are symptoms of an asthma attack. The key to this potentially life-threatening reaction in the airways might lie in specific cell membranes in the airway smooth muscle, says Marie Curie Fellow Reinoud Gosens, whose Marie Curie Fellowship took him to Canada.

Breaking the stranglehold of asthma

Smooth muscle is the tissue that lines all hollow organs and vessels in the human body, including the airways in the respiratory tract. In many diseases of the airways, such as asthma, chronic obstructive pulmonary disease (COPD), cystic fibrosis and bronchopulmonary dysplasia, the airway smooth muscle behaves aberrantly. 'In these diseases, particularly in asthma, there is an increase in airway smooth muscle mass and an increased capacity of the muscle to constrict the airways,' explains Dr Gosens. While the reason for this is not yet fully understood, 'pathological changes in airway smooth muscle behaviour are considered a primary cause of exaggerated airway narrowing in asthmatics, resulting in chest tightness'.

Little folds, big impact

In his Caveolins project, Dr Gosens analysed how caveolae, the special signalling hot spots in the cell membrane, contribute to the abnormal response of smooth muscle in asthma. 'In these caveolae, little folds or invaginations in the small plasma membrane that are abundant in smooth muscle cells, many signalling proteins and receptors are clustered,' he says. These proteins and receptors, in turn, regulate the cells' response to their environment and initiate cell growth, cell contraction or the secretion of enzymes, for instance. 'These processes are not functioning properly in asthma, in which the muscle constricts too easily and too much in response to the inflamed environment,' Dr Gosens describes.

This is an observation which he decided to put to good use. Understanding the goings-on in the caveolae, he speculated, should help to understand the irregularities in the airway smooth muscle growth and reaction, and so offer scope to find new treatment methods for asthma. And the Dutchman's research with renowned expert Dr Andrew J. Halayko at the Manitoba Institute of Child Health in Canada produced the results he had hoped for.

‘Our research revealed that the clustering of signalling proteins and receptors in these hot spots was fundamental to the regulation of airway smooth muscle function,’ Dr Gosens summarises. The conclusion: caveolae are able to influence smooth muscle contraction and – in combination with other proteins – cell growth. ‘Furthermore, we found that in lung tissue of animals that were exposed to allergens, there was increased expression of the caveolae coat protein caveolin-1, which could explain the enhanced contraction and contractile properties of the muscle in asthma.’

A new drug target

Asthma and other diseases of the airways are not the only ailments linked to caveolae; they might well play a role in cardiovascular diseases and viral infections, and even cancer. ‘In addition, it is now evident that a significant portion of the repertoire of drugs available to us works on receptors and signalling proteins that are clustered in caveolae. Therefore, it is vitally important to understand their behaviour, their function and their usefulness as drug targets in health and disease,’ Dr Gosens points out.

For now, however, Dr Gosens continues to focus on asthma and COPD. Meanwhile, following his return from Canada he has established his own research programme at the University of Groningen in the Netherlands to reveal more of the secrets of smooth muscle cells. And the knowledge he acquired during the Marie Curie Fellowship serves him well in this task: ‘The molecular and cellular biological techniques that I learned and the multidisciplinary environment in which I trained are all central now in my own research programme.’ This research, he hopes, is finally going to enable him to translate his findings into practice in a clinical context, so that new treatment methods coming out of his work will ease the suffering of asthma and COPD patients at some point in the not too distant future.

Of course, Dr Gosens still has a long way ahead of him. But he would not have made it this far without Marie Curie, he believes. ‘My Marie Curie Fellowship was fundamental to most, if not all aspects of my current research,’ the 32-year-old remarks. ‘Dr Halayko is a world expert in airway smooth muscle and works on the mechanisms that regulate its aberrant responses. His expertise in this area and his work on mechanisms of signal transduction in these cells provided a unique environment for me to reach my research goals.’

Back to the roots

‘Without this fellowship, I would not have been able to explore my own ideas and expand my scientific horizon the way I did,’ he adds. ‘It created a framework for my current research and teaching skills, which I transfer to the students and research trainees I am supervising. Most importantly, this fellowship also gave me the possibility to return to my native Netherlands to embed myself within the research environment here. This greatly facilitated my reintegration into the European Research Area.’

Even though he has returned to his roots now, connections with the research community outside the EU are thriving. Dr Gosens has an impressive number of publications and projects under his belt, most of which were the result of international collaborations. *‘My fellowship embedded me in an international network of leading scientists in the field with whom I am still collaborating today,’* he says. All of his current research projects also reach well beyond the borders of the Netherlands, involving colleagues all over Europe as well as in Asia, Australia and North America. What is more, Dr Gosens’ experiences during the Caveolins project

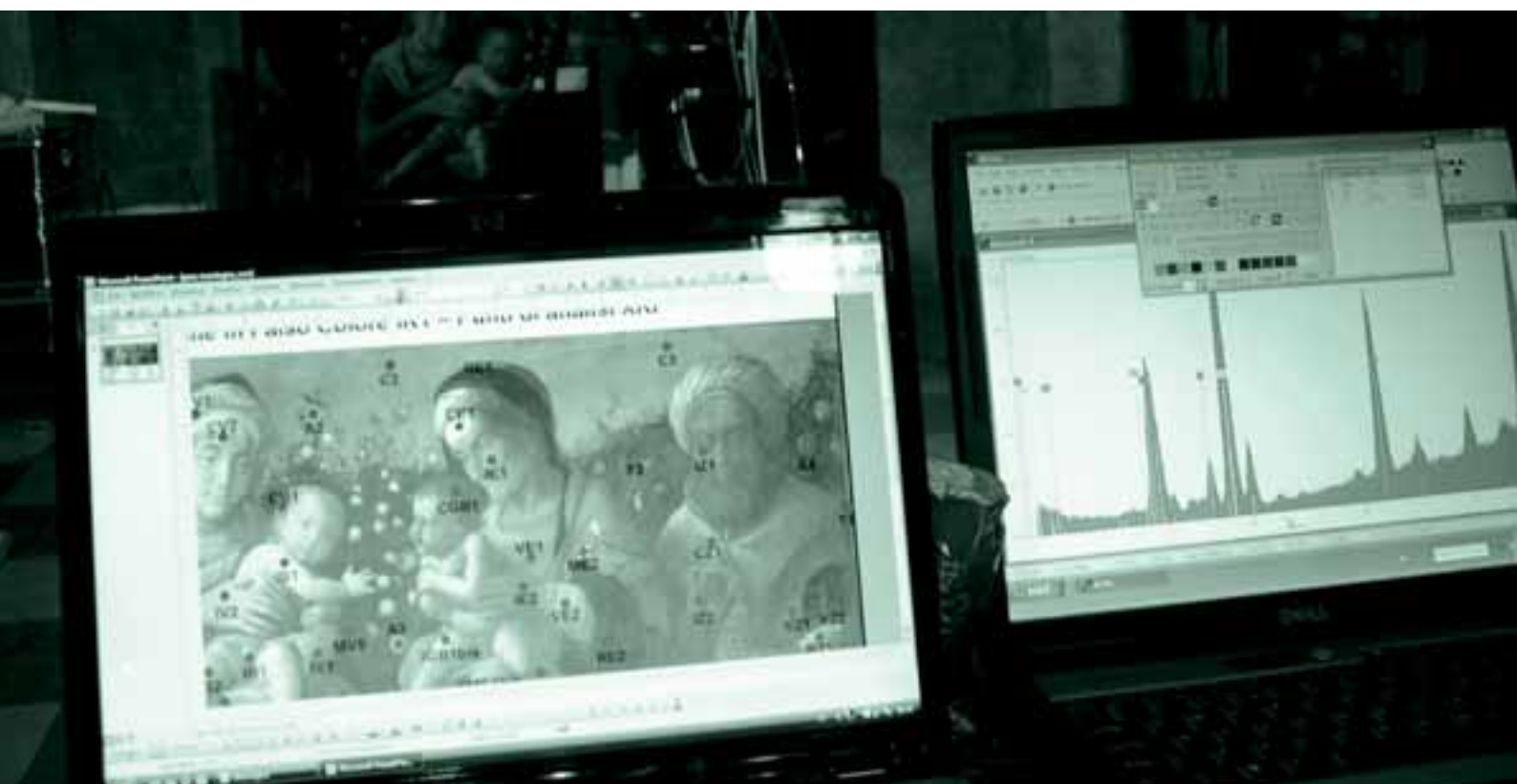
have permanently altered his perspective on a professional as well as personal level, he says: *‘It broadened my horizon in many respects and changed my point of view of the scientific community and the world in general.’*

Project acronym ■ Caveolins
Full project title ■ Caveolae and caveolins: integrating signals for airway smooth muscle cell proliferation

Type of grant ■ Outgoing International Fellowships
Budget ■ EUR 192 106
Duration of project ■ 01-03-2005 - 29-02-2008
Scientific discipline ■ Life sciences

Host institutions ■ Andrew J. Halayko, PhD
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EPISCON

The conservation and preservation of cultural heritage is a complex field. It comprises myriad conservator-restorers, archaeologists, historians, collection managers and museum curators on the one hand, and conservation scientists on the other. But a new breed of scientist – with a totally new skill-set – was required, and the Episcon network had the answer.

Episcon: creating 'true' conservation scientists

Whether it is the restoration of 16th century paintings, the excavation of newly discovered ruins or the cleaning of world-famous sculptures, the natural sciences play a critical role in the optimum selection of conservation materials, methods and strategies. But scientific research in conservation is often conducted by scientists who originally come from outside the cultural heritage field. This means they often lack the affinity with the heritage and conservation fields necessary to fully understand and communicate the significance and the consequences of their work to non-technical colleagues. With this in mind, Episcon, which stands for European PhD in Science for Conservation, was set up under the Marie Curie Programme in 2005. It has provided young researchers with education, training and research opportunities in the conservation of cultural heritage, creating this new breed of scientist. With young researchers from three continents having taken part in the project, this is good news for culture cultures worldwide.

From Baltic amber to monumental mortar

The programme supported 16 three-year fellowships involving six months of intensive training at the University of Bologna-Ravenna Campus in Italy in all aspects of the conservation of cultural heritage. This was followed by a two-and-a-half-year research project at one of the 10 host institutions. The Fellows were working in areas such as understanding the degradation mechanism of archaeological Baltic amber in the museum environment, and the use of linseed oil in monumental mortar for the more effective and longer-lasting repair of Greek and Italian monuments.

The young scientists benefited from ample networking opportunities with other Fellows – they participated in yearly internal monitoring meetings during which members of the Episcon commission evaluated their scientific progress. They also took part in international conferences where they presented results from their research project in the company of international scientific experts.

Having completed a PhD in Science for Conservation under Episcon at the University of Bologna, Elsebeth Langholz Kendix is a firm supporter of the project: 'Scientifically, I have been

able to follow whatever course my career path has taken me, with the enthusiastic support of my supervisor and coordinator of the Episcon project. I have been able to participate in scientific conferences, workshops and courses, such as the conservation science conference held in Milan in 2007 and the HSC5 (Hercules Specialised Courses): 'Synchrotron Radiation and Neutrons for Cultural Heritage Studies' held in 2007 at the European Synchrotron Radiation Facility in Grenoble. This has enhanced my scientific knowledge and experience in the field, preparing me for a future career in the scientific community. Working in the host institution has not been frictionless but rather *a case of north meeting south concerning work ethics, communications, humour, differences in educational background and professional expectations.*'

Brain gain on an international scale

The involvement of non-EU researchers from Colombia, Canada and Japan, hosted respectively at the Iasi University in Romania, the University of Perugia in Italy and the National Institute for Conservation in Amsterdam, the Netherlands, broadened the knowledge pool: everyone was able to learn from culturally

different approaches to the preservation of cultural heritage. And, of course, the new skills learned during Episcon were transported to very distant parts of the globe once the Fellows moved on. The project also crossed borders, with Fellows participating in dissemination actions not only across Europe but in the Far East as well.

'The Episcon project highlights the need for an academic curriculum specifically devoted to the education of conservation scientists. This need is based on the observation that during recent decades the interest of the scientific community in conservation and restoration has increased due to a growing understanding that the causes of deterioration, the characterisation of the state of conservation, and the development and testing of new conservation-restoration materials and methods are a priority for the correct safeguarding of cultural heritage,' explains Professor Rocco Mazzeo of the University of Bologna.

He feels this trend is likely to continue as the scientific community involved is shifting its interest from the application of analytical techniques aimed at gaining a profound knowledge of the constitution of heritage materials and of ancient production techniques, to problem-solving approaches to conservation.

Good news for Europe's crumbling castles and fading frescos: the dissemination and communication of the project's results has increased the visibility of science applied to cultural heritage. Indeed, other universities are now embracing the Episcon model, says Professor Mazzeo.

The future for our cultural past?

'There are many research issues which are not yet fully developed and need further attention from the conservation science community. These include the development of new conservation materials and methods and the development of non-destructive portable equipment capable of evaluating and monitoring their performance,' says Professor Mazzeo. 'In this regard, research projects developed at the PhD level, such as those implemented within the Episcon project, would represent a very valuable contribution.'

But it seems that the future of the Episcon experience will depend on each partner institution playing their part. In short, it will continue if they provide PhD scholarships on their own or seek funding for new European projects. But one thing is for certain – the European dimension will play an important

role if researchers are to continue benefiting from the obvious advantages of an international environment, including exposure to specific competencies and fields of specialisation that the young scientists are unlikely to find at home. They are a catalyst for forming networks, too. The team has also applied for further funding so stay tuned to see what happens.

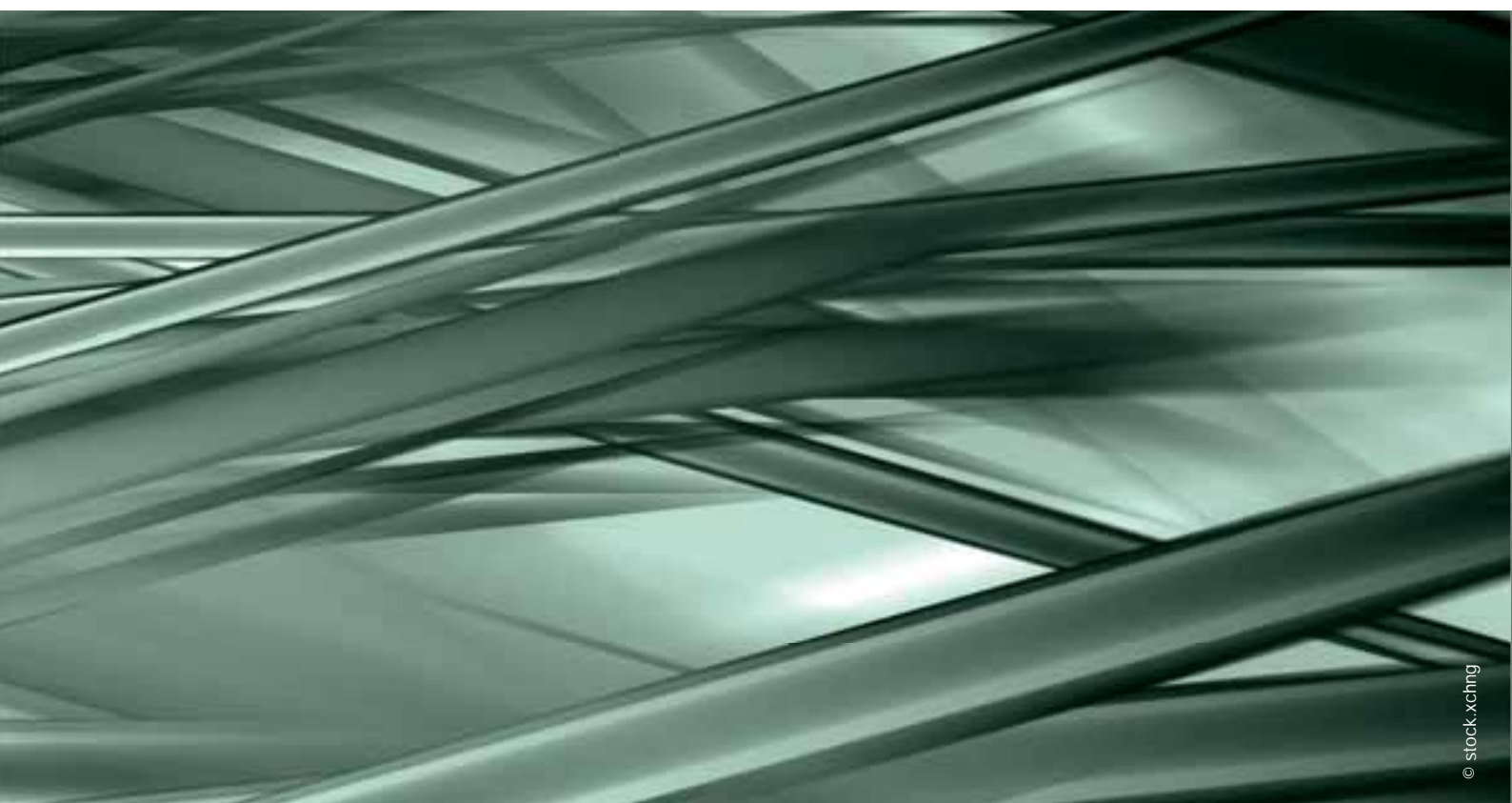
'At this point I can only guess what the future will bring when returning to my home country. *My goal is to continue my career in the science community, preferably performing research in the field of cultural heritage*, says Elsebeth Kendix.

Project acronym ■ Episcon
Full project title ■ European PhD in Science for Conservation
(<http://www.episcon.scienze.unibo.it/episcon>)

Type of grant ■ Training Networks
Budget ■ EUR 2.6 million
Duration of project ■ 14-10-2005 - 14-10-2009
Scientific discipline ■ Sociology

Lead partner ■ Prof. Rocco Mazzeo
University of Bologna - Microchemistry and microscopy art diagnostic laboratory (M2ADL)
Via Guaccimanni 42
IT-48100 Ravenna

Other partners ■ Bologna University, University of Perugia and the Institute of Conservation (CNR), Italy - Oviedo University, Spain - Thessaloniki University, Greece - Iasi University, Romania - ELTE University and the Hungarian Museum, Hungary - National Institute for Conservation in Amsterdam, Netherlands - School of Conservation, Denmark - Consiglio Nazionale delle Ricerche, Italy



PARSEM

Under the Marie Curie-funded Parsem project, young researchers from around Europe and around the world have investigated a variety of semiconductor material systems, developing innovative methods and experimental techniques for crystal growth.

