

# CELTIC STRENGTH: SCIENCE IN IRELAND

Lush green hills, miles of rugged coastline, a vibrant history, charming neighbors, a pub at every corner, and a prospering economy ... Sounds like an idyllic place to live, but would you want to do your research there?

By Laura Bonetta

A decade ago the answer likely would have been “no” for most scientists, but today Ireland is carving a place for itself among those countries leading the world in scientific research and development. A significant commitment by the government to develop a “knowledge economy” has resulted in greater opportunities for scientists and engineers. “We are in a totally different world,” says **David McConnell**, head of the genetics department at Trinity College Dublin (TCD). “Now we have the government behind us.”

In 2007 the Irish government and European Union invested €995 million (US\$1.328 billion) in research. This is a considerable investment in a country with a population of just over 4 million people. And the results are easy to spot. A growing number of research institutes/centers and biotech companies are popping up across the country, and more Irish students are obtaining graduate degrees than ever before. As Ireland’s science enterprise begins to establish itself, it is providing researchers with challenges, as well as unparalleled opportunities.

## The Switch to Irish Funding

Until about 10 years ago, there was next to no funding for research in Ireland. “The real lift-off began in 2000,” says **Patrick Cunningham**, the government’s chief scientific adviser since 2007. “In the subsequent seven years the government spending on research went up by 264 percent. That means that the growth rate in research and development increased at twice the rate of the economy, which is growing at a rate of 7 percent a year in Ireland.”

The Irish government announced in June 2006 a Strategy for Science, Technology and Innovation involving an investment of €8.2 billion (US\$10.9 billion) over the next seven years. The purpose of the strategy was to turn Ireland into a knowledge economy as the best way forward for economic development. “It was a very deliberate policy change,” explains Cunningham.

Historically many pharmaceutical companies had established a presence in Ireland because of favorable corporate tax breaks and relatively cheap labor. “But the government realized that, if we were to remain attractive for foreign investment, our people would have to be trained to perform higher level functions,” says Cunningham.

In 2006, the seven Irish universities and a number of institutes of technology awarded 979 Ph.D.s, 565 of which were in science and engineering disciplines. One of the targets under the Strategy for Science, Technology and Innovation is to increase the annual Ph.D. output to 1,300 by 2013. Additional goals are to “increase the number of research teams led by internationally competitive principal investigators” and to “develop sustainable career paths for researchers.” *continued »*



“The growth rate in research and development increased at twice the rate of the economy”



From Top: Ireland’s coastline; **Issault Lynch**; **Patrick Cunningham**; The CRANN SFI CSET Building at Trinity College Dublin

## UPCOMING FEATURES

- Regenerative Medicine (online only) — November 7
- Diversity: GLBT (online only) — December 5
- Faculty 1: Choosing the Right Postdoc for Your Lab — February 6

## Focus on Ireland

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These tasks fall in the hands of the Science Foundation Ireland (SFI), the country’s main research funding agency—a cross between the National Institutes of Health (NIH) and the National Science Foundation (NSF) in the United States. SFI was established in 2000 to support researchers working in those fields of science and engineering that underpin biotechnology, information and communications technology, and sustainable energy and energy-efficient technologies development. “SFI’s mandate is to invest in basic science in areas related to the economy,” says Cunningham.

SFI has a budget of €1.4 billion (US\$1.9 billion) to spend over 2007–2013, translating to about €200 million (US\$267 million) per year. “SFI is a component of a national economic program. We are focused on scientific excellence rather than short-term results,” says **Frank Gannon**, who became SFI director general in July 2007, after leaving his post as executive director of the European Molecular Biology Organization (EMBO).

A major area of research funding for SFI is “interdisciplinary” research—a catchword for many granting bodies but, says Gannon, a good match for Ireland. “The country is extremely well placed to be a leader in this area. We have many leading pharmaceutical and software companies in a small country with strong social networks. At SFI we look to develop programs in convergence areas,” says Gannon. “In many other countries research programs have grown more in silo fashion.”

### A Changing Landscape

People who have worked in Ireland for many years have seen a huge change. “After graduating from Caltech [California Institute of Technology] in 1970, I came back to Ireland,” recalls McConnell. “But it was not a good idea from the point of view of a scientific career. In fact it was a silly move.” McConnell left for Harvard University, where he worked 1976–1977, but then returned to Ireland once again because “it looked as if things were going to change,” he says.

McConnell joined the department of genetics at Trinity College Dublin in the late 1970s, a department that had been founded in 1958 with money from the Irish Sugar Company. At the time, it was difficult to obtain funds to conduct the kind of research McConnell had been used to doing in the United States.

By 1979, the European Commission (EC) started providing some grants for research. McConnell and colleagues at Trinity

became very adept at obtaining these grants. “We relied heavily on EC funding for many years and built a lot of contacts with European scientists,” recalls McConnell. With EC funding, geneticists at Trinity were able to participate in three of the early genome sequencing projects in yeast, *Arabidopsis*, and *Bacillus subtilis*.

