COVERING THE GMO ISSUE – AN OVERVIEW FOR SOUTH AFRICAN SCIENCE REPORTERS

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I, the undersigned, hereby declare that the work contained in this assignment is my own original work and that I have not previously in its entirety or in part submitted it at any university for a degree.

ABSTRACT

The aim and function of this paper is to provide a balanced account of how the media, international and South African, have dealt with the issue of genetically modified organisms (GMOs). A selection of interviews, presentations, articles, transcripts and published reports forms the background of this interpretation, and offers insight into the history of the technology, the major role players, the legislation required and implemented, the question of environmental accountability, and the power of the media's influence. It addresses aspects of the causal relationship between the media and public understanding, and the subsequent power of the consumer as manifested by the perception of risk. The central theme of genetic engineering conjures up a variety of meanings and applications, and the plethora of available information is evaluated in an attempt to develop informed understanding for reporters covering the many dimensions of this development within the arena of science and technology.

ABSTRAK

Die doel van hierdie verhandeling is om 'n ewewigtige oorsig te verstrek van hoe die media – Suid-Afrikaans sowel as internasionaal – die kwessie van geneties gemodifiseerde organismes gehanteer het. 'n Seleksie onderhoude, aanbiedinge, artikels, transkripsies, en gepubliseerde verslae vorm die basis van hierdie interpretasie, en verskaf 'n insig in die geskiedenis van die tegnologie, die belangrike rolspelers, nodige en geïmplementeerde wetgewing, die vraag van omgewingstoerekenbaarheid, en die mag van die media se invloed. Dit spreek aspekte aan van die kousale verwantskap tussen die media en begrip deur die algemene publiek, en die daaropvolgende mag van die verbruiker, soos dit duidelik word in hulle insig in en begrip van die risiko-faktor. Die sentrale tema van genetiese modifisering bring te voorskyn 'n verskeidenheid betekenisse en aanwendings; en 'n oorsig van die massa beskikbare inligting word hier aangebied in 'n poging om aan verslaggewers ingeligte begrip aan te bied van die veelsydige omvang van die ontwikkeling van genetiese modifisering in die gebied van wetenskap en tegnologie.

Dedicated to my parents,
Alfred and Marie Frost

and to my beloved son,
Jackson Frost

CHAPTER 1:

GENETICALLY MODIFIED ORGANISMS – A REVIEW

Bring up the subject of GMOs in any company, in any country, and you are sure to elicit heated opinions covering the broadest of spectrums: on the benefits; the sinister implications; the scientific advances; the destruction of biodiversity; the feeding of the world; the contamination of ecosystems; the agricultural redemption of the Third World; and all claiming irrefutable proof for their arguments. The proof of this particular pudding, however, lies within the genetic makeup of its ingredients, and the recipe is still in the making.

> *The recipe for the public GM debate has many incompatible ingredients – a good solid chunk of science; a liberal dash of scientific uncertainty; a spoonful of myth; a dollop of ethics; all lightly tossed with media hype; and baked in a political cauldron. No wonder the brew is so explosive (*Richard Ayre*, Food Standards* Agency, United Kingdom, 23 October 2000: 7)

The issue of Genetically Modified Organisms, also known as GMOs, has percolated into the collective global awareness through the media mechanism, predominantly in Europe and America, with African and Asian countries rapidly following suit. It has become a contentious and bitterly divisive subject, one that American futurist writer Alvin Toffler describes as *Future Shock* - the title of his book – in *New Scientist* (31 October 1998: 28). According to this special GM Edition, the debate has moved to the front burner and "is on the boil" (Editorial: 3).

The question of the media's role to inform the public about genetic modification, and the potential (through the tone of the publicity surrounding the technology) to derail it, will be addressed throughout this overview.

What exactly is Genetic Modification? Why does it evoke such emotive debate; how accurately is the case *for* and *against* presented by the media; how credible are the sources of information; where are the checks and balances in biotechnology; what recourse do the proponents and opponents have to pursue their innately conflicting goals; and should public fear be fanned or assuaged? First, a look at genetic modification itself:

Biotech Basics

Biotechnology is an umbrella term that covers a broad spectrum of tools and techniques, ranging from fermentation (for example of bread, wine and cheese) to plant and animal breeding, cell and tissue culture, antibiotic production and genetic engineering. The traits of every organism are encoded in its genetic material (DNA or RNA) which is organised into individual units called genes. Genetic modification is achieved by changing the code or organisation of the genetic material of an organism. This includes, but is not limited to, moving a gene or genes from one

organism to another. This is commonly called genetic engineering (*Health Canada Information:* The Safety of Genetically Modified Food Crops: 2).

Novel foods, on the other hand, are defined as products that have never been used as a food; foods which result from a process that has not previously been used for food; or, foods that have been modified by genetic engineering. This last category of foods has been described as genetically modified foods (often referred to as GM foods, genetically engineered foods or biotechnology-derived foods). Novel crops are produced in laboratories, and studied in growth chambers or greenhouses under conditions of environmental isolation.

Conditions are designed to minimise the possibility of environmental impact, and the criteria include: measures to prevent the transfer of pollen to other plants, inspection, post-harvest land use restrictions, and follow-up monitoring. Typical GM crops that have been approved in the USA and Canada include:

- *corn, including strains resistant to corn borers and herbicides;*
- *canola, including strains resistant to herbicides;*
- *potato, including strains resistant to Colorado potato beetles;*
- *tomato, including strains that ripen slowly;*
- *squash; soybean; flax; and cottonseed oil* (*Health Canada Information*: The Safety of Genetically Modified Food Crops: 3: www.hc-sc.gc.ca).

In the USA, the *Food and Drug Administration (FDA)* is responsible for assessing the human health safety of all products, including those derived through biotechnology such as food, drugs, cosmetics, medical devices and pest control products. In the case of novel foods, each safety assessment considers the process used to develop the novel food, its characteristics compared to those of its traditional counterpart, its nutritional quality, the potential presence of any toxicants or anti-nutrients, and the potential allergenicity of any proteins introduced into the food. It holds responsibility for the regulation of products derived from biotechnology including plants, animal feeds and animal feed ingredients, fertilizers and veterinary biologics. For genetically modified crop plants, it assesses the potential risk of adverse environmental effects; authorises and oversees import permits, confined trials, unconfined release and variety registration (*Health Canada Information*: The Safety of Genetically Modified Food Crops: 7).

History of Genetic Modification

In the late 1970s, Baron Professor Marc Van Montagu, working at the University of Gent in Belgium, observed a type of soil bacterium that created tumours in plants. In 1980, he demonstrated that this agrobacterium inserted its own DNA into the DNA of the plant from which it was feeding, thereby transforming its genetic structure. This, he emphasised, was "a type of genetic modification which already occurs naturally", and he then set out to answer the question whether the agrobacterium's natural capacity to "modify plants genetically be harnessed to transfer other genes into plants" (*BBC* Transcript: The Rise and Fall of GM, Channel 4 Television, 20 March 2000: 1).

Two years after Van Montagu's discovery, a member of his team at Gent solved this problem. His colleague, Mexican scientist Luis Herrera-Estrella, used agrobacterium to transfer an antibiotic resistance gene into a tobacco plant, and in doing so, "became the first person to create an artificially, genetically modified plant" (The Rise and Fall of GM: 2).

Suddenly a "door had been opened", and a small group of scientists at the biotechnology company Monsanto started researching the possibility of developing a virus resistant plant. After five years of unsuccessful experiments, a breakthrough came in 1996, when Professor Roger Beechey, on a grant from Monsanto at the University of Washington, succeeded in moving a gene from a mosaic virus into cells from tomato plants. It was considered the first of a "series of historic breakthroughs", and the following year Monsanto announced that it had engineered the first artificially insect-resistant crop plant, and followed that up with herbicide resistant soya bean plants.

Considering the fact that farmers spend an estimated $8 billion a year in the US on herbicides and insecticides, this new technology appeared to hold the potential to transform agricultural production. "For farmers in the West, GM held the promise of greatly reduced costs, increased yields and healthier plants. But for the Third World, scientists believed GM could be a life-saving technology" (Rise and Fall of GM: 4).

In 1990, Professor Don Grierson, at the University of Nottingham, made a "discovery of immense significance to the Third World. By removing a gene from a tomato, reversing it and then re-introducing it, he showed how vegetables and fruit could be made to ripen more slowly and stay fresh longer" (Rise and Fall of GM: 5).

The narrator explained why this discovery held such major implications:

> *African farmers also face problems which we in the affluent West have left behind. The biggest is transportation and storage. For African farmers, getting food to the market before it goes off is a mammoth task. There is little or no refrigeration or packaging, very few good roads or refrigerated lorries. It is estimated that as much as half of the food harvested in countries like Kenya simply rots before it reaches the mouths of the consumer* (Rise and Fall of GM: 6).

In addition to the potential of delaying the ripening process and making plants virus-resistant, GM science also introduced concepts like improved protein quality and quantity, primarily in the sweet potato, chosen because it is a primary food crop and protein source to poor people around the world (Rise and Fall of GM: 6).

And so it was that genetic engineering was born, made, spliced and created. But if scientists thought that things would get exponentially easier, once the important technological breakthroughs had been made, they were wrong. Once the public picked up on the broader implications of the "wunderkind", as fueled by the media and other watchdog organisations, questions and accusations starting flying.

> *It wasn't until 1996, after 15 years of research and testing, that scientists finally made the first GM product available to farmers. But, just as the technology was starting to be of some practical use, mounting concerns about the safety of GM food*

> *were building into a campaign which would threaten to put an end to this new science* (6).

A roller-coaster ride was to follow, and no end appears to be in sight. An examination will be made regarding some of the major concerns, confusion, consternation, contradictions, claims, counter-claims, comparisons, currents, contention and context. Sources of information range from a selection of newspapers, scientific journals and magazines, radio and television broadcasts and interactive talk shows, press releases and forum transcripts. A comparison will be made between the perspectives and insights offered, the quality and objectivity of the coverage, and the interpretation made by the public as represented by its emotional and economic comments.

Substantial Equivalence

A term has emerged in connection with genetic modification. It is "substantial equivalence". The *Canadian Food Inspection Agency (CFIA)*, in a report on GMOs, refers to it as an "effective safety assessment". Their approach is based on comparing genetically modified foods with conventional non-modified foods with a long history of safe use. This is known as "substantial equivalence", but the report qualifies that it does not necessarily mean that they approve a genetically modified food if it is substantially equivalent to its traditional counterpart. The scientists assess the GM food against the traditional counterpart that has been safely consumed in the human diet, and identify novel traits and components (*Health Canada Information*: The Safety of Genetically Modified Food Crops: 6).

They then focus on these novel traits and components, assessing them according to the process used to develop the novel food, its nutritional quality, the potential presence of any toxicants or anti-nutrients, and the potential allergenicity of any proteins introduced into the food. When the research and testing satisfies the criteria, the foods are allowed access to the Canadian market. The safety assessment process is based on principles developed through international consultations carried out by the *World Health Organisation (WHO)* and the *Food and Agriculture Organisation (FAO)* of the United Nations, and the *Organisation for Economic Cooperation and Development (OECD)*.

The approach to the safety assessment of biotechnology-derived foods, using the concept of substantial equivalence, is currently applied by regulatory agencies around the world, including the European Union, Australia, New Zealand, Japan and the United States (*Health Canada Information*: The Safety of Genetically Modified Food Crops: 7: www.hc.sc.gc.ca).

Responding to the question as to whether there is sufficient independence in the review process, the *CFIA* claims that:

> *...all information is evaluated by scientific experts in the areas of nutrition, molecular biology, chemistry, environmental science and toxicology - reviews are based on a scientific assessment of the results, as well as the protocols and methodologies used to derive the information (www.hc.sc.gc.ca).*

On the issue of labeling, *Health Canada* and the *CFIA* share the responsibility for food labeling policies under the *Food and Drugs Act*. Mandatory labeling is required for GM foods where safety concerns such as allergenicity and compositional or nutritional changes are identified, so as to alert consumers or susceptible groups in the population. Voluntary labeling of foods derived from biotechnology is permitted under current legislation as an option for food companies to meet marketplace demands. The *CFIA* is also responsible for protecting consumers from misrepresentation and fraud with respect to food labeling, packaging and advertising.

The food labeling issue is by no means concluded. It represents an ever-evolving dynamic, much like the science it descends from. As countries wrestle with the concepts and wording of new laws, and appeals get lodged, the central issues become murky under pending legislation and threatened litigation. Some current examples will be examined more comprehensively in Chapter 7.