Parsem, light years ahead in semiconductors

Semiconductors are a worldwide phenomenon. Everyone reading these words has probably benefited from the workings of a broad range of semiconductors within the last hour. Whether you have used a mobile phone, a PC or your digital camera, watched TV, used any form of transportation or listened to an MP3, you can be sure that semiconductors have been involved.

Technically speaking, semiconductors are insulators at absolute zero temperature that conduct electricity at room temperature. The interesting property of semiconductor materials is that they can be doped with impurities that alter their electronic properties in controllable ways.

Because of their use in transistors and lasers, so common in modern-day consumer devices, the search for new semiconductors and the improvement of existing materials have become important fields of study, bringing together materials scientists and researchers from across the globe.

Getting to grips

Semiconductors are classified according to their constituent atoms, and the periodic table groups from which they come. One such group, III-V, is the focus of the Marie Curie-funded Parsem project.

'III-V semiconductors are promising for the realisation of devices for the next generation of optoelectronic applications, and of high-temperature, high-frequency and power electronics,' explains Parsem coordinator Professor Philomela Komninou of the Aristotle University of Thessaloniki.

'The aim of the Parsem project was to provide in-depth knowledge on polar III-V semiconductors,' she explains. 'Specifically, we are looking at detailed structures within these materials, which we hope will lead us to new insights into their growth mechanisms and how they interact, as well as the relationships between their structural and physical properties.'

The most commonly used semiconductor materials are crystalline inorganic solids. So, like all crystals, they 'grow' through the (natural or artificial) process of crystallisation.

The research objectives of Parsem were to develop new growth techniques and ways to control growth processes, to increase understanding of atomic structures, defects and other phenomena, to analyse physical properties and to develop new models of atomic and electronic structures and growth processes.

Parsem consortium members, including 12 contractors from both academia and the industrial sector, collaborated closely in cross-disciplinary research on III-V materials. Importantly, with support from Marie Curie, the partners developed a structured training programme employing the most modern educational methods, including e-learning, workshops, seminars and exploitation of research methodologies, all under expert supervision, and with a strong emphasis on scientific ethics and management skills.

‘The integration of research and training has enabled us to jump forward in specific scientific areas such as crystal growth mechanisms, interfacial structures, physical properties of materials and multi-scale modelling,’ says Professor Komninou.

Global mix of young researchers

A total of 19 Marie Curie Fellows were involved in the project. ‘They took graduate courses and attended lectures that were relevant and helpful to their research needs,’ explains Professor Komninou. ‘And *they were trained in a variety of state-of-the-art methods and techniques through extensive collaboration, visits and secondments, participation in conferences and workshops, etc.*’

Marie Curie Fellow Suman-Lata Sahonta, now working in the UK, says, ‘I was surprised at how easily the young researchers exchanged ideas, and how encouraging the project leaders were about our requests to visit partner laboratories for collaborative studies. We were allowed to guide our own research, and from the beginning I was given a lot of scientific independence.’

Professor Komninou emphasises the fact that a third of the research done under Parsem was carried out by non-EU young researchers. They came from Algeria, Burkina Faso, China and India. ‘Our non-EU Fellows did important computational modelling and analysis of physical properties. All had strong scientific backgrounds which fitted well with the aims and objectives of the project.’

Julita Smalc is a Marie Curie Fellow currently working in Poland. ‘I received training on planning and performing experiments with a transmission electron microscope, on the use of specialised lab equipment for sample preparation, and with new simulation and analytical software,’ she says. ‘Parsem was also a great opportunity to develop my interpersonal and teamwork skills. I met many interesting people and gained new friends and the project opened new opportunities for collaboration.’

Caroline Cheze had a similar experience: ‘This collaboration has been very stimulating. I particularly appreciated the Parsem meetings, during which we could discuss our results, exchange ideas and think about other lines of investigation.’

For Professor Komninou, a major contribution towards the training of the young researchers at network level was the construction and implementation of the 'e-course' service on the Parsem web-server. This comprised a large number of specialised tutorial courses and was constructed in collaboration with all project contractors.

'The role of the young researchers was in fact crucial in the development of the "e-course" service,' explains Professor Komninou. 'Depending on their individual backgrounds, our Fellows contributed interactively to the development of particular courses.'

More achievements

To date, six Parsem Fellows have completed the presentation of PhD theses and others will follow. Twelve Fellows, including the non-EU researchers, have obtained postdoc positions or permanent positions in universities and research centres, or in the private sector.

In keeping with the international make-up of the Parsem network, its results have been disseminated worldwide: *'Parsem research resulted in a total of 130 peer-reviewed articles in scientific journals, 48 of which were joint publications among the partners,'* reports Professor Komninou. 'The great work of our project also resulted in 25 invited talks in various international conferences and meetings, which contributed to a broad dissemination of the research results.'

Overall, acknowledges Professor Komninou, the Parsem project has been a real success. 'The consortium has extensively investigated a variety of material systems with modern growth techniques and processes using innovative methods and experimental techniques.'

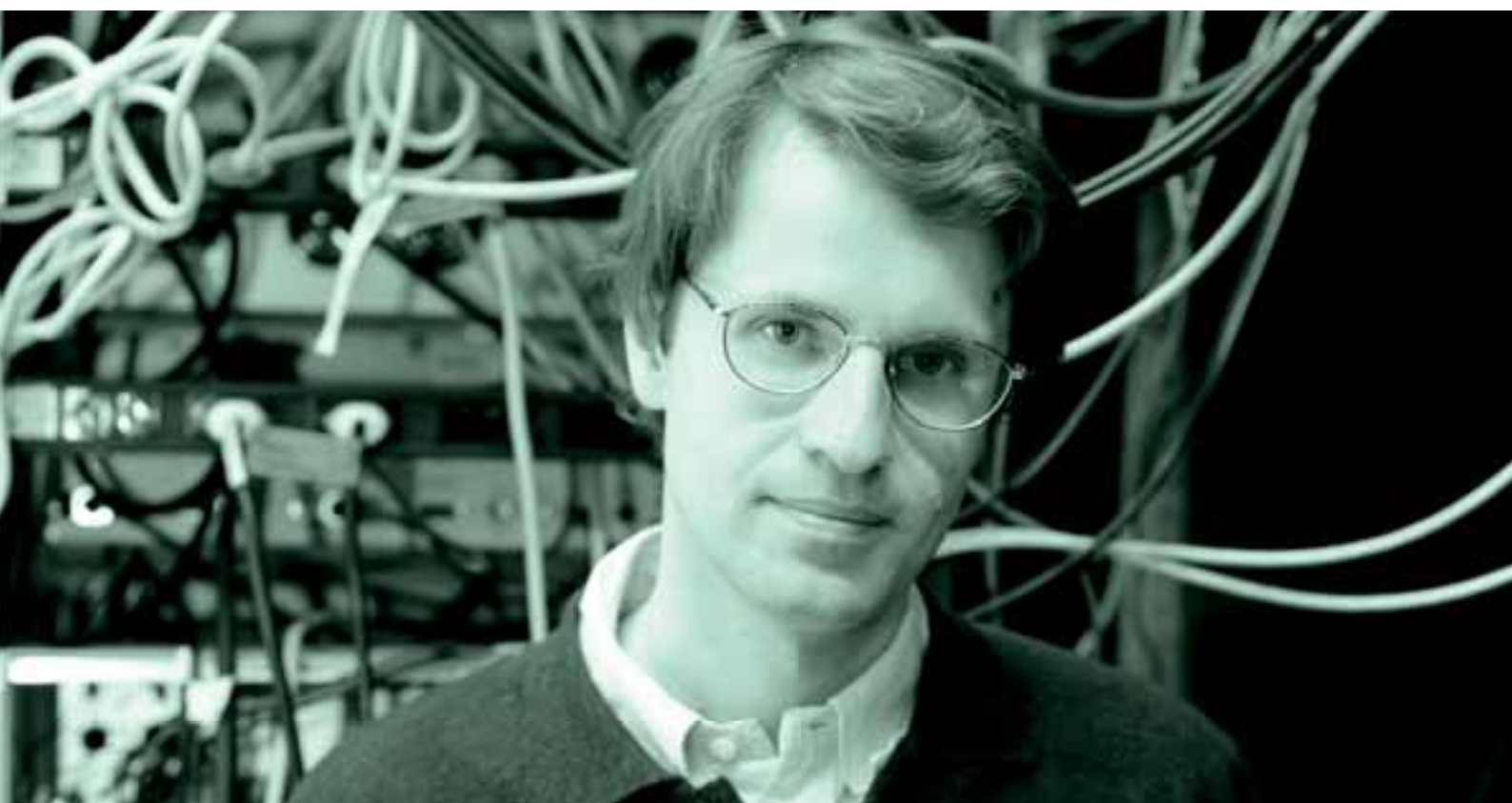
During the project's closing meeting, she says, all consortium members recognised that Parsem has developed a valuable international platform for efficient training through research and established a solid basis for the mutual recognition of degrees at European level.

Project acronym ■ Parsem
Full project title ■ Interfacial phenomena at atomic resolution and multi-scale properties of novel III-V semiconductors

Type of grant ■ Conference
Budget ■ EUR 2 889 317
Duration of project ■ 01-03-2005 - 28-02-2009
Scientific discipline ■ Materials science

Lead partner ■ Prof. Philomela Komninou
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GR-54124 Thessaloniki
E-mail: komnhnny@auth.gr

Other partners ■ The Chancellor, Masters and Scholars of the University of Cambridge, United Kingdom - École Nationale Supérieure d'Ingénieurs de Caen et Centre de Recherche, France - University of Liverpool, United Kingdom - Centre National de la Recherche Scientifique, Délégation Côte D'Azur, France - Universität Paderborn, Germany - Université Blaise Pascal-Clermont II, France - Instytut Podstawowych Problemow Techniki PAN, Poland - Foundation for Research and Technology, Greece - Thomas Swan Scientific Equipment Ltd, United Kingdom - Humboldt-Universität zu Berlin, Germany - Forschungsverbund Berlin e.V., Germany



NEURAL CIRCUIT

Blind mice can now see – so hopefully the next step is humans. Dr Botond Roska and a team of scientists have developed a novel technique that has the potential to reverse some forms of blindness. A Marie Curie Excellence Grant propelled the research and fostered the international effort that led to the discovery.

A vision on blindness

Botond Roska has a remarkable vision. He wants to reverse the effects of a degenerative eye disease so that those affected by the genetic disorder can once again see the wonders of life.

The Hungarian-born scientist's international collaborations have helped him to make some outstanding discoveries that could potentially reverse some forms of blindness without any surgical intervention.

Dr Roska devoted his younger years to playing the violoncello at the acclaimed Ferenc Liszt Academy of Music in Budapest. But an accident damaged his fingers and effectively ended his music career. He switched to studying mathematics and medicine in Budapest before going to the University of California, Berkeley, in the USA, then on to Harvard University as a Society Fellow. He has won numerous awards, including most recently the Young Investigator Award 2009 from the European Molecular Biology Organisation.

Today, Dr Roska is a group leader of the neuroscience, genetics and physiology unit at the Friedrich Miescher Institute for Biomedical Research (FMI) in Basel, Switzerland. His research focuses on the workings of the eye. He is particularly interested

in how neurons in the retina interact and link to physical processes in the brain.

Blinding condition

It was at FMI that he, along with an international team of researchers, developed a breakthrough technique that restores light sensitivity to previously unresponsive retinas affected by retinitis pigmentosa, a genetic condition that leads to blindness.

'We were able to restore visual function in blind mice, a treatment that is currently being considered for clinical trial to restore vision from retinitis pigmentosa, a blinding disease,' explains Dr Roska.

Retinitis pigmentosa is a group of inherited retinal conditions that affects about 1.5 million people worldwide. It causes the progressive deterioration of specialised, light-absorbing cells in the retina, the paper-thin tissue that lines the back of the eye. Many of those afflicted with the condition do not become legally blind until their 40s or 50s and retain some sight all their lives. Others may lose all sight during childhood.

Its progressive nature means late-stage retinal degeneration makes treatment extremely difficult and requires surgical intervention. Often treatment is not possible.

An international effort

Recognising the potential of Dr Roska's research, the European Commission awarded him a EUR 1.8 million Marie Curie Excellence Grant. The grants are designed to help promising scientists set up their own international research teams. With the grant, he was able to put together a team of researchers from seven different countries, pooling expertise from around the world.

Marie Curie Fellow Santiago Rompani left Brazil to join Dr Roska's team and was particularly impressed with the Swiss lab's facilities.

'The decision to join Botond's lab was not difficult despite Switzerland being very far from my family in Brazil and friends in the USA, in addition to the language barrier,' says Dr Rompani. 'This was mostly because the Roska lab had institutional, financial and intellectual resources that were unmatched in any other lab at which I was interviewed for a position.'

Japanese researcher Keisuke Yonehara came from Japan to join the team and echoed this sentiment: 'I came to Basel to join the group because only his group had all multidisciplinary cutting-edge experimental techniques that I needed to reach my scientific goal. *I could not find any comparable groups in the US or Japan.*'

Another Fellow, Dr Karl Farrow of Canada, wanted both the career opportunity and the European experience: 'I came to the laboratory at FMI for two distinct reasons. Firstly, *I wanted to learn about the cutting-edge approaches being developed in the lab to dissect neural circuits. I also wanted to have the experience of working and living in a European city.*'

Basic insights in neural computation

Working with Connie Cepko of Harvard Medical School, Dr Roska and his team pioneered a new area of neural science. By administering a gene of light-activated protein from green algae to selected retinal cells, the team was able to treat blind mice. Those that received the treatment were subsequently able to navigate behavioural tasks requiring vision. The team's achievement was hailed as a breakthrough in respected medical and scientific journals.

'Contrary to common belief, the retina is a complicated organ, with more than 50 types of neurons, performing sophisticated image processing tasks,' says Dr Roska. 'By targeting a select population of these retinal neurons, we have been able to restore a meaningful response to light.'

The non-invasive technique developed by Dr Roska is also seen as a potential treatment for masclar degeneration. This condition destroys photoreceptor function and is particularly acute among

the ageing population. Current treatments involve the surgical implantation of light-sensing arrays.

In collaboration with theoretical physicist Rava Azeredo da Silveira of the Laboratoire de Physique Statistique of the École Normale Supérieure in Paris, another FMI team led by Dr Roska gained basic insights into the workings of retinal circuits. They identified a new neural circuit in the retina that responds specifically to approaching objects. Typically, neurons are thought to perform one specific task. But the neuron in particular bipolar cells that detects approaching objects during the day also performs an entirely different function at night.

The neural circuit identified by Dr Roska and his team is also responsible, via other photoreceptors, for night vision. The team demonstrated that a circuit of neurons is able to perform multiple functions when subjected to specific physiological conditions.

Marching ahead with nanomachines

A third team in Dr Roska's lab collaborated with a group led by Dr Zsolt Boldogkői of the University of Szeged, Hungary. Together they engineered living nanomachines – trans-synaptic viruses that could leap from one neuron to the next in the brain and perform operations. For example, these viruses created proteins which coloured the nerves yellow for an active circuit and blue for an inactive circuit. Next, the team developed a wide range of

fluorescent colours that could trace how individual circuits drift apart, come together again, and where they ended up in the brain.

Such techniques enable researchers to better understand the dynamic mechanisms involved in how neural circuits compute particular brain functions.

‘With these new techniques we can start to tackle questions that so far were beyond our means,’ says Dr Roska. ‘We can now not only understand what happens in the brain after a particular stimulus, but for the first time we can also ask how neural circuits compute particular brain functions.’

‘We still have one more year left from the grant period. After that, I plan to continue the research direction I have started,’ concludes Dr Roska.

Project acronym ■ Neural Circuit
Full project title ■ Neural Circuit: combining genetic, physiological and viral tracing methods to understand the structure and function of neural circuits

Type of grant ■ Excellence Team
Budget ■ EUR 1.84 million
Duration of project ■ 01-11-2006 - 31-10-2010
Scientific discipline ■ Life sciences

Host institution ■ Dr Botond Roska
Novartis Forschungsstiftung Zweigniederlassung
Friedrich Miescher Institute for Biomedical Research
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4058 Basel - Switzerland
Tel. +41 616 978575 // Fax +41 616 973976



FAMILY-FRIENDLY WORKING CONDITIONS

Being able to simultaneously build a family and progress in one's career is a right that everyone can expect. Embracing this social responsibility is one of the underlying principles of the Marie Curie Actions, ensuring that excellent researchers remain in their chosen career.

Research: a family-friendly career?

With the help of the Marie Curie Actions, successful initiatives across the EU are developing ways to promote a better work-life balance in the research world. As experience from other sectors shows, employers can take simple steps to make work and family more compatible for all of their staff, an investment that will quickly pay for itself, not least in greater staff motivation and retention.

Before any practical steps are taken, efforts to create family-friendly working conditions have to challenge long-established perceptions. Raising a family requires parents to adapt their lifestyle and working conditions to the needs of their children. Long hours, unpredictable schedules and single-minded personal dedication, traditionally seen as a requirement for a successful research career, are stereotypes that are being eroded by the Marie Curie Actions.

Improving family-friendly working conditions actually ensures the best researchers remain in a research career. This is achieved through a variety of tools, not least of which is the requirement for full social security for researchers, providing for maternity, paternity and parental leave for fathers and mothers. Marie Curie Actions ensure that fathers' rights are also encouraged and respected.

Time is of the essence


Most parents are loath to miss out on the first precious years of their children's lives. Lack of control over the amount of time that they have to spend at work ranks highly among the reasons cited for withdrawing from the workforce. When workers feel that they are supported and have an influence over the amount and conditions of their work, however, they are less likely to view work and family as being in conflict. Time sovereignty and flexibility are therefore key to keeping parents on the payroll.

A number of initiatives can be implemented to achieve this. Flexible and part-time working patterns, for example, allow researchers to structure their work around times that are convenient to them.

Limited flexibility with regard to such arrangements can easily translate into extended career breaks, for example following the birth of a child. Active support for the resumption of work and a constructive attitude enabling parents to combine work and childcare when their children are very young can help to avoid extended absences and the disruption that these may cause both in the researcher's career and in the work of their teams. In addition to flexible or part-time arrangements, sharing parental leave between both parents also reduces the burden on individuals. The Marie Curie Actions allow for fathers to take the paternal leave to which they are entitled – family-friendly careers require a change in work habits and mentality from everyone, not just women. Family units are diverse in nature, and entitlements should be available and shared by both parents.

Further support can take the form of childcare facilities with opening hours mirroring the work pattern of parents.





Academic institutions and companies are beginning to offer such services on-site or nearby, making it more convenient for parents to pick up and drop off their children and also enabling them to see their children during breaks at work.

