

SPECIAL REPORT

An indifference to boundaries

As some of the world's largest universities undergo dramatic departmental restructuring to foster interdisciplinary research, **John Whitfield** asks whether they're making the right move.

Immunologists at Imperial College London have been tripping over a sticky problem: the structures of the molecules they are working on. The obvious go-to team is the institute's strong corps of structural biologists. But the immunologists are in the division for cellular and molecular biology, whereas the structural biologists are in the division of molecular bioscience. Splitting the funding — and the credit — causes turf wars. The solution? A department of life sciences that merges three biological divisions. "We decided we needed to break the incentive to be selfish," says ecologist Ian Owens, who heads the new interdisciplinary department.

Established three months ago, the department is part of a trend at traditionally structured universities towards initiatives that foster interdisciplinary research. Harvard University — which has a reputation as a place of powerful departmental fiefdoms — and University College London are also rejigging their institutions to remove internal barriers and encourage researchers to come together in new combinations. Part of the trend springs from subject areas that have emerged over the past decade — such as global health, climate change, neuroscience and systems biology — that

straddle the boundaries of older disciplines.

It is an idea pioneered by boutique institutes such as Santa Fe Institute in New Mexico, where complexity theory was developed; Bell Laboratories in New Jersey, where lasers and information theory were developed; and the UK Medical Research Council's Laboratory of Molecular Biology in Cambridge, where a group of physicists-turned-biologists pioneered molecular biology.

Social engineering

"Without any exceptions, over the past century the lead scientist on any major discovery has internalized a great deal of scientific diversity," says science historian Rogers Hollingsworth of the University of Wisconsin-Madison. He studies the types of research that lead to major breakthroughs in biomedical science — the kinds that win Nobel, Lasker or Crafoord prizes — and what gives the places that do that research their edge. Such internalization, Hollingsworth says, is most likely to happen in small institutes that have few internal barriers and flat hierarchies, where the bosses stay close to the labs. He points to Rockefeller University in New York and the California Institute of Technology in Pasadena as the exemplars of such an ethos.

Escape the intellectual blinkers

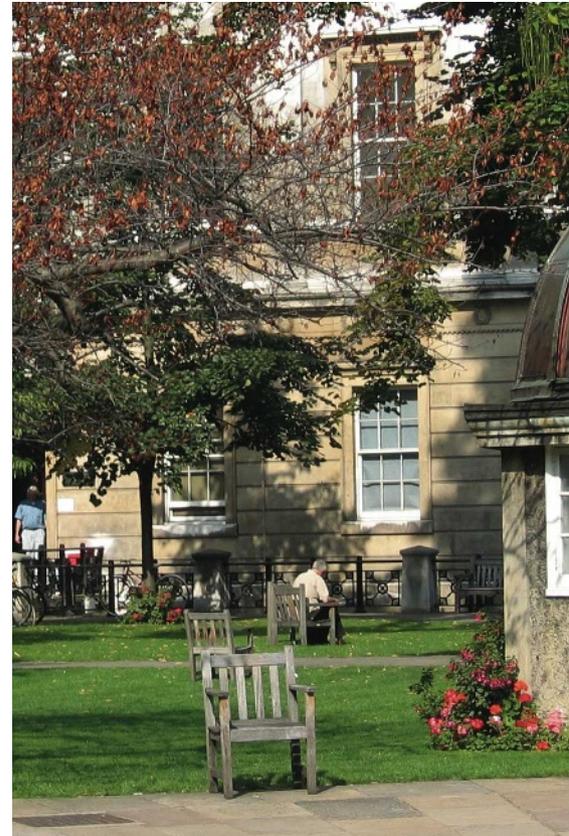
Researchers working in traditional departments have several places to go to escape the grind of teaching, applying for grants and running a lab. And the demand for such places is rising, says ecologist Marten Scheffer of Wageningen University in the Netherlands, who is helping to set up two interdisciplinary institutes.

Scheffer is a founding father of the Institute Para Limes (IPL), currently being installed in a fourteenth-century monastery in

Doesburg in the Netherlands. The IPL started running scientific meetings last year and plans to be fully operational by 2012, with an annual budget of €5.5 million. It will be staffed by cast of 'visitors' coming in for anything from a few days to a few months, and what they do is up for grabs, says Scheffer. "The most important thing is to bring the right mix of people together, and let it evolve."

He is also involved in setting up a similar but

more focused institute in Uruguay, the South American Institute for Resilience and Sustainability Studies, which will look at issues such as fisheries, biodiversity and climate change from the broadest possible viewpoint. Like the IPL, everyone will be just visiting. Meetings should start in 2009. "We're planning to get policymakers involved at an early phase," Scheffer says. He hopes that humanities researchers, politicians and artists will also visit the institute. **J.W.**



Getting the right people together is important (see 'So, you want to be interdisciplinary ...'), as is the physical environment. While planning for the Janelia Farm research campus in Loudoun County, Virginia, director Gerald Rubin discovered that many of the most successful research institutes valued their canteen above all other facilities, owing to the contacts it helped people to create. So Janelia Farm serves three meals a day, seven days a week — but the cafeteria is open for just 90 minutes at lunchtime, encouraging people to bump into one another. Tables seat eight people, but research groups have a maximum size of six, so they must mingle, and you pay more for take-out than eating in. There's also an on-campus pub, serving free coffee all day to deter people from brewing up in their labs, and beer and meals in the evening. "We have done a huge amount of social engineering," says Rubin.

