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From the Editor

This is a bumper issue with many hot topics that are inextricably linked in the current scientific debate on genetic engineering: Genetic civil rights and global ethics which require urgent attention in the fall-outs from the human genome project; the crisis of public confidence and of science created by the corporatization of science; the repression of scientific dissent; victimization of independent scientists who try to tell the truth; the suppression of scientific data; the use and abuse of the precautionary principle in collecting and interpreting scientific evidence; the persistent failure of our regulatory authorities to heed sound scientific advice to protect health and the environment; the scandal of bad science and big business in xenotransplantation, biological weapons and many more.

Though not directly concerned with genetic engineering, our star feature is an article by Harash Narang, a brilliant, independent scientist who lost his job in the BSE crisis that he could well have prevented. It illustrates the corporatization and repression of science and scientists that are having drastic effects on public health and democracy, as well as on the ethical practice of science.

Among the new postings on ISIS website is a compilation of scientific advice given by scientists of the US Food and Drug Administration (FDA) which went unheeded, and remained unknown to the public until the biointegrity lawsuit brought by civil society forced the FDA to release the secret memos.

Due to the uncertainties of funding and other reasons, this may be the last ISIS News, *though we sincerely and desperately hope not*. We also hope you can take up our collective struggle for socially and ecologically accountable science to serve a just, equitable and compassionate world. Give ISIS News to all your friends. Copy and distribute as widely as possible.

And don't forget to publicize our World Scientists' Statement and Open Letter. Get your fellow-scientists to sign on and be counted.

Genetic Civil Rights Alert

To prevent companies and governments from stealing genes, invading genetic privacy and undermining human rights and dignity, we urgently need a Genetic Bill of Rights and a Global Ethics Council, ***Mae-Wan Ho*** *warns of the fall-outs from the human genome project.*

A visit to your local hospital, or a routine medical check-up may result in your DNA being 'finger-printed' into a database owned by a private company or by the government. Your gene sequences and cells may be patented and sold on the open market without your ever knowing about it. Your genetic information can be correlated with your life-time habits and medical history. Using this kind of genetic information, mass screening can be done. If you happen to carry a gene or genes associated with a whole range of diseases, you may be refused unemployment and health insurance. Should you wish to have children, your health insurance provider may require prenatal screening of the foetus, or pre-implantation screening of embryos in order to eliminate the 'bad' gene(s). Not only that, if you are ever suspected of having committed a crime, this information can be used to track you down in no time at all. The UK Government is committing major public funds to creating a DNA database of some three million suspects, to be held by the police.

These are some of the fall-outs from the Human Genome Project (see Human Genome: The Biggest Sellout in Human History, this issue). And it has prompted the public interest organization, the Council for

Responsible Genetics in the US to draft a comprehensive Genetic Bill of Rights www.gene-watch.org to protect "human rights and integrity" and the "biological integrity of the earth". This is a very timely document that should serve as an excellent basis for legislation notably missing or incomplete worldwide.

But even this Bill of Rights may be inadequate to cope with rapid developments further down the line, such as human cloning, cell and tissue replacement and embryonic stem cell techniques. These procedures are likely to lead to an increase in international trafficking of human cells, eggs and embryos. Already, according to a South African government official who spoke at the recent State of the World Forum (see ISIS Gagged in State of the World Forum, this issue), biotech companies have contracted hospitals in South Africa to ship frozen placentas of black people to Paris.

A Global Ethics Council consisting of independent scientists as well as a representative cross section of civil society should be established as a matter of urgency to deal with these gross violations of human rights, privacy and dignity.

Corporatization of Science Threatens Integrity of Science

Top unions launch a Charter for Science, **Brian Goodwin** reports

The corporatization of science has come to a head. Trade union leaders warn that the integrity of British science is being threatened by "a dash for commercial cash', reports the Times Higher Education Supplement (Sept 8), the main newsprint for University academics.

An alliance of four leading unions (lecturers' union NAFTHE, the technicians' union MSF; the Association of University Teachers AUT and the Institute of Professionals, Managers and Specialists IPMS) launched a "charter for science" at the British Association's Festival for Science at Imperial College last week. The charter will include safeguards for those who blow the whistle on unethical scientists and their practices. An IPMS survey earlier this year found that unethical behaviour is shockingly common: a third of scientists working in government or in recently privatised laboratories had been asked to change their research findings to suit the customer's preferred outcome, while 10% said there was pressure on them to bend their results to help secure contracts.

In Britain's handful of top research universities, dependence on private sources of income is acute, often amounting to 80-90% of the total research budget. The charter says that research must be guaranteed "by peer review, open publication and by autonomy over a significant proportion of its resources". Commercialisation smashes all three tenets. The only way to be sure that science retains its integrity is to enshrine open and clear-cut whistleblowing, the unions claim.

ISIS Gagged in State of the World Forum

Prominent progressive figures and world leaders in science and the global society have been invited to this year's State of the World Forum held in New York (4-10 September) raising great hopes that genuine dialogue may begin to heal the divisions in society that led to the collapse of the World Trade Organization Conference in Seattle. But Mae-Wan Ho experienced the dark underbelly of repression and the insidious extent to which corporate science has infiltrated civil society.

I was invited to attend this year's State of the World Forum (SWF) by some of the co-organizers of the event at least six months ago. Some time later and quite independently, John Templeton Foundation and International Space Sciences Organization (ISSO) also invited me to the concurrent, overlapping event on science and spirituality, Future Visions, which they are sponsoring. I was delighted to be invited along with eminent scientists that I would love to meet in person, primatologist Jane Goodall and Amory and Hunter Lovins of renewable energy fame, not to mention prominent figures who have been vigorously opposing globalization, among them my good friends, Martin Khor, Vandana Shiva, Hazel Henderson, David Korten, Nicanor Perlas. I was also full of hopes that I could once again draw attention to the World Scientists' Open Letter by submitting it to the SWF, and speaking about the convergence between the scientific, spiritual and poetic visions, which could serve as the basis for a new global ethic (see The Organic Revolution in Science and Implications for Science and Spirituality www.i-sis.org)

Right from the start, however, I sensed that something was not quite right. My e-mail messages to the organizers were not acknowledged. They claimed never to have received them. My 'visions' and biography were therefore not circulated in advance even though they had been submitted in time. When I finally received the programme, I discovered that my name was not included in any panel, least of all those that had to do with genetic engineering. I decided to attend the conference, if only to deliver the World Scientists' Open Letter as I had promised. The letter was e-mailed to the organizers, with a request that it be posted on the SWF website.

Our letter was not posted, and I was told it could not be. When I asked for it to be circulated at the Future Visions conference, several representatives of Templeton and the ISSO took away the paper and did nothing. When I pressed the matter, they told me the letter had to be 'reviewed'. I also tried to present it again to the SWF. At first, no one claimed to represent the SWF. But finally, through my influential friend, I managed to deliver a copy directly into the hands of Jim Garrison, President of SWF. And that was the last I heard from him. He was careful never to make eye-contact with me again, as were representatives of Templeton and ISSO. I got the message that the matter was not to be raised ever again, or else I would be ex-communicated, ostracized, obliterated.

I did manage to pass a few copies out to key people, but alas, I lost the final copy to a woman who promised to make copies and bring them back the next day. And that was the last time I saw it. She left them 'at home', and claimed she thought I did not need it anymore.

I also managed to intervene from the floor to present a flavour of my 'visions' and got an applause from the audience. But that cost me dear. Next time I tried to intervene, I was told to restrict myself to short questions. At a plenary on science and ethics, I raised the issue of the corporatization of science which is standing in the way of ethical practice of science (see previous item). This was met with stony silence, as were my subsequent interventions on science and spirituality. As for the conference on science and spirituality itself, there were some excellent talks, from unexpected quarters, but few and far

between. Overall, there was a distinct lack of either science or spirituality.

But the genetic engineering sessions were worse. It transpired that a Link Foundation, run by a man named Walter Link, was sponsoring all the sessions. The two other scientists invited were Dr. Martha Herbert, pediatrician from Massachusetts General Hospital, and Dr. Doreen Stabinsky, molecular geneticist and scientific adviser to Greenpeace USA. Both of them, signatories to our World Scientists Open Letter, had been invited at the last minute, which caused me to wonder why. I still thought I was paranoid until the Chairman of the State of the World Forum told me he had tried to get me on as a speaker in the main Forum events, and that too, failed.

Still, someone must have complained, and that got me onto the first, small panel discussion. We were strongly discouraged to go into detail, on grounds that plenty of time ought to be given to the floor. All the same, we managed to broach many fundamental issues: genetic discrimination, eugenics, public participation, accountability in the face of commercialization of science. William Tiga Tita from Cameroon, representative of a network of chambers of commerce and industry, eloquently reminded the proponents of genetic engineering biotechnology not to forget the point of view of the 'Cameroon village boy' in their eurocentric enthusiasm for genetic engineering. He confessed to be 'terrified' as a black man of the resurgence of eugenics, and stressed the need for some form of world governance (see Genetic Civil Rights Alert, this issue).

As to playing God, a theologian declared that was exactly what we should do, as we are all made in the image of God! That terrified me most of all. There is a distinct tendency for commentators, many of them theologians and bio-ethicists and others who don't know much science, to fail to distinguish hype from reality. This leads to fantastic future projections on the one hand and on the other, resignation that there is nothing we can do to stop whatever scientific progress may bring. (Speaking of fantastic projections, Paul Davies, famous physicist and author, stated in his opening plenary lecture that the human genome map is showing how everything is genetically determined, even evil; and he questioned whether it was moral to remove evil which is intrinsic to human nature by genetic engineering!)

And that was the last and only time I was allowed on any panel. I got an inkling of the hidden agenda at another session I attended. This time, Walter Link himself was in the Chair. Panelists were given about two minutes each to say what their position is on the human genome project and all its fall-outs (see Human Genome: The Biggest Sellout in Human History), while the Chair and moderator (also from Link Foundation) were allowed longwinded, pious-sounding and essentially empty speeches. The audience were therefore invited to comment in the absence of any real information or knowledge. Martha Herbert and Doreen Stabinsky defended accountable science brilliantly and gallantly throughout.

I finally lost patience when Walter Link said it was ethical to reduce suffering with genetic engineering, and Martha Herbert and Amory Lovins both pointed out that there were other means, and that it was a pity Biology has been completely taken over by molecular genetics. I intervened and said I can confirm that the Universities have been completely taken over by corporations and that molecular genetics is excluding almost all other approaches. Also, we are attracting the wrong kind of people into science who are more interested in making money than in science, let alone alleviating suffering. And those who want to work for public good are being victimized and villified. We should be banning and revoking all biotech patents in the interest of alleviating suffering. The bottom line of ethics is to ask if something will be done when there is no hope of making lots of profit.

Walter objected that I was straying too far from ethics, that the issue of patents had been thoroughly discussed at another panel the day before, and he asked people not to go into that again. In his long summing up, Walter announced that he was very satisfied with the discussions, and it was the first time that people with such a wide range of disparate opinions are brought together so that they can listen to one another. He even chided the audience for applauding the scientists who urged caution and respect for the web of life, but not those 'bioethicists' who proposed going ahead with genetic engineering.

Walter Link reminded me of some of the people who earn a fat fee 'facilitating' conflict resolution. As soon as anyone raises any point of substance, they would steer the discussion away to calmer waters in order to engineer a 'consensus'. Walter is looking for funding to bring panels, such as the ones he has assembled, around the world so that "all voices will be heard". (Actually, it is easy to guess whom he is going to exclude.) His next stop is India. So watch out. I can imagine a string of conferences stretching out to infinity, accompanied by the ceaseless droning of soothing voices to calm all dissidents, to lull people into thinking that their concerns are being addressed, reducing them to a state of confused impotence, talking them into mental and physical exhaustion if not paralysis while industry trundle on full speed.

Dangerous GM Wastes Recycled as Food Feed and Fertilizer

Mae-Wan Ho *and* ***Joe Cummins*** *report why there is still no biosafety after Cartegena.*

The safety of GM crops and GM foods has been grabbing headlines over the past two years, and a lot of effort appears to be directed towards addressing many of the concerns raised in the current draft amendment of the EC Directive on Deliberate Release (see next report, this issue). However, a potentially much more serious source of hazard remains unregulated. We pointed to fundamental flaws in the regulation on contained use in a comprehensive review published in a scientific journal in 1998 (Ho *et al*, *Microbial Ecology in Health and Disease* 10. 33-59). This paper was submitted to the World Health Organization, European Commission, the Biosafety Conferences at the UN, as well as to the UK Health and Safety Executive, with additional comments from Mae-Wan Ho and others.

More recently, we raised the matter again in an update calling attention to the increasing variety and volume of 'naked' and 'free' nucleic acids produced in the laboratory and biotech factories under contained use, which are in fact not contained at all, but discharged in one form or another into the environment, as sanctioned by the current EC Directive on Contained Use (Council Directive 90/219/EEC), last amended

in 1998. Our paper was circulated at the Montreal meeting on Biosafety in January, and contributed to the strength of the Cartegena Biosafety Protocol that was agreed in the last hours of that conference. But there has been no real change since to the Directive on Contained Use. This Directive is fundamentally inadequate for the following reasons.

1. The scope covers only genetically modified micro-organisms; transgenic animals, fish and plants are not included. It also excludes nearly all classes of naked or free nucleic acids, except for viroids (infectious naked RNAs that cause diseases in both plants and animals).
2. Notification only and not explicit approval is needed for use of Group 1 GM microorganisms, GMMs, considered nonpathogenic or otherwise safe; however, there is no agreement among EU nations on which microorganisms are pathogens or not; and it is effectively left up to industry to decide
3. For Group 1 GMMs, only 'prinicples of good microbiological practice' applies, ie, there is no containment.
4. 'Tolerated release' of Group 1 GMMs are allowed to take place, without treatment, directly into the environment.
5. No treatment of GM DNA or RNA is required to break them down fully before release.
6. There is no requirement for monitoring for escape of GMMs or GM constructs, horizontal gene transfer, or impacts on health and biodiversity.

We have presented evidence alerting to the dangers of horizontal gene transfer, among which are the creation of new viral and bacterial pathogens and the spread of antibiotic and drug resistance among the pathogens.