Contention Tension

Genetic modification has taken on almost mystical proportions. The press needs to demystify it in order for the public to understand it and make informed choices. An inherent struggle lies in the interpretation of the science, in the applicability of product, in the fear of possible ramifications beyond control, and in defining the role players. These were some of the concerns raised in a radio talk show:

- GM technology is developing too fast for adequate control studies
- the inherent invasiveness of the techniques suggest an "unnatural" product, giving rise to the pejorative Frankenfoods
- the bottom line of the biotech companies creating GMOs is economic, not social or philanthropic, as claimed
- patenting pre-existing life forms after making miniscule genetic adjustments or insertions amounts to bio-piracy
- small or subsistence farms will be annihilated by this technology, whereby seeds are owned by the company responsible for "creating" them, and "leased" to the farmers for single-crop yields

These views were presented by call-in listeners to the Tim Modise radio show (SAfm: 4 August 2000), where a guest speaker led a discussion on genetic engineering. This naturally represented a small section of the South African public and their response to the issue of genetic engineering, but as will be developed in Chapter 6, appears to be synonymous with concerned sentiment expressed worldwide.

Public Response

A bumper sticker that received popular support in the States during the late 1990's was one bearing the cautionary wording: *If you're not outraged, you're not paying attention*. As people become more attentive and sophisticated in their

understanding of science, they seek more functional explanations of the issues or events they find relative to their lives. People seek information about risk; to themselves, their health, and their environment – and the fact that the media provides a steady flow of information on the potential risks of GMOs, to be expanded on in subsequent chapters, has heightened the issue and polarised the supporters from the non-supporters.

Is GM technology the solution to world hunger? One of the strongest prevailing counter-arguments is that world hunger is a political problem, with people suffering from malnutrition and hunger because they cannot afford to buy food; not because it is unavailable through prevailing agricultural techniques. Therefore, as a solution to world hunger, biotechnology could be seen as a very expensive technology, with the use of "terminator seeds" preventing germination, resulting in farmers having to buy new seeds each year.

These seeds are not commercially available, but they have elicited a strong response because of their "once-off" agricultural use, as they have been modified to produce a single crop.

Companies promoting GM food, one of the most well known being Monsanto, have been coming under increasing pressure, with accusations of unfair corporate practices and censorship, ties with the Food and Drug Administration in the USA and the development of terminator seeds with only profit in mind, as shall be explored in later chapters.

> *Capitalist biotech companies like Monsanto have been accused of monopolising the world seed market and forcing farmers to buy their products. Although Monsanto is the company most people associate with GM food, there are in fact more than 20 other companies currently producing GM seeds, such as Advanta, Novartis, Dow, Pioneer, and Aventis* (*BBC*: Rise and Fall of GM: 13).

Public protest appears to be widespread, predominantly in Europe, as manifested in NGO publications, demonstrations, and activists destroying test fields where GM crops are growing (with occasional dumping in front of government offices). Are they perceived to be articulate representatives of the collective whole, or radicals appearing on behalf of fringe groups? Our impression relies largely on the language of the media source conveying the information, an indication of the media's power to reflect, distort or enhance the credibility of what it is covering.

> *But for many campaigners, their opposition to GM is not based on science but rather ideology. In particular, anti-GM demonstrators at the World Trade talks at Seattle were opposed to free trade and the power of so-called multinationals* (Rise and Fall of GM: 13).

The media's role in promoting awareness of this issue, with the by-product of a more informed and discerning public, can be instrumental in major policy and paradigm shifts within companies and government. Major supermarkets have started banning GM ingredients in their own branded food, or taken to clear "non-GMO" labeling, and have extended the availability of organic produce, as a response to consumer demand (as explored further in Chapter 7). Not to do so, it appears, is tantamount to economic or business suicide, when 1999 figures for

organic and related non-GMO food products reflected an industry worth 13 billion pounds.

Dorothy Nelkin, author *of Selling Science: How the Press Covers Science and Technology*, says:

> *The health risks of biotechnology have never been established, and as yet there is little evidence they exist. Rather, biotechnological risk is in many ways a surrogate issue, linked to deeper ethical and religious issues, concerns about economic inequities, and public mistrust* (1995: 60).

She speaks of the media's enthusiasm about biotechnology being "tempered by expressions of doubt", with criticism of the "growing links between the biotechnology industry and universities for their effect on open research, calling attention to the conflicts of interest that are endemic to this field where profits and ethics collide". This seems to be an exact synopsis for the kind of mistrust and doubt finding its way into the public forum, where health is seen as potentially being traded at the expense of technological advances.

Whether or not this is a valid argument is extremely difficult to prove, due to the very nature of the public perception of risk, the contradictions in the information provided, and it would seem that a stalemate is being reached. The campaign against genetic modification seems to have been very successful, as "one after another, food retailers (first in Europe and now in America), have banished GM produce from their shelves. Gm farmers now struggle to find buyers. Politicians who once defended GM scientists, have now publicly distanced themselves" (*BBC*: The Rise and Fall of GM: 1). Their response?

> *GM scientists say the campaign is based not on sound science but rather on prejudice; that it is being waged by people in the affluent West, who have a self-indulgent and irrational disdain for science and modern food production; and that the widespread acceptance of environmentalist arguments by ordinary people is effectively prohibiting a technology which might have transformed the developing world* (*BBC*: The Rise and Fall of GM: 1).

Someone who fervently expresses her support of GM technology, stating that "a hungry person is not a myth ... it's a person I know", is Kenyan-born Florence Wambugu, described as one of Africa's leading plant geneticists (*New Scientist*, 27 May 2000: 40).

Describing her as "no puppet of agribusiness", despite being on Monsanto's "payroll", *New Scientist* offers an insider's perspective on realities facing most African countries, and her belief in the technology that can stave off starvation.

Agreeing with Wambugu is Dr Cyrus Ndiritu from Kenya's Agricultural Research Institute:

> *I would like to make something very clear. It is not the multinationals that have a stronghold on Africa. It is hunger, poverty and deprivation. And if Africa is going to get out of that it has got to embrace modern technologies, including GM technology* (*BBC*: Rise and Fall of GM: 18).

These arguments, provided by African scientists who believe in and want the technology for their country and continent, offer a different perspective to the more commonly held view, where African countries are seen as victims hoping for no more than a sustained handout from the wealthy First World countries. Both scientists believe in taking a pro-active stance, determining the potential for agricultural redemption through the capacity of GM technology to counteract devastating blights.

The Contradictions Inherent

> *The human eye has an active role to play in the story. It is the selecting agent. It surveys the litter of progeny and chooses one for breeding ... Our model, in other words, is strictly a model of artificial selection, not natural selection. The criterion for 'success' is not the direct criterion of survival, as it is in true natural selection. In true natural selection, if a body has what it takes to survive, its genes automatically survive because they are inside it. So the genes that survive tend to be, automatically, those genes that confer on bodies the qualities that assist them to survive. In the computer model, on the other hand, the selection criterion is not survival, but the ability to appeal to human whim. Not necessarily idle, casual whim, for we can resolve to select consistently for some quality such as 'resemblance to a weeping willow'. In my experience, however, the human selector is more often capricious and opportunistic* (Richard Dawkins, The Blind Watchmaker, 1986: 56).

Taking the stance that messing with "God's creation" is wrong, and not supporting GM foods for that reason; or alternatively deciding that because it is scientifically modern it is good, and not contesting it based on that reason alone, are both very unhelpful positions in determining the direction of this issue. Because science is funded by public money, it is political. The inherent contradictions commonly found in public perception lie in the expectation that scientific advances should adhere to scientific rationality, but provide miracle cures; that new and better medicine becomes available, but not at the expense of animal rights.

Society is increasingly preoccupied with risk, and science is being polarised by journalists. "Objectivity" is a value of science. Journalism is subjective, holding to the concept of "fairness", and when these two values collide there is conflict regarding fairness and accuracy. The attitude of the audience is influenced by either supportive or critical coverage, and editorial surveys show a consistently pro-environment surge that has to be answered to.

There is a great deal of discrepancy between sources, and although the forum for discussion and analysis has been created, it is an intriguing problem to "read between the lies". The figures regarding amounts of land presently farmed with GM crops vary hugely, with representatives from pro- and anti-organisations offering completely contradictory information. For the general public, this presents the problem of trying to establish, paradoxically, where the truth lies.

The proclamation that the underlying motivation for biotech foods is to resolve the issue of world hunger seems impossibly compromised by the (shorter-term) economic value of the technology to the companies responsible. The argument that strains of genetically altered seeds can benefit the environment by eliminating the

need for certain pesticides seems refuted by evidence that they are limited to very specifically targeted organisms. Are the biotech companies paying lip service to the concerns of conservationists and environmentalists, with assertions that their technology will be a benefit, and not a burden, to an increasingly besieged environment?

Richard Dawkins offers:

> *We can take wild populations and impose our own forces of selection upon them ... Animal and plant species are usually immediately amenable to selective breeding, and breeders detect no evidence of any intrinsic, anti-evolution forces. If anything, selective breeders experience difficulty after a number of generations of successful selective breeding ... because ... the available genetic variation runs out, and we have to wait for new mutations ... species having built-in resistance to evolutionary change* (1986: 247).

Systems of weed and pest control used in previous years, with the controversial use of DDT being one of the more obvious examples, were shown to have been indiscriminate in what they affected. They were responsible for wiping out "friendly" insects and entering the DNA of the plants, altering them in a way that proved detrimental to the health of those who ingested them, and ultimately working through to humans (*Science News:* The case of DDT, 1 July 2000: scinews@sciserv.org). In looking to this as an example of how nuances in natural ecosystems may be unknown to us, and yet imply vital links in the chain, the following words, written more than half a century ago, seem to echo back to us.

Aldo Leopold, a scientist and author, and acknowledged by many as the father of wildlife conservation in America, said in his book *A Sand County Almanac*:

> *... a system of conservation based solely on economic self-interest is hopelessly lopsided. It tends to ignore, and thus eliminate, many elements in the land community that lack commercial value, but that are (as far as we know) essential to healthy functioning. It assumes, falsely, I think, that the economic parts of the biotic clock will function without the uneconomic parts. It tends to relegate to government many functions eventually too large, too complex, or too widely dispersed to be performed by government* (1949: 214).

The use of DDT has, incidentally, received renewed attention as a possible answer for controlling malaria in Southern Africa, including sections of South Africa. The weighing of the pros and cons is presented in terms of "what can be done to save human lives", with the effects on the environment afforded second place in the hierarchy of needs (according to a *BBC* broadcast covering this debated issue on Morning Live, hosted by John Pearlman, SAfm, 4 December 2000).

Frankenfood Furore

The public has a strong collective memory. DDT was approved, promoted and sanctioned by the highest authorities. Thalidomide was heaven-sent to help pregnant women. Disillusion and mistrust of science were the results when time revealed the damning truth. On a smaller scale, some of the health scares

originating from the biotech industry also served to set the scene for doubt and suspicion.

One of the publicised examples of a food that was derived from biotechnology without being given regulatory approval by the government was the one involving the Brazil nut.

> *When molecular biologists shuttle new genes into plants, they might inadvertently introduce proteins capable of triggering respiratory or inflammatory problems in people who suffer from food allergies* (*New Scientist*, 31 October 1988: 45).

Evidently, this was "learned the hard way" by scientists at Pioneer Hi-bred, one of the world's largest seed companies. Research was being conducted to improve the nutritional quality of soybean meal as an animal feed, and involved the transfer of genetic material coding for a storage protein from a Brazil nut to soybean. It was determined that an allergenic protein had been transferred to the soybean, and because the "hybrid was likely to trigger a major attack" in people with nut allergies, the research was discontinued.

Consumers were told that the product had never been commercially developed, and the soybeans containing a Brazil nut protein were never available on the market, but it seemed "like a narrowly averted disaster" (*New Scientist*, 31 October 1988: 45). Argentina and Brazil have been sources of non-GMO soy for Britain and Europe, but "Monsanto has succeeded in getting Brazil's approval of Roundup Ready soybeans, and intends to capture 20% of the Brazilian market by 2001" (*Health Canada Information*: Frequently asked questions on genetically modified food: 2).

In the special *Living in a GM World* edition of *New Scientist* (31 October, 2000: 42), the food industry is encouraged to "come clean about products with bolted-on DNA". Reference was made to a new strain of celery introduced in the US in the mid-1980s, highly resistant to insects and purported to be able to boost yields dramatically. The problem was, according to *New Scientist,* that people who handled it got severe skin rashes, and dermatologists found that the celery was shedding psoralens, natural chemicals that become irritants and mutagens when exposed to sunlight.

Another product hastily removed from the market was the "notorious American Lenape" potato, when its burning flavour was identified as dangerous levels of toxins called glycoalkaloids. "Many nightmares predicted for genetically engineered crops have already happened", according to Tony Conner of the *New Zealand Institute for Crop and Food Research* (*New Scientist*: 42).

