assessment of the global balance of power among the major players in the debate, and its implications for the legitimacy of the scientific arguments being put forward.

The estimated \$6 billion market for xenotransplants, for example, and the huge public demand for organs, have been intelligently interpreted by many as considerations that could influence assessment of the real risk that the technology could create pandemics (see *Nature* 391, 320–325; 1998).

It has been of little help that the most outspoken scientists on the matter tend to be those with interests in seeing the technology progress. The delays to introducing the technology may not have pleased private investors. But they have forced a broader discussion of the issues.

As for GMOs, a massive campaign by Monsanto to educate the public only reinforced perceptions that the company was unhealthily powerful and keen to flatten debate. The public needs to be reassured

that the balance of power on such issues — long dominated by powerful multinationals and the scientific community — has become more even and trustworthy.

A new contract is evolving, in which scientists, like other 'experts', will be forced to redefine their roles in shaping public policy. The violent backlash against experts, and current resistance to GMOs, can be seen as an inevitable part of a transitional period from the old order — where scientific authority prevailed — to a more sophisticated approach to managing scientific and technological change.

Some common threads are already emerging, such as the need to broaden the expertise of advisory committees to include consumer and other organizations, complete transparency in decision-making procedures, and not allowing wolves (such as agricultural ministries) to guard sheep (such as public health). In this new order, scientists and their professional societies will need to be more active in carving out a

role as honest brokers who can help clarify the issues and ensure impartial information.

But this rethink could not have come at a better time. Over the next few decades, the human and environmental consequences of scientific research will become much broader, and the lessons of the last decade will need to be taken on board if the full promise of biology is to be realized.

This may require scientists taking more of a back seat. Human genetics is leading to a worrying rise in many scientific quarters of insidious and naive genetic determinism, which, if allowed to dominate public policy, could ultimately discriminate, ostracize or even eliminate those not meeting some genetic norm.

Thomas Jefferson did not need genetics to know that humans are not born equal, and that constitutions should compensate for these inequalities. Many of the ethical issues raised by genetics are human rights issues. Scientists are not experts in this area — and thus have little to say. **Declan Butler**

'Japan's scientists must learn to take action'

David Swinbanks is the Asia-Pacific editor of *Nature*, and has been on its Tokyo staff since 1985.

Tokyo

At the start of the new millennium, can scientists in Japan look forward to a bright future? On the surface, things seem to be improving. Following the new basic law for science and technology and the associated five-year plan, launched in 1995, large amounts of extra public funds have been pumped into science.

Japanese scientists are publishing increasing numbers of papers in international journals, and Japan stands second only to the United States in terms of the output of papers in the Science Citation Index of the US Institute of Scientific Information. But underlying these superficial improvements, deep-rooted problems remain.

Japanese scientists made a significant contribution to the recent milestone paper on the sequencing of human chromosome 22 (*Nature* 402, 489–495; 1999). But while their counterparts in the West worked in comfortable, modern facilities armed with bankloads of DNA sequencers, the scientists at Keio University, who made the Japanese contribution, had to make do with a handful of sequencers in a dingy, cramped laboratory in the basement of one of the university's oldest buildings.

The appalling laboratory conditions in

Japan's leading universities were highlighted in the early 1990s by Akito Arima, then president of the University of Tokyo. In response, the government pumped money into new university buildings. But most university researchers must still make do with buildings and laboratory conditions more akin to those in the Third World than in one of the world's leading economies.

To some extent, conditions have actually worsened. In a government push to strengthen graduate schools and university research, the number of graduate students in national universities has doubled in the past decade to 180,000. But the laboratory floor space available has increased by only 10 per cent, according to a recent report by the Japan Science Council, a body of academics that advises the government. Thus, researchers are crammed into even less space.

Starved of funds

The five-year plan to increase public spending on science by 50 per cent between 1996 and 2001 has triggered a plethora of large research grants from the various science-related ministries. But most of this extra money has gone into buying new equipment rather than the fundamental renovation of infrastructure that is required.

Furthermore, the money is dispersed in an uncoordinated and wasteful fashion by the several ministries, with some researchers receiving far more than they need while others who may be equally deserving are starved of necessary funds.

This is the case with the researchers at

Keio University who, despite making world headlines, are not benefiting from the bonanza in funding for genomics-related research that the government plans to provide at the start of the new millennium (see *Nature* 402, 569; 1999).

Who is to blame? Much of the fault clearly lies with the fact that the ministries and agencies responsible for science are more concerned with preserving and expanding their own budgets than with focusing on the overall needs of the country.