Despite our efforts, successive versions of the Directive have been relaxed and shaped by the European Federation of Biotechnology. This industry-dominated group have produced a series of 'safe biotechnology' papers, the latest, published this July (*Trends in Biotechnology* 18, 141-146), specifically addresses DNA content of biotechnological wastes.

The paper admits that DNA persists in soil and aqueous environments, that it is transferred to bacteria and cells of animals, and that it may become integrated into their genomes.

But they defend current practice by claiming 1) Horizontal transfer of GM DNA occurs, if at all, at very low frequencies, especially in nature, 2)The persistence of foreign DNA depends on selective pressure, especially in the case of antibiotic resistance marker genes, and 3)DNA taken up is unlikely to be integrated into the cell's genome unless designed to do so.

The first claim is unwarranted. Evidence of horizontal gene transfer from transgenic plants to soil bacteria has been obtained in the laboratory as well as in the field, although the researchers themselves are downplaying the findings, in violation of the precautionary principle (see Horizontal Gene Transfer Happens, ISIS News#5). The second assumption has been shown to be false. There is now substantial evidence that antibiotic resistance can and does persist in the absence of the antibiotic – the so-called selective pressure (see Phasing Out Antibiotics Will Not Reduce Antibiotic Resistance, this issue), mainly because biological functions are, as a rule, all tangled up with one another, and cannot be neatly separated and selected one at a time.

The third point is false as well, for it has been demonstrated in gene 'therapy' experiments that naked DNA-constructs, not intended for integration, have nevertheless become integrated into the genome. Integration occurs not only in somatic cells, but also in germ cells (see Unregulated Hazards: 'Naked' and 'Free' Nucleic Acids www.i-sis.org).

The most dangerous aspect of current practice, defended by industry, is that solid wastes, heat-treated, or autoclaved, containing large amounts of intact or incompletely degraded GM constructs and transgenic DNA are being recycled or disposed of as food, feed, fertilizer, land reclamation and landfill. Only in cases where GM constructs are specifically made to transform higher organisms, such as gene vaccines and genetic pill applications (for gene therapy) is there a recognition that there may be a need to "inactivate waste by validated procedures rendering DNA nonfunctional by either reducing DNA fragment size below functional entities or altering the chemical composition and structure of the DNA." However, no such validated procedures exist.

Our regulatory authorities at all levels persist in ignoring scientific advice and scientific evidence. It is yet another example of the anti-precautionary approach (see Use and Abuse of the Precautionary Principle, this issue). They, together the biotech industry, should be held legally responsible for any harm resulting from the uncontrollable horizontal transfer and recombination of GM genetic material.

EU Directive on Deliberate Release Still Inadequate

Angela Ryan *reviews the current Directive being negotiated and points out its deficiencies*

European Parliament June 2000 voted on the 1998 amended EU Directive 90/220/EEC on Deliberate Releases of GMOs. But major issues remain outstanding between the texts proposed by the European Council of Ministers (representing the member nations of the EU), and that of the European Parliament. Industry is still fearful that political opposition in Europe will continue to stifle marketing progress (1).

The new directive is much tighter than its predecessor in terms of assessing the environmental impact of GMOs but serious inadequacies remain that present hazards to health and the environment.

There is no requirement for the molecular characterisation of each transformed line over generations (2). Every genetically transformed plant is unique, due to factors associated with the random insertion of transgenes. Transgenes are also unstable (see More on Instability of Transgenic Lines, and More Trouble with Transgenic Lines, this issue) especially over generations, and they can move around within the host and horizontally, across species barriers. Molecular data need to be taken over a number of generations to ensure genetic stability, and horizontal gene transfer must be carefully monitored. There is still no requirement to monitor for horizontal gene transfer.

Parliament rejected the amendment that attempted to prevent horizontal gene transfer. This amendment is the most important in terms of safety. An industry spokesman said it would have "killed off the whole technology" forgetting to add that industry has been claiming all along that horizontal gene transfer does not happen, or happens at extremely low frequency, and is therefore not a safety concern (see item above). Whilst Parliament has officially acknowledged that horizontal gene transfer is a natural phenomenon, it fails to provide measures for adequate monitoring or prevention. The risks associated with horizontal

gene transfer present the greatest hazards to health and the environment and could result in widespread genetic pollution of the environment.

The EU Commission called for a ban on the use of antibiotic resistance marker genes due to the risk of horizontal gene transfer, but Parliament voted only for a phasing out by 2005. The Commission also want released pharmaceutical products included in the scope, as agreed in the Cartegena Biosafety Protocol, but parliament voted them out too. Industry was further let off the hook regarding specific liability for environmental harm associated with their products. However, this may be only a temporary measure as Parliament is already committed to introducing liability rules by 2001.

A conciliation process is underway and expected to take several months to complete. The Directive will be enacted during the French presidency and this does not bode well for industry as the French are especially sensitive regarding safety issues. Dominique Voynet, the French Green Minister, insisted the political moratorium will remain in place until there is legislation to ensure GM products can be traced through the entire production chain, from field to plate. But without collecting molecular data for each transformed line over generations and adequate monitoring for horizontal gene transfer, GM DNA will be passing through this new regulatory net unchecked.

1. Industry still fears political opposition to European Union GM legislation. By John Hodgson. Nature Biotechnology, Vol 18, June 2000, p589.

2. The need for detailed molecular characterization is presented in Biosafety Alert: Submission to TEP on the detailed molecular characterization required for commercial approval of transgenic lines <www.i-sis.org>

Angry Thai Farmers Say Ban GM Rice

They demand protection of indigenous knowledge and wisdom ***Mae-Wan Ho*** *reports on an extraordinarily invigorating and informative gathering of farmers, activists, government officials, academics and rice research scientists (with many thanks to tireless interpreter, Chalotorn Kansuntisukmongkol, back home on holiday from University of California, Davies).*

Farmers from all over Thailand flocked to the day-long Rice Forum held in the Museum Hall for Culture and Agriculture in Kasetsart University near the outskirts of Bangkok on August 15. There, they met with activists, government officials, academic scientists, students and indigenous peoples to hear speakers which included distinguished Professors from the Universities and Ministry of Agriculture in Thailand, the leader of the Karen tribes as well as invited foreign guests. This was in preparation for the long march in September, in protest of the introduction of GMOs to Thailand. Monsanto from next door sent their representative to listen in.

Professor Rapee Sakrik, twice Rector of the University and orchid breeder, opened the morning session with an elegant reminder of the importance of orchids to Thai culture in developing an inner appreciation of the fine things of life. It is the good intention from the heart that would really change people's perception and action, he said.

Dr. Ampon Kittiampon, Deputy Secretary of the Ministry of Agriculture and Cooperation, regrets that modern knowledge does not include traditional wisdom, and that the emphasis on cost-effectiveness has sidelined societal values. The recent economic crisis gave the opportunity to reassess the balance between cultural conservation and external demands. "Rice is what supports our society" he said, "Export is important but cannot be the only focus." External influence and the Intellectual Property Rights both undermine traditional knowledge. Furthermore, if farmers have to buy seeds, it would compromise food security.

Joni, leader of the Karen, told his audience that "rice is life for the Karen" and that losing the seed is to lose life itself. Their whole culture revolves around rice. The spirit of rice rises to heaven every year and a rice ceremony takes place before planting. The Karen used to plant 100 varieties of which only 5 are now left. He blamed the academics and the authorities for not understanding swidden (shifting) agriculture which works on a four year cycle. Planting rice in the same place for 4 years led to the loss of both the rice crops and the forest.

Prof. Prapas, rice breeder from the Ministry of Agriculture and Day-ene Siripetra from the Khoaw Kwan (or Rice Spirit) Foundation gave differing versions of the history of rice breeding in Thailand. In the olden days, Prof. Prapas told us, there were four ministries, one of which was the Ministry for rice affairs. The Department of Rice, which became the Rice Research Institute, used to research social and cultural aspects of rice and not just genetic modification. During the reign of King Rama V, Thailand was exporting rice, but the price was very low. So the King organized a competition on rice varieties. This led to many varieties being developed, and for years, the top ten in the Canadian rice competition went to Thailand. Now, only jasmine rice is left. In those days (45-50 years ago) the main focus of farmers was to plant for their own use. Now the focus is on export and high yield. Prof. Prapas suggested that genetic engineering may be used on traditional varieties to create high yield and good taste, or to resist pests.

Day-ene Siripatra told his audience that the practice of rice planting did not change until the British forced Thailand to open her market. After that, Thailand developed irrigation systems, rice research stations and organized rice competition. The Rice Research Institute was established to get varieties that were good for export (those that won prices in Canada). Of the ten that won prices, nine were no longer used, but kept in the seed bank. After World War II, Thailand had a contract with the US. Dr. Love, a rice specialist from the US, came to Thailand to train Government officials to collect rice varieties. A total of 120 000 varieties were collected, which Dr. Love took to the US. (So, biopiracy is nothing new!) The present day Jasmine rice was also developed by the farmers themselves.

In the 1960s, the Green Revolution was introduced to Thailand by the World Bank and the Rockefeller Foundation, and caused drastic loss of traditional varieties through emphasis on high yield with high input. Farmers were told to exchange their traditional varieties for the new ones which turned out to be very susceptible to disease. Norman Borlaug, father of the Green Revolution, came to Thailand two weeks earlier to promote GMOs. From past experience, Day-ene is not at all convinced GMOs are the way ahead.

Farmer after farmer made passionate and at times angry

contributions from the floor. "Jasmine rice is losing fragrance because the Ministry of Agriculture is promoting new varieties. The new varieties cross with the old and make them lose fragrance. Farmers are in debt because merchants reduce the price for the loss of fragrance."

"We must revive traditional varieties and the Government must raise the price of traditional varieties."

"Lots of fragrant rice used to be planted but the Government developed varieties for export and emphasized yield, so farmers stopped planting fragrant rice varieties."

"To conserve rice varieties, the Government must buy different varieties."

Farmers confirmed that the use of pesticides and fertilizers resulted in many diseases, while traditional varieties never gave so many problems. They also pointed out that the benefit of rice planting is that it provided food and feed for animals as well as a surplus for selling on the market. "Without rice planting, we become poorer." They called for more integrated farming.

In concluding the session, Joni deplored the fact that people are losing their natural cooperative tendencies on account of the money culture. Siripatra called for a change of paradigm, and not just try to patch the old one up. The really holistic way is to integrate agriculture with culture: rice as life and not rice as commodity.

The first session in the afternoon dealt with the technical aspects of GM rice, which confirmed what had been said in the morning already. I gave an overview of the state of resistance to GM crops all over the world, explained what genetic engineering is and how it is really a whole way of life that threatens not just food security but our most deeply held social values. The resistance to GM is a struggle to reclaim the good life for all in every sense.

Devlin Kujek from the Barcelona based ngo, GRAIN (www.grain.org) gave a very useful review of the transgenic rice engineered to resist bacterial blast, BB rice for short; which the International Rice Research Institute (IRRI) is to field trial in South East Asia, starting in the Philippines. The Philippine's Biosafety Guidelines actually state that,

"Genetic manipulation or organisms should be allowed only if the ultimate objective is for the welfare of humanity and the natural environment and only if it has been clearly stated that there is no existing or forseeable alternative approaches to serving the welfare of humanity and the environment." It turns out that only green revolution varieties are susceptible to bacterial blight and not the local varieties. IRRI has in fact caused bacterial blight and is proposing to use the GM rice to solve the problem . But past experience has shown that this strategy will not work, as the bacterial blight will merely mutate to a new form. Lene Santos, also from GRAIN, exploded the myth of the 'golden rice' - engineered to produce pro-vitamin A in the polished grain – that is supposed to cure widespread vitamin A deficiency in the Third World. She pointed out that the poor and malnourished are actually deficient in multiple vitamins and nutrients, and that the problem cannot be addressed by pro-vitamin A alone. There are already some 70 patents on the golden rice, owned by 32 companies. The rice variety modified is a temperate rice unsuitable for growing in the tropics. (See also ISIS Sustainable Audit #1, The Golden Rice, an Exercise in How Not To Do Science www.i-sis.org).

The Monsanto representative finally spoke up and said that the company is only trying to improve the quality of life for people in the Third World, and villagers can choose not to use GM crops. China and Singapore, she said, are promoting and embracing the technology enthusiastically just so they won't be dominated by foreign countries.

According to Devlin, a Chinese contact told him that they had the same problems with Monsanto's GM cotton that was known in the US, with cotton balls dropping off when the crop was sprayed with Roundup. But the farmers were under contract to Monsanto to say nothing!

Monsanto was rebutted by a Professor from Prince Songkla University who dwelt on the importance of protecting Thailand as a centre of biodiversity of rice, and that it would be very dangerous to release rice GMOs. (Thailand already has a huge variety of rice, all differing in both fragrance and colour - shades of yellows, reds and black - rich in all kinds of vitamins and minerals.) Another forceful speaker from the floor said, "Monsanto, don't try to push us! Academics and Government officials ought to try to find a clear understanding of how to protect the natural world. Instead Thailand is being dominated by a group of corporate scientists reaping benefits from the developing to the developed world. Small farmers are being forced into contractual arrangements, or bribery, and have no choice. The Philippines are taking an aggressive stand before the GM crops come in."

The last session was on intellectual property rights and the speakers were Professor Chakkrit , an academic from the Department of Law, and Mr. Bantoong of the Biodiversity Institute. Thailand already has comprehensive draft legislations to protect her genetic resources, the forests and especially her rich tradition of herbal medicines, which is being recovered for use in public health, in an effort to substitute for the high costs of imported medicine and to promote the exchange of knowledge and resources in the form of medical herbs, health foods and other healthcare items. Western scientific knowledge is combined with indigenous scientific knowledge, and government agencies, ngos and academics are all involved in the important task of recovering traditional medicines. Provisions are being made to register inventions under the ownership of communities, ngos, traditional healers, monks and private individuals. This model should be taken seriously by countries all over the world, as it will do much to counteract corporate biopiracy as well as unsustainable corporate monopoly on food and health.

