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Everybody's fault

The Kashmiri earthquake highlights the urgent need for Pakistan and India to put aside their differences and build stronger scientific ties.

In the past 15 years, the dispute between India and Pakistan over the military 'line of control' that divides Kashmir may have cost between 40,000 and 60,000 lives. But even that formidable death toll was surpassed in a few moments last autumn, when the boundary between the Indian and Eurasian tectonic plates shook, killing an estimated 75,000 people. The earthquake of magnitude 7.6 left many more homeless on both sides of the border.

The mayhem was made worse by the failure of either Pakistan or India to adequately address their well-established earthquake vulnerabilities. As a News Feature on page 16 of this issue reports, there is now a movement among Pakistan's geologists to deal with earthquakes. But so far, there has been no real move towards closer collaboration with researchers in neighbouring India.

Such collaboration has the potential to significantly strengthen the two nations' earthquake defences, potentially saving thousands of lives. Kashmir is home to some of the subcontinent's poorest people. They cannot afford reinforced concrete or 'seismic isolation', but they can make simple modifications to house designs — such as integrating a roof into a house's frame — that will greatly improve their chances of surviving future earthquakes. Government facilities such as schools, bridges and hospitals could also be built at relatively low cost with earthquakes in mind, dramatically strengthening future disaster response in the region.

Real change will still require substantial public investment, however. Better scientific cooperation could help both nations set priorities for such investment. By mapping and studying the many faults that run through the line of control, Pakistani and Indian seismologists could build a better understanding of which towns are at greatest earthquake risk. Together they could devise building regulations that would be sensitive to the region's limited resources while ensuring that more of their citizens would survive. They could also provide insight into how relief could be most efficiently distributed to the region in the aftermath of a major earthquake.

Both countries have recently tried to de-escalate the conflict over the disputed province of Kashmir. Collaboration in all fields of civil society, including science, has a role to play here too (see *Nature* **393,** 499; 1998). There are finally some promising signs: in the past few years, scientific leaders from the nations have met, and joint efforts are now under way in fields such as agricultural biotechnology.

But when it comes to seismology in Kashmir, the two nations are still barely talking. They are both paranoid about ceding military advantage in the disputed region — with the result that geologists bearing maps or GPS receivers are banned from entry. Consorting with 'enemy' researchers is also viewed with deep suspicion.

In May, however, geologists from both sides of the border will attend a 'science for peace' workshop in Lahore, Pakistan, where they will discuss topics such as remote sensing, geophysics and seismology, as well as the idea of turning the hotly contested Nanga Parbat glacier into a scientific peace park. The meeting's US coordinators hope that it can serve as a starting point for scientific exchange in geology.

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Both nations' scientists should take advantage of this gathering to begin serious and sustained collaboration. Their governments should make provisions to allow scientific exchange and the open dissemination of data of the sort that is needed for such work. Indian and Pakistani scientists based abroad, who often work side-by-side in Western laboratories, can help by acting as go-betweens for researchers in the region who currently share no direct contact.

If India and Pakistan are to get to grips with earthquakes, they must overcome enormous technical, social and economic challenges. The task is formidable and requires the two nations to put their manifest political differences to one side and work together. By allowing their scientists to collaborate openly, governments in both countries can gain an understanding of the risks their citizens face, and help them prepare for the future. ■

Evaluate this

The objective evaluation of research isn't working as it should.

The rigorous evaluation of research projects and programmes is in increasingly common demand across the world. Attempts have been made to implement it in Europe, Japan and the United States — but until the calibre of these efforts improves, scientists will continue, justifiably, to view them with suspicion.

Policy-makers have talked for years about the need to rigorously evaluate research programmes that consume billions of dollars of taxpayers' money. Researchers — especially those doing basic research that can't be readily tied to concrete outcomes — have tended to be sceptical. Nonetheless, evaluation is now under way on a significant scale in every major economy.

Yet nowhere is the circle between research programmes, evaluation and research funding decisions quite complete. A process for measuring 'performance' is firmly in place at many agencies. Yet few research managers genuinely believe that the outcomes of these assessments are really driving funding decisions.

Take the United States, where the Government Performance and Results Act demands significant qualitative assessment of all federal programmes. The Bush administration has also proactively pursued research evaluation through the all-powerful White House Office of Management and Budget (OMB), which sets the president's annual budget proposal. A lot of evaluation is now taking place. And to its credit, the OMB seems to have focused much of its attention on programmes that are not properly peer reviewed.

But in the end, what is the evidence that anyone in the government is listening? Where are the examples of programmes that the administration doesn't like being revived because they perform well — or ones that it intuitively favours being cut back?