Mobility and stability

Making European researchers more mobile in their careers is a key tenet of the Marie Curie programme. Mobility is essential both for the quality of research and for enabling researchers to realise their full potential.

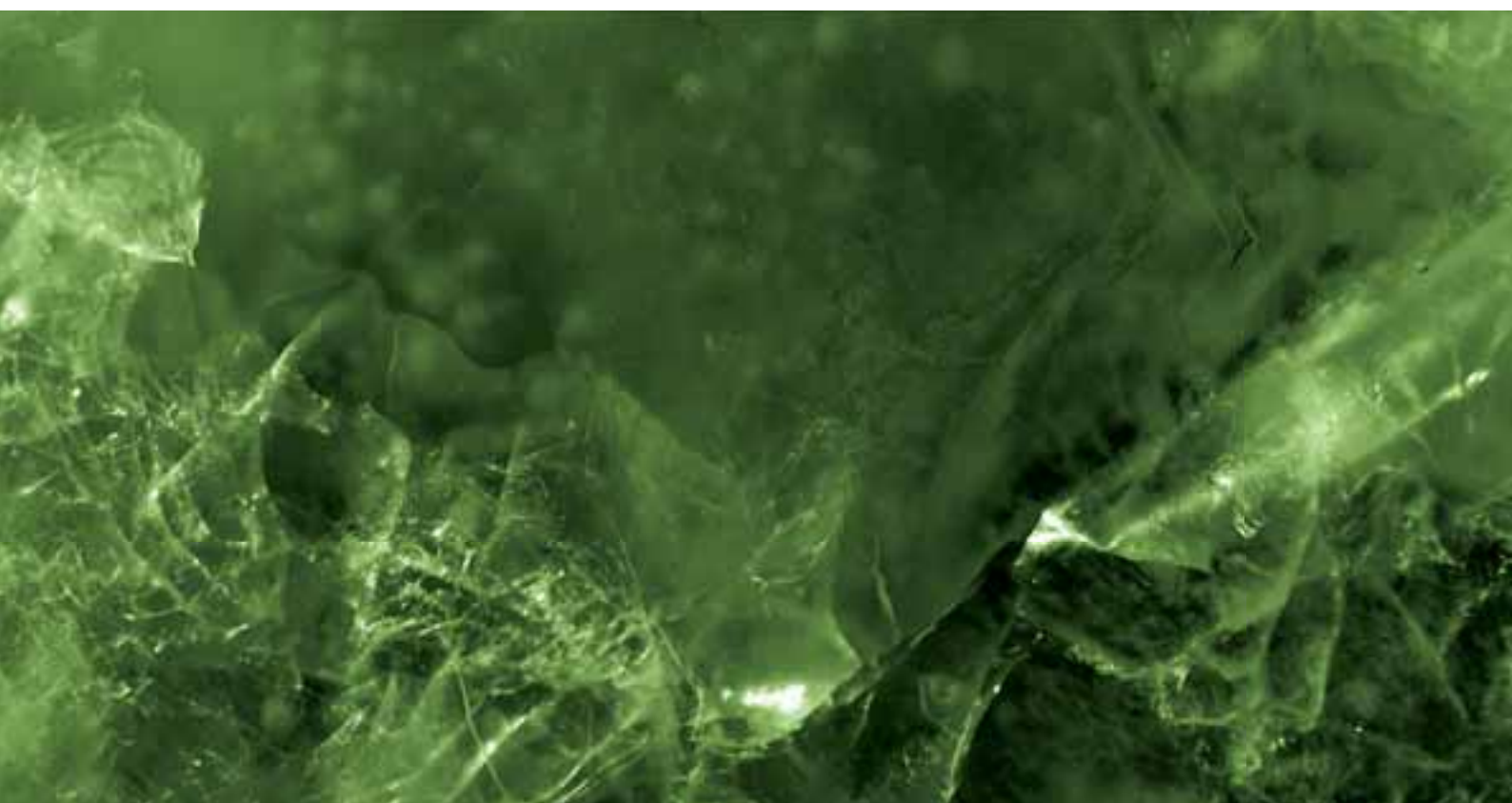
However, mobility can be disruptive to a happy home. An opportunity for mobility may involve uprooting a whole family – or leaving loved ones behind. In an attempt to tackle this problem, the Marie Curie programme ensures proper remuneration, including a family mobility payment and higher salaries. An increase in salaried research positions, rather than grant-maintained working, also brings the benefit of social security, which is important for the family, wherever it is. It means that Marie Curie Fellows can take maternity and parental leave, too. For

those arriving from outside of the EU, the ‘scientific visa’ facilitates family reunification.

Marie Curie Actions acknowledge their social responsibility to change the working conditions of the research community not only through better employment conditions, but also through the selection of projects to be funded. Family-friendly measures are considered when evaluators assess which projects should receive a grant.

Family-friendly policies in action

The following pages show examples of Marie Curie-funded schemes that enable researchers to benefit from family-friendly working practices. These include cases where parental leave has been combined with publishing papers and where institutes have set up on-site crèches or organised schedules that allow parents to care for their children. They are powerful examples of the advances that are possible when mindsets begin to change.



EURYTHRON

Young researchers working in the Marie Curie-funded Eurythron network boosted understanding of anaemia, did the groundwork for new therapies to cure the condition, and in the case of two Fellows, even found time to start a family at the same time.

A matter of blood: understanding anaemia

It is one of the most common and widespread human genetic disorders in existence and there is no effective cure, as of yet. Swimmer and Olympic silver medallist Tim Shaw has it, and so do countless others. The symptoms are evasive and fluctuate. They range from constant fatigue to dizziness, a lack of concentration and others, some of which can be quite debilitating.

Hereditary anaemias deplete the red blood cells of oxygen and in some cases force the heart to beat at a faster pace. In severe cases, organs may even suffer from a lack of oxygen. In other cases, lips go pale and finger nails become brittle.

Finding ways to tackle hereditary anaemias is a demanding task for any scientist, and is impossible without thorough

knowledge of how the condition develops. A group of 14 talented Marie Curie Fellows under the coordination of Professor Sjaak Philipsen set out to understand the underlying mechanisms of how the body produces red blood cells, a process known as erythropoiesis. Eurythron, a research training network, received almost EUR 3 million in funding from the Marie Curie programme for the four-year study.

Anaemias are caused when erythropoiesis stops functioning properly. Understanding how erythropoiesis is controlled at the molecular level allowed Eurythron to design novel therapies that could potentially lead to cures for anaemias. The team was able to generate a comprehensive molecular description of the mechanisms that drive the entire process. The knowledge obtained through their multidisciplinary approach may also be instrumental in tackling other erythroid disorders, such as leukaemias.

If science is to help Europe remain competitive on the world stage, researchers must remain in Europe. Creating the right working conditions to keep the best brains here is one of the goals of the Marie Curie Actions, and one that the Eurythron partners adopted as their own.

Flexible work environment

The research organisations involved in Eurythron went to great lengths to attract the best research Fellows. They also ensured that having families was not a barrier to participation by creating a flexible environment that would further the careers of all Fellows. Professor Philipsen says the additional family allowances and support from Marie Curie helped the project attract 14 molecular biologist Fellows from across Europe, of whom 9 were women.

‘Some of the trainees brought their partners and small children to their new positions,’ says Professor Philipsen. ‘Without the conditions set by the Marie Curie programme, this would have been much harder, if not impossible.’

Marie Curie funding also supported an extension in the duration of the project to take account of the maternity leave taken by two of the Fellows. ‘This allowed us to make the most of the last stages of the project, with a very successful final network meeting in Lisbon,’ he says.

The two Fellows, Hana Manceau-Forejtníková and Ronja Bahadori, returned to work when maternity leave ended. Originally from the Czech Republic, Dr Manceau-Forejtníková was based at

the Institut National de la Santé et de la Recherche Médicale (Inserm) in Paris, France, for her fellowship. ‘My son was born after 23 months of my contract,’ says Dr Manceau-Forejtníková. ‘In France I benefited from 16 weeks maternity leave. The support of my group was excellent. Thanks to flexible working hours, help from other group members with specific tasks that I needed to avoid during pregnancy, and also being able to interrupt my work to care for my newborn without loss of funding, allowed me not to lose time in my scientific career planning.’

Meanwhile Dr Bahadori, a citizen of both Iran and Germany, conducted her Eurythron research in the UK at the Medical Research Council, University of Oxford. She says the added allowances given to Fellows helped her maintain her career after her child was born. ‘The conditions of my employment helped me to take the full maternity leave and take up work again,’ she says. ‘The travel allowance component of my salary enabled me to visit my family after the birth of my child.’

Another Fellow, Francesco Cerisoli, was able to take his family from Italy to his research base in the Netherlands at the Rotterdam Erasmus University Medical Centre. He says the network enabled him to attend numerous international conferences. He also attended a training event in Porto, Portugal, that opened up career opportunities for him.

'The money set up for meetings and congresses allowed me to join many important international meetings and made [it] easier for me to keep in touch with my scientific community,' he says. 'The additional family allowance helped me afford a better standard of living even though my wife was not working.'

Expanding research, launching new careers

During the project Fellows were exposed to a wide variety of approaches, techniques and experimental model systems through workshops, lectures and exchange visits, says Professor Philipsen.

'These interactions have been very beneficial for the trainees but also for their principal investigators and host laboratories,' he says. *'This has resulted in a steady flow of scientific publications that is still increasing after the official lifetime of the project.'* And the benefits continue after the project has ended. Eurythron led to several new and unanticipated collaborations between the network's participating laboratories. Professor Philipsen notes that holding annual network meetings is particularly useful for fostering international collaboration and exchange visits.

'Also, most of our trainees made enormous progress in their presentation skills during their traineeship,' he says. 'The annual meetings gave them opportunities to practice in front of an international and critical – although friendly – audience.'

Eurythron work has not only resulted in new research on the basic science behind anaemias; it has also sparked more research and helped young scientists advance their careers.

Today, several of the Eurythron Fellows are working in academic research while others have found positions in companies. One is coordinating clinical trials. And perhaps just as important – all are continuing their scientific careers working and living in Europe.

Project acronym ■ Eurythron
Full project title ■ Molecular control of erythropoiesis

Type of grant ■ Training Network
Budget ■ EUR 2 875 995.61
Duration of project ■ 01-10-2005 - 31-04-2009
Scientific discipline ■ Life sciences

Lead partner ■ Erasmus Universitair Medisch Centrum Rotterdam
P.O. Box 1738
Dr. Molewaterplein 50
NL-3015 Rotterdam

Other partners ■ Institute of Molecular Medicine, Portugal - Institut National de la Santé et de la Recherche Médicale, France - Forschungsinstitut für Molekulare Pathologie Ges.m.b.H., Austria - Medical Research Council, United Kingdom - Istituto Superiore di Sanità, Italy - University of Groningen, Netherlands



INNATE IMMUNITY

The Innate Immunity project carried out key research in the fight against infectious disease. And to do so effectively, it relied on the combined talents of all its team members. When Adelheid Cerwenka's baby was born, creative solutions were found to enable her to reconcile her goals both as a mother and as a project leader.

Success on two fronts: combining research career and family life

Human beings are constantly exposed to infectious agents, most of which the immune system helps us to resist. One arm of the immune system is the innate or non-specific immune system, our first line of defence against invading organisms. It carries out a crucial protective function using both cellular and soluble agents. The innate immune system also has anatomical features that function as barriers to infection.

Mustering new allies in the fight against infection

‘The aim of the Innate Immunity project was to identify novel molecular players in innate immune pathways, using functional genomics and biochemical approaches,’ explains Dr Cerwenka, the project’s group leader.

The innate immune system has several genetically encoded receptor families – biological molecules to which a drug binds – that interact during the detection and elimination of pathogens. The toll-like receptor (TLR) family recognises a diverse group of molecules that have remained largely unchanged throughout evolution. The engagement of these receptors results in pro-inflammatory signalling. Another family of innate immune receptors, known as triggering receptors expressed on myeloid cells (TREM), are able to alter the downstream signalling potential of the TLR molecules.

Molecular pathways are sequences of actions by molecules within a cell, generally involved in some aspect of cell functioning. Most experts agree that components of a particular molecular pathway, the TREM-1/DAP12 pathway, could provide a promising therapeutic strategy for the treatment of inflammatory diseases. ‘The TREM-1/DAP12 pathway that we were mainly interested in activates myeloid cells to produce inflammatory cytokines and amplifies experimentally induced septic shock,’ explains Dr Cerwenka.

When the immune system is fighting pathogens, cytokines signal immune cells to travel to the site of infection. In addition, cytokines activate those cells, stimulating them to produce

more cytokines. Normally, this feedback loop is kept in check by the body. However, in some instances, the reaction becomes uncontrolled, and too many immune cells are activated in a single place, a situation that can, in turn, lead to serious medical conditions such as sepsis.

'The identified novel players in the TREM-1/DAP12 pathway could be promising targets in the treatment of sepsis,' says Dr Cerwenka.

Better working conditions for better science

The German Cancer Research Centre (Deutsches Krebsforschungszentrum) in Heidelberg is the largest biomedical research institute in Germany and a member of the Helmholtz Association of National Research Centres. More than 2 000 staff members, including 850 scientists, male and female, are investigating the mechanisms of cancer and other serious medical conditions. In addition, the Centre's Cancer Information Service offers information about the disease for patients, their families and the general public.

Promoting equal opportunities for women and people with families is a high priority for the research centre. One of its stated aims is to provide opportunities for its staff members to realise their potential and rise to leading positions, regardless of background, gender or family situation.

A designated representative at the centre ensures adherence to the German 'Agreement for Support of Equal Opportunity', which aims to advance the well-being of both men and women in the working environment. The centre promotes personnel development, further education, part-time working arrangements, home working, vacation and family leave.

'My son was born during the period of the Marie Curie project,' explains Dr Cerwenka. 'I started my pre-birth maternity leave in July and became a happy mother in August.' By German law, maternity leave extends for two months after birth. 'After my two months were up,' she says, 'I worked part-time (70 %) for the first year before I returned to full-time work.'

During Dr Cerwenka's absence from the laboratory, several provisions were made to secure her guidance and enable other team members to carry on with their work. Dr Cerwenka was constantly available by phone and e-mail for all organisational and scientific questions, and special technical arrangements were made so that she could telework. When necessary, meetings with individual team members took place at her home, and one of the postdoctoral researchers working on the project acted as substitute team leader.

Marie Curie Excellence Grants give promising researchers the opportunity to set up or develop their own research teams in Europe. The action helps enhance the careers of these researchers by helping them attain research independence more rapidly.

But Marie Curie also has some built-in flexibility, encouraging researchers to develop in their personal lives as well. This was clearly evident when it came to Dr Cerwenka's family circumstances. *'Thankfully, the Marie Curie programme allowed us to extend the duration of the project from four to five years* without additional funds', she says, 'and that helped me a great deal to successfully carry out the project.' Her son, now two, goes to a day-care centre supported by the research centre and, she says, is very happy there.

Progress for families, progress for medicine

'Using biochemical approaches, we have now identified several negative and positive regulators of the TREM-1/DAP12 pathway,' explains Dr Cerwenka. *'This project produced five publications in prestigious international journals and several additional publications are currently in preparation.'*

She notes that the project has enabled students to obtain PhDs and postdoctoral work to gain additional scientific experience, adding that all of the Marie Curie Fellows were very successful in finding their next jobs in Europe.

'One Greek PhD Fellow went back to Greece for postdoctoral studies,' continues Dr Cerwenka. 'One postdoc went back to the Netherlands for a job in publishing and another became a group

leader at a company in Denmark. Taken together, the project and the training in my laboratory have enabled all Marie Curie Fellows to pursue outstanding international research careers.'

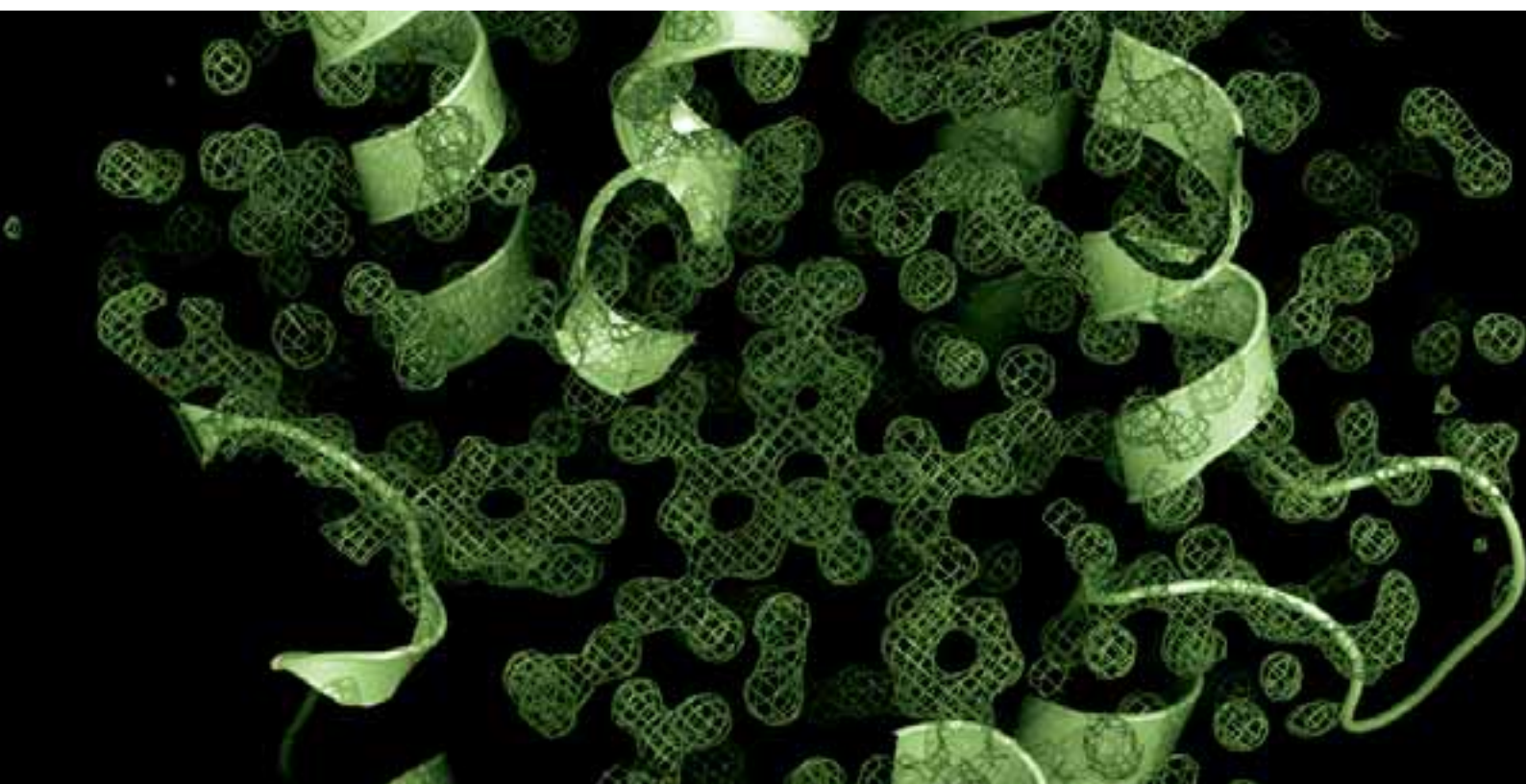
An important part of that has been a proper balance between work and family life, a balance that Dr Cerwenka encourages everyone to respect and maintain.