The merger of the Science and Technology Agency with the Ministry of Education, Science, Sports and Culture (Monbusho), due to be complete by next year, is an attempt to restructure and improve efficiency in the government's management of science. But the officials at the education ministry are experts at creating inefficient and ineffectual bureaucracies, and are hardly in a position to lead restructuring forward.

But Japan's scientists are also to blame for their passive acceptance of the poor conditions under which they have to work. Reformers such as Arima who lobby for change are the exception, and, rather than receiving support from their colleagues, they are often criticized for being too outspoken.

The university system is riddled with unproductive faculty members content to work out their lifetime employment with the minimum of effort. As a result of the Asian recession, Japanese industry is in the throes of major restructuring.

A similar shake-up of the university system is required. The government's moves to

convert universities into semi-autonomous 'agencies' is being presented as an attempt to introduce more efficiency, accountability and cost-effectiveness. But the real drive behind this proposal is merely a shallow attempt by politicians to reduce, on paper, the number of government employees by removing university staff from the official government payroll, while taxpayers will continue to foot the bills.

Japan's best scientists will no doubt soldier on, making significant contributions to science in the face of adversity. Their situation, however, will only improve if scientists themselves join together to form more effective bodies to lobby the government and to build greater public awareness and under-

standing of science. They also need to make far greater efforts to bring about much-needed reform within their own institutions.

Some small steps in this direction have been taken. Early last year, for example, Earth, marine and atmospheric scientists from various departments at the University of Tokyo linked up to create a new interdisciplinary regrouping of departments. The new arrangements were then opened to external comment and review by a team of foreign and Japanese scientists.

Only through such grassroots activity by scientists themselves can there be hope for significant improvement in the working environment of Japanese scientists in the new millennium.

David Swinbanks

'I have reported on astonishing achievements in times of hardship'

Alison Abbott is senior European correspondent for *Nature*, and has been based in Munich since 1992.

Munich

I seem to have spent much of my seven years as *Nature's* Munich correspondent reporting depressing news of recession, budget cuts, broken political promises and disappointed scientific hopes.

Certainly all the European science organizations, including the European Southern Observatory (ESO), the European Laboratory for Particle Physics (CERN), the European Molecular Biology Laboratory and

the European Space Agency (ESA) have seen their budgets fall in real terms during these years. And the erosion of research budgets in Germany, Italy and neighbouring countries have confirmed the fickleness of political promises.

But I have also reported on astonishing achievements in times of hardship. For example, CERN is building the Large Hadron Collider, which will be the world's most powerful particle accelerator when it begins the search for the Higgs boson in 2005.

ESO's Very Large Telescope, now being built atop a remote mountain in northern Chile, will be the world's largest and most advanced optical telescope when it becomes fully operational in 2003. ESA, despite its clipped wings, has launched several important scientific missions, including the X-ray satellite XMM launched just before the end of the millennium. Unfortunately, no such grand visions are pushing the frontiers

in the life sciences, where investment is sadly lacking both in Germany and Italy.

But the greatest achievement that I have witnessed has been the rebuilding of research in east Germany after reunification (see *Nature* 401, 635; 1999). This has been more than just watching buildings sprout up among the *Plattenbau* (concrete apartment and office blocks). It has also been about watching the complex social readjustments within the east German scientific community, which had lost so much during the last ideologically and financially bankrupt years of communism.

Many scientists lost even more following reunification. More than half lost their jobs,

and most of those who did not found themselves working for west German research directors. Few could seek refuge in a sense of injustice, as personal restrictions and material shortages were immediately replaced by freedom and plenty, courtesy of the west. Even those most deeply humiliated by the west German take-over admit to its historical inevitability, even necessity.

Interviewing in east Germany has always been a poignant experience, leaving feelings of both optimism and sadness, and a vague guilt for my luck at having been born in peacetime and on the right side of the Iron Curtain. The saddest story I covered concerned the suicide of an east German professor who was cleared of abusing communist party connections to the detriment of his colleagues — but only after his job had been given to someone else.

The most frustrating stories to unravel have been those on the restructuring of a reunited Berlin, for which the western side of the city paid a high price. It was hard to feel too sorry for west Berlin scientists, who had been kept in relative luxury — sometimes indolence — by subsidies that vanished when the city lost its island status, and who were forced to share their bounty with their new colleagues in the east.

Interviewing in Berlin was exhausting, as both sides of the divide expressed their deep frustration, or even anger, with gusto, wearing their mutual antipathy and lack of understanding with pride.

In the relative calm that now prevails, it is clear that east Germany has gained much more than it has lost from post-communist restructuring. So has west Germany, in that cash shortages have forced it to become more competitive.

Further east, the balance is less clear-cut.

Walls came tumbling down: the reunification of Germany led to a short, sharp shock for east German scientists, but the whole country's science has emerged the better for it.