A spokesperson from the Agricultural Research Department said, "Our biodiversity is our national treasure. The problem is how to protect our treasure which include tropical fruits and microorganisms." He stressed the need to conserve living organisms in nature and not only in gene banks. In the Rice Research Institute in Central Thailand, 30 000 varieties of rice have already been collected, and it is not at all clear that they can keep. "About GMOs, we don't allow the use of GMO commercially, only for research."

This brought a torrent of condemnation from the farmers.

"The Government has led us in the wrong direction. Up to now we did not know anything about GMOs, but thanks to this seminar, things have changed. Research Institutes have concentrated in creating varieties that are sensitive to fertilizers and

dependent on pesticides, and now GMOs are much worse. We are losing our life!"

"The lies we have been told! The patents that have been obtained based on modifying our varieties. And adding vitamin A to our varieties for higher profit."

"Anyone pushing GMOs is wicked. We have to stop them. We cannot allow GMOs in Thailand."

"We have to collect names of villagers in Thailand who do not want GMOs and tell the Department of Agriculture and Development to stop."

"Stop explaining the benefits of GMOs!"

"Patenting of rice is robbing us of our liveihood."

"We still have lots of varieties But we may lose them because of Government policies. The Government does not care about the traditional way of life in the highlands. Government says people don't have knowledge and destroy natural resources under swidden agriculture, and arrest them. It is the Government that is destroying our rice varieties, first through the green revolution, and now trying to fix-it with GMOs"

In a television debate two days later, Dr. Suthep Limtongkul, Director of Rice Research Institute, announced that they have put all GM rice in the gene bank, and will not carry out any more research on them. But still, farmers want the GM rice destroyed.

World Scientists in US Congress

Mae-Wan Ho *reports on a special Educational Forum on Biotechnology that packed the Golden Room on Capitol Hill*

There was standing room only when Rev. David Beckmann began his introduction as Moderator of the event, and people were still filing in. The educational forum "Can biotechnology help fight world hunger?" (June 29, 2000) attracted a record number of congressional staff as well as members of the public. Our World Scientists Open Letter, updated, and signed by 327 scientists from 38 countries, was presented to US Congress on the occasion and was crucial in drawing attention to the scientific debate.

The event was sponsored and organized by Congressman Tony Hall, well-known for his efforts in raising the profile of world hunger. In his opening remarks, he stressed that he was not interested to know if biotechnology could make money, but in how it could do something for hungry kids and how we can share prosperity with the poor.

Senator Richard Lugar, Chair of the Senate Agricultural Committee, a strong supporter of biotech industry, condemned the opposition as 'emotional' and stressed the 'enormous potential' of GM crops, citing 'golden rice' - engineered to produce pro-vit. A - as a cure for vit. A deficiency in the Third World. In anticipation of just this bit of biotech propaganda, ISIS' Sustainable Science Audit #1, "The 'Golden Rice' – An Exercise in How Not to Do Science" had been circulated in advance, thanks to Consumer Choice Council.

Representative Robert Ehrlich, who claimed to represent small businesses, answered yes to the question. "Sound science" ought to be used, he admonished. He had seen what happened in Europe when ideas get demonized quickly, and it should not happen in the US.

Representative Dennis Kucinich, who has introduced a bill for labelling of GMOs to Congress, reminded everyone that we all have a common interest to feed the hungry. But his answer to the question was no. The world is not short of food, he stated, and if people are hungry, then we have to think again. It is financial hardship and poor distribution of food that are the causes of world hunger. Perhaps sustainable agriculture can help, but the Green Revolution did not. Biotechnology should encourage sustainable agriculture that can be compatible with mandatory labelling, which is the right to know.

"No one should have to choose between food inadequately tested and no food at all!" Kucinish stated, "Food standards should be the same all over." He was against food aid dumping. It was an ethical responsibility not to do so. This remark was particularly pertinent, as Dr. Vandana Shiva had just presented Congress with a memo objecting to GM food being dumped as relief to flood victims in Orissa and elsewhere.

Four scientists were the main presenters, with Dr. Martina McGloughlin of UC Davies and Dr. C.S. Prakash of Tuskegee University arguing that biotechnology is needed to combat world hunger and Dr. Vandana Shiva, Director of the Foundation for Science, Technology and Natural Resources in India and myself from ISIS arguing that it is far from needed. On the contrary, sustainable agricultural methods are already proving successful all over the world, that biotechnology and corporate monopoly on food through seed patenting and biopiracy can only exacerbate world hunger, while the question of safety is at best unresolved.

After the presentations, a questions and answers session was led by prominent 'challengers' representing the ngos, the industry and the press. It was notable that although McGloughlin and Prakash were both scientists, neither spoke about science at all. They refused to acknowledge that there is already evidence of actual and potential hazards, while offering no scientific evidence to back up their claims that GM crops are safe. McGloughlin even went as far as to accuse the European Union of erecting false trade barriers on grounds of safety. When Vandana Shiva brought up the subject of the patents on the Indian Neem tree, Basmati rice and other indigenous plants that Indian farmers have developed and used for centuires, Prakash loudly proclaimed, " I am sick and tired of hearing about biopiracy. Thank God for biopiracy…"

I stressed that there was genuine scientific dissent within the scientific community, as witnessed by the hundreds of scientists who have signed our open letter and the FDA's own scientific advisors who warned of new risks associated with GMOs. When I reminded the house that the lack of scientific consensus and uncertainty are the conditions for applying the precautionary principle, supporters of the biotech industry predictably scoffed. (For more detailed arguments for the precautionary principle as part and parcel of sound science see Use and Abuse of the Precautionary Principle, this issue).

The representative from Zeneca, also predictably, sang the praises of golden rice, which they have recently acquired the rights for, and have announced that they will offer it 'free' to the Third World. I challenged her on how something that already has 70 patents can be offered free, and hoped that Zeneca will reply in detail to ISIS' Audit. She replied, admitting that the patents issue is very complicated and has to be solved.

Michael Pollan, the N.Y. Times journalist who stunned the United States into action on GMOs with his famous article on Monsanto's GM potato, confessed to be not at all convinced by the arguments on benefits. "Have the benefits been proven?" He asked, "Have the risk been proven to outweigh the benefits?" He urged precautionary approach. "Industry is in trouble", he stated, "But why should I eat a GM potato?"

In his summing up, Rev. David Beckman, President of Bread of the World, stressed that other tools besides biotechnology must be used to combat world hunger, that it is the imbalance of power that is the cause of world hunger. He also touched on the ethics of science and the fact that people don't quite trust scientists anymore.

Bad Science and Big Business Put the World at Risk from Viral Pandemics - Xenotransplantation

This is the finding of ISIS Sustainable Audit #2 by ***Mae-Wan Ho*** *and* ***Joe Cummins***

Xenotransplantation - the transplant of animal organs into human beings - is a multi-billion dollar business venture built on the anticipated sale of patented techniques and organs, as well as drugs to overcome organ-rejection. It has received strong criticism and opposition from scientists warning of the risks of new viruses crossing from animal organs to human subjects and from there to infect the population at large. But regulators are adopting a permissive attitude for clinical trials to go ahead. Scientific reports of virus crossing from pig to human cells and of viral infections in humans subjects transplanted with baboon livers are being ignored or dismissed, while inconclusive, widely faulted papers are taken as evidence that no viruses are found in xenotransplant patients. Our audit exposes the shoddy science that puts the world at risk of viral pandemics for the sake of corporate profit, and concludes that xenotranplantation should not be allowed to continue in any form. Instead, effort should be devoted to developing safer, more sustainable alternatives that are already showing promise. One particular approach suggested is to encourage stem cells in adults to regenerate within the body, without the need for transplantation.

See the full paper on ISIS website www.i-sis.org

Ban Biological Weapons and Agent Green!

Clinton admits that US' plan to use Fusarium to eradicate drug crops in Colombia may have an impact on biological weapons proliferation. ***Joe Cummins*** *reviews the scientific literature showing why that is the case. Please write to your Government to give them this information, and demand a total ban on this and other similar biological weapons.*

The United States government is considering using biological control agents to eradicate coca plants in Columbia. Because of its illicit coca crop, Colombia is on the front line of US biological warfare plans. Other projects to develop biological agents to kill opium poppy and marijuana are also funded by the US and the British Governments.

Clinton overruled the US Congress to decouple the link between Colombian acceptance of Agent Green and the overall implementation of the US 1.3 billion dollar bilateral assistance package for Plan Colombia.

Clinton states that the US will not use Agent Green until "a broader national security assessment, including consideration of the potential impact on biological weapons proliferation and terrorism, provides a solid foundation for concluding that the use of this particular drug control tool is in our national interest." That implies it is still on the cards.

The preferred biological control agent is the fungus *Fusarum oxysporum* a common plant pathogen. To be effective and safe for application, strains of the common pathogen would have to be selected and those strains would have to be supremely resistant to mutation and sexual gene exchange because small changes in a few genes can alter host range and the range of side effects on animals. The best available scientific evidence suggests that those goals of genetic conservatism and stability are unattainable, and that widespread saturation of a geographical area with this plant pathogen may not only impact on food crops, but on human health and a wide range of mammals and birds.

Fusarium oxysporium is a fungus without a reproductive cell (without sexual spores) but one well known to have very active genetic recombination following fusion of mycelia (the fungal mat). Mitotic recombination (recombination during ordinary cell division) is common in asexual fungi (1).

The presence of several families of transposable elements (jumping genes) also contribute to mutation and chromosome rearrangement (2). Among the transposons is the *impala* element, a member of the *mariner* transposon family that is known to spread horizontally across fungi, plant and animals (3). Horizontal gene flow contributes to the variability in *Fusarium*. There is no known way to control gene flow in *Fusarium* and such gene flow is the key to the success of the pathogen.

It is certainly ill-advised to drench a geographical area with a fungus known to infect humans or animals. In humans with normal immune systems, *Fusarium oxysporum* was associated with infection of skin and nails (4). A respiratory disease along with fungal infection of the liver was observed in a patient (5). People with undeveloped, aging or compromised immune system are highly sensitive to fungus infection. *Fusarium oxysporum* is associated with Kaschin-Beck (KB) disease, an early aging disease affecting numerous people in China and Russia, and the disease also strikes mammals and birds. For example, *Fusarium oxysporum* infected corn caused KB disease symptoms in chickens (6). *Fusarium oxysporium* infected grain caused KB symptoms in rats (7). and monkeys (8). The main onset of KB disease in humans is between the ages of 4 and 13 and the disease was twice as prevalent in boys than in girls (9).

We cannot allow the US Government to spray a fungus associated with such a serious disease. It is tentamount to waging biological warfare on the people of Columbia and their neighbours.

In conclusion, *Fusarium oxysporium* is unlikely to eradicate coca in Columbia but there is a reasonable chance that it will spread a horrific disease among young humans and animals.

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For more information, please see The Sunshine Project www.sunshine-project.org

CaMV Promoter Active In Animal and Human Systems

Since the publication of our original paper on the CaMV promoter, we have been subjected to personal abuse and attack of the kind meted out to many other scientists who refuse to be intimidated into a 'scientific consensus' by the corporatized scientific establishment.

In a continuing campaign to mislead and obfuscate, the pro-biotech brigade have been re-cirulating again and again the same scientific critique of our paper which we have already rebutted in full in an article published in the same issue of the Journal.

But the worse is yet to come. Plant genetic engineers, including our critics, have been telling us that the CaMV promoter is safe because it is a plant promoter that only works in plants and plant-like species. We have now found in the scientific literature more than 10 years old that the CaMV 35S promoter is active in frog eggs as well as in extracts of a human cell line. It means that if the CaMV promoter ends up in our genome, it could well have unpredictable, untoward genetic effects.

We submitted a short paper to *Nature Biotechnology* which has been publishing the most despicable attacks on us, but they rejected it after a two months delay. This paper is now in press in *Microbial Ecology in Health and Disease*, practically the only scientific journal that would allow a fair debate in their pages. The paper is posted on ISIS' website.

It is nothing short of a scandal that the plant genetic engineers have not bothered to check whether the CaMV promoter is active in animals before they started to use it so widely. Those who are still supporting the use of the CaMV 35S promoter should be held legally responsible for any harmful consequences arising from it.

Articles

The Beginning of Real Progress for the BSE/CJD Crisis?

*In this exclusive feature article, **Dr. Harash Narang**, pioneering researcher in new variant CJD, who lost his job because he dared to disagree with the orthodox opinion, tells his story of the crisis and how he is being vindicated by recent discoveries. If he had been heeded, many lives could have been saved, and the needless slaughtering of tens of thousands of cattle could have been prevented. "The tragedy of the BSE crises is that from the start, the government has approached BSE as a matter of policy instead of as a matter of science. But science is not a convenience store where one can browse around and pick up the hypotheses that best suits one's policy". But misrepresentation and misconduct in the corporate scientific community continues.*

An article on the BSE crisis (Reservoir Sheep*? New Scientist* July 27) reports that Prusiner told a scientific meeting in Birmingham that his colleague Mike Scott believes sheep carry two strains of the BSE agent, the scrapie prion and the BSE prion. Furthermore, Scott also believes that the scrapie strain is somewhat dominant, preventing the BSE strain from infecting cattle and people when both are present. In other words the scrapie strain acts as a vaccine against the BSE strain.

This is not news. Clinically speaking, it has been known for more than 30 years that there are two distinct strains of the scrapie agent. Type I is common and causes sheep to loose their wool. This is the common scrapie strain. Type II, is very rare and appears in only 1 sheep in 100,000 or more. It causes trembling and is the BSE strain. The most important difference between the two strains is the mode of transmission – the BSE strain can be transmitted orally whilst the scrapie strain cannot. This has helped the BSE strain to spread to a large number of mammalian species whilst incorporated into cattle feed.

In fact, twenty strains of the scrapie agent have been isolated and the phenomena of interference between strains has been known for a number of years (1). I have proposed that the eradication of BSE would be achievable if a vaccine were to be developed based on this phenomena.

The BSE inquiry reveals that MAFF has known since 1989 that Type II - the BSE strain - was different. Transmission studies revealed type II clinical symptoms in sheep, showing that the BSE strain poses a threat not only to cattle but also to sheep. MAFF have also known since 1990 that scrapie resistant sheep can be infected with type II, whilst sheep infected with type I cannot. Why then is MAFF presently asking sheep farmers to breed from scrapie resistant sheep? This would only reduce the numbers of scrapie-infected sheep in herds and thus leave sheep farmers vulnerable to a rise in the incidence of the BSE strain in sheep. Furthermore, scrapie infected meat acts as a vaccine against the BSE agent and therefore offers some protection to the human population.