'For my own part', she says, 'the project has enabled me as a group leader to obtain preliminary results for a further grant that will be submitted soon to a local funding organisation. In addition, it has resulted in new networks of working contacts for myself and my colleagues, including other European group leaders and former Marie Curie Fellows, a network that, I expect, will persist for many years to come.'

Project acronym ■ Innate Immunity
Full project title ■ Functional genomics of innate immune pathways in mammalian cells

Type of grant ■ Excellence Team
Budget ■ EUR 1.4 million
Duration of project ■ 15-07-2004 –14-07-2009
Scientific discipline ■ Life sciences

Lead partner ■ Dr Adelheid Cerwenka
German Cancer Research Centre
Im Neuenheimer Feld 280
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NLRS IN IMMUNITY

More than a million people suffer from Crohn's disease and Blau syndrome in Europe and North America alone. Both conditions are known to be linked to a recently discovered class of proteins which may hold the key to better treatments once their role is fully understood. In Austria, a team of scientists drawn from across the EU and beyond is rising to the challenge.

Solving a genetic puzzle

The NLRs in Immunity project team is working on the structural characterisation of a new class of proteins called NOD-like receptors (NLRs). NLR proteins are crucial components of the immune system. Mutations within these receptors can lead to severe disorders like Crohn's disease.

The project is led by Robert Schwarzenbacher, a professor of structural biology at the University of Salzburg. He was the recipient of Marie Curie funding which supports the future development of promising scientists by providing them with the opportunity to develop their own research teams in Europe. Marie Curie grants also aim to retain research talent in the EU and to encourage researchers who have left to return from overseas.

Mapping the pathways to disorder

Support from the programme allowed Professor Schwarzenbacher to relocate to Austria after a long period of research in the

US, gain a tenured position at the university and assemble a hand-picked team of scientists for his research project. 'We are exploring the molecular world of human NLR proteins,' Professor Schwarzenbacher explains. 'NLRs are an important part of our immune system. They play a role in important genetic disorders like Crohn's, inflammatory bowel disease and Blau syndrome. *Our research will provide the foundation for future treatments for these autoimmune diseases.*'

This area of scientific research is relatively new as NLRs were discovered only recently. Their role in the human immune system is to recognise foreign products, such as peptidoglycans, and to initiate a range of defensive reactions.

'The main goal of our Marie Curie team is the structural characterisation of this new class of proteins,' Professor Schwarzenbacher remarks. The team is focusing on the characterisation of full-length proteins as well as on complexes composed of receptor and adaptor proteins. For higher efficiency they share their research with other scientific groups to gain more insight into the functions of the proteins.

'Furthermore, we are working in collaboration with different research groups to determine the role of NLRs in different

organisms and to shed light on the signalling pathways by using different cell lines,' he says. 'Together, these findings should help us to understand the exact mechanism of action of NLR proteins in immunity and inflammation.'

A flexible framework for cooperation

Talent transcends gender divisions, and Professor Schwarzenbacher reports that his department has taken specific measures to encourage applications from both men and women. One of the steps taken to support women scientists was the setting up of a safe and flexible workplace to enable pregnant scientists to continue their work on their own terms and to set their own schedule. In addition, the department has an in-house kindergarten with flexible opening hours.

'We were also able to change a couple of things with our human resources department, related to contracts, maternal leave regulations, refunds for international travel and scientific exchange,' Professor Schwarzenbacher says, noting that the NLRs in Immunity project team includes two young mothers, Katharina Dobias and Nicole Wopfner.

The mobility and travel allowances provided through the Marie Curie grant were also helpful in assuring that all moving and travel activities within the team could be carried out smoothly without disturbing their research, he says. The project used some of the money to recruit PhD Fellows Ana Gimeno, Julia Wenger and Victoria Fairweather from abroad, which would not have been possible with the fellowships available through the university.

'Our Marie Curie grant really changed the way our university looks at mobility and travel costs now,' acknowledges Professor Schwarzenbacher. 'They finally realised that young researchers are the ones who need to be supported in a quick and easy way and not just faculty members who have a good salary anyway.'

Dr Wopfner from Austria is especially pleased with the support: 'I returned from a postdoc in the US and thought moving would be tough, expensive and throw my research back. But no, the Marie Curie grant covered it all and I was able to continue my research without losing time. *Now I have a baby and a career.* The mobility allowance really helped.'

Unravelling the mysteries of NLR proteins

The support from the Marie Curie project has paid off, both by bringing more brain power to the research and by helping the researchers continue to work in their chosen field. Professor Schwarzenbacher says the team's first breakthrough has been to unravel the mysteries of the immunity signalling mechanism for NLRs. The team's research paper, entitled *The Fas/FADD death domain complex structure unravels signalling by receptor clustering*, has received extensive international recognition and will also appear in *Nature*. 'In addition, we received considerable attention and press coverage in Austrian and German papers as well as local radio and TV stations,' he remarks.

Professor Schwarzenbacher says that the Marie Curie programme can really pay off for researchers. 'It is the best one for international mobility,' he advises.

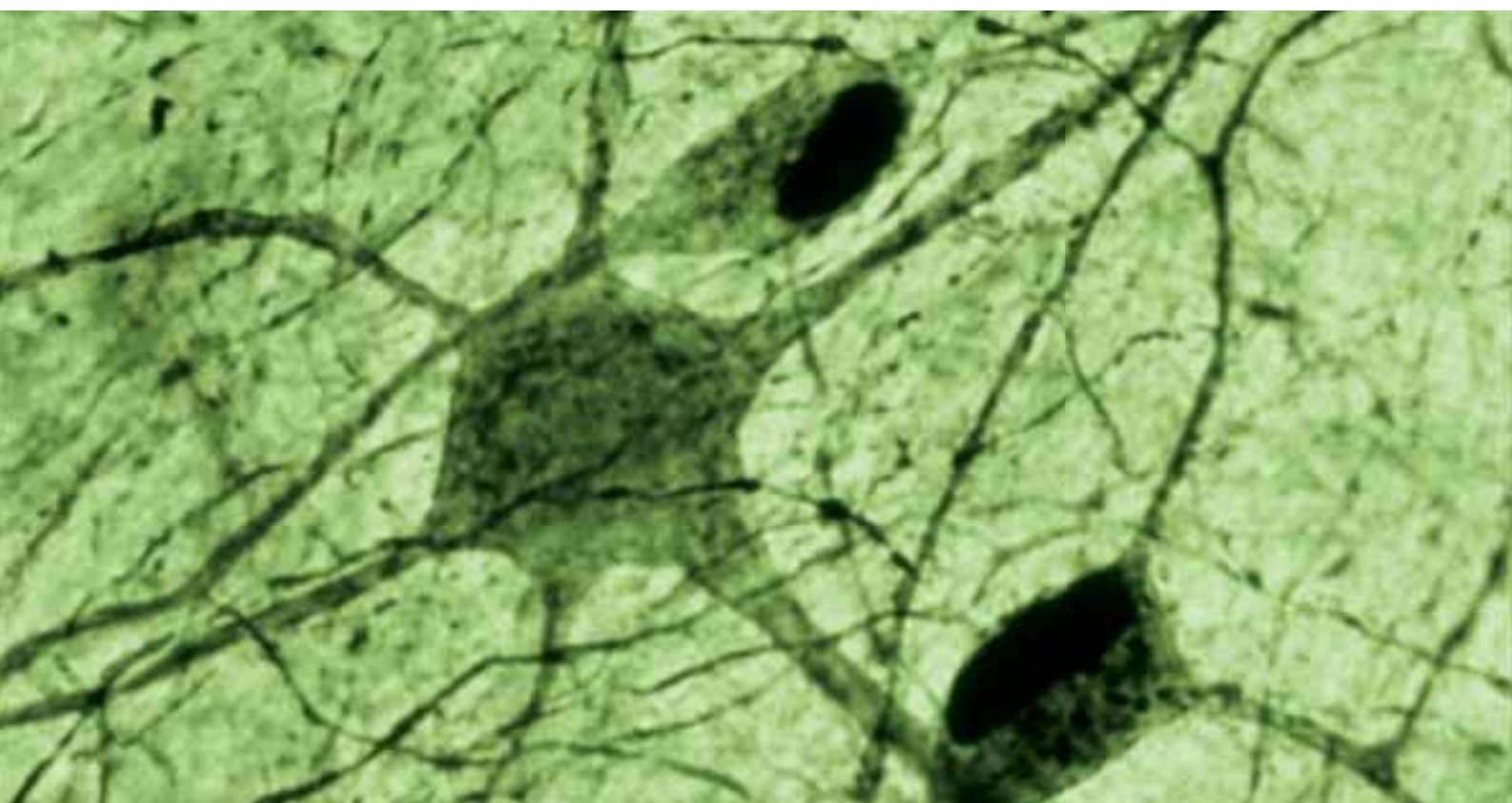
He has succeeded in securing a permanent professorship, while team members Stefan Riedl and Nicole Wopfner have both been appointed as assistant professors. Two other researchers, Martina Pröll and Roland Wagner, were accepted

for postdoctoral work in the US. The team has also applied for a European Research Council advanced grant to continue its important work.

Project acronym ■ NLRs in Immunity
Full project title ■ NLRs in immunity and inflammation

Type of grant ■ Excellence Team
Budget ■ EUR 1.73 million
Duration of project ■ 01-10-2006 - 30-09-2010
Scientific discipline ■ Life sciences

Host institution ■ University of Salzburg
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<http://www.uni-salzburg.at/biotec>



ZSN-PHD PROGRAMME

It takes talent, training and a lot of hard work to shine in the sciences – but this does not mean researchers have to be married to their studies. The Centre for Systems Neuroscience (ZSN) in Hanover, home to several Marie Curie Fellows from around the world, has taken steps to improve conditions for researchers with families.

Raising a new generation of neuroscientists

The neurosciences represent one of today's most exciting fields, encompassing the systematic, scientific, experimental or theoretical investigation of the central and peripheral nervous systems. The methods used by neuroscientists have expanded enormously in recent decades, from biochemical and genetic analyses of individual nerve cells and their molecular constituents to real-time imaging of perceptual and motor functions in the brain.

The Centre for Systems Neuroscience (ZSN) is a virtual cooperative centre of the Hannover Medical School, based at the University of Veterinary Medicine and including the Leibniz University and the University of Music and Drama in Hanover. The ZSN provides comprehensive PhD training in the neurosciences for outstanding graduates of biology, veterinary and human medicine, and affiliated natural sciences such as physics. Its three-year doctoral programme gives researchers a broad knowledge base

'from bench to bedside' and helps them to develop valuable complementary skills in a family-friendly working environment.

'We believe the risks of premature specialisation and loss of interdisciplinary approaches are particularly acute in the neurosciences,' explains Professor Baumgärtner, head of the centre's study commission. 'The ZSN PhD programme meets an important need in the public health sector, with ramifications for the larger European research strategy and European economic competitiveness.' And, he adds, by contributing to the development of higher standards for PhD training in Europe, ZSN is helping to put the brakes on brain drain, which continues to draw some of the best and brightest away from the EU.

Excellence thrives...

Results of research projects carried out by ZSN's Marie Curie Fellows have been presented to the scientific community in the form of 10 accepted publications. 'Five of our Fellows have now published as first authors in international peer-reviewed scientific journals,' says Dr Dagmar Esser of the centre's coordination office. 'The others have publications in preparation or under

review.' The ZSN has also encouraged its Fellows to participate in international scientific meetings in Canada, Croatia, the Czech Republic, France, Italy, Switzerland, Turkey and the UK, and to present posters or talks wherever possible.

'This fellowship has offered me the opportunity to take part in the excellent ZSN PhD programme,' says Marie Curie Fellow Danai Dima from Greece. Her fellowship allowed her to undertake PhD studies in another country and familiarise herself with the research being done there. 'Moreover, thanks to the programme,' she says, 'I have met and collaborated with outstanding scientists in the field of neuroscience.' She also participated in the 2008 Marie Curie Conference in Barcelona, which helped broaden her career perspectives and enabled her to meet other Marie Curie Fellows.

...in a supportive environment

Another Fellow, Spain's Maria Herrojo Ruiz, says, 'Marie Curie has helped me develop my academic career in a significant way, due to the excellent training and the mobility requirement of the programme. Working in a German research institute and cooperating with world-leading scientists has been a great opportunity. *The last three years of my Marie Curie*

Fellowship have been the most productive and creative period of my academic life.' She has decided to continue her research work in Germany.

Two ZSN Marie Curie Fellows have received prizes for presentations at conferences in Croatia and New Zealand. '*This international attention shows the outstanding quality of the research and the efforts of our Marie Curie Fellows,' says Dr Esser, 'and we believe the emphasis on family-friendly working conditions has contributed to that excellence.'*

A friend of the family

Indeed, these family-friendly working conditions are what makes this institution outstanding.

Basic services and procedures that enable PhD researchers to combine personal and professional aims and manage their own schedules can go a long way towards ensuring they receive the best possible training under the best possible circumstances. 'To improve the studying conditions of PhD researchers with children,' explains Dr Esser, 'the Graduate School for Biomedical Sciences in Hanover has established a consultancy service for PhD researchers who are parents.'

Since 2008, ZSN PhD researchers, including all of the Marie Curie Fellows, have had the opportunity to receive support for different day-care possibilities, free of charge. 'This has been an important further step towards family-friendly studying and working conditions,' says Dr Esser. Ensuring the best researchers can continue their career as their family life develops is one of the objectives of the Marie Curie Actions. Projects that are both scientifically excellent and offer a supportive working environment are highly praised.

The results can be illustrated in concrete terms, continues Dr Esser: 'One Marie Curie Fellow became pregnant during her stay with us. The labour inspectorate carried out an evaluation of her working conditions, with particular attention to safety measures for pregnant women. In addition, her supervisor, Professor Wolfgang Löscher, confirmed an agreement that allowed her to change her research topic and complete her PhD project under new conditions and with new deadlines to suit her circumstances.' These accommodations, he says, were made with the approval and support of the Marie Curie project officer. The Marie Curie Fellowship is an employment contract and ensures full social security for funded researchers. This allowed the Fellow to take maternity leave and benefit fully from Germany's social security system. 'She then returned to the lab and is now finishing her thesis.'

This example, Dr Esser remarks, is just one of many showing how ZSN is working to change its perspectives in terms of employment and training policy, with the help of the participating universities. Personal constraints, she notes, should not be considered a hindrance but rather an opportunity to promote family life and gender equality. And these efforts have not gone unnoticed. Since 2005, the Medical School has been certified family-friendly by 'Berufundfamilie', a non-profit organisation that performs audits and issues certificates on behalf of the German Ministry for Families and the European Social Fund.

Project acronym ■ ZSN-PhD Programme
Full project title ■ International, Interdisciplinary PhD Programme of the Centre for Systems Neuroscience Hanover (ZSN)

Type of grant ■ Training Network
Budget ■ EUR 1.7 million
Duration of project ■ 01-04-2006 - 31-03-2010
Scientific discipline ■ Life sciences

Lead partner ■ Prof. Dr Wolfgang Baumgärtner
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Other partners ■ Hanover Medical School - Hanover University of Music and Drama - Leibniz University, Hanover



RECOGNISED ACHIEVEMENTS

The Marie Curie Actions are founded on recognition of past achievements and future potential, and that is why their Fellows and Networks are widely renowned for their scientific excellence.

The epitome of excellence

Marie Curie, the celebrated physicist and chemist, is the only person ever to win Nobel Prizes in two different sciences. This is hardly surprising given that, over her long career, she coined the term radioactivity and created the theory explaining it; she developed techniques for isolating radioactive isotopes and discovered two new elements, polonium and radium. No wonder then that some 75 years after her death, she remains a byword for scientific excellence.

And it is this heritage of scientific excellence that the EU's Marie Curie Actions seek to maintain and continue. The programme's commitment to distinction starts at the very beginning, in its selection process.

The application process for individual Fellows is designed to highlight all the merits of candidates and gauge their

achievements and future potential, as well as the work they plan to carry out with EU funding. The same is true for research groups applying for network funding: the Marie Curie Actions' bottom-up evaluation process selects them on basis of their excellence in their field. The peer review procedure meets the highest levels of quality by guaranteeing the independence and adequate qualifications of the experts. In addition, experts come from all over the world which ensures that the peer review process is truly international. The Marie Curie Actions selection procedure also ensures a good balance of women and men among independent experts and an adequate representation of both private and academic sectors.