After the year 2000, Irish scientists began to switch from EC funding to grants from SFI and other Irish agencies. “Today the funding is outstanding,” says McConnell. “It is sufficient to allow you to compete internationally.” McConnell’s department—which moved to the Smurfit Institute of Genetics in 1998 with support from various philanthropies—currently receives €7 million (US\$9.3 million) in annual research funding to support 15 groups and a total of about a hundred researchers. This year the department celebrated its fiftieth anniversary with a symposium held on 17–20 September with James Watson as a guest of honor.

**Ciaran Regan** also returned to Ireland in the pre-SFI days, after having worked many years in The Netherlands and London. “The transformation has been phenomenal,” says Regan, a professor of neuropharmacology at University College Dublin (UCD). Regan’s lab is located in UCD’s Conway Institute of Biomolecular and Biomedical Research, a new building constructed in 1999 with funds from government and private donors. “It is the most magnificent and largest research center in Ireland,” says Regan. “Working in this building has an unimaginable impact. It brings pressure to deliver and maintain a certain standard of research, but also an incredible sense of pride.”

Regan’s research focuses on synaptic plasticity—the ability of connections between neurons to change in strength—and its role in learning and memory. In addition to running his own lab, he directs the Applied Neurotherapeutic Research Group, a collaborative research initiative funded jointly by SFI and Wyeth, to understand the molecular underpinnings of changes in behavior and to identify new drug targets for diseases such as schizophrenia.

This type of collaboration is not unique. GlaxoSmithKline is investing up to €14.6 million (US\$19.5 million) in a collaboration with TCD and the National University of Ireland (NUI) Galway to discover new therapies for Alzheimer’s disease.

### Investing in R&D

Industry and academic partnerships are a common theme of Irish research. It is not surprising considering that the small country has a very high concentration of major pharmaceutical companies: Genzyme, Pfizer, Amgen, GlaxoSmithKline, Merck Sharp & Dohme (part of the US company Merck & Co.), Boston Scientific, Wyeth, Johnson & Johnson, Abbott, and others have substantial operations in Ireland. According to the Industrial Development Agency (IDA), Ireland has established itself as the most popular destination for development and manufacture outside the United States. In 2006 the pharmaceutical and biotech industries brought in the bulk of the €2.6 billion (US\$3.5 billion) the region saw in capital investment projects. **continued »**

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Focus on Ireland



Researcher at Trinity College

Featured Participants

**Applied Neurotherapeutics Research Group**  
[www.ucd-neurotherapeutics.com/~conway](http://www.ucd-neurotherapeutics.com/~conway)

**European Commission (EC)**  
[ec.europa.eu](http://ec.europa.eu)

**Industrial Development Agency**  
[www.idaireland.com](http://www.idaireland.com)

**National Institute for Bioprocessing Research and Training**  
[www.nibr.ie](http://www.nibr.ie)

**National University of Ireland (NUI)**  
[www.nuigalway.ie](http://www.nuigalway.ie)

**Science Foundation Ireland (SFI)**  
[www.sfi.ie](http://www.sfi.ie)

**Trinity College Dublin (TCD)**  
[www.tcd.ie](http://www.tcd.ie)

**University College Dublin (UCD)**  
[www.ucd.ie](http://www.ucd.ie)



Regent House at Trinity College Dublin

Several factors make Ireland attractive to foreign investors. The country has one of the world’s lowest rates of corporation tax, with the maximum rate for trading profits of 12.5 percent. It also provides many economic incentives for intellectual property developed and licensed from the country, such as patent royalty exemption and a research and development tax credit.

But another attraction is that Ireland has a skilled labor force, according to **Daniel Hoey** and **Bryan Meehan**, managers at two Merck, Sharp and Dohme facilities in Ireland. The plant in Ballydine, established in 1976, currently employs 340 people. Merck is now investing €100 million (US\$133 million) to expand the plant and create 120 new positions over the next three years. “We will now start doing late-stage process and analytical development as well as the launch of new products from this site,” says Hoey.

Plans are also under way to establish a new €200 million (US\$267 million) vaccine facility in Carlow Town with the support of IDA Ireland. The plant, which will develop and manufacture human vaccines, is expected to launch in 2011 and will create 170 new jobs. “We decided to build the plant here after considering a number of sites worldwide,” says Meehan, adding that key considerations included government collaboration, access to top scientists, and a proven track record in Ballydine. “We are just starting to hire now and the talent we are seeing is first class.”

And Merck is not unique in its expansion efforts. Pfizer will build a €190 million (US\$252.7 million) biotechnology factory in Cork to make drugs the US company is testing to replace older medicines. The plant will be Pfizer’s sixth in the country. In December 2006, Eli Lilly and Company announced it was to invest up to €400 million (US\$532 million) in a program to establish a biopharmaceuticals development and manufacturing facility in Kinsale. “Until 10 years ago most companies only did production in Ireland. Most carried out no development,” says **Barry O’Dowd**, IDA Ireland’s manager for pharmaceuticals and biotechnology. “Today 70 percent of companies are doing some development work.”

