THIS WEEK

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Accidents in waiting

Every researcher and institution should question their own attitudes to safety in the lab after the death of an undergraduate student in a Yale University workshop.

The shocking death of physics and astronomy undergraduate student Michele Dufault in a machine shop at Yale University in New Haven, Connecticut, last week should grab the attention of researchers and safety officers at universities across the United States, and the wider world. Rightly, the immediate focus is on whether the university could have taken more precautions to prevent the accident. But whatever the verdict, Dufault's death — late at night and probably while working alone — should remind every researcher to consider their own attitude to safety, and whether it is crowded out by other priorities.

Most scientists are well aware of poor safety practices in their laboratories — such as too many people working on their own, students not properly trained to use equipment, or a general reluctance to wear safety glasses and lab coats. But, just as bottles of unidentified solvents can be stashed guiltily in the depths of a fume cupboard, so such problems are often pushed to the back of the mind, and only properly confronted after an accident.

Most worrying is that it seems researchers only change their attitudes to safety when affected directly by an accident, such as in their own laboratory. A tragedy elsewhere is not always sufficient motivation. After the 2009 death of research assistant Sheharbano Sangji following a fire in the chemistry department at the University of California, Los Angeles (UCLA), safety policies there, such as snap lab inspections to make sure researchers wear protective coats, were reviewed and tightened. But the impact outside the University of California system is hard to determine, and there is little evidence that other chemistry laboratories have responded by changing their practices (see page 270). This could soon change — the deaths of both Sangji and Dufault will feed into ongoing federal-level inquiries into laboratory safety by the US Chemical Safety and Hazard Investigation Board and the National Research Council.

It is certainly true that laboratory researchers work in much safer conditions now than during the more reckless days of the 1950s and 60s. But such improvements must not breed complacency. For years, environmental health and safety officers have complained that there is no good source of consistent data on laboratory accidents, which could be studied to determine effective safety interventions. As such, it is impossible to say with certainty which laboratories perform well on safety and which badly. And no one can rigorously compare academia's accident rate to that of industry.

UCLA has just announced a centre to study laboratory safety, which may start to pull together some of this information. That would be a good start, and many of the data it would need for the task already exist. Individual research departments in both academia and industry often keep statistics far more detailed than required by federal authorities — recording minor incidents and near misses, as well as major accidents. The American Chemical Society's health and safety division has started informally tracking statistics of deaths in academia and industry, to see if any discernible patterns arise. Last year, it surveyed the safety culture in chemistry laboratories, and it plans to repeat the exercise.

The UCLA centre would be a good place to pool this knowledge and make it widely available — and not just between health and safety officers, who already discuss experiences and data. There are useful examples of collaboration on safety issues elsewhere, such as an MIT peer-review process with the National University of Singapore, in which each institution audited the health and safety programmes of the other. If asked, researchers are usually more than happy to make safety policies available or send them out to others. Imperial College London and UCLA both make their safety plans widely available and grant requests for information from researchers in other countries.

"Poor safety practices are often pushed to the back of the mind and only confronted after an accident."

To see safety precautions as a drag on research is an irresponsible and counter-productive attitude, but one that is hard to change. At UCLA, for example, too many researchers see newly introduced safety officers as 'police' to skirt round, rather than experts with whom to collaborate.

Leaders of research projects must take responsibility for the safety of the scientists doing the work, and must start to work with safety officers, rather than endure them. In turn, senior figures in academic departments must realize that practices and priorities have changed since their earlier days, and be willing to shut down laboratories until any potentially dangerous working practices are improved.

The circumstances that ended the life of Michele Dufault last week may have been unusual, even unique. But universities and researchers who feel that there are no lessons to learn from such accidents are a danger to themselves and others. ■

Fix the PhD

No longer a guaranteed ticket to an academic career, the PhD system needs a serious rethink.

The world has many problems and it will take a lot of bright, educated people to solve them. So, on the face of it, it seems like a good thing that more and more people are earning PhDs in science, technology and engineering. Most countries, convinced that higher education and scientific research are key to economic growth and prosperity, are expanding doctoral education in science. The thought, as one researcher who has studied doctoral-education trends puts it, is that you can "grow PhDs like mushrooms".

The consequence of that mushrooming depends on where it is taking place, and in which discipline, as our overview of PhD systems

around the world shows (see page 276). Clearly, such expansion results in an extraordinary amount of good research (see page 283). And in the rapidly growing tiger economies, for example, most of those with PhDs quickly find good jobs.

But there are reasons for caution. Unlimited growth could dilute the quality of PhDs by pulling less-able individuals into the system. And casual chats with biomedical researchers in the United States or Japan suggest a gloomy picture. Exceptionally bright science PhD holders from elite academic institutions are slogging through five or ten years of poorly paid postdoctoral studies, slowly becoming disillusioned by the ruthless and often fruitless fight for a permanent academic position. That is because increased government research funding from the US National Institutes of Health and Japan's science and education ministry has driven expansion of doctoral and postdoctoral education — without giving enough thought to how the labour market will accommodate those who emerge. The system is driven by the supply of research funding, not the demand of the job market.