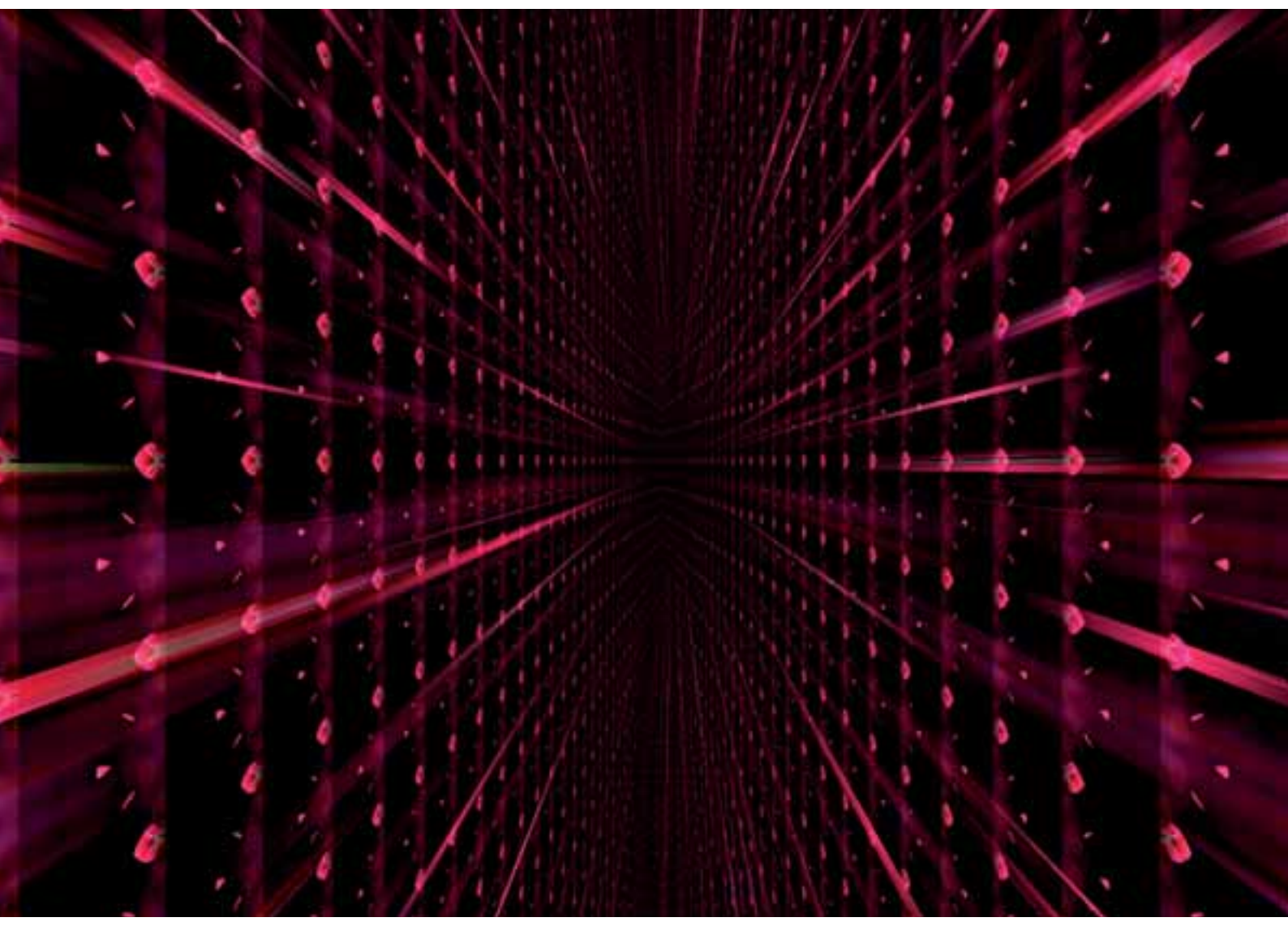
Later on, by ensuring Marie Curie Fellows work at the best institutions in Europe and beyond and that Marie Curie Networks are made up of top-calibre researchers and organisations, the programme takes on the status of an excellence multiplier and helps set in motion the ripple effect that creates new synergies.

All this is designed to achieve one aim: unlimited excellence in both the academic and private research sectors.

Rewarding brilliance

Researchers do not embark on their career path for fame and glory. They do so because research in itself is a rewarding activity, and Marie Curie Fellows enjoy a high level of job satisfaction. Nevertheless, it is important that their contribution to research is recognised, not only by their peers but also by society as a whole. As regards peer recognition, Marie Curie Fellows publish in the best scientific reviews and enjoy international recognition. Generally speaking, research activities tend not to receive a high level of public recognition, despite the quiet contribution made to the advancement of society. That is why this chapter celebrates award-winning Marie Curie Fellows whose achievements have been recognised either during or after their fellowships.

This chapter profiles some of our exceptional Marie Curie beneficiaries who have received notable accolades in their chosen field. Several of the researchers profiled here have won prestigious awards, including a Nobel Prize and an Academy Award. Others have contributed to the world's most prestigious scientific journals, and one is even an Olympic medallist!





AMGISS

Soft soil can pose a serious challenge to engineers, particularly those wishing to build on difficult terrain. The Tower of Pisa, for example, was built on soft sediments, with dramatic results. With the aim of taking geotechnical engineering a major step forward, the Amgiss project dug deep into these troublesome soils – and one of its Fellows even struck (Olympic) silver.

On soft ground

When faced with ground which comprises soft sediments, such as clays, silts or peat, construction engineers need to utilise ground-improvement techniques or their road, embankment or building will deform or fail. Soft soil poses a problem for many important development projects. In Eastern Europe, for example, lumpy clay soils are a result of many former open-cast coal mines that left vast 'moonscapes' where new infrastructure and housing redevelopment are urgently needed.

Columns and drains are commonly used to make the ground suitable for building, but complex interaction problems often arise between the reinforced soil and the new structure. A major reason for this is that current analysis techniques are based on outdated and over-simplified methods which do not take account of the physical principles governing these soils. According to project leader Minna Karstunen of the University of Strathclyde in the UK, these methods are 'at best very crude and conservative, hence uneconomical, or at worst unsafe'.

Soft soils in three dimensions

The Amgiss project, dedicated to advanced modelling of ground improvement on soft soils, brought together academic and industrial partners to develop innovative numerical techniques that could vastly enhance the analysis of ground-improvement systems. It counted 10 Marie Curie Fellows among its team of 50.

Currently, analyses of ground-improvement systems rely on one- or two-dimensional mathematical models. The project partners used advanced constitutive modelling, laboratory testing, centrifuge modelling, numerical implementation and numerical modelling to create advanced, three-dimensional (3D) numerical tools. Their new modelling techniques were developed to examine how soft soils interact with specific interventions, such as vertical draining and stone columns.

Until now, Dr Karstunen explains, such high-level 3D modelling had not been used in geotechnical engineering. 'This can be considered as a major advancement of the current state of the art,' she acknowledges.

Putting the models to the test

Having developed the models, the partners focused on applying them to real-life problems. Ultimately, their goal was to upgrade current design methods and to suggest ways to fine-tune the application of ground-improvement systems, not only for soft soils but also for other geotechnical problems. Academic and industrial network partners collaborated closely to develop new laboratory testing techniques and instrumentation. They used the Tower of Pisa as well as several other well-known structures as test cases.

The physical model-testing was carried out using a drum centrifuge that spins soil around and creates a scaled model with real stress levels. Several soil-structure interactions were studied, notably the effects of installing sand drains or stone columns on clays. Simulations of dynamic compaction of lumpy clays were particularly useful in addressing the problems posed by former open-cast coal mines. The experiments showed that the project's 3D simulation models are far more representative of real soil behaviour than existing ones.

Towards a new industry standard

The project partners pushed the boundaries of numerical modelling in geotechnical engineering, creating new, advanced models that are simple to run and have the potential to become an industry standard. Future studies, to be carried out in a follow-on Marie Curie project, will develop new ways to predict the effects of installing different ground-improvement systems.

The network members have already set the groundwork for the new project with a new numerical analysis method, the Material Point Method. Again, academic and industrial partners in several countries performed pioneering work on a novel method that could replace current computational tools within 10 years.

The benefits of the new models are potentially far-reaching, according to Dr Karstunen. 'The developments in laboratory testing will also have long-term benefits for the scientific and practising community of geotechnical engineers, and could benefit other fields involved in soft material testing, such as bioengineering,' she notes.

Sharing knowledge

One of the key objectives of the Amgiss network, Dr Karstunen explains, was to ensure that the results were disseminated openly and transparently, so that practitioners and scientists alike could benefit. Transfer of knowledge was a fundamental part of the project, and was tailored to the needs of both network partners and the scientific and engineering communities at large.

The network's training courses, workshops and conferences, complemented by study visits and secondments, proved invaluable in this respect. 'The more Marie Curie Fellows engage with the other teams in the network and participate actively in identifying external training opportunities, the more they get from their appointments,' Dr Karstunen advises. Amgiss results were

shared through annual workshops, international conferences and scientific meetings as well as professional presentations and articles in peer-reviewed journals.

Amgiss Fellows conquering new ground

Amgiss proved to be a stepping stone for many participants. The work is featured in 13 doctoral theses, with two more on their way. Two postdocs have been offered permanent academic positions, and five Fellows are working in industry.

Three of the network's postdocs have started a spin-off company providing computational geotechnical services. Thomas Benz, Markus Wehnert and Martino Leoni met in Stuttgart and have now opened branches of Wechselwirkung Numerische Geotechnik there and in Italy. 'The start-up of such a highly specialised company in a difficult market such as the Italian one is a challenge,' admits Dr Leoni, but he is confident of success. The international character of the company was 'inspired by the stimulating research environment at Stuttgart and supported by EU-funded projects such as Amgiss', he says.

Dr Karstunen stresses that the network has aimed to offer appointed Fellows and other researchers at the host institutions 'an inspiring and flexible working environment'. This support enabled some Fellows to pursue excellence beyond the remit of the project. Tailor-made contractual arrangements notably helped Marie Curie Fellow Emma Pooley to train intensively for the 2008 Olympics in

Beijing, from which she brought home a silver medal for cycling, while conducting cutting-edge research.

'I was able to use state-of-the-art equipment and develop experimental techniques for centrifuge testing, thanks to the financial support of the Marie Curie Fellowship,' says Ms Pooley. 'Through the Amgiss network I was able to attend conferences and take part in networking events which furthered my understanding of the subject. *I'm also particularly grateful to the Amgiss network for allowing me the flexibility with my work contract to be able to combine my sport – cycling – with my research.* This helpful attitude to work-life balance allowed me to take cycling to a higher level than I could have dreamed of at the start of my fellowship.'

Project acronym ■ Amgiss
Full project title ■ Advanced modelling of ground improvement on soft soils

Type of grant ■ Training Network
Budget ■ EUR 1.38 million
Duration of project ■ 01-02-2005 - 31-01-2009
Scientific discipline ■ Engineering

Lead partner ■ University of Strathclyde
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Department of Civil Engineering
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GB-Glasgow G4 0NG
Tel. +44 141 548 3277 // Fax +44 141 553 2066

Other partners ■ ETH (Swiss Federal Institute of Technology) Zurich, Switzerland - Graz University of Technology, Austria - Helsinki University of Technology, Finland - Norwegian University of Science and Technology, Norway - University of Glasgow, United Kingdom - University of Stuttgart, Germany



AXIOM

It is rare that an award for scientific achievement involves a red carpet and an acceptance speech beamed around the world. But that is exactly what happened when a British software company and Irish scientists used their Marie Curie grant to develop new technologies for the big screen. The most impressive of their many accolades is undoubtedly an Oscar.

And the Oscar goes to...

When your cinematic superhero flies past a backdrop, chances are that The Foundry's software was used to trim away the wires that held him or her up. Its research partner, Trinity College Dublin's Sigmedia, boasts of post-production tools and motion estimation technology that have been used for such Hollywood Blockbusters as *The Matrix*, *Lord of the Rings*, *X-Men*, *Spider-Man* and *Harry Potter*. The idea for the Marie Curie-funded Axiom (Automated extraction of image metadata) project grew out of four years' collaboration between the two organisations, who shared a dream of taking digital image processing one step further.

The Marie Curie Fellows involved in Axiom benefited from a combination of the Sigmedia Group's research skills and The Foundry's practical knowledge. Through the partnership, The Foundry has been able to study Sigmedia's latest research

into 3D image processing, while the Fellows hosted by Sigmedia have enhanced their understanding of film media and software.

'Academics need good connections with industry to keep their work relevant, and Trinity College Dublin's Sigmedia Group gained insight into the post-production industry first hand through its connections with The Foundry,' says Abi Bowman, The Foundry's Project Manager. 'We have also benefited in that we have been able to learn more about image and video-processing technologies through working closely with Sigmedia's experts.'

François Pitié of Trinity College Dublin agrees: 'Being part of the Axiom project was a great shared-learning experience and being partnered with The Foundry gave us an invaluable industrial insight. Learning industry practices and specific problems greatly helped me to refocus my research and think about how to integrate the end-user in image processing algorithms. We established an excellent working relationship which we still have today.'

Axiom has produced new algorithms, software plug-ins (miniature programs that ‘plug into’ a host program for additional functionality), research publications and, last but not least, employment opportunities for highly skilled researchers in academia and industry. Ms Bowman specifies two plug-ins of particular importance. The first is a diagnostic one for ‘grain detection’ and the second is a matting plug-in known as ‘ForegroundMatter’. Both are now included in the Foundry’s products.

Oscar Night

Without a doubt, the most important moment to date for Axiom came on 10 February 2007 when Dr Bill Collis, Simon Robinson and Ben Kent from the Foundry, along with Dr Anil Kokaram of Trinity College, were honoured with a Scientific and Engineering Award from the Academy of Motion Picture Arts and Sciences for their ‘Furnace’ software package. The Academy considered the Furnace tool set’s modularity, flexibility and robustness to have ‘set a high standard of quality for optical-flow-based image manipulation’.

Dr Kokaram said that he was delighted to have won the award, ‘especially given the stringent examination process employed by the Academy in selecting the winners. It involved six months of deliberation and assessment by two panels made up of both academics and members of the film industry.’

About the Furnace

In a given film, 25 pictures or frames are taken every second. Using motion estimation, Axiom developed algorithms capable of tracking the movement and properties of every pixel in a frame in relation to the corresponding pixels in subsequent and preceding frames in a sequence. This allows for special effects and enhancement operations without manual intervention.

The software can also be used to restore old film footage. Traditional and costly restoration methods involve converting film using a digital scanner into a digital format and then employing someone to trawl through the movie frame by frame.

Using the software package means the computer program can ‘guess’ what should be in shot and make adjustments. Not only

this, the software can take characters in and out of scenes. Instead of shooting against a green screen, the software can estimate where the person should be and add them.

The collaboration continues

The positive experience has encouraged both partners to sign up to a new collaborative project – ‘i3DPost’. This project will develop new methods and intelligent technologies for the extraction of structured high-quality 3D content models from video.

One of the i3DPost’s first products is ‘Ocula’ – a unique collection of plug-ins providing a powerful armoury of tools that solve common problems with 3D stereoscopic imagery, boost productivity in post production, and ultimately help to deliver a more rewarding 3D-stereo viewing experience.

Ms Bowman is in no doubt about the added value of Marie Curie funding, saying that it has financed the researchers’ training, living allowance, travel, mobility and a few additional overhead costs. *‘It would have been difficult to achieve our*

objectives without the funding because it enabled research “space” in an industrial setting and gave us the time to experience each other’s approach,’ she says.

‘In the film post-production industry there is the constant hunt for time-saving applications that can remove the repetitive work from the post-production processes yet retain the artistic input from the user,’ says Ms Bowman. ‘Currently, there are big changes going on in the film industry, especially surrounding high definition and 3D. *The collaboration* with TCD Sigmedia scientists *has helped us produce cutting-edge products and compete more effectively in worldwide markets.’*

Next time you go to the cinema, be sure to look out for the Axiom touch.

Project acronym ■ Axiom
Full project title ■ Automated extraction of image object metadata

Type of grant ■ Industry Academia Partnership
Budget ■ EUR 239 000
Duration of project ■ 01-01-2006 - 31-12-2008
Scientific discipline ■ Engineering

Lead partner ■ The Foundry
1 Wardour Street
GB-London W1D 6PA

Other partners ■ Trinity College Dublin, Ireland

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$$\text{Diagram 1} = c_4 \text{Diagram 2} + c_3 \text{Diagram 3} + c_2 \text{Diagram 4}$$

$$\text{Diagram 1} = c_4 \text{Diagram 2} + c_3 \text{Diagram 3} + c_2 \text{Diagram 4} + c_1 \text{Diagram 5}$$

HQPRECISION

Where do we come from? What was the early universe like? Theories abound, but certainty has seemed eternally out of reach. Now, one area of science is attempting to unlock the secrets of our origins: particle physics. It is not all magnetic forces and photons, however – global positioning technology has been keeping one research team firmly on the ground.

Recreating the early universe

Particle physics is the study of tiny particles, including the small pieces of matter that build up in the world around us and particles which carry fundamental forces, such as photons. Physicists find out all about minute objects by studying collisions between them. If they have enough energy, colliding particles can create new particles.

Particle physics is also key to developing new technologies and know-how that can change our lives in a big way. For example, all microelectronics around us, like mobile phones and global positioning system (GPS) navigators, make use of theoretical particle physics. Even the search for novel sources of energy cannot escape its rules. Interestingly, some of the most important inventions of the past century, such as the World Wide Web and medical therapy combating cancer, were only made possible by particle physics. It includes the biggest and most complex experiments in the history of science, using the fastest computers and the strongest magnets.

Modern particle physics involves firing particles at other particles to create new ones inside a particle accelerator. Such experiments can help us learn about the early universe, because conditions similar to our world all those years ago can be recreated in a small space using these collisions.

Dr Pierpaolo Mastrolia, an Italian national, wanted to push the limits of our understanding about physics phenomena via 'new-frontier colliding machines', as he calls them. His Marie Curie Fellowship began at the University of Zürich in early 2006 and lasted for almost two years. While there, he developed a very powerful method for computing the probability of producing new particles when a collision among sub-atomic particles takes place.

Know your particles

Dr Mastrolia's method is based on the exploitation of general mathematical properties of fundamental interactions between sub-nuclear particles (all particles, including those that result from high-energy collisions). It can therefore be applied in all the contexts of particle physics by admitting a so-called perturbative

regime, where a higher level of precision is reached through repetition, using calculations of ever-increasing complexity.

This method has led to an unprecedented level of analytic accuracy. In fact, it is now regularly used by the theoretical particle physics community at the CERN Large Hadron Collider (LHC), the world's largest and highest-energy particle accelerator, located near Geneva, Switzerland.

'The Marie Curie support gave me the opportunity to transfer the knowledge I had started to acquire during my postdoctoral research at the University of California, Los Angeles. *It enabled me to develop my own research ideas in one of the most stimulating locations for particle physics,*' enthuses Dr Mastrolia. As his project processes vast amounts of information, he needed excellent computing equipment, along with the possibility to visit the most active institutions of particle physics worldwide. 'The Marie Curie support made all this happen,' he says.

A ringside seat for the LHC

Dr Mastrolia is convinced that Marie Curie put him on the path to scientific independence by bringing him back to Europe – to Switzerland – from the United States. The University of Zürich is unparalleled in this area of physics and therefore ensured that he could carry out his research project in a world-class environment, in the company of leading experts.

He feels that his Marie Curie international experience, coupled with valuable collaborations that the fellowship has opened up to him, has certainly helped him progress in his career and boosted his tally of achievements. 'Devising a novel computational method during my Marie Curie Fellowship was a crucial step towards being awarded the CERN fellowship,' he says.