Now that Prusiner has openly admitted the phenomena of interference between the two strains of the agent, it further suggests that the BSE agent could not be a protein after all. It must be a virus. Moreover, Prusiner's group, following a number of experiments in transgenic mice, have concluded that another "X" protein, a chaperone, is required in

the post translational process (2), as has been previously suggested by myself (3).

The final conclusion of these findings suggest that the prion protein is not the agent and therefore it is something else. Moreover, Prusiner's earlier work has proved not to be repeatable (4) and the protein only hypothesis has no direct evidence to support it. On the contrary, most of the new evidence supports a virus hypothesis.

I have published a large number of papers supporting the hypothesis that the BSE/CJD agent is a virus. More recently, I transmitted the disease using isolated single stranded DNA – in demonstration of Kock's postulate – that a single stranded DNA genome is the viral genome for the disease of BSE/CJD (5). I have also described this in detail in my book, *The Link*.

The tragedy of the BSE crises is that from the start, the government has approached BSE as a matter of policy instead of as a matter of science. But science is not a convenience store where one can browse around and pick up the hypotheses that best suits one's policy - the main priority of which is the avoidance of public alarm.

When I found young patients dying from CJD in the late 80's I kept my employer, The Public Health Service Laboratory, well informed of my investigations. However, it took a further eight years before the government and SEAC, the advisory body, admitted publicly the link between BSE and CJD. To this day, after spending millions of pounds and years in time, MAFF still do not know the source of the BSE agent or how to eradicate the disease.

The extent of the problem can be demonstrated in recent announcements from government regarding BSE/CJD. Since 1991 a body of evidence has revealed that maternal transmission of the BSE agent has occurred. In June 1999, 39,384 BSE cases were confirmed in cattle born after the feed ban in July 1988. MAFF can no longer deny the reality of maternal transmission. I began developing a practical BSE diagnostic test in the late 80's for use in abattoirs. Had this test been introduced BSE infected cattle would have been stopped from entering the food chain. But the government still to this day has not taken it up.

In recent weeks the government has acknowledged a number of other real BSE/CJD issues that I have also been highlighting for many years. First, they have acknowledged that there is at least one cluster of CJD cases in a community living in close proximity to one another. Then SEAC announces there maybe a theoretical link between CJD and dental instruments (See p 268, *The Link*). In fact the same problem also extends to other medical instruments, such as those used in surgery. The SEAC spokesperson said there is no means available to sterilise dental instruments contaminated with the CJD agent. This is however not accurate and there are methods available for decontamination (See p 71,*The Link*). Finally, Nick Brown ordered an inquiry into whether there is a connection between BSE, milk and dairy products. Unfortunately this inquiry is not based on good science. The only way to establish whether the agent is lurking in milk or dairy products is to feed BSE infected dairy products to mink (See p 38, *The Link*). These animals are very susceptible to the BSE agent and will develop clinical disease within 14 months.

All this amounts to some very disturbing news on the BSE/CJD front and in order to calm public fears, a new study by Neil Ferguson and colleagues has been highly publicised with headlines such as "CJD epidemic fears unfounded". However, even this study does not escape the grip of the continuing BSE crisis. It was a computer based study and according to the data imputed, CJD will claim 136,000 victims in Britain. With some simple calculations one can work out that one person in 400 will contract the disease. This is greater than the death toll for TB and AIDS. Furthermore, the study estimates that 750,000 cattle infected with BSE were slaughtered for human consumption in Britain. But in 1988, when I was developing an abattoir test for BSE, most of the cattle being slaughtered were incubating the disease.

Now, John Collinge from MRC Prion Unit at St Mary's Hospital London, suggests (*PNAS* Aug 2000) that the BSE agent can be easily transmitted to many other animal species. Moreover, he presents his evidence, as if it where new and daims these animals often incubate the disease without showing clinical symptoms. But in my evidence to the BSE enquiry (1997) and in my book *The Link*, I have demonstrated and described that chickens and sheep do develop clinical and pathological disease. Furthermore, Collinge is fully aware of this fact, having often been present at scientific meetings in which I have presented these findings. He also possesses a copy of *The Link*. Has Collinge broken the scientific code of ethics by not quoting my work and is he guilty of scientific misconduct by reporting this as a new finding in his recent PNAS paper?

There are also several outstanding issues regarding the actual death toll from CJD and in addition, the methods employed for diagnosing CJD are also questionable in my opinion.

A recent report in *The Lancet* (vol 356, p481) shows that 15 CJD deaths have occurred this year compared with 18 for the whole of 1998. This is a four-fold increase in incidence of CJD between 1998-99. However, it is important to note that whilst BSE is a notifiable disease, CJD is not and therefore no one really knows how many people are actually dying from CJD each year. One thing is clear, in comparison with the 50 recorded deaths in the early 1990's, the incidence is rising.

In addition, the name "new variant CJD" (nvCJD) is very misleading as nvCJD is caused by the BSE strain of the agent, which is not a 'new' strain - it originates from Type II scrapie in sheep. And like with scrapie and BSE there are two types of CJD. Type I, which is classical CJD and Type II, termed 'new variant' CJD (nvCJD), which is caused by the BSE strain of the agent. For diagnosing classical Type I CJD there are three major distinguishing features. First, classical CJD starts with dementia. Second, confluent spongiform changes are not usually found in the cerebellum. And third, PrP plaques are rarely observed. In Type II CJD, three main features distinguish it from Type I classical CJD: a) the first leading clinical signs are difficulty in balancing and ataxia. b) Confluent spongiform changes are seen in the cerebellum and c) the distribution of PrP plaques are unique and different from those observed in classical CJD.

Since the first appearance of BSE in cattle, nvCJD in people has only been recorded in young patients. However, based on the three main distinguishing features described above and following a literature review, I have evidence that patients of all ages are dying from Type II

CJD and that these patients are not been recorded. It is imperative that Type II CJD be made a notifiable disease so as the actual death toll can be determined more accurately.

After ten wasted years in the wilderness with BSE/CJD there is still hope that we can eradicate this disease from Britain. Prusiner's admission should mark the beginning of real progress in pinpointing the disease. In the short term, we must restore public confidence in meat products by announcing decisive measures that can really address the BSE crisis. The first of which should be the implementation of a diagnostic test for identifying BSE and CJD cases. The second of which must be the development of a BSE/CJD vaccine.

Dr Harash Narang was a microbiologist for the British government until 1994, when he was made redundant from his job at the Public Health Laboratory Service in Newcastle. Despite official denials, he maintains he was dismissed because of his controversial scientific investigations, which established the link between BSE and CJD. He is an expert on BSE/CJD and has written two books " The Link" (ISBN 0-9530764-0-7) and "Death on the Menu" (ISBN 0-9530764-1-3)

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Human Genome -The Biggest Sellout in Human History

Our Governments have handed over the human genome to private ownership.

The hype continues, but will it deliver? Not likely. ***Mae-Wan Ho*** *concludes that, unless and until there is a quantum leap to a new paradigm for understanding the organism as a coherent whole, human genome research will remain a scientific and financial black hole that swallows up all resources without any return to investors or to improving the health of nations.*

"To-day, we are learning the language that allowed God to create life." That was how Clinton greeted the announcement of the human genome map on June 26. The Human Genome Project, (HGP) an international public consortium of research laboratories led by the United States, and Celera, a private American company, made the announcement jointly, ending months of competition to complete the first sequence of the human genome. Craig Venter, Director of Celera, marked this "historical day in the 100,000 years of human history" when, for the first time, "the human species can read the letters of its own text." Not to be outdone, Francis Collins, head of the public project, called it "the revelation of the book of life".

French Research Minister, Roger-Gérard Schwartzenberg, hailed the event as " the victory of those who wanted knowledge to remain free". In reality, it is the biggest sellout in human history dressed up with the most far-flung hyperboles.

The human genome has been sequenced with major public finance from the United States and the European Community. The US Government alone had earmarked $3 billion for the initiative. But that has not prevented the human genome from being patented, owned and exploited by private companies.

Celera's genetic maps would eventually be available on the Internet, and the company will claim royalties from any commercial pharmaceutical application of its discoveries. In contrast, the gene sequences and gene maps produced by the public consortium have been deposited regularly within 24 hours of completion in GenBank, a public database set up in the early 1980s when DNA sequencing began, access to which is totally free. Celera kept its own human genome data secret while benefiting from free access to the public database throughout the period that the company was busy sequencing, thereby significantly reducing the time and effort needed to complete the task.

Celera is not the only company stealing from HGP's Genbank. Others such as Incyte has mined the public data to help build its catalogue of genes and patents. There are some 20 000 patents on gene sequences pending at the US patent office.

The US Patent and Trademark Office had tightened up the criteria for gene patents by issuing two new directives under section 101 "utility", and section 112 "written description requirements" last December. Under the new utility guidelines, the USPTO is looking for "specific utility" and "substantial utility". So, DNA fragments or express sequence tags (EST) will require a written description of their specific utility in order to be patented (though millions of patents based on those have already been granted in the US). Similarly, according to the current EU Directive on biotechnological inventions, genes and gene-sequences can still be patented if an "industrial application" is specified.

However, an "industrial application" may amount to no more than speculation on function based on similarity to gene sequences in the existing database. Another industrial application for which many patents have been awarded is "association with condition X", where X is anything from cancer to criminality. There are already 740 patented gene tests on the market, among them are BRCA1 and BRCA2, genes linked to breast cancer in women. Years after the tests were launched, scientists still do not know to what degree those genes contribute to a woman's cancer risk.

But it is precisely ignorance that is fueling a goldrush in 'bio-infomatics' - a fusion of information technology with biology - that promises to turn the raw genomic base-sequence data into knowledge for making even more lucrative new drugs. It is already a $300 million industry expected to grow to $2 billion within 5 years.

The public GenBank holds sequence data on more than seven billion units of DNA, while Celera Genomics claims to have 50 terabytes of data in store, equivalent to 80 000 compact discs. The raw sequence data consist of monotonous strings of four letters - A, T, C and G -that make up the 3 billion or so bases in the human genome. It is impossible to access the data or to make any sense of the sequences without

special software. Some softwares are developed and made freely available in the public domain, but the databases of private companies are provided to paid-up subscribers only. Incyte launched an e-commerce genomics program in March that allows researchers to order sequence data or physical copies of more than 100 000 genes on-line. Subscribers to the company's genomics database include drug giants such as Pfizer, Bayer and Eli Lilly. Celera's gene notes, similarly, will cost commercial subscribers an estimated $5 to $15 million, and academics, $2000 to $15000 a year.

Close on the heels of bioinformatics is 'proteomics', details on when and where genes are active and on the properties of the proteins the genes encode. It attempts to make sense of the complex relationships between gene and protein and between different proteins, and has so far attracted hundreds of millions in venture capital.

Proteomics has spawned a number of technical innovations, among which is the Gene Chip, developed by Affy-metrix in Santa Clara, California. It consists of glass microarrays coated with cDNAs (complementary DNA) to identify which mRNA species are made (and hence which genes are expressed). One microarray allows researchers to identify more than 60 000 different human mRNAs. The US National Cancer Institute has been examining the mRNAs produced by various types of cancer cells in a Human Tumor Gene Index project involving government and academic laboratories as well as a group of drug companies including Bristol-Myers Squibb, Genetech, Glaxo Wellcome and Merck. So far, more than 50 000 genes have been identified that are active in one or more cancers.

The sequencing of the human genome is undeniably a technical feat comparable perhaps to landing on the moon. And it is difficult not to be caught up in a frenzy of speculation on what can be achieved as genomics joins forces with the latest in information and nanotechnology. But will it deliver health, let alone happiness?

Two medical geneticist writing in the *New England Journal of Medicine*, warned that the 'genetic mantle' " may prove to be like the emperor's new clothes." As has been pointed out by many scientists, most diseases are complex, and correlations between genes and disease are therefore weak. Associations between a disease and a 'genetic marker' (of unknown function) can occur by chance and some have proved to be spurious. Although many disease-related genes have been mapped to regions of specific chromosomes, no clear markers for asthma, hypertension, schizophrenia, bipolar disorder, and other disorders have been found despite intensive efforts.

Searches for susceptibility genes in breast cancer, colon cancer, rare early-onset forms of type II diabetes, and Alzheimer's disease have been more successful, but in each case these account for less than 3 percent of all cases. That is because the risk of disease depends not only on other genes but also on environmental factors.

Holzman and Marteau conclude, "In our rush to fit medicine with the genetic mantle, we are losing sight of other possibilities for improving the public health. Differences in social structure, lifestyle, and environment account for much larger proportions of disease…Those who make medical and science policies in the next decade would do well to see beyond the hype."

Let us take stock of some of what is on offer. The human genome sequence, we are told, will enable geneticists to,

- cure cancer
- understand more about diseases and thereby to design better drugs
- design customized cures based on our individual genetic makeup
- prescribe an individual's lifestyle based on genetic makeup.

More contentious are the claims to

- diagnose all the bad genes that cause diseases
- identify all the good genes responsible for desirable qualities such as longevity, intelligence, being slim and beautiful, good at sports, and so on
- replace bad genes in 'gene therapy', including germline gene therapy
- create 'genetic enhancement' by introducing 'good' genes
- create 'designer babies' and superior human beings.

In reality, the only concrete offering from mapping the human genome are the hundreds of patented gene tests. The high costs of the tests have prevented them from being used in cases where it might benefit patients in providing diagnosis. At the same time, those healthy subjects who have tested positive are likely to suffer from genetic discrimination and risk losing employment and health insurance. The value of diagnosis for conditions for which there is no cure is highly questionable. The claim to identify putative 'bad' and 'good' genes is also fueling the return of eugenics, which has blighted the history of much of the 20th century. This is exacerbated by the dominant genetic determinist mindset that makes even the most pernicious applications of gene technology seem compelling.