The "Flavr Savr" tomato was introduced at the end of 1991, which was initially hailed as a fruit that would not rot in transit, and then the skepticism started to emerge with the first descriptions of "Frankenfoods" and "killer tomatoes" (Dorothy Nelkin: *Selling Science*, 1995: 59). She says that "biotechnology applications have inspired futuristic risk reporting – speculations about the possible harm of bioengineered products yet to appear" and uses the example of "Ice Minus" as one of the earliest disputes over biotechnology. This referred to genetically altered microbes intended to inhibit water crystallization, to help prevent strawberries from

getting frost injury. Nelkin speaks of the "striking and provocative" photos of field workers, wearing protective clothing "resembling moon suits associated with the cleanup of toxic chemicals and nuclear wastes".

In *New Scientist*'s "Is it or isn't it", the issue of the Flavr Savr tomato was rekindled at the *OECD* (*Organisation for Economic Cooperation and Development*) meeting in Edinburgh in March 2000. American evidence contained findings "unearthed from 1993" which raised fresh doubts, where memos of an experiment in which 4 out of 20 female rats, fed the first GM tomato (the Flavr Savr), suffered 'gross stomach lesions'" (*New Scientist*: 4 March 2000).

What is the result of these findings, and how does the publicity of the events influence public opinion? Firstly, the public feels betrayed, lied to and deceived. Science can often appear patronising, in that the public are given the impression that problems are only revealed on a "need to know" basis. Outrage can accompany this perception. This generates the second, more knee-jerk response, whereby the more emotive, visceral reaction precipitates a complete rejection of whatever science or industry is involved, regardless of possibly uncontestable benefits.

This points to one important thing. The media can, and does, through the power of the words and the images it conveys, positively or catastrophically influence its readers to form opinions on the subject under scrutiny. Memories of the nuclear industry, and the images generated and seared into public consciousness, remain potent reminders of this power. Genetic modification is now under the same scrutinising spotlight, and as Nelkin reminds us:

> *Indeed, the images pervading the media coverage of biotechnology are remarkably similar to those that had been projected during the nuclear power controversy – the synthetic monsters, the mutant animals, the mad scientists, and an industry out of control* (1995: 60).

Economic undercurrents as origins and outcomes of biotechnology tides

There is no question but that biotechnology is big business. Jeremy Rifkin calls it "Green Gold" (in his book *The Biotech Century*, 1998), and one of the most pressing concerns that has arisen is whether "more and more of the world's food production will be controlled by a handful of big companies, to the detriment of poor farmers" (*New Scientist*, 31 October 1998, Editorial: 3).

The media's role, and responsibility, lies in decoding not only the environmental and health ramifications of biotechnology, whether they be positive or detrimental, but also to expose the machinations behind the economic curtains. The power to influence market value through publicity is indicative of the potential for misuse, and as Nelkin puts it:

> *In light of their influence on public policy, the media today represent a battleground for political and economic interests seeking to convey their views to the public* (1995: 76).

There appears to be a direct correlation between the market trends within a company and the mood of the publicity surrounding the company. In an article in the business section of the *International Herald Tribune* on 10 November 1999, Monsanto was written up as putting "Itself Up for Sale". The *Wall Street Journal* reported that Novartis AG of Switzerland, one of the world's largest drug makers, had discussed buying all or part of the US company as they "both face sagging profits in their agricultural divisions". The fact that this coincided with a spate of very strong criticism against the biotechnology developments Monsanto was associated with, is probably no coincidence.

> *The extensive media coverage of biotechnology suggested its growth potential, increasing the availability of venture capital for new biotechnology firms during the 1980s. Later, in the 1990s, media reports of public concerns about biotechnology encouraged caution. When the press reported the opposition to Calgene's Flavr Savr tomato, the price of the company's stock fell, and it temporarily took the product off the market. By amplifying possibilities and calling attention to potential problems, the media can influence the dissemination of new products and shape the direction of scientific and technological priorities* (Nelkin, 1995: 77).

The ebb and flow of public support is connected to the perception of the integrity of the companies involved, and the discerning of hidden agendas. Ambivalence must prevail in the need to communicate enough to generate funding, whilst playing cards that represent huge commercial value close to the chest. Convincing the public, who represent certain control and power over policymakers, and securing funding, can be at cross-purposes in "the growing commercial interest in academic science and the dependence of researchers in fields such as genetics and biotechnology on the support of industries interested in their products" (Nelkin, 1995: 132). She illustrates her point further, saying:

> *The possibility of patents, especially in biotechnology, has increased incentives for secrecy. Biotechnology research is expected to yield important agricultural, pharmacological, and diagnostic products. University research in these potentially profitable areas is often supported by interested industries in exchange for rights to license, produce, and market the results of the search (1995: 153).*

Tim Raney, a financial analyst at Deutsche Bank in New York, offered his opinion on the effects of the campaign against biotech companies producing GMOs, on *The Rise and Fall of GM* (24). He had written a pessimistic report on Wall Street called "GMOs Are Dead" in May 1999, and commented on its impact:

> *When we published our report in May we really felt that the issue would be very controversial and would swing from a solidly positive perception of GMOs on Wall Street to a very negative one very quickly and that would impact share prices. So we advised investors to begin selling the shares of anything related to genetically modified foods.*

Deutsche Bank's call to sell had a major and immediate impact in the financial markets, as the prices of biotech companies plummeted. In a matter of weeks the market value of Monsanto almost halved, from $60 to $33. Although Monsanto's

shares have since recovered, many others have not. The shares of GM firm Agribiotech fell 70%, and in January 2000 they filed for Chapter 11 bankruptcy (Rise and Fall of GM: 24).

GM scientists feel that this campaign against their work is based on ignorance and prejudice. Expressing frustration, Professor Marc Van Montagu calls the prohibition of GM food "dangerous because it's censorship that is not based on science ... and if you block scientific curiosity, that is the basis of our progress" (Rise and Fall of GM: 26). He sees the suppression of the technology as an "almost medieval attack on rationalism and freedom", and forecasts an increase in starvation in Third World countries as a ramification.

Alternatively, Julian Borger, a science journalist with the British newspaper *Guardian*, sees the economic realities of the anti-GM campaign as representing a victory for democracy and the consumer:

> *It's shown that there are limits to the power of corporations and those limits are set by consumers in the same way that voters set limits for governments in democratic societies. So in a way, what we've seen is the democratisation of the new economies – the new technology-driven economies – with people cutting them down to size, down to a size that they can understand, and down to a pace that they want to move at* (Rise and Fall of GM: 26).

New Scientist (31 October 1998: Food For All: 50) examines the economics behind some of the deals going on. Providing the background that five million Brazilians faced starvation that year, attributed to El Nino in this case, but qualifying that "famine is perennial in Brazil", the following food for thought was offered:

> *In September Monsanto ... announced it would invest $550 million in Brazil to build a factory producing its herbicide Roundup. Shortly afterwards the Brazilian government made Monsanto's Roundup-resistant soya beans the country's first legally approved, genetically modified crop. The soya beans will boost profits for the big landowners who grow them to feed beef cattle for export. But most rural Brazilians are subsistence farmers who do not grow soya. No help will trickle down from Monsanto's beans to the starving millions.*

New Scientist said this exemplified the "limited contribution" GM crops have made to eradicating world hunger. They write that the high price of the technology could allow a few farmers who can afford it to out-compete their poorer neighbours and eventually buy them out, driving people from the land (*New Scientist:* 52).

It seems a fairly new concept, that companies be held "morally responsible", and yet this appears to be what is being asked of the biotechnology business. In what could be called a *Catch-22* situation, the expectation is leveled at them to provide proof that the technology is not going to be harmful (to people or the environment) – which implies huge cost and research. If it is not, then the expectation is that they act philanthropically and make it available to eradicate the (by no means small) problem of world hunger, without expecting appropriate compensation.

Are patents a weapon used by big companies to protect their own interests? The patent system was started in 18th century America to "Promote the Progress of Science and useful Arts by securing for limited Times to Authors and Inventors the

exclusive Right to their respective Writings" (*Cape Times*, International Business section: 23 March 2000). Now it seems that the 18th century system is coming unstuck when faced with 21st century reality. The article, entitled "Patently, it just doesn't work", suggests that information is the backbone of the new technology-driven economy.

Agricultural biotechnology faces a fundamental problem. The question of ethics in biotechnology and patenting is raised consistently. If turnabout really is fair play, it makes sense that the ethics of forcing a company's hand, by means of media pressure and influencing public perception, to act in a way that is not commensurate with it's own economic bottom line, also be questioned. The millions – indeed, billions – at stake make it a vastly complicated issue, and further exploration with regards to this shall be made in chapters 5 and 8.

CHAPTER 2:

TERMINOLOGY

As is often the case in our rapidly-developing technological world, jargon and newly-coined words and phrases become integrated into public and professional use, like those now taken for granted in our computer-literate and internet-accessing culture, and yet nowhere to be found in dictionaries no more than five years old.

Terms commonly used in connection with GMO issues

GMO - genetically modified organism

GM Food - genetically modified food

GE - genetic engineering

GE food - genetically engineered food

Terminator seeds - Seeds that have an incapacity to reproduce themselves after one harvest; researched and developed by Monsanto, but not commercially available.

Substantial equivalence - Comparing qualities of GM foods to their traditional counterparts and evaluating differences, problems and similarities.

Organic farming - Farming without use of chemical pesticides, herbicides and fertiliser – it takes 3 years of growing crops free of these chemicals before a farm can become certified organic and accepted as detoxified. The farm also has to have access to clean water, the crops have to be rotated, and may not be within six miles of a non-organic farm.

Bio-dynamic farming - Farming without use of artificially-derived chemical pesticides, herbicides and fertiliser – it takes 7 years of growing crops conforming to the prerequisite criteria before a farm can become certified bio-dynamic.

Transgenic plants – Another term for genetically manipulated or modified plants. The dictionary describes the word "transgenic" as being "transformable".

Hybrids – Traditional term for crossbreeding in agriculture.

Eco-efficiency - Eco-efficiency is a term used to explain the ecological efficiency of goods and services by measuring their economic price (including consumer demand and monetary cost) and checking it against production or manufacturing successes in reducing environmental impact, improving quality of life and lessening overall negative environmental impact on the earth. The higher or better the eco-efficiency ratio of the goods and services, the less the negative environmental impact and the lower the use and abuse of natural resources (Environmental Diary: April 2000).

Biodiversity – Also known as biological diversity, it denotes the extraordinary diversity of plant, animal and insect species that exist on earth. Each grouping of species has a different genetic make-up to cope with a specific range of circumstances such as climate, food supply, habitat, defense and movement. Biodiversity is made up of three related concepts: genetic diversity, species diversity and ecological diversity. Genetic diversity is the variability of genes within a singular species (like African and Indian elephants, which are the same species but have a different genetic makeup). Species diversity is the variety of species on earth and in different parts of the planet (for example forests, lakes, and oceans) (Environmental Diary: January 2000).

Ecological diversity – This describes the variety of biological communities that interact with one another and with their environments. To date, scientists have classified almost 2 million different species on earth. It is suspected that the actual number may be over 40 million, with insects accounting for as much as three quarters of that total. Diversity of species allows a maintenance of ecological stability. And reduction of this diversity directly threatens and weakens ecosystems. This is particularly true in monoculture systems of agriculture where the loss of species opens crops to a greater risk of disease and pest infestations. (Environmental Diary: January 2000).

Triple Bottom Line - Describes one of the new theories of sustainable development which says that true sustainable development in business must not just consider the financial "bottom line" or prosperity and profit, but also other "bottom lines" such as environmental quality and social equity (Environmental Diary: November 2000).

Sustainable development – This refers to the kind of development that meets the needs of the present without compromising the ability of future generations to meet their own needs. "Our global future depends upon sustainable development. It depends upon our willingness and ability to dedicate our intelligence, ingenuity, and adaptability – and our energy – to our common future. This is a choice we can make..." World Commission on Environment and Development Report "Our Common Future" 1987 (The Brundtland Report: Environmental Diary: November 2000). It also depends on an inventory of environmental assets, and a system of allocating value to these assets. Then the triple bottom line can be calculated.

CHAPTER 3:

NEW SCIENTIST: THE GMO ISSUE FROM 1998 TO 2000

On 31 October 1998, the British magazine *New Scientist* ran a special issue on "Living in a genetically modified world", entitled *WEIRD: Gene Revolution 2 – Beyond Your Imagination.* On the cover of this issue, they listed four of the articles within: *Superweed, supermyth; Paradise engineered; Celery from hell;* and *Biotech giants rule.* The cover showed a surreal, hugely magnified view of French fried potatoes, and the word WEIRD in bold, green letters across them.