The CERN fellowship came about in 2008 – a feat which is a definite sign that the scientific community is sitting up and taking notice of his work. 'My time at CERN coincides with a very exciting phase for particle physics due to the fact that so much is expected from the LHC. Despite the initial setbacks, we are on course to restart very soon. Watch this space.'

Imagination equals discovery

Dr Mastrolia believes firmly in imagination. *'I think you need to embrace your imagination in order to find the big idea,'* he continues. 'Breakthroughs and discoveries which are responsible for improving the world we live in happen in my line of work. All you need is diligence and patience. Then you will see them.'

To succeed in his area, Dr Mastrolia is convinced of the need to carry out research in the best institutions, where excellence is a prerequisite. He is also a staunch supporter of collaboration and travelling across borders, saying, 'International interaction is key for developing into a mature researcher. *Marie Curie Fellowships are fantastic for pursuing mobility and excellence, which cannot but positively affect the career development of those lucky enough to be awarded one.'*

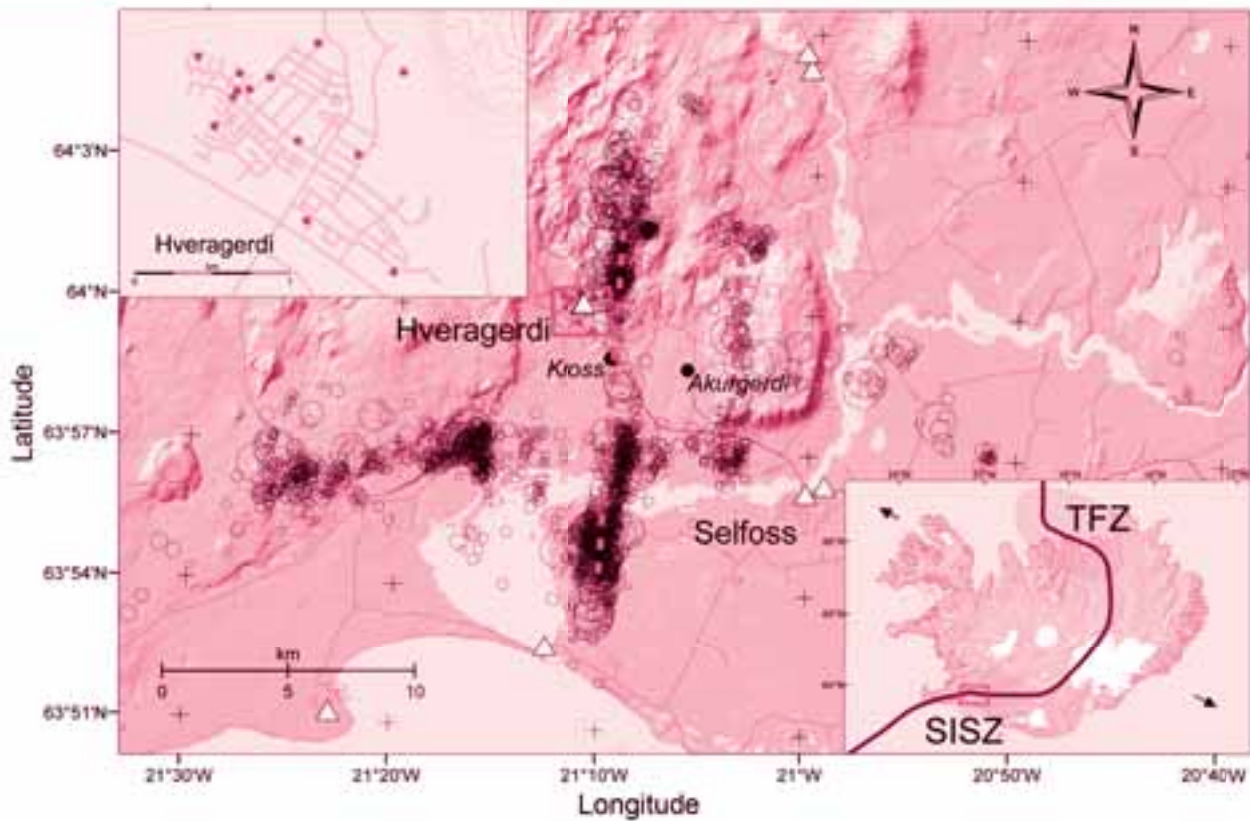
He believes his method will shed light on the principles of quantum theories and facilitate understanding of findings from future experiments. He also hopes to secure a permanent position that will allow him to eventually head up his own research team in Switzerland, 'because the LHC is located there and

this would ensure support from the scientific community'. He would, however, also be delighted to set up a new research team in his home country of Italy. No matter where he ends up, one thing is certain – his passion for particle physics. 'Understanding nature at its fundamental level is one of our ultimate goals as imperfect human beings,' he concludes.

Project acronym ■ HQPrecision
Full project title ■ Precision study of heavy quark production at high-energy colliders

Type of grant ■ Intra-European Fellowship
Budget ■ EUR 180 620
Duration of project ■ 01-02-2006 - 31-01-2008
Scientific discipline ■ Physics

Host institution ■ University of Zürich
Rämistrasse 71
8006 Zürich - Switzerland



ICE ARRAY

Southern Iceland regularly experiences destructive earthquakes that threaten the region's pipelines, electric transmission systems, dams and bridges. In an effort to estimate the effects of these earthquakes reliably and prepare for future impacts, an award-winning scientist has developed an innovative measurement network known as the 'IceArray'.

Rock-solid research into shaky ground

Picture the scene: 29 May 2008 at a quarter to four ... an earthquake strikes just outside the town of Hveragerdi. The ground shakes. People drop whatever they are doing to deal with the emergency. And once they have located their loved ones and tackled any immediate threats, they expect clear information on the extent of the damage, and a realistic assessment of future risk.

With the help of a Marie Curie grant, Benedikt Halldorsson was installing a dense network of accelerographs in Hveragerdi only seven months prior to the earthquake. The network, called IceArray, intended to record the ground acceleration from precisely such destructive earthquakes in the South Iceland Seismic Zone (SISZ), as the one that took place on 29 May 2008. The IceArray performed well, producing a unique dataset of earthquake motion in the immediate vicinity of the fault. IceArray data on the earthquake will be used to create models

of how seismic waves change when travelling over distances. Such information is crucial when designing lifelines such as pipes, electric transmission systems, dams and bridges. It is hoped that this knowledge will help in the assessment of such effects on lifeline structures in future earthquakes.

‘The “Specific Barrier Model”, which provides the most physically realistic, yet economical, description of earthquake fault rupture, is also used to create an even more complete picture,’ says Dr Halldorsson. ‘The models from the IceArray data, coupled with the specific barrier model, will provide us with comprehensive simulations of strong ground motions. The developed models and techniques are easily transferable to other regions in Europe so they too can benefit.’

Winner of the ECEES Award

Dr Halldorsson’s achievements have not gone unnoticed. He was awarded the ECEES Award for an ‘Excellent Contribution by a Young Scientist’ at the First European Conference on Earthquake Engineering and Seismology in Geneva, Switzerland.

The award has been a great source of inspiration for the scientist, encouraging him to pursue increasingly ambitious goals in earthquake and engineering seismology.

It marks a milestone in this young researcher's career, which began with a Bachelor of Science degree in geophysics in 1994 and a Masters in civil engineering in 1997 – both from the University of Iceland. After teaching at the university's Department of Civil and Environmental Engineering, in 1999 Dr Halldorsson started a PhD in earthquake engineering at the University of Buffalo in the United States. He then returned to Iceland and eventually joined the university's Earthquake Engineering Research Centre (EERC) in 2006 on a Marie Curie International Reintegration Grant. Dr Halldorsson is currently also an adjunct professor at the university's Faculty of Civil and Environmental Engineering, School of Engineering and Natural Sciences.

Measuring a major earthquake

Thanks to the Marie Curie support, Dr Halldorsson was able to install the IceArray network in the town of Hveragerdi, in

the western SISZ – just a few months before the magnitude 6.3 earthquake struck in May 2008. The IceArray produced a globally unique dataset which confirms that the earthquake was caused by a complex rupture on two separate faults: the first motions originating some 6.5 km east south-east of Hveragerdi, on what aftershocks appear to indicate is an almost 10 km-long north-south trending fault. The second fault rupture occurred two seconds later on a north-south trending fault nearly 20 km in length located less than 2 km from the town. The recordings also show high-intensity ground motion close to the faults that lasted around four or five seconds. Despite the intensity, thankfully there was no loss of life, and the vast majority of structures withstood the strong motion without significant visual damage. Notably, there was no interruption to lifelines such as water and power.

Iceland hosts international symposium

Both Dr Halldorsson and the EERC have been taking full advantage of the earthquake data and are currently analysing its unique features. *'To make the most of this rare opportunity, we have forged new partnerships and strengthened*

existing ones with international scientists and institutes of seismology and engineering across the world,' he says.

These collaborations have created an impressive network, which met in Iceland for the first International Symposium on Strong-Motion Earthquake Effects. This inaugural gathering was held on 29 May 2009, exactly one year on from the Ölfus earthquake near Hveragerdi, where the IceArray came into its own.

It is not only experts in seismology who have taken notice of Dr Halldorsson's findings – the public has also expressed an interest in the IceArray. Moreover, Dr Halldorsson and the EERC have made regular appearances in the media to present the findings.

And so the scientist's journey continues. The coming three years will see him building on what he has already achieved. In fact, he was recently awarded a research grant by the Icelandic Centre for Research (Rannis) for a project further exploring 'The Ölfus earthquake of 29 May 2008 in South Iceland'. The data are being comprehensively analysed to reveal the nature of the fault rupture, as well as the locations, dynamics and complexities of the two earthquake faults.

As part of the new project, 'The Ölfus earthquake will be represented by the Specific Barrier Model and the strong-motion recordings will be replicated. Their parameters will be compared with recent earthquakes in Iceland as well as with the worldwide dataset of near-fault motions. Interestingly, *the IceArray data shows us in great detail, second by second, how the earthquake ground motion relocated the town of Hveragerdi, so that it came to rest around 20 cm further north-west from where the town was located before the earthquake,*' says Dr Halldorsson.

Project acronym ■ IceArray
Full project title ■ Icelandic strong-motion array

Type of grant ■ International Reintegration Grant
Budget ■ EUR 80 000
Duration of project ■ 08-08-2006 - 07-08-2008
Scientific discipline ■ Environment

Host institution ■ Earthquake Engineering Research Centre
University of Iceland
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MACNET-UWB

Wireless technology is developing rapidly, and users and applications rely on it increasingly. But this growing reliance may involve risks. Unstable connections may just be a minor irritation under normal circumstances, but in critical situations they could cost lives. Researchers like Dr Gil Zussman are striving to ensure that our trust in wireless applications is not misplaced.

Wireless wisdom

Computer networks have become a cornerstone of modern society. Over the past 30 years they have drastically altered the way people live and work, and the emergence of wireless networks in the 1990s has taken the technology to another level. In recent years, wireless devices and networks have gone through several transformations, largely driven by rapid growth in design, development and the deployment of several networks including cellular, wireless local area, sensor, mobile ad hoc and ‘mesh’ networks.

Wireless technologies offer such flexibility that their use in an ever-widening range of applications is easy to imagine. The possibilities seem endless: highly diverse applications such as mobile banking, inter-vehicle communication, space exploration and climate-change tracking are just a few recent developments. Today, wireless networks form the backbone of crucial systems such as healthcare, disaster recovery, public safety, manufacturing and city-wide broadband access.

But wireless networks are not a one-size-fits-all solution, and they sometimes fail. It is becoming increasingly important to

understand the specificities of this relatively new technology and to address its limitations. Dr Gil Zussman, currently of Columbia University in the USA, used his Marie Curie Fellowship to look into ways of ensuring the efficient operation of wireless networks.

A stable mobile network

Dr Zussman spent his four-year fellowship at the Massachusetts Institute of Technology (MIT) Laboratory for Information and Decision Systems (LIDS), in its Communications and Networking Research Group (CNRG), as well as in the Department of Electrical Engineering at the Technion – Israel Institute of Technology. Together with other researchers, he worked on network architecture design and wireless network protocols that are both efficient and scalable.

‘Efficiently controlling wireless networks is a challenging task,’ Dr Zussman admits. He explains that this is partly because of interference, mobility of the nodes, limited capacity, energy limitations and lack of central control. ‘Such distinct characteristics set wireless networks apart from other networking technologies and pose numerous challenging theoretical and

practical problems, many of which remain to be solved, despite extensive recent research,' he comments.

His specific project dealt with the design and analysis of methods for enhancing the efficiency of wireless networks. 'Due to special characteristics of these networks, the project dealt with architectures and algorithms that are optimised across multiple layers of the networking protocol stack,' he explains.

Dr Zussman developed a novel protocol or mode of communication between wireless devices. Using this new protocol, wireless devices are able to send information packets to one another more efficiently. Through his research, he showed that this protocol increases the average rate of successful message delivery over a communication channel by 100 % compared to existing algorithms.

Engineering excellence

Dr Zussman's background in industrial engineering, economics, operations research and electrical engineering enabled him to bring a unique set of skills to bear on a complex problem.

Before his Marie Curie Fellowship he had worked largely in Israel, receiving Bachelor's and Master's degrees from the Technion in the 1990s, obtaining his PhD in electrical engineering from the same place in 2004. As part of his Marie Curie Fellowship, he worked as a research Fellow back in Israel in the Technion's Department of Electrical Engineering from 2007.

During his Marie Curie research, Dr Zussman was also awarded a Fulbright scholarship, a highly prestigious fellowship awarded to postdoctoral scholars wishing to take part in an academic exchange programme within the United States. Each year, only 10 Israeli postdoctoral scholars are eligible. During this time, he presented the results of his team's research on throughput maximisation in wireless networks at Sigmetrics, a major scientific meeting of the Association for Computing Machinery (ACM), and received a 'Best Paper' award – no mean feat as only 14 % of papers submitted were accepted for the conference.

Together with a team of four other researchers, Dr Zussman recently built on the results of his fellowship research, this time focusing on active networked tags for disaster-recovery applications. Their work won first place in the Vodafone Foundation Wireless Innovation Project competition. In addition,

he recently received a Young Investigator Award from the USA's Defense Threat Reduction Agency.

Robust, reliable, resilient

Dr Zussman continues to improve wireless networks. His current research team is focusing on five projects: energy-harvesting network tags, controlled mobility of wireless nodes, dynamic-spectrum allocation and cognitive radio, interfaces between wireless and optical networks, and the resilience of networks to geographical failures. All of these projects build on the research he carried out during his Marie Curie Fellowship.

His work is both timely and relevant, as it helps to ensure that the investments we make into wireless networks and applications are carefully researched, and that emerging applications operate efficiently and reliably. This is particularly important for devices used for healthcare and emergency-response applications.

Project acronym ■ **Macnet-UWB**

Full project title ■ **Design and analysis of medium access control and network protocols for ultra-wideband ad hoc networks**

Type of grant ■ **Outgoing International Fellowship**

Budget ■ **EUR 270 000**

Duration of project ■ **01-12-2004 - 18-10-2008**

Scientific discipline ■ **Mathematics**

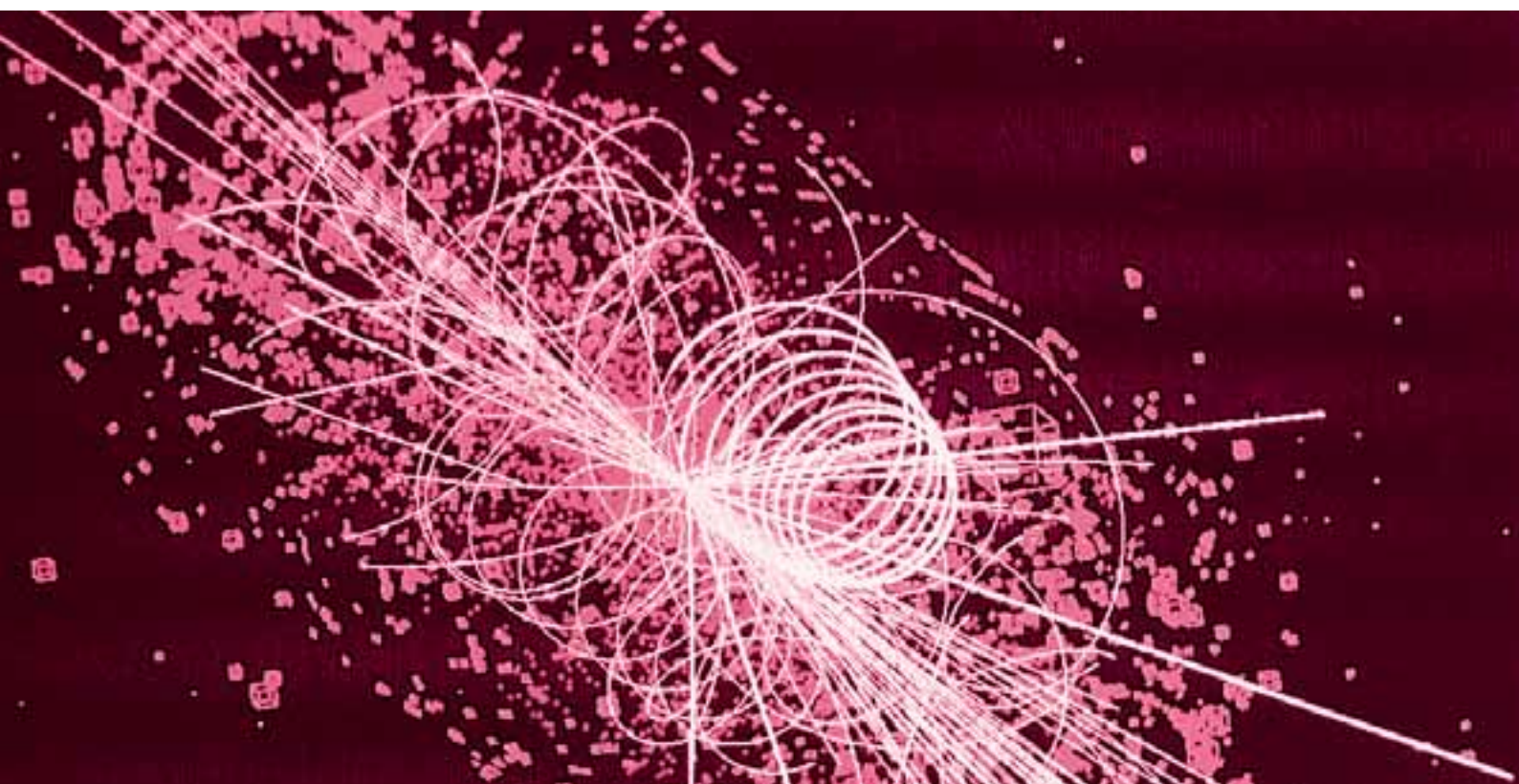
Host institution ■ **Outgoing phase: Prof. Eytan Modiano (modiano@mit.edu)**
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77 Massachusetts Ave
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Department of Electrical Engineering
Technion

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QUEST FOR UNIFICATION

'There are more things in heaven and earth, Horatio, than are dreamt of in your philosophy,' says William Shakespeare's Hamlet. In an attempt to explain the fundamental forces at play between elementary particles beyond the accuracy of the Standard Model of particle physics, the Quest for Unification network delved deep into the world of quarks, leptons and neutrinos.