The problem is widely discussed, yet many PhD programmes remain firmly in the traditional mould — offering an apprenticeship for academic research, even as numbers of academic positions stagnate or decline. Yes, there are many worthwhile careers outside academia for science PhD holders (*Nature* would be down to a skeleton staff without them). And most people with science PhDs eventually find satisfying jobs. But they probably feel that spending years performing minipreps was not the most appropriate way to become a banker or a teacher. Widening concerns about dismal job prospects are dissuading some of the brightest candidates from taking the PhD route.

Something needs to change — but what? Ideally, the system would produce high-quality PhD holders well matched to the attractive careers on offer. Yet many academics are reluctant to rock the boat as long as they are rewarded with grants (which pay for cheap PhD students) and publications (produced by their cheap PhD students). So are universities, which often receive government subsidies to fill their PhD spots.

One way in which governments can bring about change is to better match educational supply with occupational demand. They should get smart, independent labour economists to comb through wage and employment data that reveal which types of science-related job are in short supply, and talk to stakeholders on the ground to confirm the findings. Governments should then open the doors to more PhDs only where they are most needed. Such analyses are already under way, and should be encouraged.

A second route is to reform the PhD itself (see page 261), and reset the expectations of those in the system. Imagine bright young things entering a new kind of science PhD, in which both they and their supervisors embrace from the start the idea that graduates will go on to an array of demanding careers — government, business, non-profit and education — and work towards that goal (see page 381). The students meet supervisors from a range of disciplines; they acquire management, communication, leadership and other transferable skills alongside traditional academic development of critical thinking and analysis; and they spend six months to a year abroad.

"Widening concerns about dismal job prospects are dissuading the brightest candidates from the PhD route."

Some such efforts have already begun: for example, US institutions vie to win prestigious grants from the Integrative Graduate Education and Research Traineeship (IGERT) programme run by the National Science Foundation, which promotes highly interdisciplinary PhDs (see page 280)

The IGERT scheme shows how appropriate reward structures can drive change. Governments and funding agencies should require educational institutions to release figures showing how many of their PhD students complete the course, and how many go on to find employment and where, and should award some proportion of funding accordingly. This would also help prospective students to select a good course, and force worse-performing programmes to shape up or close.

Until any of this becomes commonplace, it is up to prospective graduate students to enter a science PhD with their eyes open to the opportunities — or lack of them — at the end. Not all mushrooms grow best in the dark. ■

Home truths

A new report offers useful insight into the continuing stalemate over global warming.

In just over six months' time, officials from the world's nations will meet under the auspices of the United Nations to try again to complete the task that was beyond them in Copenhagen in 2009, to establish a legally binding treaty to curb global warming. It is hard to see why it could go any better this time — if anything, the global economic slump and the failure to pass cap-and-trade legislation in the United States will make it even harder. A report published this week in the United States does an excellent job of probing the reasons for this stalemate, and shines light on some uncomfortable truths. It should be essential reading for anyone with a passing interest in the climate-change debate.

The report, *Climate Shift: Clear Vision for the Next Decade of Public Debate*, is written by Matthew Nisbet, a professor of communication and environmental science at American University in Washington DC. It focuses on the situation in the United States, and particularly its political failure to pass comprehensive climate legislation. But the points it makes go far beyond Capitol Hill. And it effectively dismantles three of the most common reasons given by those who have tried, and failed, to garner widespread support for policies to restrict greenhouse gases.

First — the failure of the US Senate to pass a cap-and-trade bill in 2010 cannot be blamed directly on the financial lobbying muscle of the conservative movement and its allies in industry. In 2009, the report says, although a network of prominent opponents of cap and trade, including ExxonMobil and Koch Industries, spent a total of US$272 million lobbying policy-makers, environmental groups in favour of cap and trade mobilized $229 million from companies such as General Electric and other supporters to lobby for environmental issues. Indeed, the effort to pass cap and trade, Nisbet notes, "may have been the best-financed political cause in American history".

Second — most of the mainstream media coverage of climate change gets it right. During 2009 and 2010, Nisbet writes, around nine out of ten news and opinion articles in *The New York Times*, *The Washington Post* and CNN's online site reflected the consensus scientific position. *The Wall Street Journal* regularly presented the opposite view in its opinion pages, but eight out of ten news items still backed the science.

Third — conservative media outlets such as Fox News and controversies such as the coverage of e-mails hacked from the University of East Anglia in the United Kingdom have a minimal impact on public attitudes to climate change, because such influences tend to only reinforce the views of those who already hold doubts.

The failure of cap and trade in the United States, Nisbet concludes, was not down to poor communication, but was due to framing the issue of greenhouse-gas emissions as a problem that could be solved by a specific policy. More useful, he says, would be to present climate change as an issue that needs to be addressed at many levels, similar to public health or poverty. Those, of course, are far from ideal models — but we live in far from ideal times. ■

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