Evaluation that doesn't work is, according to a discussion at the annual meeting of the American Association for the Advancement of Science (AAAS) last month, worse than none at all. It costs a substantial amount of money — anything from 0.25% to 2% of the cost of the programme under scrutiny — and it exhausts and sometimes demoralizes the researchers obliged to participate. Some argue that this process is of inherent value in lending direction to projects and programmes, but that is a minority view.

Even so, demands for accountability will not go away. The systems in place, flawed as they may be, are unlikely to be dismantled. In Japan, hard-done-by researchers are in rebellious mood (see *Nature* **438,** 1051–1052; 2005). And in the United States, the process contains little of the transparency Americans expect of their government.

The OMB is almost as secretive as it is powerful — but researchers need to be convinced that all of its evaluation is leading somewhere. Congress should therefore ask the Government Accountability Office to report on the OMB evaluation process as it relates to science and technology. Such a study, from a watchdog of established integrity, might reassure research managers that they are not being sent each year on a wild goose chase. ■

Gradual force

A delicate probe, twenty years old this week, has transformed our understanding of the nanoscale.

What difference can a breakthrough in science make over two decades? A quick comparison of the respective fates of two discoveries made twenty years ago reaffirms how daft it is to try to predict research outcomes over such a timescale.

Both tales begin at IBM's Zurich research laboratory in the early 1980s. In one corner of the lab, Gerd Binnig, Heinrich Rohrer and others were building an instrument that would come to be known as a scanning tunnelling microscope (STM). In another, Georg Bednorz and Alexander Müller were doing experiments on materials that they thought might hold promise as superconductors.

In early 1986, Bednorz and Müller got the first hints that they were on to something. An oxide of lanthanum, barium and copper seemed to retain the ability to conduct electricity without resistance at temperatures of up to 35 K (−238 °C). This, at the time, was striking: for more than a decade, the ceiling on transition temperatures for superconductors had been stuck at less than 24 K.

Within months of publishing their first paper (*Z. Phys. B* **64,** 189–193; 1986), the result was successfully replicated, and interest in its ramifications exploded. The buzz over high-temperature superconductivity at the March 1987 meeting of the American Physical Society in New York was such that *The New York Times* dubbed the event "the Woodstock of physics".

By the time Bednorz and Müller picked up their Nobel prize in December of the same year, similar ceramic materials that could superconduct at the temperature of liquid nitrogen, 77 K (−196 °C), had been discovered. This, it was thought, would open the door to widespread practical use — and, briefly, industrial and government funding surged in at the speed of the magnetically levitating trains that the field was, according to countless news stories, due to produce in the fullness of time.

By contrast, few members of the public had even heard of the humble scanning tunnelling microscope, which Binnig and Rohrer first described in an internal IBM document in March 1981. It took until 1986, by which time the STM was already widely used to study materials, for them to receive the Nobel prize.

An STM exploits a quantum phenomenon called electron tunnelling: when two conducting materials are held close together and a voltage is applied, electrons hop from one to the other, producing a current that is highly sensitive to the distance of separation. An STM scans a sharp tip over a surface, translating the current registered into a topographical map of the surface. The instrument was powerful enough to reveal the positions of atoms.

But the STM only worked for materials that conduct electricity, which many of the things that interest biologists and materials scientists don't do. This problem was addressed by a paper published twenty years ago this week, on 3 March 1986. The paper, 'Atomic force microscope' (*Phys. Rev. Lett.* **56,** 930–933; 1986), introduced the instrument that has fuelled the current explosion of interest in nanotechnology.

The atomic force microscope traces topography by scanning a sharp tip over the surface. It measures tiny forces between the tip and the sample via the deflection of a thin cantilever to which the tip is attached. This is an immensely versatile technique (see page 14), and that first paper has clocked up more than 4,500 citations.

"Atomic force microscopy is an immensely versatile technique."

High-temperature superconductivity, on the other hand, never quite lived up to its commercial hype. The materials in question have been difficult to fabricate, their properties are more constrained than some physicists had hoped, and there is still no agreement on why they work as they do (see papers in this month's *Nature Physics*). The materials remain rich systems for experimental study and pose intriguing theoretical problems, but their practical use is largely confined to making superconducting quantum interference devices (SQUIDs) to measure magnetic fields, and prototype transmission lines that can carry high-density current.

In terms of their technological and economic application, it looks like the dark horse made it to the wire first. That should serve to remind managers of research agencies and industrial laboratories of the folly of trying to predict how much value any particular scientific breakthrough may hold. ■