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Food for thought: evidence that Mexico's diverse maize (left) is contaminated by transgenic strains is hotly contested; GM proponents argue that the technology will benefit those in rice-growing areas.

Agribiotech

More heat than light

Another year, another controversy: that was the story in the perennially contentious area of genetically modified (GM) crops.

In 2002, arguments centred on David Quist and Ignacio Chapela's study of Mexican maize. It was simultaneously a bitter ideological feud among biologists at a single US university and a flashpoint between the agribiotech industry and anti-GM activists over the acceptability of transgenic crops in the developing world — which is becoming a key battleground. And it illustrated how, in this field, the quest for scientific truth is conducted in a minefield of opinion and accusations of vested interests.

The story began in November 2001, when Chapela, an assistant professor at the University of California, Berkeley, and Quist, his postdoc, published a paper in *Nature*[1] reporting that a 'promoter' sequence from transgenic crops was present in native Mexican maize, and had fragmented throughout the genome. It was a provocative finding, as Mexico is the world's centre of genetic diversity for maize, and operates a moratorium on commercial GM planting.

Supporters of GM technology pored over the paper, and soon argued that the pair's results were an artefact of the molecular techniques they had used[2,3]. Quist and Chapela disagreed, but the further evidence they produced[4] failed to convince all of the experts, and in April *Nature* published the exchange with an editorial note[5] saying that, in hindsight, the original paper's publication was unjustified.

By this time, pro- and anti-GM websites were buzzing with claims and counter-claims, and journalists were realizing that many of Quist and Chapela's scientific opponents also had Berkeley connections. Indeed, some critics had clashed with Chapela and Quist over the pair's opposition to Berkeley's controversial deal with Syngenta, which gives the Swiss-based agribiotech firm privileged access to the findings of the university's plant scientists. It then emerged that some Internet postings attacking Quist and Chapela had been made from computers at a public-relations firm retained by GM giant Monsanto of St Louis, Missouri. Clearly, this was not solely a technical debate.

The scientific facts remain unclear. For months, Exequiel Ezcurra, president of the National Institute of Ecology in Mexico City, has been suggesting that Mexican scientists have replicated Quist and Chapela's findings, but the results have yet to appear in a peer-reviewed journal. Meanwhile, scientists at CIMMYT, the International Maize and Wheat Improvement Center in Texcoco, Mexico, have drawn a blank in their search for transgenic DNA in Mexican maize.

Why is everyone so agitated about the alleged contamination? In part, the answer is that developing countries such as Mexico now represent the front line in the war over GM technology. Agribiotech companies have largely saturated the North American market, and face a bleak future in Europe thanks to consumer opposition and the imminent introduction of strict labelling for GM food. The consumers and farmers of Central and South America, Asia and Africa represent the firms' main potential for growth.

Some companies are keen to stress the benefits that the technology could bring to rice farmers, for example. This year saw the publication of drafts of the entire rice genome[6,7], plus finished versions of two of its 12 chromosomes[8,9], and GM proponents are full of ideas for how the crop could be improved. Among the most appealing is the prospect of launching a second 'Green revolution' by radically overhauling the efficiency with which rice makes sugars by photosynthesis[10].

But such goals remain distant. In the eyes of many activists, GM crops are primarily tools to advance the profits of agribiotech firms and wrest economic control of the food chain from small-scale farmers. This helps to explain one of the year's most perplexing developments: the decision of several southern African countries, though facing famine, to reject US offers of food aid containing GM grain. Most have since relented, provided that the grain is milled to prevent planting. But as *Nature* went to press, Zambia was still holding out.

Elsewhere in the developing world, attitudes are diverging. India emerged as a GM proponent in March when it approved commercial plantings of cotton engineered by Monsanto to produce bacterial insecticide. In Brazil, meanwhile, the official line seems set to swing against transgenic agriculture after the victory of Luiz Inacio Lula da Silva, a left-winger allied to the country's small-scale farmers, in October's presidential election. Lula's adminstration replaces a government that approved commercial planting of GM soya, only to be blocked by a legal challenge from Greenpeace and a local consumer group. The case is still awaiting resolution.

Doubts remain, however, about the developing world's ability to implement and monitor policies on GM agriculture. Despite the *de facto* moratorium imposed by Brazil's court proceedings, much of the soya grown in the southern state of Rio Grande do Sul is

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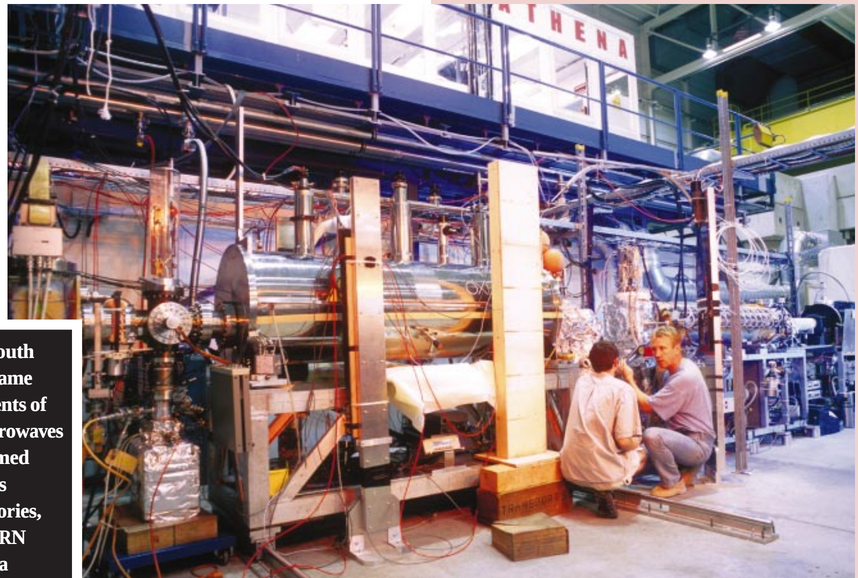