New Scientist has provided consistent coverage on the GM issue, and starting with this special report, an analysis will be offered regarding the content, the literary style, the visual techniques and the question of balanced reporting. In the editorial, the "two urgent questions that are being asked by public and governments right now" are, more than two years hence, still being asked. These are:

> *Should all GM foods be routinely segregated by farmers and labeled by manufacturers? And should there be a moratorium on growing GM crops?* (1998: 3).

The first article, "Mutiny against Monsanto" (4), offers insights into the collapse of consumer acceptance of GM foods as a response to Monsanto's herbicide-resistant Roundup Ready soya beans, which were mixed with ordinary soya and shipped to Europe. While Monsanto officials admitted to "misjudging the mood in Europe", they did claim that the "company is being singled out because it is the market leader", and stated that they were attempting to clarify the controversy.

> *Suddenly, plant science is no longer a quiet backwater for genial professors and their cuttings. It is the stuff of big business, patent rivalries and closely guarded technical tricks. If you believe biotech's gainsayers, this brave new plant science is also ushering in a dark age in which all genes will bear a "no trespassing" sign, and the companies that own them will move them from species to species like Lego bricks, to the detriment of what's left of the natural world and our respect for it* (Living in a GM world: Future Shock: 29).

In the above introductory article, *New Scientist* introduces the "raging debate" about the pros and cons of living in a GM world, and offers the opinion that for now it revolves around transgenic plants, because "their impact will be felt soonest".

In the futuristic "Brave New Rose" (30), a pun on Aldous Huxley's *Brave New World* (which he wrote in 1932, revealing his aversion to biotechnology), we are invited to imagine ourselves in the year 2020; "lying on a lemon scented lawn ... the roses are blue". Cotton plants will produce wrinkle-free fibres; potatoes will double as vaccines; smart plants will use a fluorescent "SOS" protein to warn farmers of drought or disease; oilseed rape will contain bacterial genes for producing biodegradable plastic. This is a small selection of a few of the developments purported to be part of the genetic revolution in action (Living in a GM world: 30).

This is followed by the "heretical views" of Jeremy Rifkin, "the biotechnology industry's most famous critic", in the article "Apocalypse When?" It alludes to Joseph Conrad's novel, *Heart of Darkness*, upon which the movie *Apocalypse Now* was based. Rifkin is not a man to pull his punches, and he states: "My bet is that agricultural biotechnology is going to be one of the great disasters of corporate capitalist history" (Living in a GM world: 37).

> *The life science companies will argue that all they are doing is a more sophisticated form of breeding, and we have had breeding since the Neolithic revolution. That is their argument and it is wrong.*
>
> *This is not an extension of classical breeding. In classical breeding, it is possible to cross relatives to create hybrids – you can cross a donkey and a horse and get a mule – but you can't cross a donkey and an oak tree.*
>
> *But with genetic engineering technology you can cross all the biological boundaries: you can make mice with human growth genes and you can have firefly genes lighting up tobacco plants.*
>
> *Once you can cross all biological boundaries, you begin to see a species as simply genetic information that is fluid. That brings us into a whole new way to conceptualise not only our relationship with nature, but also how we use it.*

Rifkin points out that "genetic pollution", (a new concept he introduces in his book, *The Biotech Century:* 1998, which is reviewed in the same issue of *New Scientist*), is happening at a scale that needs to be appreciated.

He refers to the introduction of thousands of gene-spliced organisms over millions of acres of land and water, where biotech companies will "re-seed the planet with a second genesis". He cites the example of microbes that will eat up landfills and radioactive wastes, and plants designed to secrete chemicals, pharmaceuticals and plastics "in every cell". He does not stop at the conclusion that because something is biodegradable and sustainable, it is necessarily acceptable.

> *But what they don't say is what happens when this plant is producing plastic in every cell over millions of acres. What happens when foraging birds and insects and microorganisms and animals come in contact with that plant? (36).*

He states two reasons for thinking that the issue of liability will be the biotech industry's "Archilles Heel". Firstly, he feels that they have "misjudged where the consumers are moving in terms of their food preferences ... the middle class sets the trends in Europe, Japan and North America, and they are moving towards organic foods". In Chapter 7 the organic industry and the figures quoted two years after he made this claim seem to bear out his argument.

Secondly, he says "liability is going to kill this industry", because of the inability to deal with "gene jumping". He defends himself as being in "favour of genetic science", but qualifies that he takes the soft path versus the hard one. He elaborates on this ideal: "Genetic science could be used for developing a sophisticated organic-based agricultural production system in the 21st century" (Living in a GM world: 37).

Jeremy Rifkin may be a thorn in biotechnology's side, but *New Scientist* gives his views credibility and weight, especially with the inclusion of the review of his book, *The Biotech Century* (1998), in the same special GM edition. His commentary is described as "shrewd, helpful and far-sighted", and although it is presented to offer balance for the pro-GM articles, it tends to set the precedent of caution evident in the articles written over the next couple of years.

Following the special GM edition in October 1998, a brief synopsis of *New Scientist*'s coverage of the ongoing GM issue between October 1999 and October 2000 is hereby presented, with the Internet as the source of the material at www.newscientist.com/gm/gm.jsp.

Terminator terminated (9 October 1999)

- *This covers Monsanto's decision not to use the "controversial terminator technology", but they qualified that they did not rule out using genetic technologies that 'turn off' modified genes after a single application.*

It's that man again (16 October 1999)

- *Referring to Arpad Pusztai, the scientist who sparked the uproar with his research on "toxic" GM potatoes, and the release of his work for publication.*

How safe is safe? (16 October 1999)

- *Offering a different perspective about toxins occurring naturally in plants, it follows on the Pusztai story in the same issue.*

Hold the radicchio (23 October 1999)

- *Bioengineered salads are off the menu in Europe, according to a seed company in the Netherlands. GM food products approved in Europe so far are cooked and processed before being eaten, but the possibility of DNA from raw vegetables being taken up by gut bacteria has put a hold on GM salad leaves for now.*

US ready to rethink rules for engineered food (30 October 1999)

- *Growing concerns about GM food may force health officials in the US to reconsider their procedures for approving GM food products for sale.*

GM deal (13 November 1999)

- *Genetically modified crops won't be grown commercially in Britain for at least another three years. Companies developing the crops have agreed to wait until the end of a 3.3-million government-funded experiment to see if GM crops damaged wildlife more than conventional ones.*

On your markers (20 November 1999)

- *New ways of engineering plants could win over skeptics: Novartis has developed a sugar-based replacement for the controversial antibiotic resistance marker genes used in some GM foods.*

Splitting headache (20 November 1999)

- *Monsanto's modified soya beans are cracking up in the heat. Researchers found that hot climates don't agree with Monsanto's herbicide-resistant soya beans, causing stems to split open and crop losses of up to 40 per cent.*

Ignorance is bliss (20 November 1999)

- *Americans do not share the deep concerns about the safety of GM foods in Europe, according to an opinion poll. Countered, however, by the fact that although more than two-thirds said they would buy products "enhanced through biotechnology", only 40 per cent realised that they were already eating them through their supermarkets purchases.*

Relative values (27 November 1999)

- *Crossing rice with its wild cousins works wonders – unlikely marriages between scrawny wild species of rice and their commercial relatives are boosting yields by 10 to 20 per cent, and also offer protection against a virus. Greenpeace calls for the technique to be adopted as an alternative to genetic engineering.*

Trade wars on the web (27 November 1999)

- *Offering all the pertinent web sites to help with the confusion arising from the disputes to be discussed at the WTO meeting in Seattle, like the issue of hormone-treated beef.*

Toxic leak (4 December 1999)

- *Insect-killing toxins from GM maize plants leak into the soil and persist for weeks, biologists in the US have found. Neither finding was expected, say the researchers, raising questions about the impact of the toxins on soil ecology.*

Fighting blight (11 December 1999)

- *An artificial gene keeps potatoes disease-free. GM potatoes that would have prevented the Irish potato famine in the 19th century have been developed in Canada. The potatoes thwart the fungal blight which devastated Irish potato harvests in the 1840s.*

Impasse (11 December 1999)

- *The world still can't agree on how to regulate biotech trade – with the adversarial nature of the WTO meeting in Seattle, and the coinciding announcement of plans to consolidate the agribiotech industry into a handful of multinational companies.*

False Economies (18 December 1999)

- *Next time you're in a supermarket, ponder the true cost of your shopping basket. Saying that agriculture is in deep trouble throughout the West, the point was made of the external costs resulting from present farming techniques. These include the cost of the BSE-crisis, the stranglehold of huge supermarket chains wiping out local crops, the destruction of family farms, the GM-resistance in Europe, the pollution to water supply, the damage to habitats, and the health effects of pollution.*

Against the grain (15 January 2000)

- *The poorest nations are refusing to let the US set the agenda when it comes to GM crops. Could they pull off a remarkable coup? They refer to a "David and Goliath style diplomatic battle" set to resume in Montreal when Africa takes on the US in the latest "skirmish of the war".*

Two cheers for Montreal (6 February 2000)

- *The deal may be flawed but at least sense is returning to the biotech debate. Now that's how to negotiate. The Biosafety Protocol, agreed last Saturday in Montreal and designed to control the international trade in GMOs, has left everyone a winner.*

Let battle commence (6 February 2000)

- *The fight over GMOs has only just begun. Governments last weekend won the right under international law to ban imports of genetically modified organisms. Or so they*

hope. But concessions won by major grain-exporting nations such as in the US in the final hours of negotiations in Montreal may create a scientific and legal minefield.

Deep impact (6 February 2000)

- *More than half of Asia's children suffer varying degrees of vitamin A deficiency. If GM rice could make up that deficiency ... why not let it? Greenpeace has a set of arguments as to why this rice – dubbed "golden" because of its colour – is not worth developing. Vitamin A supplements are cheap, at 4 cents a year per child; intensively farmed rice of the sort needed for vitamin A production is a bad thing; alternative farming methods can meet all requirements for micro-nutrients like beta-carotene. In sum, golden rice is undesirable because it distracts us from more sustainable solutions.*

Resistance is useless (19 February 2000)

- *In the first officially confirmed case of its kind, weeds in Canada have become resistant to three kinds of herbicide. The plants picked up genes from three different, genetically modified varieties of the rapeseed crop canola.*

Food for thought (26 February 2000)

- *Edinburgh will host the world's largest ever conference on the safety of genetically modified food next week. Run by the Organisation for Economic Cooperation and Development, it will focus solely on the issue of whether GM food is safe to eat, sidelining all other concerns relating to trade, environment and ethics.*

Is it or isn't it? (4 March 2000)

- *We're no nearer to knowing if genetically modified food is safe. The argument was stoked up as an OECD conference on the topic was held in Edinburgh, with conflicting evidence raising some doubts.*

Forget modified soya, let animals eat lupins instead (11 March 2000)

- *Flower power could allay the fears of farmers worried about feeding their livestock genetically modified soya, say researchers in Wales. Their answer? Russian lupins.*

So far so good (25 March 2000)

- *For the moment, the gene genie is staying in its bottle. One of the most convincing arguments leveled against GM crops is that the various genes in them that confer resistance to antibiotics will spread into the environment, eventually making life-threatening bacteria resistant to those drugs. But such doomsday scenarios look less convincing this week, as British researchers report having tried and failed to get various bacteria to take up such a gene from a commercial variety of GM maize.*

Formidable froth (1 April 2000)

- *Eat crisps, wear lipstick ... you won't spoil the look of this beer. Beer looks stale unless it has a decent head on it. But the foam is fragile stuff: grease from a packet of crisps, or even lipstick, can destroy it. So brewers in Germany decided to work out how to make a more dependable head – so long as drinkers are willing to stomach genetically modified beer.*

Filling the bowl (1 April 2000)

- *For billions worldwide, a modified grain could end the lean times. Rice, which provides more than half the daily food for one third of people across the globe, is a key target for genetic engineers seeking to develop new crops to feed the world's burgeoning population. Just such a strain of GM rice, which boosts yields by a massive 35 per cent, was unveiled this week in the Philippines and an international conference on rice biotechnology.*

Still a mess (15 April 2000)

- *There has to be a way to bring sanity to the gene food fiasco. A good clean fight it is not. In the battle over genetically modified foods, both contestants have been hitting way below the belt. In the green corner, environmental groups are lined up with those protesting against the power of the multinational companies. They've been punching wildly, using extravagant speculations based on tenuous research to convince us that all GM foods are dangerous to health and environment. In the other green corner – the money corner – stand companies pushing their modified crops. They countered that genetic engineering will end global food shortages. But while the companies' crops are good for profits, they've offered little to perplexed customers. In Europe, the first round went to the environmental bruisers. In the US, the bell still hasn't rung. But many people sitting ringside are asking if the referee needs glasses. Come to think of it, where is the referee?*