A prominent band of scientists and 'bioethicists' are actively advocating human genetic engineering, not just in 'gene therapy' for genetic disease, but in positively enhancing and improving the genetic makeup of children of parents who can pay for the privilege, and have no qualms regarding human reproductive cloning either. They have been given much attention in the mainstream media.

The promises as well as the threats remain largely in the realm of future potential if not outright fantasy. We were promised no less than "the blueprint for making a human being" by no less than Nobel laureate James Watson when the Human Genome Project was first touted, along with miracle cures for cancer and other diseases, and even immortality. Now, ten years and dozens of sequenced genomes later, it is all too obvious that geneticists haven't got a clue of how to make even the smallest bacterium, or the simplest worm, let alone a human being. Nor has anyone been cured of a single disease on the basis of genes or genetic information.

Rather than address the contentious claims of the human genome project, let's concentrate on those offerings generally seen to be beneficial and uncontroversial; for if it cannot deliver on those, it can certainly not deliver on the rest.

The growth in 'bio-informatics' and 'proteomics' is an admission of the vast realms of ignorance that separate the 100 000 genes in the human genome from the living human being. It is also an acknowledgement that the genetic determinist paradigm which has done so much to promote the human genome project has failed miserably. There is no simple, linear causal chain connecting a gene to a trait, good or bad. Behind the hype is a desperate attempt to turn the exponentially increasing amount of

information into knowledge that can pay off the heavy investments already sunk into the project.

Private ownership of the human genome is obviously not ever going to benefit those who cannot afford to pay. Proponents of human genetic engineering, indeed, see the creation of a 'genetic underclass' to be inevitable, as those who can afford to pay for genetic enhancement will become 'gene rich' relative to those who cannot afford to pay . But can knowledge of the human genome really deliver the goods? Genuine genetic diseases that can be attributed to single genes constitute less than 2% of all diseases, and more and more geneticists are coming around to the view that even those are subject to so many other genetic and environmental influences that there is simply no such thing as a single-gene condition. For the rest, the association between the condition and the specific genes or genetic markers reduces to tenuous 'predispositions' or 'susceptibility' (see above).

'Predipositions' to cancer for example, conceals the fact that important environmental factors are left out of consideration. These include the hundreds of acknowledged industrial carcinogens polluting our environment. It is well-known that the incidence of cancer increases with industrialization and with the use of pesticides. Women in non-industrialized Asian countries have a much lower incidence of breast cancer than women living in the industrialized west. However, when those Asian women emigrate to Europe and the United States, their incidence of cancer jumps to that of the white European women within a single generation. Similarly, when DDT and other pesticides were phased out in Israel, breast cancer mortality in pre-menopausal women dropped by 30%.

The overwhelming causes of ill-health are environmental and social. That is the conclusion of a major body of research findings, still growing everyday. Environmental influences swamp even large genetic differences.

The genetic determinist approach of the human genome programme is pernicious because it diverts attention and resources away from addressing the real causes of ill-health, while at the same time stigmatizing the victims and fueling eugenic tendencies in society. The health of nations will be infinitely better served by devoting resources to preventing environmental pollution and to phasing out agrochemicals, rather than by identifying all the genes that 'predispose' people to ill-health. Even the UK Royal Society, not known for holding progressive views, has produced a report in July calling for national and international coordination to deal with the dangers posed to humans and wildlife by endocrine-disrupting chemicals, substances thought to mimic or block natural hormones in amounts too minute to trigger a conventional toxic response.

But it is the inherent complexity of the human organism and the lack of a concept of the organism as a coherent whole that will continue to frustrate all attempts at understanding health and disease within the dominant, reductionist framework.

Despite the almost weekly hype on cancer cures, there is none, or none that has resulted from information on genes and gene sequences. As mentioned earlier, some 50 000 genes have been identified that are active in one or more cancers using the Gene Chip, which is half of the maximum number of gene predicted in the human genome!

In principle, knowing the genes that are over-expressed or inactive in individual cancers can allow specific genes to be targeted. But this is no different from interventions that have previously been available to single-gene defects such as sickle cell anaemia or cystic fibrosis, none of which has been cured as a result; which is why gene therapy has been attempted, equally to no avail so far.

To try to understand disease in terms of genes and protein interactions is worse than trying to understand how a machine works in terms of its nuts and bolts, simply because the parts of the organism, unlike those of a machine, are inseparably tangled up with one another. That is how they have to function. This kind of understanding is extremely unlikely to lead to the design of better drugs, which requires knowledge of the design of the human organism. And no amount of information on genes and protein interactions will ever add up to the complex entangled whole that is the organism.

The promise of customized medicine and prescribed lifestyle based on an individual's genetic makeup is a pipe-dream. The effect of each gene depends not just on environmental factors, but ultimately on the genetic back-ground of all other genes in the genome. It is estimated that individuals differ on average by one per thousand bases. This amounts to three million bases over the entire genome. As each gene is at least a thousand bases in length, it means that every gene will most probably be different. In fact, hundreds of variants are typically found for each gene. Consequently, every individual is genetically unique, except for identical twins at the beginning of development, before different genetic mutations can accumulate in each of the pair. That is why it is generally impossible to give accurate prognosis of even single gene diseases unless the genetic background is homogenous, as in an inbred laboratory strain of mice. And even then, the mice have to be raised in a uniform environment.

The Icelandic population is thought to approach a genetically homogenous population, which is why the company deCode Genetics has acquired the genetic database of Iceland's 270 000 inhabitants, linked, anonymously to medical records. The hope is to enable all the genes linked to a variety of diseases to be identified. Unfortunately, the results will be valid for the Icelandic population only, and will not be transferable to other populations. Thus, mutations in the gene giving rise to cystic fibrosis among Northern Europeans is associated with quite another condition among the Yemans; while *bona fide* cystic fibrosis in the latter population is due to mutations in another gene altogether.

There is a current debate as to whether genetically heterogeneous populations, such as those in Manhattan and London, or homogeneous populations, such as those in Iceland and Finland, could yield better genetic data for linkage to diseases. According to biometrical genetic analysis, the net effects of a gene should be determined over all environments as well as over all genetic backgrounds, so we are back to the limited predictive power based on averages obtained in large populations. *It is impossible, in principle, to predict anything based on any individual genome. Those who claim otherwise are doing so in ignorance of the most basic principles of population genetics.*

In case you still think that the blueprint for making a human being is written in our genome, just take

note that up to 95% of the human genome may be 'junk' DNA, so called because no one knows what its function is. The same is true of all genomes of higher organisms. The rough draft of the human gene map announced in June is only 85% complete for the coding (functional) regions only.

It is difficult to see any strategy within either bioinformatics or proteomics that can pay off, either in terms of basic understanding the human organism as a whole, or in terms of miracle cures and wonder drugs. There is nothing beyond the proliferation of more and more detailed information on genes and proteins that have been spilling out of the pages of scientific journals for the past decade. The one million proteins encoded by the 100 000 genes interact with one another, with the genes themselves, and small molecular weight 'cofactors' and 'messengers'. Those interactions vary in different cells and tissues at different times, subject to feedback from the environment. Feedback from the environment can alter the genes themselves, and hence the cascades of interactions involved. All that is the reality of the fluid and adaptable genome which the moguls of genomics and bioinformatics have yet to come to grips with. The prospect of understanding the human being by a detailed description of its molecular parts is essentially nil. This reductionist fallacy has been exposed in different forms, starting with the physicist Walter Elsasser.

Even if a computer is large enough to represent the states of all the molecules and their interactions, and fast enough to give a description of how these change in real time as the organism goes about its business of living, we would still be left with no understanding of what is being described. Current computation cannot handle the dynamics of one single protein folding, even given all the information on the amino-acid sequence and the final shape of the folded protein. It takes the computer four hours to find a solution at best 70% accurate. But the protein itself folds to perfection within a fraction of a second.

Unless and until there is a quantum leap to a new paradigm for understanding the organism as a coherent whole, human genome research will remain a scientific and financial black hole that swallows up all public and private resources without any return either to investors or to improving the health of nations. (See the full version of this paper on <www.i-sis.org>)

Use and Abuse of The Precautionary Principle

Proponents of biotechnology have been busy attacking the precautionary principle lately. Why? Because it holds the key to protecting health and the environment and require the industry to prove beyond reasonable doubt that a technology or a product is safe before it can be adopted. ***Peter Saunders****, Professor of Mathematics and co-Founder of ISIS shows how the precautionary principle is just codified common sense that people have accepted in courts of law as much as mathematicians have accepted in setting the burden of proof in statistics. But pro-biotech scientists have been abusing science as well as the precautionary principle. A version of this article has been submitted to the US Senate Committee on Biotechnology*

There has been a lot written and said about the precautionary principle recently, much of it misleading. Some have stated that if the principle were applied it would put an end to technological advance. Others argue that it fails to take science properly into account, though in fact it relies more heavily on scientific evidence than other approaches to the problem. Still others claim to be applying the principle when clearly they are not. From all the confusion, you might think that it is a deep philosophical idea that is very difficult for a lay person to grasp (1).

In fact, the precautionary principle is very simple. All it actually amounts to is a piece of common sense: if we are embarking on something new, we should think very carefully about whether it is safe or not, and we should not go ahead until we are convinced it is. It's also not a new idea; it already appears in national legislation in many countries (including the United States), and in international agreements such as the 1992 Rio Declaration and the Cartagena Biosafety Protocol agreed in Montreal in 2000.

Those who reject the precautionary principle are pushing forward with untested, inadequately researched technologies and insisting that it is up to the rest of us to prove that they are dangerous before they can be stopped. At the same time, they also refuse to accept liability, so if the technologies do turn out to be hazardous, as in many cases they already have, someone else will have to pay the costs of putting things right.

The precautionary principle is about the burden of proof, a concept that ordinary people have been expected to understand and accept in the law for many years. It is also the same reasoning that is used in most statistical testing. In fact, as a lot of work in biology depends on statistics, neglect or misuse of the precautionary principle often arises out of a misunderstanding and abuse of statistics.

The precautionary principle does not provide us with an algorithm for decision making. We still have to seek the best scientific evidence we can obtain and we still have to make judgements about what is in the best interest of ourselves and our environment. Indeed, one of the advantages of the principle is that it forces us to face these issues; we cannot ignore them in the hope that everything will turn out for the best whatever we do. The basic point, however, is that it places the burden of proof firmly on the advocates of new technology. It is for them to show that what they are proposing is safe. It is not for the rest of us to show that it is not.

The Burden of Proof

The precautionary principle states that if there are reasonable scientific grounds for believing that a new process or product may not be safe, it should not be introduced until we have convincing evidence that the risks are small and are outweighed by the benefits. It can also be applied to existing technologies when new evidence appears suggesting that they are more dangerous than we had thought, as in the cases of cigarettes, CFCs, lead in petrol, greenhouse gasses and now genetically modified organisms (GMOs) (2). In such cases it requires that we carry out research to gain a better assessment of the risk and, in the meantime, that we should not expand our use of the technology but should put in train measures to reduce our dependence on it. If the dangers are considered serious enough, the principle may require us to withdraw the products or impose a ban or moratorium on further use.

The principle does not, as some critics claim, require industry to

provide absolute proof that something new is safe. That would be an impossible demand and would indeed stop technology dead in its tracks, but it is not what is being demanded. The precautionary principle does not deal with absolute certainty. On the contrary, it is specifically intended for circumstances in which there is no absolute certainty. It simply puts the burden of proof where it belongs, with the innovator. The requirement is to demonstrate, not absolutely but beyond reasonable doubt, that what is being proposed is safe.

A similar principle applies in the criminal law, and for much the same reason. In the courtroom, the prosecution and the defence are not on equal terms. The defendant is not required to prove his innocence and the jury is not asked to decide merely whether they think it is more likely than not that he committed the crime. The prosecution must establish, not absolutely but beyond reasonable doubt, that the defendant is guilty.

There is a good reason for this inequality, and it has to do with the uncertainty of the situation and the consequences of taking a wrong decision. The defendant may be guilty or not and he may be found guilty or not. If he is guilty and convicted, then justice has been done, as it has if he is innocent and found not guilty. But suppose the jury reaches the wrong verdict, what then?

That depends on which of the two possible errors was made. If the defendant actually committed the crime but is found not guilty, then a crime goes unpunished. The other possibility is that the defendant is wrongly convicted of a crime, in which case his whole life may be ruined. Neither of these outcomes is satisfactory, but society has decided that the second is so much worse than the first that we should do as much as we reasonably can to avoid it. It is better, so the saying goes, that a hundred guilty men should go free than that one innocent man should be convicted.

In any situation in which there is uncertainty, mistakes will occur. Our aim must be to minimise the damage that results when they do.

Just as society does not require a defendant to prove his innocence, so it should not require objectors to prove that a technology is harmful. It is up to those who want to introduce something new to prove, not with certainty but beyond reasonable doubt, that it is safe. Society balances the trial in favour of the defendant because we believe that convicting an innocent person is far worse than failing to convict someone who is actually guilty. In the same way, we should balance the decision on risks and hazards in favour of safety, especially in those cases where the damage, should it occur, is serious and irredeemable.

The objectors must bring forward evidence that stands up to scrutiny, but they do not have to prove there are serious dangers. The burden of proof is on the innovators.

The Misuse of Statistics

You have an antique coin that you want to use for deciding who will go first in a game, but you are worried that it might be biased in favour of heads. You toss it three times, and it comes down heads every time. Naturally, this does nothing to reassure you. Then along comes someone who claims to know about statistics. He carries out a short calculation and informs you that as the "p-value" is 0.125, you have nothing to worry about. The coin is not biased.

Now this must strike you as nonsense, even if you don't understand statistics. Surely if a coin comes down heads three times in a row, that can't prove it is unbiased? No, of course it can't. But this sort of reasoning is being used to prove that GM technology is safe.

The fallacy, and it is a fallacy, comes about through either a misunderstanding of statistics or a total neglect of the precautionary principle – or, more likely, both. In brief, people are claiming to have proven that something is safe when what they have actually done is to fail to prove that it is unsafe. It's the mathematical way of claiming that absence of evidence is the same as evidence of absence.