In addition, an increasing number of startups are popping up in Ireland. Opsona Therapeutics, for example, a drug development company focusing on the regulation of the human immune system, was founded in Dublin in 2004 by three immunologists at Trinity College Dublin. One of Opsona’s main investors is the California-based biotech company Genentech.

**A Developing Science Environment**

An indication that Ireland provides a favorable research environment is that researchers from the United States, UK, Germany, and other European countries are moving there. To facilitate the move SFI provides awards to established researchers relocating to Ireland—up to €500,000 (US\$665,000) per year for up to two years to set up a new lab.

After obtaining one of these awards, **Kevin Sullivan** left his lab at the Scripps Research Institute in sunny San Diego, where he had spent close to 20 years, to join NUI Galway on the west coast of Ireland.

In 2004, Noel Lowndes at Galway was gearing up to form a center of excellence for the study of chromosome biology, Sullivan’s field of expertise. The prospect of joining that group, which today comprises 10 labs in the Center for Chromosome Biology, combined with increased science funding in Ireland and a gloomy funding scene in the United States prompted Sullivan to move. “It is a very collegial environment,” he says. “Here at the center, there is a desire to inform and participate in each other’s research.”

One of the goals of the Center for Chromosome Biology is to establish screening techniques using small interfering RNAs (siRNAs) to find new targets for anticancer drugs, as well as gain a better *continued »*

Focus on Ireland



Pauline Rudd

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—Kevin Sullivan



Kevin Sullivan

understanding of fundamental cancer mechanisms. While Sullivan is optimistic that this kind of research can be done in Ireland, he believes that the expensive and extensive infrastructure it requires is not yet in place. “We budget about €15,000 (US\$19,950) operating expenses for each researcher per year. To do one of the siRNA screens you need about €50,000 (US\$66,500), more than three years worth of operating expenses for an individual,” he explains. “This type of science is a big investment and, while the return in terms of basic science can come rapidly and with high impact, the translation to biotechnologies is less certain and certainly longer term.”

While in the United States there is a long history of funding basic science and there are many large and established centers that researchers can tap into, Ireland’s research enterprise is still in its budding stages. “Ireland is still very youthful in its drive to become an internationally competitive center for biomedical research,” says Sullivan. That can be a source of some frustration at times, but being in a position to impact positively on Ireland’s scientific development is an attraction to many people.

**Pauline Rudd** at UCD is one of them. “There is a real sense that you can help make a difference. A few weeks ago I met the minister of the Department of Enterprise, Trade and Employment [Jimmy Devins] and he actually knew who I was. That would be unlikely to happen in a country like the UK,” she says. “Here, you can influence the direction that science is taking because you are close to the people making the decisions.”

**Collaborations Take Center Stage**

Rudd moved to UCD from the Glycobiology Institute at the University of Oxford in the UK to join the National Institute for Bioprocessing Research and Training (NIBRT). The goal of this newly established institute, funded to the tune of €72 million (US\$95.76 million) by IDA Ireland, is to support the biopharmaceutical industry at all levels. “If a company decides to move to Ireland and has specific scientific issues they are grappling with, they can come to NIBRT and we will help them solve their problems,” says Rudd.

NIBRT scientists will provide training in the whole spectrum of bioprocessing activities as well as undertake research projects to advance current knowledge of bioprocessing technologies and techniques. “It is always a dream for academics to see practical applications of their work,” says Rudd. “It would be a privilege

to know that we contributed to the development of a drug that is helping patients.”

Rudd is a world-renowned expert in glycobiology, or the study of sugar molecules, a field that is becoming increasingly important to the pharmaceutical industry. Many of the new biological drugs, or biologics, currently being manufactured are glycoproteins, i.e., proteins with attached sugar molecules. It is thus important to have ways to quickly establish the glycosylation status of a protein at all stages of bioprocessing. For example, about 40 percent of the hormone erythropoietin has to be discarded during manufacturing because of inappropriate glycosylation.

Rudd also carries on an independent research program at NIBRT and has a joint appointment at UCD. She has found that Ireland provides wider opportunities for academic collaboration than in the UK. “Most research grants in Ireland involve being in big interdisciplinary clusters,” says Rudd. “It forces you to relate your expertise to a completely different field.”

This spirit of collaboration led to the launch of a new network of academic researchers with multimillion euros of funding, called GlycoScience Ireland, in April 2008. The network is planning a research collaboration to understand how specific bacteria colonize the human gut by modifying the sugars attached to cells that line the intestines—the results of which will have implications for the milk production industry since some bacteria in milk become part of the human intestinal flora.

“This kind of collaboration would be unlikely to happen in England,” says Rudd. “In the UK, collaborations tend to be between a small number of laboratories and we would ask relatively focused, academic-type questions. Here many more labs participate and the questions we ask are more global in relevance. It is exciting and challenging.”

There is no doubt that in a short time Ireland has undergone a dramatic change. Although the research enterprise is still just developing, today moving to Ireland can be a positive career move for many. “If you want to move to a cosmopolitan city, join a university that is over 400 years old and do first-class science, you should come for a visit,” says Trinity College’s McConnell. And for anyone worried about the unpredictable weather, McConnell says there is plenty of Guinness to go around to make up for it!

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