Judging gene foods (15 April 2000)

- *An impartial panel could quell health and environmental fears. Are GM foods safe to eat? A grand forum of internationally renowned scientists and other experts might soon be helping the world decide when they meet in July in Okinawa, Japan.*

Pockets of resistance (15 April 2000)

- *A pest might make a comeback thanks to engineered "weeds". Fields where GM cotton plants spring up as weeds in other crops could provide refuge for the cotton boll weevil, warn entomologists in South Carolina. This could mean the return of this major pest to parts of the American cotton belt from which it has been eradicated.*

Naturally repellent (22 April 2000)

- *A weakling maize has a way of keeping costly pests at bay. A scrawny strain of wild maize from Argentina ... makes chemicals in its leaves which discourage female corn borer moths from laying eggs. Farmers usually fight of the borers with larvicides, and newer GM strains can deter the larvae by making the Bt toxin. Could this be a natural alternative?*

Food curbs (13 May 2000)

- *The US government unveiled a plan to tighten controls on Gm foods. Companies will have to notify the FDA before they put GM food on the market. The FDA will also draft guidelines for food makers who want to label products GM-free.*

The green man (27 May 2000)

- *Invoking God and nature won't solve our problems with biotechnology. It's been a bad week for biotechnology. First, environmentalists in Britain were affronted to discover that honey contained GM pollen from test fields sown with altered varieties. Then it came to light that thousands of hectares across Europe have been inadvertently planted with oilseed rape containing a modified variety. But perhaps the most worrying development came in the form of a radio lecture given by Britain's highest-born organic farmer, Prince Charles. His talk laid into plant biotechnology on the grounds that it has wandered too far into God's territory.*

Sowing dissent (27 May 2000)

- *Strict segregation would keep crops free of genetically modified seed. But is it possible? Concern over the accidental planting of GM seed on several farms in Europe reached fever pitch last week. And now a company in the US has warned that the problem is probably commonplace.*

Reversal of fortune (3 June 2000)

- *Despite an inauspicious start, Germany's biotech industry is going from strength to strength. Could Britain be moving the other way? While scientists in Britain fear a*

public backlash against their activities, their German counterparts are forging ahead with new technology and inventions.

Butterfly effect (17 June 2000)

- *Pollen from maize genetically modified to produce the Bt insecticide does not harm all butterflies. Lab tests last year showed the caterpillars of monarch butterflies died when they ate leaves dusted with the pollen. But field trials with an unrelated butterfly have revealed no toxic effects.*

Picky pests (1 July 2000)

- *The spread of insect resistance to the toxins in GM crops will not be slowed by encouraging pests to live in "refuges" of weeds around the edges of farmers' fields, say French scientists. The vulnerable insects that live there just don't mix with their resistant neighbours, the investigators have found.*

Fair share (15 July 2000)

- *Can compassionate biotech defeat world hunger? It's time for the rich multinationals that dominate agricultural biotechnology to help the poorest of the poor, say seven elite scientific bodies from around the world. In an unprecedented show of unity, they are calling on multinationals to consider forgoing profits on crop varieties destined for farmers in poor countries, and put GM crops at the service of the 800 million people in developing countries who are desperate for a daily meal. (Insert: Monsanto made the gesture of donating hundreds of tons of seeds to Mozambique after the devastating floods in early 2000.)*

Modified crops could corrupt weedy cousins (15 July 2000)

- *Traits such as herbicide resistance could spread from GM oilseed rape to its wild relatives if the crop were widely grown in Britain. The first large-scale study of gene flow suggests that hybridisation between crops and weeds is rare – but does occur.*

Stick a label on it (5 August 2000)

- *Almost all GM food sold in Australia and New Zealand will have to be labeled from July 2001. The new labeling laws, which bring the countries closer to the EU's position, won't cover food sold in restaurants, low levels of unintentional contamination, and highly refined foods such as oils.*

Seeds of hope (5 August 2000)

- *Most scientists think that GM foods are safe, yet the public remains uneasy. The debate about GM foods has stagnated over the past few years. We are no closer to resolving issues such as environmental damage, food safety, globalisation and the rights or wrongs of tampering with nature. Wild assertion and distortion of the facts have all too often taken precedence over thoughtful discussion … an independent scientific panel would be best placed to drive this search and to separate the facts from the propaganda.*

Triumph for diversity (19 August 2000)

- *Traditional farming methods scored a point against high-tech monoculture this week … farmers in the Yunnun Province in China planted different rice varieties side by side in the same fields, alongside plots that contained only one strain. The yield of the sought-after "sticky" rice (which is highly susceptible to a fungal disease called blast) was a dramatic 89 per cent higher, and the blast infection was 94 per cent less severe.*

The lark descending (9 September 2000)

- *Will maths save the skylark and destroy a fledgling industry? As arguments continue to rage in the US over whether or not GM crops kill monarch butterflies, a potential*

British victim flew into view last week. The skylark could be a casualty of herbicide-tolerant sugar beet. For the agribiotech companies that make the herbicides and modified seeds, the timing of this finding couldn't be worse. The British government is carrying out trials on farms to find out if herbicide-tolerant crops harm wildlife. The Environment minister has warned that he will ban crops if they turn out to damage biodiversity.

Battlefield (9 September 2000)

- *Starving skylarks and leaked memos plague agribiotech industry. The GM food industry has suffered a double blow in the past week. First came the evidence that widespread introduction of GM crops could indirectly threaten some of Britain's most popular farmland birds by depriving them of the weeds they eat. And as New Scientist went to press, the anti-GM group, Genewatch UK, produced a leaked Monsanto document that stated the company was "instrumental" in nominating experts to a UN body, and had contacts which would help "facilitate rational regulation".*

The note of this last article, and the implication that the British public would fight the GM crops on the basis of its implied threat to the skylark alone, again brings Aldo Leopold to mind:

> *... these birds should continue as a matter of biotic right, regardless of the presence or absence of economic advantage to us* (*A Sand Country Almanac:* Substitutes for a Land Ethic: 211).

New Scientist shows an inclination (roughly 50 percent of the selected time period) towards stories that negatively reflect or impact on biotechnology. Some are representative of public fear and mistrust, and others are reports of empirical damage or problems with GM crops. They contain cautionary and evocative words: *terminated, uproar, safe?, ignorance, wars, toxic, battle, gene genie, formidable, mess, corrupt and propaganda.*

About 45 percent of the articles are fairly neutral, offering information and updates on the technology, or covering events that are related to monitoring or legislation. The are factually based, and do not offer any opinion outside of keeping abreast of current events within the technology.

The remaining 5 percent relayed advances, breakthroughs and positive expectations of GMOs.

New Scientist makes use of very effective literary techniques, and almost all the headings or sub-headings are quirky, humorous, puns, cliches and metaphors. *Terminator terminated*, an alliterative pun, works well, as does *Splitting headache*. The readers have a sense of an ongoing saga, of peripherally watching an event of huge proportions unfolding step at a time. This is reinforced by headings like *How safe is safe?, On your markers, Impasse, Let the battle commence, Is it or isn't it?, So far so good,* and *Still a mess.* The technology represents a dynamic, and there is a feeling of suspense as the developments emerge, and *New Scientist* plays on the dramatic content to full effect.

The accompanying photographs and graphics are generally surreal, which is in tune with the futuristic nature of the industry, and they encapsulate the aspirations and the connotations by using satirical comedy, like pictures of square cherries or blue grass, or a forlorn plant imprisoned in a cage. The cover of the special GM edition was of huge French fries, clearly detailed towards the front, but eerily blurred as they appear to recede from visibility. The word *WEIRD* sprawled across them only serves to emphasise the sensation of something out of this world, supported by the sub-title *Gene Revolution 2: Beyond Your Imagination.*

In "Mutiny against Monsanto" (Living in a GM world: 4), Greenpeace demonstrators are depicted, provocatively dressed in white and wearing gas masks, as they meet a shipment of Monsanto's "Roundup Ready canola" – effective photographs, and they work to create an impression of an apocalyptic event about to occur. These are followed by sketches of plants growing out of test tubes buried in the ground, and a shopping trolley containing a single, monstrously large strawberry. Cities of green, wavy buildings (imitating plants?), a leaf with a bar code imprinted on it, a rather sinister drawing of a man holding a bean on a fork, his belly full of similar beans sending waves of DNA throughout his body – they all reflect something of the bizarre, futuristic association that has generally been built up around genetic modification.

The selections do not appear biased against the industry, but rather a reflection of the fact that (at this time) there are still more concerned people than convinced ones. The extent of the coverage suggests an editorial stance that the subject remains of intense interest to the public, as there is seldom a published issue which does not contain at least some reference to the debate.

The sequence of the selection, over the 2-year period, does seem to indicate a shift towards more of a challenge for accountability. The tone of jest, with jibes like *Hold the radicchio* and *Ignorance is bliss*, is replaced with a more serious one, perhaps reflecting more accurately the public's mood of concern and frustration, like *The lark descending* and *Triumph for diversity.*

New Scientist provides a comprehensive picture surrounding GM, from the question of contamination of crops, to the labeling laws, to the claim of "filling the bowl" of the world's hungry. They cover the champions for the cause of GM, and counter with the adversaries of the technology. Forums, international scientific conferences, political maneuvering, economic ramifications – all are given exposure, and the public is encouraged to think, conclude and then apply choice.

The consistent reports, often more than one in a single issue, denote the editorial preference given to the subject. *New Scientist* hereby acknowledges the contentious, contemporary and apparently critically important core of the subject of genetic engineering. Readers stand by, as updates trickle in, building a stronger understanding of the complexities of the subject. Whereas the isolated, alarmist GM report contained in a daily newspaper may well result in a misinformed, biased opinion on the part of the public who read it, the type of sustained information gathered over a period of time through a publication like *New Scientist* would indicate a more balanced conceptualisation of the dynamics of the industry.

CHAPTER 4:

THE MEDIA'S USE OF LITERARY TERMS, VISUAL AIDS AND SELECTED COMMENTARY TO PROMOTE OR DEMOTE GMOs

There is a great deal of information available on GM food, and the polarity in the reporting makes it a bewildering task to find a definitive or satisfactory conclusion. As Nelkin puts it, "the media coverage of new technologies shifts with prevailing fashions, but plays on the desire for easy solutions to economic, social, or medical problems" (1995: 45). Making the complex clear is where science journalism becomes a synapse, connecting the mystified arena of science and technology with the layman, and providing a coherent and plausible paraphrase when translating laboratory jargon.

Even though issues are often very technical and abstract, the journalist must write in prose that appeals to the broadest audience. A more sophisticated and informed scientific understanding would be associated with readers of, for example, *Scientific American* or *New Scientist*, or to those perusing the science pages of major newspapers like the *International Herald Tribune.* There would be the "lower involvement" reader of "yellow" newspapers, where perhaps no more that a few rudimentary and sensational paragraphs be devoted to *"the latest scientific breakthrough!"*

> *In 1977 DNA researchers responded to the dispute over the safety of recombinant DNA research by initiating a remarkable media campaign to show that genetic engineering research was safe, its critics irresponsible, and regulation unnecessary. Geneticists today, seeking to maintain support for costly research, have become skilled in rhetorical strategies designed to attract the media* (Nelkin, 1995: 129)

Aristotle defined rhetorical discourse as the art of "discovering all the available means of persuasion in any given case," and focused his discussion on the devices that an orator uses in order to achieve the intellectual and emotional effects on an audience that will persuade them to accede to his point of view (*A Glossary of Literary Terms*, 1981: 159).

Language is the most important hurdle in science communication. Science language has diverged from literary language in content and style, and reconciling them is what science writers are compelled to do. The term *science* covers a large range: biological, physical, social, behavioural, medical, environmental, technological and engineering, to name some of the fields of specialisation. The journalist has to incorporate the political, social and economic aspects of science, and the vehicles for coverage are generally in feature stories, interpretive- or investigative reporting. Compressing the story into a format that is interesting, informative and accurate, given the potentially low involvement of certain readers who won't take it to its completion, is a challenge requiring great literary dexterity.

> *For most people, the reality of science is what they read in the press. They understand science less through direct experience of past education that through the filter of journalistic language and imagery. The media are their only contact with*

> *what is going on in rapidly changing scientific and technical fields, as well as a major source of information about the implications of these changes for their lives* (Nelkin, 1995: 2).

Accepting as a given that a journalist is likely to have a pre-defined angle, "effective reporting can enhance the public's ability to evaluate science policy issues and the individual's ability to make rational personal choices" (Nelkin, 1995: 2). The use of language and visual techniques to convey everything from cataclysmic consequence to benign benevolence, are used to great effect in as emotive an issue as GE. In a press release called "GE grapes and the patenting of life take a hacking!" (genetixalert@tao.co: 8 April 2000), the story of the "Petaluma Pruners" describes a group of anti-biotech activists destroying grape plants grown by the biotech corporation, Vinifera. It formed part of a worldwide week of protest against GE entitled "Resistance is Fertile", held from 1-10 April 2000.