To see how this comes about, we have to appreciate the difference between biological and other kinds of scientific evidence. Most experiments in physics and chemistry are relatively clear cut. If we want to know what will happen if we mix copper and sulphuric acid, we really only have to try it once. We may repeat the experiment to make sure it worked properly, but we expect to get the same result, even to the amount of hydrogen that is produced from a given amount of copper and acid.

Organisms, however, vary considerably and don't behave in closely predictable ways. If we spread fertiliser on a field, not every plant will increase its growth by the same amount, and if we cross two lines of maize, not all the resulting seeds will be the same. We often have to use some sort of statistical argument to tell us whether what we have observed represents a real effect or is merely due to chance.

The details of the argument will vary depending on exactly what it is we want to establish, but the standard ones follow a similar pattern.

Suppose that plant breeders have come up with a new variety of maize and we want to know if it gives a better yield than the old one. We plant one field with each of them, and we find that the new variety does actually produce more maize.

That's encouraging, but it doesn't prove anything. After all, even if we had planted both fields with the old strain, we wouldn't have expected to get exactly the same yield in both. The apparent improvement might be just a chance fluctuation.

To help us decide whether the observed effect is real, we carry out the following calculation. We suppose that the new strain is actually no better than the old one. This is called the "null hypothesis" because we assume that nothing has changed. We then estimate as best we can the probability that the new strain would perform as well as it did simply on account of chance. We call this probability the p-value.

Obviously, the smaller the p-value the more likely it is that the new strain really is better, though we can never be absolutely certain. What counts as a small enough value of p is arbitrary, but over the years statisticians have adopted the convention that if p is less than 5% we should reject the null hypothesis, i.e. we may infer that the new strain is better. Another way of saying this is that the increase in yields is 'significant'.

Why have statisticians fastened on such a small value? Wouldn't it be reasonable to say that if there is less than an even chance (i.e. p=0.5) of such a large increase then we should infer that the new strain is better?

No, and the reason why not is simple. It's a question of the burden of proof. Remember that statistics is about taking decisions in the face of uncertainty. It is a serious business advising a company to change the variety of seed it produces or a farmer to switch from one he has

grown for years. There could be a lot to lose if we are wrong. We want to be sure beyond reasonable doubt that we are right, and that's usually taken to mean a p-value of 0.05 or less.

Suppose we obtain a p-value of greater than 0.05. What then? We have failed to prove that the new strain is better. We have not, however, proved that it is no better, any more than by finding a defendant not guilty we have proved that he is innocent.

In the example of the antique coin, the null hypothesis was that the coin was fair. If that were the case, then the probability of a head on any one throw would be 0.5 so the probability of three heads in a row would be $(0.5)^3$=0.125. This is greater than 0.05, so we cannot reject the null hypothesis. Thus we cannot claim that our experiment has shown the coin to be biased.

Up to that point, the reasoning was correct. Where it went wrong was in the claim that the experiment has shown the coin to be fair. It did no such thing.

Yet that is precisely the sort of argument that we see in scientific papers defending genetic engineering. A recent report "Absence of toxicity of *Bacillus thuringiensis* pollen to black swallowtails under field conditions" (3) claims by its title to have shown that there is no harmful effect. In the discussion however, the authors state only that there were "no significant weight differences among larvae as a function of distance from the corn field or pollen level." In other words, they have only failed to demonstrate that there is a harmful effect. They have not proven that there is none.

A second paper (4) claims to show that transgenes in wheat are stably inherited. The evidence for this is that the "transmission ratios were shown to be Mendelian in 8 out of 12 lines." In the accompanying table, however, six of the p-values are less than 0.5 and one is 0.1. That is not sufficient to prove that the genes are unstable and so inherited in a non-Mendelian way. But it does not prove they are, which is what was claimed.

The way to decide if the antique coin is biased is to toss it more times and see what happens. In the case of the safety and stability of GM crops, more and better experiments should be carried out.

The Anti-Precautionary Principle

The precautionary principle is so obviously common sense that we might expect it to be universally adopted. That would still leave room for debate about how big the risks and benefits are likely to be, especially when those who stand to gain if things go right and those who stand to lose if they do not are not the same. It is significant that the corporations are implacably opposed to proposals that they should be liable for any damage caused by the products of GM technology. They are demanding a one-way bet: they pocket any gains and someone else pays for any losses. It also gives us an idea of how confident they are about the safety of the technology.

What is harder to understand is why our regulators are still so reluctant to adopt the precautionary principle. They tend to rely instead on what we might call the anti-precautionary principle: When a new technology is proposed, it must be approved unless it can be shown conclusively to be dangerous. The burden of proof is not on the innovator; it is on the rest of us.

The most enthusiastic supporter of the anti-precautionary principle is the World Trade Organisation (WTO), the international body whose task it is to promote free trade. A country that wants to restrict or prohibit imports on grounds of safety has to provide definite proof of hazard, or else be accused of erecting artificial trade barriers. A recent example is the WTO's judgement that the European Union's ban on US growth-hormone injected beef is illegal.

By applying the anti-precautionary principle in the past, we have allowed corporations to damage our health and our environment through cigarette smoking, lead in petrol, and high levels of toxic and radioactive wastes that include hormone disrupters, carcinogens and mutagens. The costs in human suffering and environmental degradation and in resources to attempt to put these right have been very high indeed. Politicians should bear this in mind.

Conclusion

There is nothing difficult or arcane about the precautionary principle. It is the same reasoning that is used every day in the courts and in statistics. More than that, it is just common sense. If we have genuine doubts about whether something is safe, then we should not use it until we are convinced it is. And how convinced we have to be depends on how much we really need it.

As far as GM crops are concerned, the situation is clear. The world is not short of food. Where people are going hungry it is because of poverty. Hardly anyone believes that there will be a real shortage within 25 years, and a recent FAO report predicts that improvements in conventional agriculture and reductions in the rate of increase of the world's population will mean we will continue to be able to feed ourselves indefinitely.

On the other side, there is both direct and indirect evidence that gene biotechnology may not be safe for health and the environment. The benefits of GM agriculture remain hypothetical.

We can easily afford a five-year moratorium to support further research into improving the safety of gene biotechnology and making it more precise and more effective. We should also use the time to develop better methods of sustainable farming, organic or low-input, which do not have the same potentially disastrous risks.

1. See, for example, S. Holm and J. Harris (*Nature*, 400 (1999) 398). Compare C.V. Howard & P.T. Saunders (*Nature* 401 (1999) 207) and C. Rafffensburger *et al*. (*Nature* 401 (1999) 207-208).

2. We are now told that in the case of tobacco and lead, many in the industry knew about the hazards long before the public did. It is not always wise to accept broad and unsupported assurances about safety from those who have a very strong interest in continuing the technology.

3. A.R. Wraight *et al* (2000), *Proceedings of the National Academy of Sciences* (early edition). Quite apart from the use of statistics, it generally requires considerable skill to design and carry out an experiment to provide a convincing demonstration that an effect does not occur. It is all too easy to fail to find something even when it is there.

4. M.E. Cannell *et al*. *Theoretical and applied Genetics* 99 (1999) 772-784.

Biopatents

Human Gene Patenting Roundup

The patenting of the human genome threatens to put the future of medicine in the hands of a few corporations. Despite the platitudes

expressed in Blair and Clinton's joint declaration and from the G8 leaders Summit in Japan this July, human gene patenting has occurred extensively and is being allowed to continue (See Human Genome, the Biggest Sellout in Human History, this issue). Companies have been given *Carte Blanch*e to capitalize on the human genome without adequate public discussion on the moral and ethical issues involved.

A leading genomics company, Incyte Genomics Inc and Motorola Inc's 'Biochip Systems Unit' have entered a licensing agreement granting Motorola rights to utilise Incyte's extensive portfolio of patented gene sequences. Incyte will receive royalties on all manufactured gene expression chips or bioarrays, developed under license to Motorola.

Incyte holds more than 500 issued and allowed full-length gene patents and its sequence database is the world's largest set of data on the human genome. The database features 120 000 gene transcripts, including more than 60 000 not commercially available elsewhere. It is based on gene expression rather than prediction, and there are nearly six million transcribed sequences derived from more than 1 200 different tissue libraries, representing more than 90% of the genes of the human genome. And 4.6 million of these are the property of Incyte.

Gene patents cover all potential functions of a DNA sequence. Consequently, owners can demand license fees for any utility as well as block any new discovered applications. A growing number of vague and broad patents are being granted without a relevant description of function. For example, Smithkline Beecham (now merging with Welcome) holds a patent on the human 'psychosis gene'. This includes the actual DNA sequence and extends to cover any cells and animals genetically engineered with the gene and any 'medical' tests that would be developed. The company can reap patent royalties from any discoveries and or creations that uses the sequence. They claim the gene is involved in controlling a multitude of traits and behaviours, from schizophrenia to manic depression.

Heads of three major science organisations in Germany, the Max Delbruck Centre for Molecular Medicine, the Helmholtx Association of National Research Centres and Deutsche Forschungsgemeinschaft, have all warned that the granting of broad patents on gene sequences will stifle research. They urged the German Science Ministry to explore ways of requiring patent rules that forbid patents covering all possible applications.

The EU Life Patent Directive 98/44/EC allows patents on genes, including human genes, plants and animals. It has been under intense debate throughout Europe and in June the General Assembly of the Council of Europe in Strasbourg adopted the Resolution "Biotechnologies" , calling for an immediate moratorium on the patenting of genes and living organisms, which the Council considers "inappropriate".

All EU-member states were supposed to transform the Directive into national law by July 30th 2000, but only two have done so, one of which is the UK. The large majority of countries have not enacted it and some have stated they will not transform it, as it stands, the most recent being German. The Governments of the Netherlands and Italy are making a challenge against it at the European Court of Justice and France is arguing that it contradicts French bio-ethics laws, which forbids the patenting of any part of the human body.

The controversy stems from the fact that the directive contradicts itself. On the one hand it states "the sequence or partial sequence of a gene…cannot by patented." But then it goes on to state that "an isolated element of the human body…produced by a technical process… including a gene sequence…can be patented…even if the structure of this element is identical to that of a natural element." The council of Europe parliamentarians called on member states to renegotiate a Directive that allows patenting of human genes.

This August, G8 Research Ministers met in Bordeaux, on the initiative of France, Mexico, Brazil, [China] and India to discuss the problem of patenting in genetics. All agreed that DNA sequences – the fundamental data – must not be patented. They are discoveries of objects, which exist in nature, not inventions. Despite all statements to this effect from civil society and governments, companies engaged in deciphering the human genome do not defend this principle, they continue to lobby hard for gene patenting and continue support for the adoption of Directive 98/44/EC.

Sources: Press Release, Incyte Genomics, Inc, See< http://www.biospace.com/news_story.cfm?storyID=3375609>

France protesting EU Directive allowing human gene patents. *Science* 23 June 2000 p2115 .

German agencies sound alarm on risks of broad gene patents by Quirin Schiermeier, *Nature* 406,111(2000)

Green Peace welcomes Councils of Europe's call for a moratorium on patents on life. Green Peace Press Release – June 30 2000.

The Minister of Research Rejects Patents on DNA sequences "No one can own a gene". Interview by Corinne Bensimon. Biotech Activists July 20 posted by Genetics@gn.apc.org AR

USDA to Support Teminator Technology

The three terminator patents, awarded to the Agriculture Research Service (ARS) and Delta and Pine Land Co (DPL), were discussed at USDA Biotech Advisory Board Meeting - July 2000.

A number of nation states and international organisations have condemned terminator technology, stating it poses unacceptable environmental, social, and economic consequences that will affect the world's poorest farmers. It has also been suggested that terminator is being used as a tool for biological and economic warfare, designed to influence economic decision-making in foreign markets.

The board was asked to consider the socio-economic implications in the deployment of terminator. These included how it would impact on the way farmers manage their crops from year to year, especially in developing countries; how it may affect the agricultural marketing chain and consumers; and whether there are any scientific question pertaining to adverse environmental effects?

The closing remarks in the USDA discussion paper on terminator notes; "A report from the National Academy of Science recommends support of research…that decrease the potential for the spread of transgenes into wild populations. Might products resulting in sterile seed developed under the new terminator patents accomplish this aim?…..Despite the controversy ….

careful consideration needs to be given to the potential benefits of supporting licensure by Delta & Pine Land Co." In other words, never mind the socio-economic considerations, let's use it anyway.

Last year Monsanto's CEO, Bob Shapiro, vowed that Monsanto would never adopt terminator. But recent reports in the New York Times reveal Monsanto and its partner Scotts are adopting terminator to 'prevent GM grass pollen jumping from lawn to lawn'. Field trials show that the pollen can migrate up to 3,000 feet and cannot be contained.

RAFI's Pat Mooney says it's a classic fifth column strategy to commercialise terminator technology. The technology is a hot potato and politically risky for the Gene Giants to embrace openly, so USDA and other scientific bodies are towing the industry line by championing so called 'environmental benefits'.

Gary Goldberg, CEO of the American Corn Growers Association, agrees, "The use of taxpayers money to develop terminator is a giant kick in the teeth to farmers everywhere. Terminator is designed to solely maximise seed industry profits. In my opinion, the Biotech Advisory Board should focus on one question; how fast can USDA ban the technology and abandon its patents?"

Sources: Discussion Paper on the "Control of Gene Expression" Patents. USDA Advisory Committee Meeting Jul 26-27,2000. http://www.usda.gov/agencies/biotech/downloads/paper72000.html July 2000. & Snakes in the GM grass: Scott says GM grass could be Greener with Terminator. USDA's Biotech Advisory Board Ruminates on Terminator. RAFI News Release - July 2000. < www.rafi.org> AR

Monsanto's Patent Waiver: One Down Thirty-one to Go

In a bid to improve its image, Monsanto Co announced it would grant free patent licenses to the developers of Golden Rice. Ingo Potrykus the Swiss Professor who developed the rice was said to be delighted. Now all he has to do is persuade the other 31 patentees, holding 70 patents in total, to join Monsanto and forgo their patent rights too.

Potrykus hopes to send-breeding stock to agriculture institutes later this year, to be crossed with local varieties and planted in paddies by 2004. But Gary Toenniessen, Director of Food Security at the Rockerfeller Foundation said that even if all the patent problems are resolved, there would still be serious barriers to deploying golden rice around the world. Notable countries have to be convinced that it poses no treat to their ecology or to human health.