It's elementary: of quarks, leptons and neutrinos

Far beyond what the human eye can discern, beyond cells and beyond molecules and atoms, the universe is made up of elementary particles. On the basis of what is known today, those particles – namely quarks, charged leptons and neutrinos – cannot be broken down any further. They are thus considered to be the basic building blocks of the universe. Their fundamental interactions can, by and large, be described by the Standard Model of particle physics that was established in the 1960s and 70s. While the findings of all high-energy physics experiments conducted since the mid-20th century are covered by this model, it is still considered incomplete; for instance, it does not take into account gravity or dark matter. And scientists believe that it does not describe certain phenomena accurately.

It is out of this belief that the Quest for Unification network went to work, looking to align theory and experiment to a greater degree. 'Our aim was to probe the physics of strong, electromagnetic and weak interactions beyond the current theory,' explains network coordinator Professor Ignatios Antoniadis of the Centre of Theoretical Physics at the École Polytechnique in Palaiseau, France, and of the Theory Unit at the European Organization for Nuclear Research (CERN) in Geneva, Switzerland. 'Another issue was to unify the quantum description of elementary particles with gravitational force. *The research goals of our network were strongly motivated by the large amount of experimental data expected over the next years* and by the prospect of important progress in several areas of theoretical physics.'

Tiny particles, huge breakthroughs

We do not have to wait for progress, however – it has already been made through this Marie Curie Network. One area of advance is the Higgs boson. Popularly known as 'the God particle', the

Higgs boson is the last missing piece of the Standard Model but a central one since it is at the origin of the particle masses. Physicists hope that the world's largest particle accelerator, the Large Hadron Collider at CERN, will help to finally catch a glimpse of it. One of many breakthroughs in high-energy physics the network contributed to lies in the development of the Higgs phenomenology and in the identification of the possible dynamics associated to this boson (new strong forces, new space dimensions, string theory).

'Other achievements have been obtained in astrophysics and cosmology,' summarises Professor Antoniadis. 'The network developed new methods for computing primordial energy density fluctuations in the spectrum of light emitted shortly after the Big Bang. And we also analysed dark matter candidates to account for the missing mass of the universe.'

Rewarded for outstanding research

All of this research was conducted by 20 young researchers hired by the network, and their various supervisors, at

12 renowned research institutes and universities. It resulted in an amazing 491 publications that have already received more than 10000 citations in the very short period since the work of the Quest for Unification teams ended. What is more, 'several members of the teams have received scientific prizes and awards,' Professor Antoniadis reports. 'This includes the University of Berne Albert Einstein Medal, the Danni Heinemann Prize of the American Physical Society, a Humboldt award and a Humboldt Fellowship.'

'All young researchers were very well integrated into the research programme of the network and contributed in substantial ways to the above achievements,' Professor Antoniadis goes on to say. 'They had beneficial interactions with the other postdocs and students, and they participated actively in the scientific activity of their host institutes. Furthermore, they have been encouraged to travel and get contacts with other network nodes and establish collaborations. They also attended and presented their works to major network meetings, as well as to international conferences and workshops related to the network research activity.'

A real career boost

Adding into the mix considerably improved expertise and complementary skills – be they presentation, computer or language skills, it is quite evident that the young researchers involved have greatly benefited from this Marie Curie Network. It was a real boost to their career prospects in more ways than one. ‘Many of them were also in charge of the organisation of research seminars and acquired organisational as well as teaching skills,’ Professor Antoniadis adds. ‘As a result, almost all of them have been offered new postdoctoral positions at the end of their contracts, and 70% stayed to continue their research at institutes that had been involved in the network. One of the Fellows accepted a long-term position in research, and three have now attained permanent academic research positions.’

The participating teams have already played a leading role across the whole spectrum of the physics involved, from theoretical aspects of string theory to phenomenological analysis of the relevant experimental data. ‘They have a long history of collaboration in previous European networks. In particular, this latest Marie Curie Network helped coordinate and further strengthen the links between

the teams, so that *they made the most of their different areas of expertise and of the complementarity of their views and approaches.*’

While this Marie Curie Network has come to an end, a new one involving essentially the same institutes will take its place and continue the quest for a better understanding of the fabric of the universe.

Project acronym ■ Quest for Unification

Full project title ■ The quest for unification: theory confronts experiment

Type of grant ■ Training Network

Budget ■ EUR 2 094 868

Duration of project ■ 01-10-2004 - 30-09-2008

Scientific discipline ■ Physics

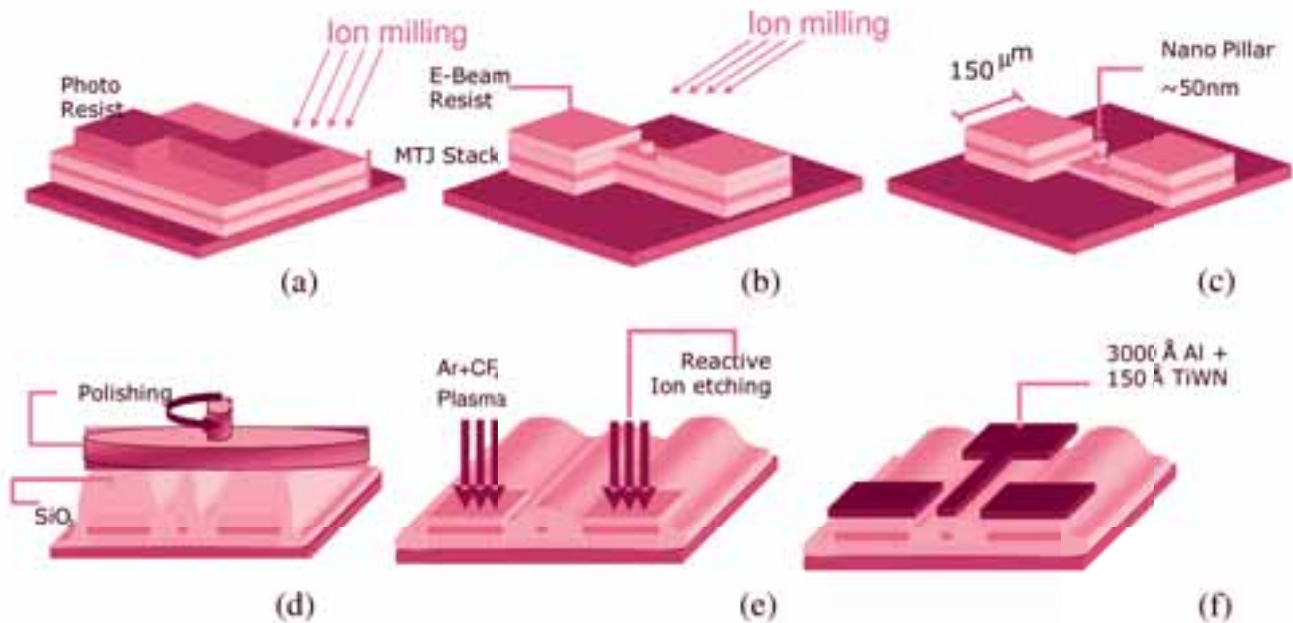
Host institution and lead partner ■ École Polytechnique

Centre de Physique Théorique

Route de Saclay

FR-91128 Palaiseau

Other partners ■ Commissariat à l’Énergie Atomique (CEA), Centre National de la Recherche Scientifique (CNRS), France - Universität Bonn, Germany - Aristotle University of Thessaloniki, Greece - Istituto Nazionale di Fisica Nucleare (INFN), Italy - Universities of Rome 1 and 2, Scuola Normale di Pisa and University of Padua, Italy - Scuola Internazionale Superiore di Studi Avanzati di Trieste (SISSA), Italy - Instituto Superior Técnico (IST) Lisbon, Portugal - Universidad Autónoma de Madrid, Spain - University of Valencia, Spain - University of Oxford, United Kingdom - University of Warsaw, Poland - Theory Division, Organisation Européenne pour la Recherche Nucléaire (CERN), Switzerland



SPINSWITCH

'Spin transport electronics', or 'spintronics' for short, has been creating quite a stir in technology worldwide. Advances in spintronics spell progress in many areas of technology: a non-volatile, more powerful and efficient computer memory, magnetic sensors and more. The Spinswitch network aimed to turn a new page in the study of so-called spin transfer torque – and had a Nobel prizewinning spintronics pioneer right in its midst.

Spin, little electron, spin

At the basis of spintronics lies the fact that electrons in an atom have an electric charge as well as an intrinsic spin, creating what can basically be considered a very small magnet. While conventional electronics only makes use of the electrons' charge, spintronics also manipulates the spin. The result: it becomes possible to change the magnetic orientation of a material at a very small scale.

'For applications in spintronic devices, electrons can be prepared with dominantly one spin orientation only,' explains Spinswitch coordinator Professor Burkard Hillebrands of Technische Universität Kaiserslautern in Germany. 'Initial efforts used small magnetic fields to "filter" the electrons by their spin, hence changing properties such as the electrical resistance. More recently, it was discovered that the flow of such spin-polarised electrons through a magnetic layer could influence its magnetisation dynamics by transferring some of the spin momentum to the magnetisation, the so-called "spin transfer" effect.'

Building on Nobel prizewinning work

A crucial step in spintronics was taken when French physicist Professor Albert Fert – a member of the Spinswitch network – and German colleague Professor Peter Grünberg discovered a phenomenon dubbed Giant Magnetoresistance (GMR) in the late 1980s. GMR describes the changes in electrical resistance in thin-film structures according to the presence or absence of a magnetic field.

Its discovery brought about the breakthrough that led to the next generation of hard disk drives, as used in various devices from computers to mp3-players. The computer technology multinational IBM got on board and used the technology to improve the storage capacity of digital devices. Thus, spintronics is helping to shape the modern world as we know it. In 2007 – at a time when Spinswitch was already in full swing – Professor Fert and Professor Grünberg were awarded the Nobel Prize in Physics for their groundbreaking work.

Meanwhile, the discovery of the spin transfer effect has enabled researchers to see the close link between spin and magnetisation dynamics, the two being virtually inseparable from, and constantly reacting to each other. They are now

trying to exploit this interconnection. 'In metallic systems, these effects take place at room temperature and above, making them very attractive to industry for device applications such as memory cells in MRAM [Magnetoresistive Random Access Memory], advanced magnetic sensors for automotive applications, fast logic, high-density recording, and high-frequency devices for telecommunications,' Professor Hillebrands specifies. In the case of MRAM computer memory, for instance, this new approach does not only have the potential to improve efficiency, but also to lower power consumption and reduce cost.

An industrial spin

These features obviously attract even more interest from industry. So, it comes as no surprise that the Spinswitch network also involves industrial partners which give the research a more application-oriented spin. *'We have strong links to big industrial players* Siemens and Thales, industrial research laboratories and to INESC-MN [Instituto de Engenharia de Sistemas e Computadores,

para os Microsistemas e as Nanotecnologias] and IMEC [Interuniversitaire Micro-Electronica Centrum],'

says Professor Hillebrands. 'These major research centres promote our work on devices and also provide us with industrial guidance. Several partners have unique analytical techniques and capabilities of fundamental importance to the measurements of the structures being developed.'

The great interest in the subject is also reflected in the number of scientific papers, talks at conferences and poster presentations that have already come out of Spinswitch, even though it is far from completed. 'Although the early-stage researchers are mostly only in their second year, Spinswitch has already implemented 22 joint dissemination actions (papers and conferences) and a further 49 actions by individual partners,' Professor Hillebrands emphasises. 'This shows the high quality of the research being performed and the relevance of the topic of spin current-induced ultrafast switching.' And news of this high-quality research is spreading – a workshop organised as part of knowledge transfer and dissemination activities by Spinswitch in Krakow, Poland, attracted more than 120 scientists from 17 countries.

The armamentarium for new research

The high quality of research will also help the 17 newly trained researchers – 10 in the early stages of their career, and 7 experienced researchers – to hold their ground in this increasingly competitive field. The relative novelty of the field means that the researchers are in a particularly advantageous position; first and foremost, the links that Spinswitch has established with industry are exceptionally strong.

But a project such as Spinswitch produces much more than purely scientific results or inter-institutional links. It also provides the researchers with the tools to operate on a global playing field, Professor Hillebrands believes. *'Newly trained researchers face a flattened world that operates globally and thus will need a skill set that includes ability to work and collaborate successfully in multinational, culturally diverse teams. Marie Curie Research Training Networks offer the opportunity to acquire these skills whilst carrying out leading-edge research.'*

Project acronym ■ **Spinswitch**
Full project title ■ **Spin current induced ultrafast switching**

Type of grant ■ **Training Network**
Budget ■ **EUR 2 831 277**
Duration of project ■ **01-10-2006 - 30-09-2010**
Scientific discipline ■ **Physics**

Lead partner ■ **Prof. Burkard Hillebrands**
Department of Physics
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DE-67663 Kaiserslautern

Other partners ■ **Universität Konstanz, Germany - Commissariat à l'Energie Atomique, France - Université Paris-Sud XI, France - Centre National de la Recherche Scientifique, France - University of Glasgow, United Kingdom - Imperial College of Science, Technology and Medicine, United Kingdom - Interuniversitaire Micro-Electronica Centrum vzw, Belgium - University of Salamanca, Spain - Instituto de Engenharia de sistemas e Computadores, para os Microsistemas e as Nanotecnologias, Portugal - AGH University of Science and Technology, Poland - Adam Mickiewicz University, Poland - National Institute of Research and Development for Technical Physics, Romania - Siemens Aktiengesellschaft, Germany - Thales SA, France**



WEAPONS RESTRICTIONS

When Princess Diana tiptoed through a minefield, she created an iconic image and helped secure a ban on weapons which had killed and maimed thousands. Yet, lives are still being wrecked. According to Handicap International, up to 98 % of cluster-bomb victims are civilians. And in some countries, such as Cambodia, children account for over 50 % of those casualties.

Putting an end to cluster bomb tragedies

Cluster bombs or cluster munitions are air-dropped or ground-launched munitions that eject smaller explosives called sub-munitions. Because they release many small bomblets over a wide area, they take a particularly heavy toll on civilian populations – not only while attacks are in progress, but often for many years to come as unexploded ordnance continues to claim innocent lives.

Alarmed by the situation, a Bulgarian researcher has set out to explain the factors influencing state positions on arms control and find ways to strengthen international law during and after armed conflict. In short, Dr Margarita Petrova wants to help stop people being needlessly maimed and killed.

To understand and address the situation, Dr Petrova – who last year won the prestigious Helen Dwight Award for her work – was

eager to explore the development of new international norms in international humanitarian law. She specifically wanted to focus her efforts on the prohibition of anti-personnel landmines and cluster munitions. Her research has led her to study the approaches deployed by various European states and by the United States to address humanitarian and security issues. It has also detailed the contribution of non-governmental organisations (NGOs) in developing international humanitarian law.

The path to signing the 2008 Convention on Cluster Munitions

A significant part of Dr Petrova's research is based on the most important advances in international humanitarian law over the last 10 years. In November 2006, Norway launched a process for the negotiation of a new treaty banning cluster munitions causing unacceptable humanitarian harm. The process was only open to those states that pledged a commitment to its humanitarian goals and, after a number of negotiation conferences and regional meetings, culminated in the adoption of the Convention on Cluster Munitions in Dublin in May 2008 and its signature in Oslo in December 2008.

According to Dr Petrova, this convention was crucial not only for developing international law, but for the people affected, for their communities and for the work of NGOs. The two conventions banning cluster munitions and landmines, she says, have ‘marked a paradigm shift in multilateral diplomacy and increased attention towards the promotion of human security over national security’.

Dr Petrova sees clear signs that such efforts are paying dividends. *‘The international processes do indeed limit the effects of the instruments of war on civilians’*, she says, ‘and as a result have captured the interest of the general public. One only has to look at the landmine campaign supported by Princess Diana that caught the attention of millions across the globe. There was also significant media interest and public outcry in the wake of the war between Israel and Hizbullah in the summer of 2006, when large amounts of cluster munitions were used.’

A deep personal commitment

During her Marie Curie Fellowship, Dr Petrova was able to observe international diplomacy in action – notably by attending several conferences where negotiations for the new treaty on cluster

munitions took place. ‘Being there in person has allowed me to gather first-hand information about the dynamics of international negotiations and law development and conduct numerous interviews with representatives from state delegations and NGOs,’ she says.

Just as importantly, the fellowship allowed her to study at the European University Institute (EUI) and its Robert Schuman Centre for Advanced Studies in Florence, Italy. The Institute was set up in 1972 by the six founding Member States of the European Community to provide advanced training to PhD candidates and to promote research to the highest level.

While there, she ‘benefited from the rich intellectual life and academic activities organised’. She also developed ties with the NGO community, and later even became involved in advocacy. ‘This means that I was not only an external observer, but to some degree I was also a participant in the process of banning cluster munitions.’

Helen Dwight Reid Award winner

In 2008, Dr Petrova received the Helen Dwight Reid Award for the best doctoral dissertation in the field of international

relations, law and politics from the American Political Science Association. Since 1966, this prize has been awarded annually to a doctoral thesis completed during the previous one or two years, selected from various nominated dissertations. It is supported by the Helen Dwight Reid Education Foundation and ranks among the most prestigious for doctoral dissertations in international relations. 'Winning this prize has been an honour and gives me huge motivation to continue my work to the highest of academic standards,' Dr Petrova says.

This motivation is visible in Dr Petrova's future plans, which include publishing a manuscript entitled: *The Politics of Norm Creation: State Leadership and NGO Partnerships in Curbing the Weapons of War*. She also intends to write articles and working papers focusing on the prohibition of landmines and cluster munitions.