These lyrical, emotive and charged sentiments take on a touch of the extreme:

> *Now that Spring is in the air, the first shoots of a truly global campaign against GE are bursting forth as campaigners around the world unite to prevent the Biotechnology companies from enslaving the earth's resources for their own ends ... Global Week of Action which aims to sow the seeds for a future. (www.resistanceisfertile.com)*

Published events included a conference in Paris, street theatre in Lyon, visits to Monsanto in the US and GE free bus tours in New Zealand. Groups from Wales responded to the go-ahead for Aventis' GM Maize by the agriculture minister by hosting a party celebrating organic and traditional seeds, vegetables and flowers. Food dumps were staged in Hollywood and supermarket leaflets distributed in Helsinki, and farmers protested against the loss of traditional rice crops in the Philippines (Press Notice: Resistance is Fertile on 31/3/2000: 1).

From the emotionally charged "...runaway-train science of GE" (Resistance is Fertile, Petaluma Pruners: 4), to the pun of "we have Grape Expectations!" and the evocative "tweak and twist every life form in order to make a buck, from the mighty conifers down to the smallest bacteria, is to live in the utter absence of the sacred" (2), language is used to convey passion and feeling. "Whether you sniff, swish, sip or swig, you have a right to know that your wine hasn't been made by anyone else but nature" (www.resistanceisfertile.com/action_grapes: 3) fires the imagination, taking the reader, perhaps unwittingly, on a sensory trip of outrage and umbrage.

The inflammatory "citizens are guinea pigs for these products" (Resistance is Fertile, Citizens Labeling, Montreal: 1) incites patriotic response. Designed to evoke an economic insight and outrage: "in order to shut down the opposition to GMOs a group of companies from the biotech industry, let by Monsanto, are planning to spend $50 million on advertising and promotion over the next three years ... and spend as much as $250 million over the next five years in the United States and Canada" (Resistance is Fertile: 2).

Nelkin (1995) says that medicine and health have proved consistently to be of the greatest concern to the public. By implication, this makes the public vulnerable to such news, as they are more likely to respond with anxiety and anger to stories that contain potential threats to their wellbeing.

The subject nature of GM allows for an appreciable amount of black comedy in the use of cartoons, photographs and illustrations. Of the more memorable choices; a strawberry (angled on its side) resembling a fish, with a fang-lined mouth – to illustrate the use of fish genes to provide frost resistance; and a picture of a Greenpeace protestor hanging a banner on a huge head of corn, likewise armed with a fearsome set of teeth, denoting the "savage" within its altered genetic makeup. Cartoons are designed to amuse, outrage and inform, and the images connoted with GM readily provide artists with good material (see Appendix for a selection).

Distortion, sensationalism, selection and omission

Be afraid. Be very afraid. Words have the power to put create fear, loathing, suspicion and anger. Considering the reality that people respond to health threats and risk more than any other type of danger (Nelkin: 1995), the media can pick up the tab for much of public perception. Genetic modification provides the perfect subject material for newspapers and magazines. It offers endless images of grossly distorted foods; exotic new gardens; greedy multinationals; victimised Third World countries; alleviation of famines; of either salvation or apocalypse.

The plethora of GMO information available contains innumerable examples of the "tricks of the trade", where facts are often obscured by emotion and rhetoric. The point is not that emotion should be exempt from the subject matter, as it has a rightful place there. The problem arises where information and truth become distorted, either by those defending the science in question, or those who question the science's defense.

Bernard Dixon, a freelance science writer based in the UK, wrote a scathing article in *Current Biology* called "Potato hash", the double entendre denoting the popular "hashed browns" potato dish in the US (or conversely a pun on "mashed potatoes"), and the other meaning of "hash" as in spoiling things or messing them up (*Mediawatch: Current Biology*, Volume 9, 11 March 1999: 1).

He focused on the "extraordinary media frenzy that erupted" on 12 February in the UK, in response to the announcement by Arpad Pusztai about toxic GM potatoes. He cited the *Guardian* as the "trigger for a growing chorus of hysteria", saying that the report had "no precision and no real data".

Dixon saw a trend following this media event, where the media succumbed to the "Doomsday scenario", going into "overdrive" during the ensuing days. He also observed that the reporters were not science correspondents, and quoted the *Express* announcement that "scientists are vying to produce the ultimate in Frankenstein foods – plants and animals with human genes". The *Guardian* proceeded to publish a list of "GM foods to avoid like the plague", with names of companies, brands and products. He said:

> *Absent from all of this was any recognition that the term 'GM food' has three very different meanings. Not one writer, over the several days of intense coverage, explained that a cheese, sugar or oil made by a recombinant organism differs considerably from a product such as tomato puree containing denatured DNA, and in turn from a plant containing viable genes.*

Dixon commended the *Times* for, "virtually alone at first", weighing in with two crucial points. One was the far greater precision of transgenic techniques, as compared to traditional plant breeding. The other was the folly of generalising – especially from a single experiment confirming that a toxin is toxic when fed to animals. "One laboratory test, whatever it reveals, does not invalidate an entire branch of science", the *Times* said in a punchy editorial. "Nobody would conclude that because one drug failed safety tests, all drugs were dangerous" (*Current Biology*: 2).

Observing that it took several days for the frenzy to start cooling, Dixon used the headlines from the *Independent* ("Expert discredits GM risks study") and the *London Evening Standard* ("Frankenstein foods – are we being hysterical") to indicate the shift in mood. He quotes, somewhat tongue in cheek, the point made by the *Daily Telegraph*: "One would think that biotech executives sit up all night thinking of new ways to kill people. In fact, they long to be regulated and monitored: the last thing they need is a scandal." He ends with the advice:

> *Common sense, rather than detailed science, may be the most potent solvent for the message that scientists, seed companies, biotechnology companies, farmers, wholesalers, supermarkets and regulators are all conspiring to see us keel over at the dinner table (*www.uct.ac.za/microbiology/dixon.htm).

A somewhat dispassionate approach to the frenzy concerning the hidden danger (and, by implication, hidden agenda) of biotechnology, but sobering and practical commentary nonetheless. It could lead to the conclusion that the media is an industry, by implication, reminiscent of a glass house, and that the occupants should be wary of throwing stones lest they damage (if not shatter) their own potentially fragile structure. If biotechnology's newborn, GMOs, is going to be criticised, it needs to be done with objective factual information, and not merely erupt as the printed voice reflecting public concerns. As Nelkin says:

> *Risk reporting is widely criticized as hysterical, sensational, and confused. Applying naïve standards of objectivity, reporters deal with disagreement by simply "balancing" opposing views, an approach that does little to enhance public understanding of the role of science.*

Will the media's coverage of GMOs contribute to the wholesale rejection of the technology? An examination will be made of a selection of publications, and a conclusion drawn as to the nature and projected outcome of the angle taken. The conflict arises naturally from the fact that those who write about the subject have to deal with their personal views, and avoid the trap of using the media vehicle to merely expound on these views.

CHAPTER 5:

INTERNATIONAL PUBLICATIONS AND PUBLISHED REPORTS ON GMOs

Can it be trusted, and can it be controlled? In this chapter, some of the terms applied to biotechnology will be explored, primarily as they are represented in a selection of publications. The concept of the "precautionary principle" will be expanded, as it represents one of the core arguments against the widespread use of GMOs before the technology can be proved more satisfactorily to be safe.

The above questions appear in scientific papers and from the layperson on the street, and their gravity cannot be undermined. Whether or not GMOs prove to completely safe and malleable in the future, the concerns remain valid at this point.

A concurrent theme in international publications seems to be the call for implementation of global moratoriums on GMOs, using the premise of the precautionary principle. The *Oxford Dictionary* defines "precaution" as *prudent foresight, measure taken beforehand to ward off evil or ensure good result* (Concise: 957). Whether or not GMOs can legitimately be classified as "evil", or that said moratoriums will indeed ensure "good result(s)", will probably always be relegated to the realms of private and subjective opinion. An embellishment on the connotations of the term *Precautionary Principle* is, however, called for:

The Precautionary Principle

> *The precautionary principle states that when there is reasonable suspicion of harm, lack of scientific certainty or consensus must not be used to postpone preventative action. There is indeed sufficient direct and indirect scientific evidence to suggest that GMOs are unsafe for use as a food or for release into the environment. And that is why more than 300 scientists from 38 countries are demanding a moratorium on all releases of GMOs (World Scientists Statement and Open Letter to All Governments* www.i-sis.org).

The above statement was taken from a paper submitted by the British-based *ISIS (Institute of Science in Society)* to the *US Advisory Committee on International Economic Policy*, entitled "The Precautionary Principle: Why We Need a Global Moratorium on GE Foods & Crops", the subject being the use and abuse of the precautionary principle (www.purefood.org/ge/precaution).

> *The precautionary principle is accepted as the basis of the Cartegena Biosafety Protocol agreed in Montreal in January 2000, already signed by 68 nations who attended the Convention on Biological Diversity Conference in Nairobi in May, 2000. The principle is to be applied to all GMOs whether used as food or as seeds for environmental release* (The Precautionary Principle: 1).

Dr Peter Saunders, Professor of Applied Mathematics at King's College London, and co-Founder of ISIS, speaks of the precautionary principle as "codified common sense", extending it to the function of a court of law, or how a mathematician uses statistics. "It begins to clarify how scientific evidence is to be interpreted in a socially responsible way which is also in accord with sound science", he says.

One of the problems with technologies being pushed forward with inadequate research, he contends, is that if they turn out to be hazardous, in most cases the companies responsible do not accept liability and others pay the penalty. He emphasises that the precautionary principle "hinges on concept of the burden of proof", and that it is "incumbent on those introducing a new technology to prove it safe, and not for the rest of us to prove it harmful" (Use and Abuse of the Precautionary Principle: 2). He says:

> *The fallacy, and it is a fallacy, comes about either through a misunderstanding of statistics or a total neglect of the precautionary principle – or, more likely, both. In brief, people are claiming that they have proven that something is safe, when what they have actually done is 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* (The Misuse of Statistics: 4).

Dr Saunders, in his chapter The Anti-Precautionary Principle (: 6), calls for attention to the significance of corporations rejecting proposals that they should be held liable for any damage cause by the products of GM technology. He cites regulators responsible for monitoring technology as putting the burden of proof on society instead of the innovator, where if a new technology is proposed, it must be permitted "unless it can be shown beyond reasonable doubt that it is dangerous".

He lists the *World Trade Organisation (WTO)* as the "most enthusiastic supporter of the anti-precautionary principle". The task of this international body is to prevent countries from setting up artificial barriers to trade, and if a country attempts to restrict or prohibit imports on grounds of safety, the onus is on it to provide definitive proof of hazard. If this cannot be done, it stands to be accused of erecting false barriers to free trade. He provides one of the recent examples of the *WTO*'s judgement, where it determined that the EU ban on US growth hormone injected beef was illegal.

> His call, on behalf of *ISIS*, for the five-year moratorium, concludes as follows: *As far as GM crops are concerned, the situation is straightforward. The world is not short of food; where people are going hungry, it is because of poverty. There is both direct and indirect evidence to indicate that the technology may not be safe for health and biodiversity, while the benefits of GM agriculture remain illusory and hypothetical* (:7).

Biotechnology in the Global Economy: Science and the Precautionary Principle

The question of the precautionary principle is one that receives worldwide recognition as a pivotal issue regarding the use and development of GM crops. It appears to have the power to evoke debates and forums and eventually legislation,

as it epitomises a basic assumption that ties in to the Hippocratic Oath, "First do no harm".

The Kennedy School of Government at Harvard University hosted a forum on 22-23 September 2000, under the above heading. It was subtitled: *Highlights from Parallel Sessions on: national experiences; international experiences; policy and institutional implications; and regulatory implications.* Attending were representatives from around the world, and a synopsis of each stance, taken more or less verbatim from the transcript, is hereby given.

The attendees offered insight into a range of GM-related issues, from concern about the connection between researchers and those who fund them, to the pressing realities of time facing impoverished nations who could not support any delays, to those who called the principle "ambiguous", and others who saw it has a hindrance to technological development in developing countries.

Some of the countries represented were the USA, Kenya, Brazil, the Netherlands, Argentina and Mexico. The speakers were scientists, economists, politicians and journalists, who covered a broad spectrum of ideas, policies and opinions. Their comments provide a good overview of parallel issues to the more widely cited ones of environment and health.