CERN

From the South Pole (left) came measurements of cosmic microwaves that confirmed cosmology's leading theories, while at CERN near Geneva (right), two teams captured atoms of antihydrogen.

derived from GM grain imported illegally from Argentina. And unapproved GM cotton varieties have reportedly been widely planted in India, hampering attempts to monitor the environmental and economic impact of the officially sanctioned crops. ■

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1. Quist, D. & Chapela, I. H. *Nature* **414,** 541–543 (2001).
2. Metz, M. & Fütterer, J. *Nature* **416,** 600–601 (2002).
3. Kaplinsky, N. *et al. Nature* **416,** 601–602 (2002).
4. Quist, D. & Chapela, I. H. *Nature* **416,** 602 (2002).
5. *Nature* **416,** 600 (2002).
6. Yu, J. *et al. Science* **296,** 79–92 (2002).
7. Goff, S. A. *et al. Science* **296,** 92–100 (2002).
8. Sasaki, T. *et al. Nature* **420,** 312–316 (2002).
9. Feng, Q. *et al. Nature* **420,** 316–320 (2002).
10. Surridge, C. *Nature* **416,** 576–578 (2002).

Cosmology

It all adds up

The embers of the Universe's primordial fire continue to provide cosmologists with data against which to test their ideas. And the most reassuring news this year has been that their favourite theories seem up to the job.

September saw the release of new results on the cosmic microwave background (CMB), the blanket of microwave radiation that pervades the Universe. The microwave photons that make up the CMB date from just 300,000 years after the Big Bang. By analysing enough of them, cosmologists can detect faint records of conditions in the youthful Universe.

For 271 days over the past two years, researchers used the Degree Angular Scale Interferometer (DASI), an observatory at the US Amundsen-Scott South Pole Station, to study microwave photons coming from two small patches of the Antarctic winter sky. The images from each day were combined into a single super-high-resolution picture, which revealed a slight polarization in the microwave background.

The polarization was created by electrons surfing the waves of energy that swept through the early Universe, says John Carlstrom, an astronomer at the University of Chicago and leader of the DASI project, who announced the news at the International Workshop on Particle Physics and the Early Universe, held in Chicago. The results are published in this issue of *Nature*[1–3]. As electrons sped along the front of the wave, they reflected photons in a preferential direction, causing the radiation in certain areas of the Universe to become polarized. When the electrons eventually fell into orbit around protons, the radiation escaped, taking with it a record of the energy waves.

The polarization data back up other results to come from studies of the CMB. During the early 1990s, temperature differences in the CMB were detected[4]. Cosmologists suspect the differences were caused by clumps of matter in the early Universe, which seeded the growth of the web of galaxies we see today. According to the leading theory, these clumps of matter were created by the energy waves — so detecting evidence of the waves was important. "The polarization is a unique signature," says Carlstrom. "If it wasn't there, we'd have to throw out this theory of waves, which means we'd have to throw out all of our recent interpretations of the CMB."

NASA's Microwave Anisotropy Probe satellite, launched in June 2001, will provide a more detailed all-sky picture of the polar-

Highlight: Antihydrogen

Holding up a mirror to physics' world view

Atoms from the mirror world of antimatter were captured and analysed for the first time this year. Two teams at CERN, the European Laboratory for Particle Physics near Geneva, have created large numbers of long-lived antihydrogen atoms, which can be used to test fundamental theories about the Universe.

In total, the teams produced thousands of antihydrogen atoms by using magnetic fields to bring together antiprotons and anti-electrons. This was a considerable technical achievement in itself, but the real interest lies in studying the properties of antihydrogen. Theory suggests that it should mirror the properties of hydrogen, but no one knows for sure, says Rolf Landua, spokesman for the ATHENA collaboration, which announced its results in September[1].

The standard model of fundamental particles and forces holds that hydrogen and antihydrogen should have the same properties and obey the same rules, but it can't predict why the Universe is almost devoid of antimatter. Finding a difference between matter and antimatter could lead to an explanation, and perhaps force physicists to reformulate the standard model.

A second CERN team, called ATRAP, has also captured antihydrogen atoms[2], and has subsequently made preliminary measurements of their most excited energy states[3]. "There's still a lot of work to do," says Gerald Gabrielse of Harvard University, spokesman for ATRAP.

"This is just the start," agrees Landua. "Everything is fresh; we haven't exploited all of our potential."

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1. Amoretti, M. *et al. Nature* **419,** 456–459 (2002).
2. Gabrielse, G. *et al. Phys. Rev. Lett.* **89,** 213401 (2002).
3. Gabrielse, G. *et al. Phys. Rev. Lett.* **89,** 233401 (2002).