Sources: "Monsanto Plans to Offer Rights to its Altered-Rice Technology" By Christopher Marquis, *The New York Times*, 4 Aug 2000. & "Monsonto Offer Patent Waiver" By Justin Gillis, *Washington Post*, 4 Aug 2000. AR

Canadian Court Rules Mammals Can be Patented

In a spit 2-1 decision, the Canadian Federal Court of Appeal ruled in favour of granting a patent to Harvard Medical School for the oncomouse, genetically engineered to carry a cancer-causing gene. A 15 year old court battle has raged over whether mother nature or a Harvard scientist invented the mouse and its offspring. The trial judge in the earlier decision ruled Harvard invented the process for inserting a gene into a mouse; they did not invent the mouse. The decision to grant a patent on a higher life form opens the door to patenting any non-human life form. The patent extends to all non-human mammals that might be similarly genetically engineered, even though Harvard has not performed these modifications.

The implications for this change in Canadian patent law are profound. Many nation states opposed to the patenting of life were hoping this case could strengthen their position at the World Trade Organisation. Allowing animal patents means that corporations can impose the same kinds of conditions on livestock farming as they have on plant agriculture.

There are approximately 250 animal patent applications pending in the Canadian Intellectual Property Office. RAFI asked Murray Wilson a spokesperson for the patent commissioner to divulge the nature of these patents. He said, " Let your mind run wild with what people could dream up for getting the body of an animal to do."

However, the history of the oncomouse demonstrates that patents stifle rather than encourage research. Restrictions have become so limiting on downstream revenues that few scientists are purchasing or using the oncomouse in their research.

Source: RAFI Aug 10th 2000. The mouse that roared on animal pharm: Canadian court ruled that mammals can be a patented invention. < http://www.rafi.org> AR

TRIPS Violate Human Rights – UN Declares

The UN Sub-Commission for the Protection and Promotion of Human Rights unanimously adopted a resolution calling into question the impact of the World Trade Organization's (WTO) Agreement on Intellectual Property Rights (TRIPS) on the human rights of peoples and communities, including indigenous communities. There is growing concern that TRIPS is an industry-driven intellectual property agreement, protecting corporate patents at the expense of national economic and health concerns.

The Commission notes dire consequences for human rights to food, health and self-determination if the TRIPS Agreement is implemented in its current form. The resolution is based on the provisions of both the UN Covenant on Economic, Social and Cultural Rights and the UN Convention on Biological Diversity.

The TRIPS Agreement, as it stands, violates farmers rights to save, exchange, re-use and sell seed from their own harvests. Already in the US Monsanto has employed detectives to find and prosecute farmers who are harvesting seed from its patented crops. If such enforcement spreads throughout the world, it would violate the human rights of millions of farmers who depend on seed recycling for survival. The TRIPS agreement has shifted the balance of intellectual property rights away from public interest and in favour of patent holders. But patent holders rights must be subordinate to human rights and TRIPS directly violates Article 1 of the Covenant on Economic, Social and Cultural Rights that stipulates;" In no case may a people be deprived of its own means of subsistence."

Furthermore, TRIPS also requires that all WTO members patent pharmaceuticals. For countries with a high level of HIV, malaria and tuberculosis infection and who have not yet developed a pharmaceutical research base, access to drugs is imperative. Given the link between

patent protection and higher prices for pharmaceuticals the TRIPS agreement can only be detrimental to public health and development in general.

This resolution comes at a time of intense questioning by developing country governments on the interpretation and implementation of the TRIPS agreement. Furthermore, there have been numerous national and international civil society alliances calling for TRIPS to be brought into line with human rights and environmental imperatives, so as to protect the social function of intellectual property.

Sources: Press Release, The International NGO Committee on Human Rights in Trade and Investment (INCHRITI) & Institute of Agriculture and Trade Policy, August 22, 2000; Human Rights Resolution, Commission on Human Rights, Sub-Commission on the promotion and protection of human rights, fifty-second session, Agenda item 4. The realisation of economic, social and cultural rights. Intellectual property rights and human rights. (E/CN.4/Sub.2/2000/7) AR

Science Bytes

Phasing Out Antibiotics Will Not Reduce Antibiotic Resistance – The Irrelevance of Natural Selection

The biotech industry have defended their use of antibiotic resistance marker genes by claiming that the widespread evolution of antibiotic resistance is due to the overuse of antibiotics and that the horizontal transfer of marker genes will not contribute significantly if both agricultural and medical uses of antibiotics were curtailed. The story goes that as 'selection pressure' for antibiotic resistance disappears, so will the antibiotic resistance genes because it 'costs' the bacteria to maintain a useless gene.

Now, a growing body of evidence is proving them wrong. Although the overuse and abuse of antibiotic may have contributed to the evolution of high levels of resistance among bacteria associated with disease, phasing out antibiotics or reducing their usage will not necessarily reverse the situation.

A comprehensive review published in May (1) presents evidence on how the functional complexity of the genes frustrates any attempt to make predictions based on the simplistic assumption that one gene is responsible for one function. In essence, an antibiotic resistance gene often serves multiple functions, while many different genes may contribute to resistance against a single antibiotic.

For example, the gene recA was discovered at least six times, first as a recombinase, then an inducer of the lambda virus, a gene regulator, a DNA repair enzyme, a membrane-binding protein, and finally a mitomycin C resistance gene. Each activity had to be independently discovered because the unknown activities could not be deduced from the known.

Aminoglycoside resistances are due to both single enzymes with multiple resistances as well as multiple enzymes with overlapping resistances. Among the 17 different classes of aminoglycoside modifying enzymes are those that inactivate just 2 antibiotics (ef, gentamycin and fortimicin by class I (3)-acetyltransferases) to those that inactivate as many as four (eg, gentamycin, tobramycin, netilmicin and kanamycin by (6')acetyl transferases, or kanamycin, neomycin, amikacin and isepamicin by (3')-phosphoryl-transferases.)

The authors recommend radical change in drug design which do not depend on killing the bacteria so much as physiologically taming them to stop doing harm.

Is this a prelude to an even more radical re-think which involves restoring ecological balance without the use of drugs at all, so that the bacteria may revert to a non-virulent, non-proliferative phase (2)?

- Heinemann, J.A., Ankerbaner, R.G. and Amabile-Cuevas, C.F. (2000). Do antibiotics maintain antibiotic resistance? *Drug Discovery Today* 5, 195-204.
- See Ho, M.W. (1999). *Genetic Engineering Dream or Nightmare? 2nd ed. Turning the Tide on The Brave New World of Bad Science and Big Business*, Chapter 13, Gateway, Gill & Macmillan, Dublin. MWH

Terminator Gene Product Alert

So far, attention has focussed on the terminator technology without considering the extremely toxic gene product, barnase, which could be a major health hazard.

Barnase is the gene product in terminator technology which prevents harvested seeds from germinating. It is a ribonuclease (RNAse), an enzyme that breaks down RNA indiscriminately, isolated from the soil bacterium, *Bacillus amyloliquefaciens*. The enzyme is normally lethal in the living cell, but is produced in the bacterium together with an inhibitor. This inhibitor is separated from the enzyme when it is excreted. Traces of barnase are toxic to the rat kidney (1) and to human cell lines (2).

In some terminator constructs, Barnase is linked to a plant promoter active only in the cells of the tapetum (the sac from which pollen cells are generated). The pollen cannot develop when the barnase gene is active (Us patent 5,723,765 is jointly held by the United States Department of Agriculture(USDA) and Delta and Pine Company, which for a time considered joining Monsanto). The terminator technology was designed to control seed production to benefit seed companies by preventing seed saving. The system has also been studied for use in seedless fruit production (3).

The barnase component of terminator is also being used to produce male sterile lines in wheat by introducing promoters from corn or rice linked to barnase gene (4). Male sterile lines are used to produce hybrids which are more uniform than inbred lines and may also show heterosis (hybrid vigor). Hybrids also benefit seed producers because saved seeds segregate undesirable progeny. Several methods have been studied for producing hybrid canola including the use of barnase.

The most significant question about use of barnase is: do the crops bearing barnase gene pose any threat to humans or animals? This question does not seem to have been addressed by those developing or testing the crops. During seed production, barnase may be present in dust and debris from the crop and surfaces, along with groundwater may be contaminated with the toxin. Humans or animals breathing the plant material may experience severe toxicity. Normally, for crop generation both the barnase gene and the gene for a barnase inhibitor are required. It seems likely that mitotic recombination could easily separate barnase gene from barnase inhibitor gene. Such complications should not be ignored.

Assuming that commercial hybrids are created , say for example, in canola, the hybrid crops are likely to produce viable pollen. The pollen

would likely segregate active tapetal barnase producing some male sterility in weedy relatives and neighboring canola producers fields. In a sense the hybrid producers would pollute the crops of neighbors in a severe manner, much like the pollution of conventional canola from GM pollen in Saskatchewan. Except that the barnase gene produces a well known toxin active against humans and animals.

1. Ilinskaya,O and Vamvakas,S (1997). Nephrotic effect of bacterial ribonucleases in the isolated and perfused rat kidney. *Toxicology* 120, 55-63

2. Prior,T, Kunwar,S and Pastan,I (1996). Studies on the activity of barnase toxins in vitro and in vivo. *Biocong Chem* 7,23-9

3. Varoquaux,F, Blanvillain,R, Delseny,M and Gallois,P (2000). Less is better: new approaches for seedless fruit production. *TIBTECH* 18,233-43

4. DeBlock,M,Debrouwer,D and Moens,T. (1997). The development of a nuclear male sterility system in wheat. *Theor and Appl Gen* 95,125-31 JC

More on Instability of Transgenic Lines

Somaclonal variation (SCV) in transgenic plants may slow incorporation of introduced genes into commercially competitive cultivars, researchers warn (1).

Somaclonal variation in transgenic barley (*Hordeum vulgare* L.) was assessed by comparing the agronomic characteristics of 44 transgenic lines in the T2 generation to their non-transformed parent (`Golden Promise'). A second experiment examined the agronomic characteristics of seven transgenic-derived, 'null' lines – those which were not transformed - in the T2 and T4 generations.

Compared to their nontransgenic, noncultured parent, Golden Promise, most of transgenic lines were shorter, lower yielding, and had smaller seed, and the variability among individual plants was higher. The frequency and severity of the observed SCV was unexpectedly high, and the transformation procedure appeared to induce greater SCV than tissue culture in the absence of transformation. Attempts to understand the sources of SCV, and to modify transformation procedures to reduce the generation of SCV, should be made, the authors stated.

The publication above deals with a fundamental problem with genetically modified (GM) crops. In order to make a GM crop for commercial use, the GM tissue cells are grown up in tissue culture, from which whole plants are regenerated. During the culture process and during later generations of selected plants, genetic variability is rife. Both gene mutation and chromosome alteration are rampant. There seems to be something about the laboratory technique and the introduction of transgenes that causes gene and chromosome instability. The best available evidence suggest that the technology activates retrotransposons (retrovirus like gene clusters) that replicate copies that jump into other chromosomes or regions of a chromosome.

Retrotransposons make up from a few percent to 85% of the genome of a higher plant. However, it only takes a few retrotransposons activated from their normally dormant state to cause gene mutation by insertion or chromosome rearrangement by re-combination between retrotransposons.

Our comments: Somaclonal variation in transgenic lines is shown to be due to both tissue culture and the transformation process. It confirms the inherent instability and unpredictability of transgenic lines that we have drawn attention to (2), which has significant implications for the safety of GM crops. As they are grown in the field, a range of hidden defects may continue to be generated that lead to toxicities and other untoward, unexpected side effects. The phenomenon has largely been overlooked in regulation on the safety of GM crops (3).

1. Bregitzer, P, Halbert ,SE, P. G. Lemaux, PG (1998). Somaclonal variation in the progeny of transgenic barley. Theoretical and Applied Genetics 96, 421-425.

2. See Ho, M.W. (1999). *Genetic Engineering Dream or Nightmare?* 2nd ed., Gateway, Gill and Macmillan, Dublin.

3. See Ho, M.W. (1999). Biosafety Alert: submission to TEP on the molecular genetic characterization required for commercial approval of transgenic lines www.i-sis.org

JC & MWH

More Trouble for Transgenic Lines

Transgenes are found to be poorly expressed due to premature poly-adenylation (adding a poly-A tail) to the messenger RNA.

The *cry* genes that code for the insecticidal crystal proteins of *Bacillus thuringiensis* (Bt) have been widely used to develop insect-resistant transgenic plants. The *cry3Ca1* gene has been reported to code for a crystal protein which is particularly potent against the Colorado potato beetle (CPB). To explore the biotechnological potential of cry3Ca1 protein, researchers introduced this gene into transgenic potato plants under the control of the CaMV 35S promoter (1).

In the resulting transformants, the *cry3Ca1* gene was very poorly expressed. In fact, no full-length transcript (2300 nt) could be detected. Instead, only short transcripts of approximately 1100 nt were observed. Analysis of these short transcripts by Northern hybridization, RT-PCR (reverse transcription followed by polymerase chain reaction) as well as by cloning and sequencing showed that they resulted from premature polyadenylation.

These processing events occurred at four sites within the *cry3Ca1* coding region (at positions 652, 669, 914 and 981 relative to the translation start site). The sites at which premature polyadenylation took place were not those that showed the highest degree of identity to the canonical AAUAAA motif. Together with other recent data, these findings suggest that premature polyadenylation is an important mechanism which can contribute to the poor expression of transgenes in a foreign hosts.

Premature polyadenylation occurs when the RNA message is terminated short of the stop signal, and is then polyadenylated. A prematurely poly A message without a stop signal might result in the polyA tail being translated as a string of the amino acid lysine added to the growing peptide. Such products have problems being released from ribosomes, and once released, tends to be destroyed by the final protein processing system. However, unnatural peptides may also be produced and cause untoward problems.

Our Comments: Many important findings seem to be ignored in regulation of GM crops and swept under the carpet in the debate over GM foods. This paper documents yet another mechanism that makes

transgenic crops unreliable and economically non-viable.