1) Aarti Gupta, School of Forestry and Environmental Studies, Yale University:
She presented her field study on the Precautionary decision-making for biosafety in India. Her main theme was that despite the inclusion of precautionary decision-making in the Cartagena Protocol on Biosafety, the relevance for developing countries remains under-examined. In India, biosafety data is being generated by the private sector and provided to public regulators who are themselves scientists engaged in transgenic research. Her concern was related to sharing of confidential information and the credibility of the information.

2) Dr. John Mugabe, African Centre for Technology Studies, Kenya:
He gave an overall assessment of different levels of biotechnology development in Africa, noting that many African countries did not have the time or choices to reduce scientific uncertainty. He said the debate on perceptions of risk and precaution assumes that society perceives of risks in a homogeneous way, highlighting the issue of values and choices. He observed that debate seems to have confused products of biotechnology and the system through which they would be distributed, and that addressing food production in most African countries requires technological as well as structural solutions, and thus the view that biotechnology does not figure into food production is false.

3) Dr. Luiz Antonio Barreto de Castro, Director General of Genetic and Biotechnological Resources, The Brazilian Enterprise of Agriculture Research:
He emphasized that new technologies soon will only be limited by those boundaries set by regulators and ethicists. Noting the increase in biosafety regulations, he described a complex web of interactions and consequences that reached beyond biosafety issues to include worldwide agrochemical markets, noting that the global fertilizer market is rising while herbicide use is declining, which affects decisions made about GM crops.

4) Dr. Piet Van der Meer, Ministry of the Environment, the Netherlands:
He highlighted his work with Central and Eastern European countries seeking entry into the EU and in the process of adjusting their regulatory frameworks to abide with EU directives

on biotechnology. He noted that biosafety frameworks need to include a regulatory framework, an administrative system, decision-making procedures and means for information dissemination. Further, the process of decision-making is key to implementing the precautionary principle and must address three steps: assessment of whether procedural requirements have been met; risk assessment on a scientific basis; and taking a decision, which is a political issue.

5) Diego Malpede, Ministry of Foreign Affairs, Argentina:
He discussed the national context of biotechnology in Argentina, as well as its perspective on international trade and environmental discussions relating to the precautionary principle. In the area of international policy, Malpede noted common fears that the precautionary principle could be used for protectionist measures, thereby restricting access to foreign markets. He concluded by noting that regulatory guidelines for the principle should consider: internationally agreed principles for its operation; open and transparent functioning; rigorous research, especially by independent bodies; no more restrictions on trade than necessary; recognition that ignorance is not equivalent to lack of scientific certainty; and reasonable timeframes for decision making.

6) Professor Ed Soule, McDonough School of Business, Georgetown University:
He spoke about regulatory legitimacy and distinguished between weak and strong versions of the precautionary principle. He defined the weak version as being highly pragmatic, providing regulators with some flexibility in determining relevant factors and deciding on the importance of environmental risks. The strong version is risk averse, limits regulators to consideration of environmental risks and urges prohibition of the commercialization of novel technologies until they are proven safe. He suggested that the Cartagena Protocol introduced weak precautionary language into an international trade agreement and was concerned that this would encourage production of environmentally risky agrochemicals. In the case of the strong version, risk is expected to trump all other concerns. It is sometimes argued that uncertainty of risks supports the principle's risk-averse stance. He rejected this proposal, stating that one can know enough about GM crops to prevent their commercialization, while not knowing enough to compare their risks to agrochemicals in order to decide which technology is preferable. He suggested that the choice is a political or moral decision and that to preclude either on the grounds of such uncertainty would be very arbitrary.

7) Professor Philip Bereano, Department of Technical Communication, University of Washington:
He characterized this conference as an expression of the political reality of the precautionary principle. Focusing specifically on the US, he noted that risk assessment, management and communication are political because definitions are not clear or obvious and costs and benefits do not fall equally on everyone. He reminded participants that risks are subjective, and arise not because scientists try to discover them but because the public encounters them. He emphasised that people will react strongly if they believe the risks of GMOs are being imposed upon them without their consent, knowledge or an open and transparent process. As for the ambiguity of the precautionary principle, he reminded participants that the "reasonable man" standard has been elaborated in the US legal system to accommodate and employ many different interpretations quite effectively. He stated that it is necessary to allow the organic nature of law to define and perfect the meaning of terms like environment and precautionary principle.

8) Dr. Gary Comstock, Bioethics Institute, Iowa State University:
He suggested that the principle's formulation in the Rio Declaration implies that new technologies should not be advanced unless there is certainty that it will be safe for humans and the environment. He suggested that this is society's expression of risk aversion and that is why it has been codified into international law and why the EU has invoked the principle to justify its current moratorium on GM crops. He asserted that a logical analysis

of the principle reveals two contradicting propositions: (i) We must not develop GM crops, as some in the EU propose and (ii) We must develop GM crops. He therefore suggested that the burden of proof is on the principle's defenders to explain why its policy implications are not incoherent. He stated that discussion should not focus on the principle, but rather on the obstacles standing in the way of delivering the potential benefits (e.g., improved nutritional content and decreased environmental and health impacts). He proposed the following questions: if biotechnology advocates want to feed the world's hungry, why aren't they putting more resources into alternative methods proven to increase production; and what gives biotechnology's opponents the right to take away the choice of using the technology from people in other countries?

9) Mario Rodriguez, AgroBio Mexico:
He noted the tendency for the debate to marginalise developing countries, by presuming that they do not have expertise in ethics, applying technologies, or developing regulatory frameworks. He also noted that developing countries should not be treated as a homogenous block, given the diverse range of economic development and interest in biotechnology. He stated that there is no precautionary principle as there is no general consensus on its formulation, and instead supported the use of long-standing principles such as comparative advantage, non-discrimination and most-favoured nation status. He stated that technology is an important indicator of a country's ability to derive national benefits and suggested that using the precautionary principle to curtail technological development would leave developing countries disadvantaged in the global economy.

10) Andrew Apel, AgBiotech Reporter:
He presented his ideas to unify the concepts of substantial equivalence and the precautionary principle. Noting recent criticism of both principles, he stressed the need to develop a mutual compromise among interested stakeholders. He noted that substantial equivalence generally embodies the idea that existing organisms used as food can be the comparative basis for assessing the safety of a similar product or variety that is modified or new. Apel did note that substantial equivalence is not equipped to address developments that are so new that they cannot be interpreted in terms of the status quo, at which point the potential risks could be assessed through the precautionary principle. He noted that the principle would thus be subsidiary to substantial equivalence and that this is consistent with the Cartagena Protocol. He called for an assessment of the risks and dangers of existing non-GM controls to their GM alternatives, suggesting the need for further research on the impacts of herbicide applications on monarchs in addition to work on Bt maize.

Above excerpts were obtained at *Sustainable Developments: Biotechnology in the Global Economy*: 22-23 September 2000: www.iisd.ca/sd/biotech/parallel.html). They reflect a cross-section of views and policies, and are representative of a more global picture of how genetic modification is being seen abroad.

Randomly selected Internet publications covering public response to GMOs

Demonstrations, dumpings and denial – a nemesis for GMOs? A rising tide of anger and concern threatens to form a tidal wave swamping the future of genetic modification. The issue of whether or not this is justified becomes secondary, as only time and revelation can offer this particular truth. In the interim, however, companies involved in biotechnology and research face the power of disgruntled

consumers and farmers, who represent a perhaps small but motivated voice against them, creating a ripple effect that manifests in purchasing choices.

While the following incidents and organisations may indeed represent only select groups taking a public stand against GMOs, the global manifestation of such events does suggest widespread and pervasive concern, if not limited to the technology itself, then to the apparent haste at which it is gaining momentum and access into the environment itself.

* Filipino rice farmers protested against the *International Rice Research Institute (IRRI)* at its 40th anniversary on 4 April 2000, citing the following grievances:

> *The IRRI's much-flaunted Green Revolution caused massive loss of biological diversity in rice paddies throughout Asia, and though the yields of hybrid rice are supposed to be high, the seeds are costly and cannot be saved for the next season, increasing the farmers' dependency on seed companies and preventing them from breeding their own strains of rice* (MASIPAG/Farmer-Scientist Partnership for Development in Philippines masipag@mozcom.com : 1).

* Peasant groups campaigned against genetic engineering and planned field tests of blight-resistant rice strains, demonstrating outside the palace gates, along with farmers and civil society representatives from Bangladesh, Thailand, Malaysia and Japan. "Like the Philippines, Bangladesh has lost almost all of its traditional rice" (*MASIPAG/* Farmer-Scientist Partnership for Development in Philippines: 1).

The action week was held to show that resistance to GE is not confined to Western Europe, but "is truly a global phenomenon". The strong concerns were about the "technology and the power it is giving to multinational companies", and the fight would be to "preserve and develop systems which are independent of transnational biotechnology companies" (*Press Notice,* Resistance is Fertile: 1).

> *The science itself is still very unpredictable and the application of patents on life raises the issue of our health systems being controlled by multinational companies. The Biosafety Protocol will give many countries more powers to control the flow of GMOs into their countries* (*Press Notice:* Resistance is Fertile: 2).

It does appear, though, that the above concerns are not limited to the "unpredictability" of the application of GMOs and the ramifications (potentially) on health, but extend to the control the "multinational companies" have. Inverting this argument, one could examine the potential of governments to acquire the technology, and make it available to farmers to utilise the purported agricultural benefits, without being bound contractually to the companies.

* In a Pasadena (California) press release, the *Organic Consumers Association, GE Free Los Angeles* and other groups conducted "symbolic" public dumping of GE foods at two supermarkets in Los Angeles on April 4th and April 8th, 2000. (*Action Alert* – Say No to Frankenfoods At a Public Dumping of Genetically Engineered Food: www.purefood.org as part of www.resistanceisfertile.com: 1).

* Ohio Congressman Dennis J. Kucinich published an article in *Action Center – Genetically Engineered Food* (19 August 2000: 1). He quoted the *US News and World Report*: "It is now virtually impossible for Americans to avoid eating [GEFs]

because they do not know which foods are engineered and which are not". He cites potential health risks as "increased toxicity, increased exposure to allergens, decreased nutritional value, and increased antibiotic resistance". The environmental risks he mentioned in the above article included the destruction of natural species, cross-pollination that breeds new weeds with herbicidal resistance and greater water pollution resulting from increased use of stronger pesticides.

With GMOs receiving this kind of publicity, it becomes clear that the public is receiving a strong and sustained message that they are potentially dangerous to people and to the environment. Resistance becomes a cause, one that has the potential to be very close to peoples' hearts, with the imprinting power of the negative review over the positive one. Casual spectators to a public dumping or demonstration can be left with a vague sense of alarm about GMOs, and end up making a more subconsciously-based choice when faced with GM food at the supermarket, opting instead for the less contentious product. The same applies to a reader who may see a few articles highlighting the potential for detrimental health effects in a magazine or newspaper, and make a choice based on limited or fragmented information.

This does not negate the power of the medium conveying this information, whether it be an update on legislation affecting consumers or product labeling, or about a demonstration in a foreign country where people are protesting the loss of crop diversity. It could be as simple as a knee-jerk reaction, or a carefully meditated and researched opinion, but the reality is that the public is the target for the information filtering through the media. The general tone is one of alarm, concern, and a demand for accountability and transparency.

Excerpts from other major magazines and newspapers

Time magazine ran a feature called "The hottest jobs of the future" (29 May 2000), and third and fourth places were given to "Pharmers" and "Frankenfood Monitors" respectively. The *Pharmers* were described as "New-age Old MacDonalds (who) will raise crops and livestock that have been genetically engineered to produce therapeutic proteins. Works in progress include a vaccine-carrying tomato and drug-laden milk from cows, sheep and goats."

The *Frankenfood Monitors* followed, incongruously enough, hot on their heels:

> *Not sure what's for dinner? With a little genetic tinkering, fast-growing fish and freeze-resistant fruits will help feed an overpopulated planet, but such hybrids could unwittingly wipe out the food chain. Eco-scouts will be on the lookout for so-called Trojan gene effects, and bounty hunters will help the USDA eliminate transgenic species that get out of hand* (*Time:* Visions 21: our work, our world: 54).

Following through with the issue "The future of technology" on 3 July, an article written by Bill Gates called "Will Frankenfood feed the world?" was presented, in which he comes out decidedly in favour of the technology. He did temper his belief in its merits for agricultural aid by saying that poverty "plays the largest role" in

world hunger, providing the United Nations figure of 800 million undernourished people in the world:

> *Making genetically modified crops available will not reduce hunger if farmers cannot afford to grow them or if the local population cannot afford to buy the food those farmers produce* (Visions 21: our technology: 49).

These were preceded by *Time*'s "Beyond 2000" special issue on 8 November 1999, where the article entitled "Will we still eat meat?" had the following:

> *... then there are the growing concerns about what happens to people who eat the flesh of animals that have been pumped full of genetically modified organisms, hormones and antibiotics* (Vision 21: health & environment: 75).

