Biotech companies must get back to basics to weigh up risks

Sir — A substantial acreage of US fields is now given over to transgenic plants that produce an insecticidal protein (a derivative of the *Bacillus thuringiensis* insect-control protein CryIA, also known as *Bt* toxin). In an effort to restrict the spread of resistance to *Bt* toxin, the use of refuges — areas of non-transgenic plants planted close to the transgenic variety — has been adopted. In News and Views[1], M. J. Crawley wrote: "The strategy might be expected to work because resistance is usually a genetically recessive trait".

However, F. Huang *et al*[2] have recently shown that, for the European corn borer, resistance is an incompletely dominant trait. Although the significance of these results has been challenged[3], they may mean that refuges will not work for this insect, a major agricultural pest in the United States.

This is something that should have been established before the widespread planting of transgenic corn. It's hardly surprising that there is distrust of agri-biotech companies[4], when they do not put significant effort into answering the basic questions that enable such risks to be evaluated.

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California's libraries get wired up to e-journals

Sir — I would like to respond to the article by Rex Dalton about the acquisition of electronic journals at California State University ("Bumpy ride for 'core e-journals' project," *Nature* **400**, 200; 1999). It is true that CSU will license fewer e-journals for its Journal Access Core Collection (JACC) than were initially projected. But the future of the project is by no means uncertain. Indeed, we consider our efforts highly successful. This project has laid the groundwork for other universities to follow in the future. For CSU it represents the first of what we hope will be many attempts at licensing additional e-journal resources which conform to JACC requirements.

Dalton's statement that the JACC project is "widely seen as a radical move with little faculty input" is inaccurate. The selection of 1,300 titles for JACC was based on the fact that 15 or more of the 21 CSU libraries were already subscribing to those titles in print. Faculty members have always had input to the selection of journals at CSU libraries and they all look forward to the many benefits that our transition to the electronic form will bring.

Finally, we understand that some libraries remain wary about dropping print subscriptions and are taking a wait-and-see approach to JACC. But this attitude is universal and it's not just about JACC. It's about the entire medium and has everything to do with the fact that many publishers have yet to consider the realities of a changing market and the needs of their customers.

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Sensible precautions make good science...

Sir — Søren Holm and John Harris strongly criticize the precautionary principle but they seem not to understand it (*Nature* **400**, 398; 1999). They complain that it is not valid for evaluating evidence, when that is not what it is for. It is a tool for decision-making, and, like many such tools, deals in expectations rather than probabilities.

The point is that it requires us to take into account not just the probability that a technology will be hazardous, but also the benefits if it succeeds and the costs if things go wrong. There may have been a very small probability that a large ship travelling at high speed in the North Atlantic would hit an iceberg, but the captain of the *Titanic* should have thought more about what could happen if it did — and all the more so because it didn't really matter if the voyage lasted a few hours more.

Holm and Harris argue that the precautionary principle would have stopped us developing genetically modified organisms (GMOs) because the greatest uncertainty about their possible harmfulness existed before anybody had produced one. But the principle does not demand that we halt research if we cannot be certain the end result will be safe (though common sense suggests it is unwise to make large investments if the end result is likely to be dangerous). It is to be applied at each stage in the process, weighing the risks in going one step further against the likely benefits if the project is successful.

That is why we and many others are arguing not for a complete ban on research into GMOs but for a five-year moratorium on field trials and commercial planting. There is a lot more research to be carried out in the relative safety of a closed laboratory first. This is always good practice, but it is especially important in the case of GMOs because of the irreversibility that is inherent in the technology. If a new drug proves to be harmful we can withdraw it, but once genes have left the laboratory there is no calling them back. The experiments in which GM milkweed was found to harm the monarch butterfly were performed in contained conditions; had this been discovered in field trials, the gene might already be spreading through the environment.

Our objection to the current field trials of GM crops is based not on whether commercial planting would be safe (though we are concerned about that), but on whether the trials themselves are safe — and whether they are well enough designed to be worth the risk. Neither has been shown to be the case. At the end of a moratorium, a much better-informed risk assessment should be possible.

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...and can mean saying 'yes' to innovation

Sir — As conveners and participants in the conference that issued the Wingspread Statement we would like to respond to the Correspondence by Holm and Harris. The precautionary principle does not instruct us to balance evidence in a specific way. It requires us to evaluate honestly all the evidence and the uncertainties. The precautionary principle comes into play when decision-makers suspect that a course of action may have harmful effects but are uncertain about their cause and possible extent. It demands more, not less, science in decision-making, relying on multiple lines of evidence from diverse disciplines and constituencies of interest.

Holm and Harris contend that the precautionary principle will block innovation. On the contrary, application of the principle may result in saying 'yes' as well as 'no'. 'No' does not always mean a prohibition, but can mean any of an array of measures to prevent harm. For example, precautionary action may consist of restrictions on use and emissions pending further examination, a requirement to monitor for impacts of an activity as a condition of going ahead, cradle-to-grave product responsibility, labelling, or requiring a proponent to examine alternatives to the use of a potentially dangerous chemical or activity.

Methods exist for regulatory approval of

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.

Sune Rosell

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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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