1. Haffani, YZ, Overney, S. Yelle, S, Bellemare, G, and Belzile, FJ (2000). Premature polyadenylation contributes to the poor expression of theBacillus thuringiensis cry3Ca1 gene in transgenic potato plants, *Mol Gen Genet*, Published online: 17 June 2000. JC

Bt Pollen Lethal to Monarch Butterflies - Confirmed

A new study from Iowa State University shows Bt corn pollen naturally deposited on common milkweed in a corn field causes significant mortality to monarch butterfly larvae (1).

Larvae fed on milkweed plants naturally dusted with Bt pollen suffered significant higher rates of mortality after 48 hours exposure compared to larvae fed on leaves with no pollen, or on leaves with non-Bt pollen.

The highest mortality rates occur on milkweed plants in corn-fields or within 3 meters of the edge. But quantification of wind dispersal beyond the edge of fields predicts mortality may be observed at least 10 meters from Bt corn field borders.

The study also investigated sub-lethal effects and found continuous exposure to Bt toxin influences developmental time and adult characteristics to various degrees. The study found sub-lethal ingestion of Bt toxins caused reduction in adult lipid levels and may indicate that larva fed less, or did not digest nutrients efficiently. Migratory adult monarchs rely on lipids for energy and a lower level of lipids, carried over from the larval stage, could reduce their ability to reach Mexico. Reduced adult weight and smaller wing lengths was also observed and similarly could decrease the ability of adults to complete migration.

Fifty percent of over-wintering adults in Mexico originate from central US, an area of concentrated corn production. In 1998, approximately 3.6 million hectares of Bt corn were planted and predictions are that by 2003, this area will have extended to 12 million hectares (1/3 of total US corn acreage).

The study concludes that because monarch larvae, milkweeds and transgenic pollen overlap spatially and temporally in the central US, Bt corn pollen will have a negative effect on monarch larvae. Larvae developing in late summer will be exposed to Bt pollen for most of their development and cumulative exposure to Bt toxin could raise mortality rates even further by preventing successful migration.

These findings indicate that Bt crops can have adverse effects on food webs that are not corn and the widespread planting of transgenic corn represents a significant mortality factor for non-target species. Ecological impact assessments must be evaluated more fully before Bt crops are planted over extensive areas.

The US EPA has convened an independent review board to assess the ecological impact of Bt crops. But they have also extended licence for plantings until 2002, despite calls for a ban.

1. Hansen L. C., Obrycki J.J. (2000) Field deposition of Bt transgenic corn pollen: lethal effects on the monarch butterfly, *Oecologia*, published online. AR

Book Briefs

Alas Poor Darwin

(eds Hilary Rose & Stephen Rose). London, Jonathan Cape, 2000. ISBN 0-224-06030-9.

Peter T. Saunders

Whatever you read, whether it's the scientific literature, popular science journals or the daily papers, you are bound to have seen a lot of articles confidently explaining yet another feature of human behaviour -- male promiscuity, rape, the fact (if it is one) that women will go for a man with money and power over one with youth and good looks, and so on.

These articles are all based on the new scientific discipline known as evolutionary psychology. It holds that human behaviour can be decomposed into individual traits and that each of these has evolved by the natural selection of genetic mutations. If we want to know why women are more patient than men and less likely to succeed in business, we have to find the adaptive significance of these traits, i.e. we have to imagine why they would help women (but not men) to survive and leave more offspring. More precisely, because biological evolution is too slow for there to have been any significant changes over the last few millennia, we have to make up a story of why these traits would have been advantageous in the Pleistocene era.

The idea that human behaviour can be explained by natural selection is very old; in fact, social Darwinism is actually older than Darwinism. But it became much more influential about 25 years ago, with the publication of E.O. Wilson's *Sociobiology*. Evolutionary psychology purports to be different from sociobiology (and some of its critics, including the editors of this volume, agree) but it is really very much the same. The difference is largely that sociobiologists write of *genes* for behavioural traits whereas the evolutionary psychologists generally refer to *mechanisms*. Since, however, the mechanisms are assumed to be determined by genes and since all we are told about them is that they somehow transmit the influence of the genes to create behavioural traits, for all practical purposes there is no difference.

It's not hard to see why evolutionary psychology is so fashionable. It makes excellent material for the Sunday papers, who naturally prefer a complete and easily understood story. It's also very good professionally for its proponents because it is relatively easy to produce a large number of papers and to turn very ordinary work into something that looks very significant. Only a very few biologists would read a paper on the mating behaviour of the scorpion fly, but turn the work into a "generalised rape hypothesis" and it's bound to attract a lot of attention.

The only trouble is that the theory doesn't stand up to scrutiny. Actually, we might have expected that. In science as in politics we can be sure that every complicated question has a simple answer -- and that the simple answer is almost always wrong. But to see that the theory doesn't work we have to look carefully at it, to see whether its assumptions are correct, or at least plausible, or in some cases whether they even make any sense at all. We have to compare its predictions with what we actually observe, not when we glance quickly at the phenomena but when we look at them closely and with the eyes of experts accustomed to studying human and animal behaviour.

That was why Charles Jencks, himself well known as an architect and a commentator on post modernism, organised the seminar from which this volume is taken. He brought together workers in many disciplines, each bringing a different expertise to the issue. The result is a powerful critique in which the assumptions and claims of evolutionary psychology are studied one by one and refuted.

Thus, molecular biologist Gabriel Dover describes how the modern genetics demolishes the simplistic picture of the gene and its functioning which evolutionary psychologists assume. The philosopher Mary Midgely explains that because thought and culture are patterns, not stuff, they cannot be granular, i.e. not only do memes (the supposed unit of culture) not exist, they are not even the sort of thing that could exist. The psychologist Annette Karmiloff-Smith shows how the "Swiss Army Knife" view of the mind (that it consists of a very large number of distinct modules, each suited to its particular task) is contradicted by studies of infant and child development. The ethologist Patrick Bateson describes how evolutionary psychology has fallen into the same sort of trap that ethology was caught in -- and extricated itself from -- years ago. And so on.

In the introduction, Hilary and Stephen Rose point out that evolutionary psychology is just one of a number of examples of what they call a present-day intellectual myth. There are also evolutionary medicine, psychology, economics, psychiatry, ... even physics. And of course there is the parent subject, evolutionary (i.e. neo-Darwinist) biology. Their supporters see them as linked, each gaining strength from the successes (as they see them) of the others. As Daniel Dennett has put it in his book *Darwin's Dangerous Idea*, natural selection is like a universal solvent, applicable to all subjects and cutting through the misconceptions in each.

But if this theory is supposed to have the same sort of effect on every subject it touches, then if it fails in one we may expect it to fail in the others as well. And sure enough, when you look closely at any of them, evolutionary biology included, you see the same shortcomings. The same simplistic arguments, the same unjustified assumptions, the same willingness to accept Just So Stories as though they were rigorous arguments backed up by solid evidence. The courtiers' new clothes are no more substantial than the emperor's.

This is only hinted at in the book, which may leave the reader with the impression that evolutionary psychology is the one unsatisfactory application of a basically sound theory. If that were so, we might expect that some day its shortcomings will be rectified and there will be a legitimate evolutionary psychology with natural selection at its core, just as some critics of sociobiology reject what they call 'pop sociobiology' while holding that the enterprise itself is valid. Only when we recognise the defects in the project as a whole will we accept that there is no way forward for evolutionary psychology.

That doesn't apply only to subjects that have the word 'evolutionary' in their titles. Genetic engineering also depends on the assumption that an organism can be decomposed into separate traits, each determined by a single gene. If that were true, could we identify and locate the gene for a desired trait and transfer it to another organism, and be confident that when we have done this we will have transferred the trait and nothing more. Because it is not true, the whole enterprise is more complicated and more hazardous than its proponents admit. *Alas Poor Darwin* provides further evidence for this, even if neither the editors nor the authors appear to be aware of it.

Where Next – Reflections on the Human Future

Duncan Poore, ed. Royal Botanical Gardens Kew, 2000. ISBN 1-84246-000-5

Angela Ryan

This book is a collection of thought provoking essays written by a group of scholars going by the name of 'The New Renaissance Group' which include many eminent people. It elaborates on the general theme that our global ecological pandominance has created a growing imbalance with nature, and our present attitudes and institutions are ill-suited to deal with the nature and scale of the problems.

'Where Next?' provides a comprehensive discussion of the urgent issues of our time in relation to human potential and the options available to us. It draws widely from philosophy, science, economics, ecology, sociology, law, entrepreneurial skills and international relations.

The book is a valuable study of the connections and interdependencies between different disciplines. It documents a lot of evidence showing that although 'sustainable development' has been the guiding principle of environmental policy for the last quarter of the 20th century, much 'development' has been going on with very little 'sustainability'. It focuses on solutions and follows through with well-developed ideas for sustainable development. The reader is constantly reminded that this is a matter of human will, and in this sense, the book is a powerful intellectual catalyst for action.

One half of the world's population – 3 billion people – are stuck in a cycle of poverty, deprivation, marginalization and exclusion, especially from the global economy. We still have major conflicts over land and water, especially in parts of the tropics. Frequent environmental disasters caused by climate change have given rise to a steady increase in the numbers of environmental refugees the world over. Our 'high-tech' culture promotes the continuing replacement of artefacts with the 'latest' model regardless of need. The numerous and costly environmental side effects have been left out of the equation, "externalising" the costs to be borne by society at large or by future generations. We are presently throwing away our *natural capital* by allowing so many biological species to become extinct.

E M Nicholson explains what the New Renaissance Group stands for and the four areas for action that they consider of paramount importance for the decades to come. These are: knowing and understanding the natural world; achieving full harmony between people and nature; achieving harmony among all members of the human species, and all human communities worldwide; and achieving a transcendent harmony with the eternal realm beyond us, both philosophic and religious.

They argue for a new agenda for the 21st century that embraces all these areas and works within the framework of evolutionary humanism. In other words, an agenda that works for both humanity and nature.

The intellectual capacity of the human mind is marveled at by a number of authors and one cannot deny that science has given us great insights into nature. However, we do seem unable to safeguard our biological future and are taking huge risks with our basic life support systems. At least over climate and ecology, there is no doubt that we are witnessing the consequence of massive and potentially dangerous human interference. The most

daunting question is: *Will science succeed?*

This book is optimistic, in part, and there is a strong belief in the scientific skills of humanity which could resolve many of our dire ecological problems. The way ahead is to apply the knowledge of ecology to the conservation of natural resources. However, as our problems are world-scale, it is suggested that this should be the job of a new international professional science body. It goes on to stress that the right sorts of scientists have to be sought and brought together to make such a body, and moreover they must be empowered and allowed to hold positions of great influence, especially in the realms of world governance.

Powerful financial and commercial interests have escaped control in many parts of the world and have shown no appreciation or understanding for the biosphere. Intensive agriculture, forestry, hydro-power schemes and the expansion of cities have all ridden rough shod over the scientific and academic establishment, who have been largely powerless to stop such abuses. The deep educational and cultural gulf between science and other subjects has remained unbridged, despite all prior warnings, and this *must* change immediately.

David Flemming argues for the lean economy and how economics as a discipline needs transforming if it is to contribute towards a new sustainable world economy, regulated by an honest and sound global house-keeping of real resources. What is needed is an urgent rethink of the relationship between the market economy and its environment. Strong political leadership is required that has a clear vision and knows what it is trying to do.

Robert Goodland compares environmental sustainability with human, social and economic sustainability and explains why it must be first on the list of priorities. Environmental sustainability concerns the *maintenance of natural capital* and can provide us with *strong* sustainability, as opposed to weak, and there is a big difference between the two.

Ashok Koasla argues that sustainable livelihoods must be the single most important point of the new millennium. It is the central issue facing society, North and South, East and West. By creating large numbers of sustainable livelihoods the world over, the extremes of wealth and poverty that are having a massive effect on the development of sustainability can be addressed. He rightly argues that for any human developmental process to be sustainable, it must be equitable, efficient, ecological and empowering for all.

David Goode points out that it might be possible for the development of Cities to act as a measure of sustainability. Growing cities in the south must develop in ways that demand less from global resources and yet can still provide a high quality of life. This would also give a valuable lead to the north in the search for solutions.

A consideration of contemporary order, peace and conflict is given ample room in this book. Sir Shridath Ramphal discusses how the advance of a sole superpower - American capitalism and American media - has had a major influence on world governance at the end of the 20th Century. In fact, the pre-eminence of the United States is a defining characteristic of our times. An isolationist US that shuns global involvement harms the functioning of the world community as a whole.

A sense of shared values on the global stage – a global neighbourhood ethic – to which everyone can comfortably subscribe, is what's needed. But such a pluralistic vision necessitates a central role for law, and N E Simmonds writes a very interesting chapter on the dissolution of law. Law is defined as being a product of human authority and will, it is poised between reason and willingness and also exists in the tensions between past and future. A not so obvious feature of modern society is that our law - rather than being a framework of rules within which social life is conducted and the limits to competitive self seeking are set - has become a resource over which contending parties struggle. Moreover, there is no willingness at present to face up to the political landscape that this problem presents, and this will stunt the growth of new ecological initiatives.

Now is the time for a re-launch of ecology and for moving towards a universal ecology, grounded in widely held philosophical principles. A new universal ecology could provide people everywhere with a framework in which to fulfil themselves in new ways, opening the door to '*The New Renaissance*'.

Towards the end of this exceptional book, Martin Palmer writes on the practice of conservation by religions. The hope is that we can journey together towards a world in which the whole of life is loved, respected and appreciated.

New Postings on ISIS Website

ISIS New # 6

ISIS Sustainable Science Audit #2

Xenotransplantation: How bad science and big business put the world at risk from viral pandemics, by Mae-Wan Ho and Joe Cummins

The scientific advice that the FDA ignored – a compilation, by Angela Ryan

Human genome – The biggest sellout in human history, by Mae-Wan Ho

Horizontal gene transfer – hidden hazards of genetic engineering, by Mae-Wan Ho

CaMV promoter fragmentation hotspot confirmed and it is active in animals, by Mae-Wan Ho, Angela Ryan and Joe Cummins

The organic revolution in science and implications for science and spirituality, by Mae-Wan Ho

World Scientists' Open Letter and full list of up-to-date signatories

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