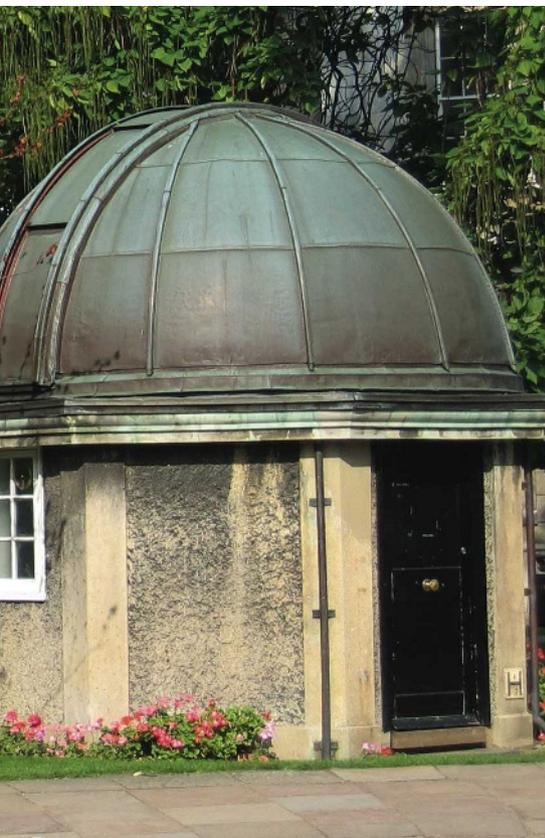
But while distinct departments still control rewards and credentials, not everyone believes that traditional universities will achieve the interdisciplinary success of specialist institutes such as Santa Fe — or even that it is a worthwhile exercise to attempt.

"Interdisciplinary is becoming the buzzword in science, but I'm extraordinarily sceptical about what's going to result in the next 10–15 years from this," says Hollingsworth. "Large research organizations have an enormous



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So, you want to be interdisciplinary ...

Interdisciplinary research is not for everyone, and personality is hugely important. At the Santa Fe Institute in New Mexico, president Geoffrey West is always looking for people who have the right mindset. "You need a person with a passion for a bigger picture of science, who can see beyond boundaries and wants to see where the threads of their ideas might lead in other contexts." But, he adds, philosophy does not guarantee quality. "There are extraordinarily smart and creative people that don't care about anything outside their discipline. And there are flaky people who are interested in everything at a very superficial level."

Here are some tips:

Pay your dues Traditional disciplines give you a strong base from which to launch yourself. "If you're not well educated in a basic discipline you can't do interdisciplinary research," says Kathleen Buckley, director of academic affairs for interdisciplinary science at Harvard University in Cambridge, Massachusetts.

Listen — and explain "Traditional disciplines have very different cultures, languages, criteria for judging what's good, and even senses of what science is," says West. "It's very easy to look over at another discipline and say 'that's a bunch of rubbish' — and it's important to make sure that doesn't happen."

Be humble Meetings of minds don't work if one party does all the talking, says Marten Scheffer from Wageningen University in the Netherlands. "Having alpha-male scientists at interdisciplinary institutes is a risk," he says. "If you have one or two very dominant people it can destroy openness."

Be patient Sean Eddy of Janelia Farm in Virginia started his research career as a developmental neurobiologist. He's now a computational biologist, but it's taken him until his early 40s to learn the requisite computer science, maths and statistics. "It was slow and painful," he says. "It's only just now that I feel I'm trained enough across three or four fields that I can get something done."

Be brave Exploring new ground is risky, says Janelia Farm director Gerald Rubin. "This isn't a place for every scientist. You need a large amount of self-confidence and the willingness to take risks. We say: 'We're going to bet \$10 million, and you're going to bet your career'." **J.W.**

Traditional universities such as University College London (left) are restructuring to encourage interdisciplinary research, inspired by the purpose-built Janelia Farm Research Center (top). Collaborations are fostered at canteens (Santa Fe, middle) and in the bar (Janelia Farm, bottom).

amount of inertia, and individuals have a great vested interest in the way they were trained, and what they were doing yesterday."

"It's the Walmart model of the university," complains pharmacologist David Colquhoun of University College London, who is unhappy that his department has become part of a new faculty of life sciences. "There's never been any barrier to interdisciplinary work — you can just pick up the phone or e-mail."

Publishing problems

But neuroscientist Paul Grobstein, who ran an interdisciplinary centre at Bryn Mawr College in Pennsylvania, says that traditional structures make it hard for researchers to be interdisciplinary. "Younger faculty tend to be concerned that if they get involved [in interdisciplinary work], their colleagues in the departments in charge of promotion and tenure will feel they haven't lived up to the standards of the discipline." Other problems, he says, include finding places to publish — "it's much easier for people to get published in traditional disciplinary settings" — and finding an audience. A physicist could, say, publish a paper on stock-market patterns in *Physical Review E*, but how many

economists will read it is another matter.

Such problems will be difficult to address through restructuring of traditional universities. Even advocates of interdisciplinary research think that the traditional departmental model will, and should continue to be, used in the majority of cases. It is needed, for example, to support undergraduate teaching and create excellence in specialist subjects. "The drive to form disciplines is a very reasonable one," says Sean Eddy, a computational biologist working at Janelia Farm. "It's phenomenal to be part of a group of labs all thinking the same thing." But you need the alternative, he says: "There's a normal mode of science that works very well, that I wouldn't want to change. But when you're trying to crack something really new, you need people with different experiences to work together."

Rather, Hollingsworth says, the solution may be to spend a small proportion of the national research budget on many small institutions in which scientists can work with as much autonomy as possible (see 'Escape the intellectual blinkers'), Hollingsworth says. "It's easier to establish a new research organization than it is to change an older one." ■

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