new technologies consistent with the principle. Assurance bonds, pre-market testing and post-market surveillance allow us to move forward carefully but to shift the responsibility for harm to the proponent of a technology. The gains achieved through 'clean production' methods provide evidence that implementation of the precautionary principle stimulates, not stymies, innovation. Clean production involves the prevention of harm at source through the use of less material-intensive and toxic production systems and products, and was a logical outcome of the principle's demand for preventive action in the face of uncertainty. The question asked is switched from 'how much pollution is acceptable?' to 'how much can we prevent?'.

Holm and Harris suggest that we wait for damage to occur before taking action. Unfortunately we already have a hole in the ozone layer, marine fish stocks are depleted, and climate change threatens future generations. The challenge is to prevent harm before it occurs.

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Sweden's answer to genomics ethics

Sir — DeCODE genetics, the Icelandic genomics company, objects[1] to critical viewpoints on its ethical practices in a News article[2]. DeCODE also criticizes the favourable review of the ethical practices of UmanGenomics, a Swedish genomics company. We disagree with deCODE's distorted description of UmanGenomics[3,4].

DeCODE says that its ethical guidelines are better than those anywhere else. However, UmanGenomics has a unique formula for handling ethical issues, developed in parallel with the ethical guidelines for use of genetic biobanks published by the Swedish Medical Research Council. This procedure was correctly described in the News article.

UmanGenomics developed a unique ethics formula fully acceptable to the individuals in Västerbotten county because it is these people who made UmanGenomics' business possible. Another reason is that UmanGenomics' customers, pharmaceutical companies, are known to refrain from collaboration with organizations that may draw them into questionable ethical issues.

It is not clear why deCODE states that "government committees and bureaucrats" granted UmanGenomics permission to use its medical bank. UmanGenomics does not own a biobank, as explained in the News article. The collaboration between the Medical Bank in Umeå and UmanGenomics is regulated by a business agreement, as is common practice between two legally separate units.

Without having access to the shareholders' agreement, and thus no knowledge about how the ownership of UmanGenomics may be exercised, deCODE gives the impression that the proper use of the biobank is not assured as "governments have a bad record on violation of privacy"! This statement is totally out of context.

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2. Abbott, A. *Nature* **400,** 3 (1999).
3. Hauksson, P. *Nature* **400,** 707–708 (1999).
4. Sigurdsson, S. *Nature* **400,** 708 (1999).

Ethics training more important than ever

Sir — Scientific enterprise is built on a foundation of trust, and research ethics are the cornerstones: they define the boundaries of responsible conduct and sustain further enquiry. Ethics are of increasing importance in today's competitive environment as the barriers between industrial and academic research diminish. Yet young British scientists often receive no formal training in research ethics.

Many students are exposed to ethics only through the example of their mentors as issues arise. I believe that ethical principles and the skills of ethical analysis should be taught explicitly to graduate students, and then reinforced by example.

I benefited immensely from the mandatory instruction in research ethics[1] that I received as a graduate student at Johns Hopkins University in Baltimore, Maryland. So, recently, I led a discussion on ethics for UK biology graduate students. The students were given copies of *On Being a Scientist: Responsible Conduct in Scientific Research*[2], which deals with issues such as conflicts of interest, subjectivity and bias, credit and authorship, and misconduct. The students enthusiastically discussed the principles of ethics, analysed the dilemmas, and shared personal experiences. The event was so well received that next year it will be expanded into a series of discussions. I hope that faculty members at other institutions will start similar programmes.

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Latin America treats science as a curiosity

Sir — Latin American politicians rarely have a clear understanding of the role that science and technology play in the modern world: these are simply seen as parts of the political game.

Commitment to those in power counts for more than professional expertise when it comes to both research funding and appointment to decision-making positions. As a result, research activities are plagued by disruptive political instabilities. Funding is not only scarce, but poorly distributed and badly spent: programmes are established without clear scientific objectives and money is given to researchers who lack the right scientific background.

This pattern may not apply to some Latin American institutions, but it is generally valid and does much to explain why Latin America's contribution to the production of knowledge is so small.

National research councils have been established throughout the region, along with modern universities with research programmes. But efforts have been mainly directed towards maintaining this uppermost level of scientific activity. Science education has never been given priority in state schools. There are few science museums for the public or specialist journalists who can spread science news in an accessible way.

This situation reflects an official belief (never explicitly expressed) that Latin America needs only a limited number of top scientists, not a scientifically literate population. It permeates research agendas and budgets, encouraging advanced projects without thought for the limitations of local expertise and industrial infrastructure, leading to frustration and wasted resources. The authorities neglect to develop modest programmes that could help strengthen a scientific culture.

Without decisive action in this latter direction, science in Latin America will continue to be a curiosity and, at most, a source of personal prestige for some gifted scientists. The ever-widening technological gap that separates us from the industrialized world will not be filled without bridges between popular thought and the language of science.

One of the greatest challenges in establishing an independent research capacity in developing countries is to support both the spread of scientific culture and the strengthening of local research teams. Both deserve adequate funding and training.

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