For the future, she hopes to build upon her interests in war and NGO activism and extend them into new areas. 'I will explore the current challenges in warfare that affect military forces and international humanitarian principles and establish how the military, NGOs, and countries have responded.' To reach this point, she intends to study recent processes aimed at developing existing international norms in three areas –

aerial and missile warfare, direct participation of civilians in hostilities, and development of codes of conduct for private military contractors.

Dr Petrova also eventually plans to concentrate more on environmental politics by studying environmental protests in Eastern Europe with a specific focus on civil society mobilisation within the context of the EU legal and institutional framework.

Project acronym ■ Weapons Restrictions

Full project title ■ Europe, the USA, and the shape of international legal order: a comparative study of international weapons restrictions

Type of grant ■ Intra-European Fellowship

Budget ■ EUR 114 214

Duration of project ■ 01-09-2007 - 30-04-2009

Scientific discipline ■ Sociology

Host institution ■ Robert Schuman Centre for Advanced Studies

European University Institute


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STRUCTURING THE RESEARCH LANDSCAPE

Marie Curie Actions defend the idea that researchers should enjoy the same working rights as any other workers in Europe: quality in training, career progression, and employment contracts with full social security coverage. But although they are funding thousands of researchers, they cannot reach everyone. Instead, in order to fulfil their social commitment, Marie Curie Actions set trends and offer best practices that are then implemented in all research institutes hosting Marie Curie Fellows. This is done with the help of an important set of tools: *The European Charter for Researchers* and *The Code of Conduct for the Recruitment of Researchers*.



Inspiring change in the wider research sector

Since the creation of the *European Charter for Researchers* and *The Code of Conduct for the Recruitment of Researchers*, also known as the Charter and Code, a wave of change has been spreading across Europe. Many institutions have signed up to them and started to implement their principles. Marie Curie Actions are playing a major role in this revolution: they are the main instrument for implementing the Charter and Code – all of these principles are fundamental to their contracts.

For instance, Marie Curie Actions require that researchers receive an employment contract, while institutions that are hosting Marie Curie Fellows and have in the past given stipends instead of employment contracts must

now adapt their practices. In an increasing number of cases, the rights obtained for Marie Curie Fellows are extended to other researchers in these institutions.

There are many more areas where Marie Curie Actions are making a difference. They have significantly encouraged participation by the private sector in research training, and in the exchange of knowledge with the academic world.

Promoting excellence

Marie Curie Actions are also shaping policies at EU level by requiring the teaching of complementary skills to all Fellows, and making sure that training is recognised by every institution funded.

Best practices developed by the Marie Curie Actions have been incorporated into other EU programmes. The Erasmus Mundus programme, supporting the mobility of postgraduate Fellows, among other activities, has drawn from the experience of the Marie Curie Actions

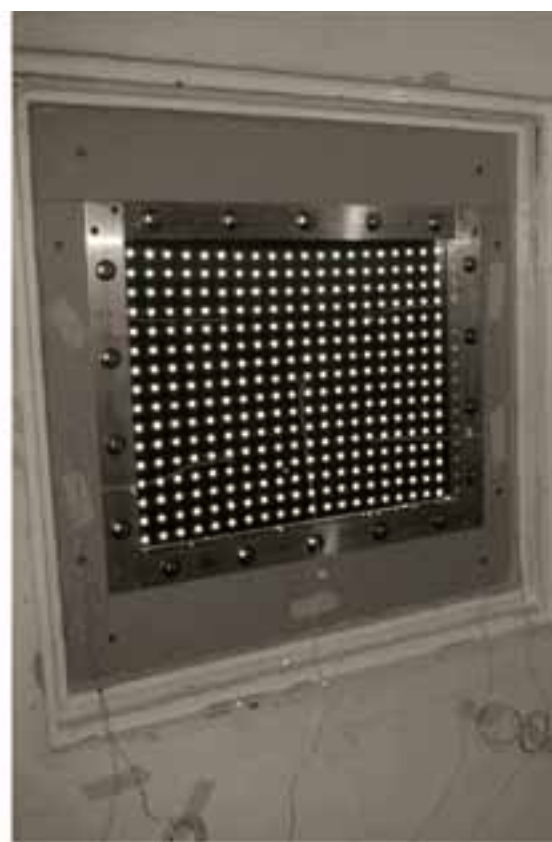
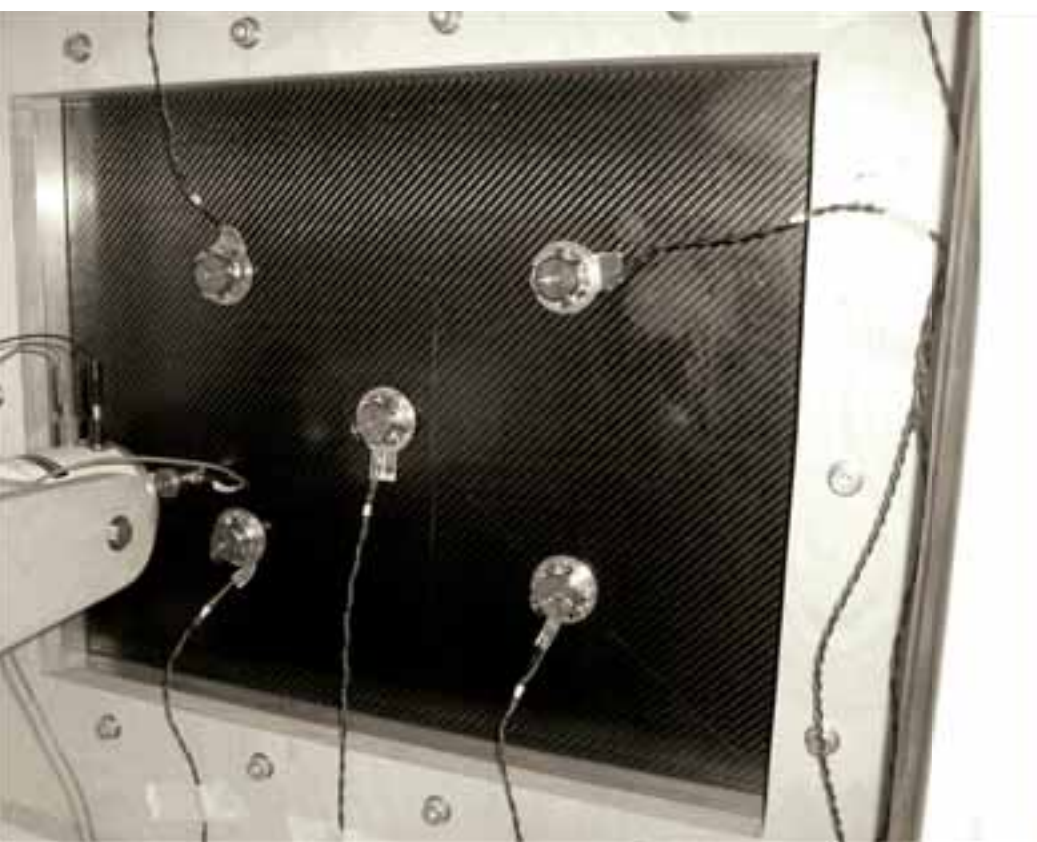
team. And the European Research Council (ERC) Starting Grants took their inspiration from the Marie Curie Excellence Grants, some of which you will read about in this book.

Making mobility easy

While EU citizens automatically have the right to live and work anywhere in the EU, the same is not true for people from outside the Union. The Researchers' Visa speeds up the visa application process for the researcher and his or her family, facilitating a move to Europe for the best brains in the world.

This chapter highlights projects which show how the Marie Curie Actions are creating lasting networks linking institutions and people across Europe.





EDSVS

Take a second to listen. What do you hear? Perhaps a car driving by, a dog barking or even a baby crying. At night time, the faintest of sounds can keep us awake. Yet, during the day, we do not always hear the screaming ambulance hurtling down the busy main road. Sound and vibrations are all around us and affect each and every one of us in many ways.

Good vibrations

The Marie Curie Actions have kept an ear to the ground, funding a network that offered a doctorate on sound and vibration for researchers across Europe and beyond. For eight years, the Marie Curie Early-Stage Research Training (EST) action funded a European Doctorate in Sound and Vibration Studies (EDSVS) for Fellows from the EU and elsewhere. At the heart of the project was a network of eight European universities active in the field of sound and vibration that, between them, provided high-level training in all subjects related to acoustic noise and vibration. Each doctoral Fellow had a 'home institute' and a 'hosting institute', which together defined the doctoral programme and set out how it was supervised.

Some facts and figures

Since its inception in 2000, over 60 Fellows have been awarded a PhD and more than 100 young researchers have undergone training by the eight hosting institutions. This training covered a total of 1 241 Fellow-months, equivalent to 100 years! Researchers from nearly all the EU countries (around three-

quarters of participants), as well as Argentina, Australia, Brazil, Canada, Colombia, India, Russia and the United States, have taken part.

Dr Stefan Zimmerman, who visited the Institute of Sound and Vibration Research (ISVR) at the University of Southampton as part of the EDSVS programme, says: 'The EDSVS fellowship programme was excellent and supervision was always competent. Open discussions on the subject and guidance ensured I made fast progress. It also gave me the opportunity to attend several short courses on acoustics, noise and vibration which provided the basic principles of advanced acoustics subjects and the latest information on recent research results. Thus, *my knowledge on sound and vibration was extended, which was very useful for finding an appropriate job in the automotive industry.*'

'The training offered provides both scientific and technical research supervision, courses at MSc level as well as research management guidance,' adds Professor Paolo Gardonio of the Institute of Sound and Vibration Research (ISVR) at the University of Southampton. 'All carry out research projects in various fields related to sound and vibration.'

These projects addressed a plethora of scientific areas, including physics of acoustics, non-linear dynamics and chaos theory; mathematics and information sciences such as signals and speech processing, systems control modelling and neural networks, applied mathematics and mathematical physics. Engineering sciences, such as analytical vibration, numerical methods in vibration and acoustics, as well as life sciences, including hearing and balance, were also on offer.

Foreign Fellows received support so that they could learn the languages spoken at the hosting institutions. Technical staff were also consistently involved in the supervision and training of the Fellows to teach them how to use the instruments necessary for their experiments. For example, most received computing support, needed not only for projects focusing on numerical simulation, but also for experimental projects where the data analysis is carried out numerically.

Beyond training, special events were also organised for the visiting Fellows. These included a review meeting where they could present their work and gain valuable feedback. A special session of papers presented by EDSVS Fellows was also held during the International Conference on Noise and Vibration Engineering (ISMA). Finally,

many attended the European Marie Curie Conference entitled 'Boost your Research Career!' held in Barcelona.

Bringing harmony

The most important aspect of EDSVS was the impact it had on structuring the sound and vibration research landscape in Europe. This can be seen in the launch of the EDSVS PhD certificate, which was awarded to those who completed a PhD in accordance with the rules set out by the Confederation of European Union Rectors' Conferences.

The EDSVS certification has certainly been the catalyst for other improvements in European sound and vibration research. For example, the need to secure examiners and jury members from various countries has strengthened links between Fellows and academics alike throughout Europe.

Interaction between the various European academic institutions has also improved. In particular, academics and administrators at European universities that offer training in sound and vibration are in closer contact than ever before. This interaction is likely

to significantly change the way PhD training in sound and vibration is carried out at European level. There have already been some interesting discussions on the way researchers are selected, trained and taught how to write their thesis and present their PhD to examiners.

Sounding off

Perhaps the most important indicator of EDSVS's success is its alumni, who have time and time again paid testament to its effectiveness and impact. One such former Fellow is Susana Quirós y Alpera from Spain who comments: 'The EDSVS programme has given me the opportunity to make good use of the facilities of the prestigious Acoustic Department at the Technical University of Denmark. I also had the chance to follow lessons on acoustics, and my supervisor gave me his support and advice as and when needed. During my visit, I also had the opportunity to write various papers related to my thesis and to attend the 17th International Congress on Acoustics in Rome.'

For Professor Gardonio, the ultimate indicator of a doctorate's success is what its past Fellows do once it is finished. *'Former*

EDSVS Fellows already have extremely interesting and promising careers which clearly underlines the importance of this programme,' he says. *'There are many who are now employed in the country they visited during their EDSVS fellowship.* Others are working in research and some have moved to industry and have quickly reached important positions within the company. *I am very proud of all of them,'* he concludes.

Yes, it is good to listen.

Project acronym ■ EDSVS

Full project title ■ European doctorate in sound and vibration studies

Type of grant ■ Training Network

Budget ■ EUR 2 875 343

Duration of project ■ 01-10-2004 - 30-09-2008

Scientific discipline ■ Engineering

Lead partner ■ Institute of Sound and Vibration Research

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MUTRA

Translation can be a tricky and subjective task. Conflicting interpretations of the finer points of tone and style may lead to project delays and serious headaches. There are multiple dimensions to the industry, and business habits vary between countries, languages and cultures. The MuTra project has gone some way towards alleviating the problems via its translation methodology, conferences, training seminars and PhD networking opportunities.

MuTra: a labour of love

While the general public might think that translation as such is uncomplicated and straightforward, those who have delved deeper into the matter know that modern translation scenarios have many dimensions. In the modern world, translations may concern several languages or media, multiple modes or even signs and symbols. Cross-cultural factors have to be taken into account, the switch from the written to the spoken word and – today more than ever – accessibility for different audiences, including the visually and hearing impaired. The Marie Curie MuTra project aimed to investigate these dimensions and ultimately proposed solutions for common problems.

Translation theory and practice offer a fertile ground for research and, more importantly, may be fruitful territory for teaching in an ever-evolving world of communication. This is why a key element of MuTra's efforts was to familiarise young researchers with the latest trends and developments in translation studies and hand them the tools to use the appropriate research methods.

The MuTra conferences were essential in this: the first MuTra conference in Saarbrücken, Germany, focused on the challenges of multidimensional translation. The second, dedicated to audio-visual translation scenarios, took place in Copenhagen, Denmark. The third conference, on the subject of Language for Special Purposes (LSP) Translation Scenarios, was held in Vienna, Austria.

Beyond organising training conferences, the MuTra project addressed the impact of new technologies on the form, content, structure and modes of translated products, established a network of PhD Fellows across Europe, and designed translation concepts and methodologies in subtitling, audio-description and written interpretation.

In fact, the MuTra approach was so successful that it led to the setting up of the international MuTra Advanced Training and PhD School. This offers a unique series of advanced training events in translation and interpreting (T&I) and is supported by the Foundation for the Promotion of Translation and Interpreting Research.

Research into a teachable art

'The project has not only led to the establishment of the MuTra PhD School, but also to a series of advanced translation seminars and an application for an Erasmus Mundus PhD programme,' explains Professor Heidrun Gerzymisch-Arbogast, lead partner at the University of Saarland. 'And it has allowed for intensified cooperation between translation scholars around the world and led to a series of sub-initiatives and contacts with the translation and interpreting schools of Bologna/Forlì, Prague, Copenhagen and Barcelona universities. *The project has also reflected European endeavours to create a European Master's and PhD programme in multidimensional translation.*'

To date, 253 translation experts and Fellows from over 20 countries have participated in MuTra. Their countries of origin include almost all EU Member States as well as Canada, China, Korea, Russia, Turkey and the United States.

And a range of PhD theses inspired by MuTra continue to spread the word. Three have been submitted, and many others are nearing completion. Recent topics include discourse interpreting, knowledge management in simultaneous interpretation, audio-description and translation, equivalence in subtitling, and interpreting and cognitive load – an eye-tracking experiment.

Sharing information on the Tower of Babel

One MuTra Fellow is Luxembourg's Kerstin Reverchon who says the project is a 'brilliant incentive' for both those starting out in translation and those with more experience. 'The carrot and the stick have proved effective,' she says. 'The project involves profitable and intense individual thesis discussions, status presentations and solution-oriented analytical group discussions. There is *an impressive interchange of ideas between congenial people of all cultures, embedded in a pleasant and inspiring atmosphere*. In short, it is a brilliant promotion recipe on both a professional and personal level, blended with care by our doctoral advisor Professor Gerzymisch-Arbogast – and you can be sure that no one goes home hungry!'

'Each MuTra training seminar offers a synopsis of translating and interpreting phenomena, their theoretical status and research potential. Taken together, the series is a structured format for PhD preparatory training,' says Professor Gerzymisch-Arbogast. 'The project also offers person-to-person instruction in English by leading university professors and experts in the field of PhD preparation, multidimensional translation, interpreting, subtitling and audio-description. MuTra seminars are organised during weekends at European higher education institutions and high-quality professional

sites in Berlin, Munich, Zürich, Saarbrücken and Fosano in Switzerland.'

The professor also believes that the project has done much to decrease the fragmentation in the translation discipline by creating a new multidimensional translation concept and the MuTra translation methodology. It has also established a group of young scholars who all attended several Marie Curie initiatives and are supported and promoted by the Gerzymisch Stiftung, Saarland University and the Advanced Translation Research Center (ATRC). Incidentally, ATRC has formed a separate entity as an association as a result of MuTra. Its research focuses on the general, language-independent concepts and methodology of translation and interpreting.

Love what you do

It may seem a little strange to those who 'work to live', but loving what you do is, according to Professor Gerzymisch-Arbogast, crucial for Marie Curie success. She also believes that completing the application form stringently is vital to actually obtaining a fellowship place. Once accepted, applicants should, she feels, strive to build up their own networks of people with the same mindset, objectives and complementary expertise

within Europe. And this is exactly what the professor has done. 'The MuTra partners include universities in Copenhagen, Vienna, Budapest and Berlin,' she says.

Someone once said 'all you need is love'. Next time you watch a subtitled film, listen to interpretation at a conference or watch the news in a foreign language, take a moment to think about the love that the professor and her Fellows have put into setting the standards of translation across Europe and beyond

Project acronym ■ MuTra
Full project title ■ Multidimensional translation

Type of grant ■ Conference
Budget ■ EUR 285 000
Duration of project ■ 01-12-2005 - 01-12-2008
Scientific discipline ■ Sociology

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The Marie Curie Actions are widely recognised as a shining example of what European funding does for researchers. They have helped to change the R&D human resources landscape in Europe, giving tens of thousands of excellent researchers the opportunity to gain new knowledge and expertise within the best research groups through prestigious mobility fellowships. But the Marie Curie Actions are not only about making researchers mobile or helping them acquire new skills; they are also about ensuring that researchers enjoy a rewarding career and are motivated and inspired. The Actions promote better, more stable careers through employment contracts with full social security rights instead of traditional stipends. This book presents stories of the passionate researchers shaping your world and shows how an effective policy was crucial to them attaining excellence in research.



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