In "Bad Seeds" (*Time*, 20 September 1999), the issue of GM crops between the US and Europe is described as a "battle" heating up. Accompanied by an eerie blue picture of milk, corn, cheese, milk and soybeans, containing the percentages of genetic engineering they represent in US crops, it offers interesting perspectives, in the business section of the magazine. Quoting examples of European anger, manifested by a number of demonstrations and dumpings at *McDonalds* in France, it confirms that investors are "backing off as biotech firms buckle under the pressure of public opinion" (*Time*: 52).

Newsweek covered the same issues in their 'The Big Food Fight" (13 September 1999), where Europeans are described as "railing against 'Frankenstein foods' ... and exporters have been forced to listen". Although the *McDonalds* vandalism was a non-genetic dispute, "it's all part of a piece".

> *Even among the broader public in France and Britain, the GM food issue seems to be intersecting with second thoughts about globalization. French farmers protest American imperialism* (*Newsweek*: 11).

The *New York Times* ran an article about the "genetically modified menagerie" in the United States, referring to the arrival of "enviro-pig, a beast genetically modified to produce low-phosphorus faeces" and also giant GM salmon under production in Canada. Consumers are described as "dismayed" and "alarmed", despite claims by that sheep will be able to produce milk that can be used to treat cystic fibrosis (in the *Sunday Independent*, 7 May 2000: 3).

> In the same article, in what one scientific critic described as *"ludicrous, the FDA has decided to treat GM salmon as a drug and not a food for regulatory purposes ... nor can the growth hormone be regulated as an additive, because it is not deemed to change the nature or quality of the fish".*

The developers of the fish claim, as with those of GM vegetables, that they will be able to feed more people, more efficiently and cheaply than with conventional fish. "Of course, such fish will also be more profitable, as they take only half the time to reach marketable maturity", is the final sentiment the article conveys.

The *International Herald Tribune* (4 August 2000: 1) ran the front-page story: "Genetically Modified Trees: A Blessing or Danger for the World?" It offered descriptions of "dream trees" growing in Canada, Israel and the US, designed to

grow fast or containing "novel woody fibres" that can be processed into pulp without the "tons of toxic chemicals that now poison rivers around paper mills".

Calling this "a little-noted biotech revolution in forestry that experts predict will hit its commercial stride in the next five years", scientists are quoted as saying that they are "poised to harness the enormous economic potential of the biggest, longest-lived and most biologically productive land plants on Earth".

Opponents say that it could be an "ecological crisis in the making", because due to the long life of trees, predicting long-term impact on the countless species that depend on them, including the "soil-dwelling fungi and microbes that are the foundation of the planet's terrestrial food chain", will be impossible. This has now give rise to the term "Frankenforests".

Proponents talk of forests "gobbling up carbon dioxide", and providing paper and pulp products – the demand for which is expected to "increase by 50 percent in the next two decades, exceeding supplies by 2010". Therefore, they see biotech trees as offering the "only way to increase the production of lumber, paper and other wood products without decimating existing forests and exacerbating global warming" (*International Herald Tribune*: 2).

The Cartagena Protocol – "Rules of the Game"

An important move, like an intricacy in a game of chess, was the Cartagena Protocol.

Scientific American (April 2000: 24) contained a report on the deal signed in Montreal in January 2000, whereby more than 130 countries agreed on a protocol for commerce in genetically modified organisms. This agreement "forestalled an all-out trade war between US-allied food-exporting nations on one side and the European Union on the other, but skirmishes are likely to continue".

Calling the protocol a "compromise between strict controls advocated by environmental groups, notably Greenpeace, and exporters who wanted to prevent countries from erecting spurious trade barriers", it is seen as providing "modest controls". It does not affect countries' obligations under other agreements, particularly the World Trade Organisation (WTO).

Quoting Val Giddings of the Biotechnology Industry Organisation, "the protocol does a pretty good job of keeping the baby and pitching the bathwater" (*Scientific American*: Technology and Business: April 2000: 24).

This protocol can certainly be seen as a step in the right direction. Representatives of all sides of the issue are provided with a forum for their views, and this enhances a broader understanding and creates an opportunity for cooperation instead of resistance. This technology is still so relatively new, and the need to create a framework and develop a set of guidelines that can be accepted as neutral, is essential to the resolution of the conflict inherent.

However, the old story of the Chinese man who was offered the reward of his choice after providing a service to his emperor, comes to mind. He asked for a grain of rice, to be doubled for every square on a chessboard. The emperor agreed, and was then mortified to discover that there was not enough rice in his kingdom to cover his debt to the man, whom he promptly had executed to alleviate this vexing problem.

The issue of GMOs is vast, complex, and contains so many variables; that it seems impossible to calculate all the ramifications potentially involved. But fear is a powerful motivator, and information trickling through has a cumulative effect. From scientific reports with some weight like the ISIS one recommending the moratorium, to the questions raised at the forum held at the prominent Kennedy School of Government, to various Internet publications taking an incendiary approach, to the credibility associated with major newspapers and magazines - these are all pathways that lead to a deal like the Cartagena Protocol. Will it prove to have any meaningful function or staying power, or turn out to be a temporary plug in a dyke threatening to indeed "throw out the baby" along with the water?

CHAPTER 6:

THE SOUTH AFRICAN MEDIA ON GMOs

Radio as a forum for news and dialogue

The GM debate has reached South Africa, and is being discussed and analysed on the radio and in magazines and newspapers. A selection of broadcasts and publications, offering insights and arguments, illustrates the growing awareness of the technology and the demand for answers. Again, the nature of public reaction does not necessarily have a sound scientific basis, and attitudes can often be attributed to a general mood of disquiet and alarm. The fact remains that as the consumer forms an opinion, and then acts accordingly, this has the power to have a major influence on the companies promoting the research of GM technology. As South Africa enters the arena, so too do its lawmakers and its citizens.

Dr Vandana Shiva, a scientist, physicist and environmental activist from India, visited South Africa to instigate further dialogue in the biotechnology debate. Interviewed on the *Tim Modise* radio talk show on *SAfm* (2 August 2000), she presented some of what she singled out as being the most pressing concerns raised in her country about biopiracy and biodiversity.

> *These capital investment technologies take both seed and biodiversity away from farmers, regard their seeds as intellectual property, and introduce untested genes into unrelated species like the genes of bacteria or animals into plants. The smallholder is becoming more displaced, and the argument that biotechnology will provide food for the starving masses is nonsense. They have labeled*

> *environmentalists as lunatics and fanatics, for expressing their concern at the hazards and risks* (Vandana Shiva, Tim Modise Show, 2 August 2000).

South Africa presently has 100 000 hectares of corn planted with a bacteria gene engineered to produce toxins; this, she said, has a detrimental effect on beneficial species like butterflies and bees, who are repelled and therefore do not function as pollinators. Dr Shiva calls herself a "crusader" against GMOs, taking the issue to its "philosophical, biological and sociological" ramifications. She declares that, unbeknown to the general population, GMOs enter South Africa in processed foods imported from the USA, China and Argentina, where they are not segregated from the other ingredients. She cited that 60-80 percent of soya, maize and canola imported contained GMOs.

Dr Shiva uses quotes from environmental lawyers in South Africa to back her case, who say that the GMO act in place is nothing more than "a cynical piece of law masquerading", with exclusions implicating the "user as being liable for damages". The consequences of GMO tampering are, according to her, the destruction of the balance in the ecosystem. Another of the inherent risks is the "contamination of organic crops", as the certification criteria requires a minimum of six miles between an organic farm and farms where non-organic methods are used.

She referred to the *Green Revolution* as a "crisis" in India, where monoculture and single commodity yields deflected attention from the "whole foodbasket" concept, where all the necessary dietary needs would be derived from the diversity of agriculture represented by small agricultural holdings. The fact that up to 70 percent of women in India are iron deficient, is attributed to this lack of crop diversity. She expanded on the "unprincipled" principle of "highly subsidised dumping of crops in the name of free trade", where cheap soya, sorghum and corn were arriving in Third world countries from First world countries, and wiping out the small farmers.

In the USA, at the height of the *Green Revolution*, a modified "big rice" almost wiped out the original rice, and then "totally failed after two seasons", Dr Shiva recalled. India has been saving and re-using seed as an endeavour to reclaim autonomy, and the fact that Monsanto's contracts had "clauses where prison or fines" were the consequence of replanting had generated outrage, she said. The industry was looking for public funding, and this "would increase the debt burden in the Third world".

The questions Dr Shiva raises, and the answers she provides, may well be seen as alarmist, and her agenda one against capital investment technologies. The implicit premise is that they are "devoid of moral content" by virtue of the very nature of capitalism. Critics argue that capitalism is, on the contrary, a system bulging with moral content, both defined by freedom and engendering freedom (according to Bun Booyens, University of Stellenbosch lecturer, in an email on 22 December 2000). The disputes between protestors and law enforcement at WHO gathering in Seattle proved this subject to be a hotbed of violently opposing ideologies.

Dr Florence Wambugu, the Kenyan plant geneticist whose pro-GMO beliefs were introduced in Chapter 1, was one of the people who called in to respond to Dr Shiva. She stressed that the benefits of the technology outweigh the risks, and

referred to the "emotional and hysterical" responses evident in public opinion regarding the issue. Calling the technology "sustainable", and pointing out the benefits of insect-resistance and the use of less chemicals, she said that it would help African countries improve crops, as proved by the sweet potato trials (Tim Modise Show, SAfm, 2 August 2000).

The program provided a good cross-section of listeners, proponents and opponents. It revealed a strong tendency towards concern, manifested by questions about possibilities for the science to move out of control and irreversibly pollute the environment as well as the human body. Working on the assumption that risk is of paramount interest, the conclusion can be reached that this broadcast, reaching a substantial number of people, could be judged to have had a catalytic effect on those who may or may not have considered the topic before.

Print media: South African Coverage of GMOs

"Honderd miljoen oorleef al GM voedsel", was the heading of an article in *Landbou-Burger* (19 May 2000: 8), postulating the fact that at least a hundred million people had been eating genetically modified food in the United States over the past six years, with no "scientifically proved" detrimental effects to themselves or their environment. The accompanying cartoon shows two farmers on either side of a fence; the one in the distance is staring in a bemused way at a normal-sized apple in his hand, while the farmer in the foreground is shown with a huge apple requiring both hands to hold it.

The director of *AfricaBio*, Dr. Jocelyn Webster, is quoted in the article as saying that South Africa has been doing GM research for the past twenty years, and evaluating the products of this research for ten years, with more than 160 projects in agricultural biotechnology underway. She spoke enthusiastically about tomatoes that ripen slower and taste better; altering the fat composition and flavour of other products; potatoes that absorb less oil when used for making chips; and transgenic rice containing higher levels of vitamin A:

> *Lewende hawe word bestudeer en gebruik vir die produksie van waardevolle farmaseutiese produkte soos spesifieke menslike proteiene in die melk van koeie en varke* (LandbouBurger, May 2000: 8).

This technology in itself may seem incomprehensible to the general reader, but the general tone of the article is reassuring if somewhat avuncular. *AfricaBio*, according to the informational Internet publication "About AfricaBio" (www.up.ac.za/academic/fabi/africabio/about.html), seeks to "promote the enhancement of food, feed and fibre through the safe and responsible application of biotechnology" (1).

It is a self-described non-profit section 21 company, and lists its immediate objectives as:

1) *Informing and lobbying key stakeholders (e.g. ministers, executive council members, and parliamentary portfolio committees and industries in the food, feed and fibre sectors).*

2) *Providing accurate information on biotechnology to the media and general public.*
3) *Providing international organisations lobbying for or against biotechnology with information on the need for this technology in South Africa and Africa* (2).

Conversely, the *Mail & Guardian* (*M&G:* 25 February 2000: 7) ran the article, "SA receives bulk shipments of Frankenfoods", concerning shipments of genetically engineered yellow maize arriving "quietly" in South Africa. Fiona Macleod, the journalist who wrote the article, called attention to the fact that the maize was being used for animal feed and the manufacture of glucose for human consumption, "despite fears that altering gene structures may have a serious impact on human health and the environment".

The newspaper ran the response of one of their readers, a genetic engineer, the following week (*M&G*, 3 March 2000), who stated unequivocally that "GMOs are not Frankenfoods". He objected to the pejorative "Frankenfood" and other "emotive terms", saying that no one had ever "convincingly showed that GMOs pose any significant threat to human or other animal health". He decried the use of "fuzzy and imprecise terminology" with regards to what "altering gene structures" really means, and stated that "the majority of people who are informed as to both the nature of the engineering and the relative risks have no problem with this technology at all".

Macleod wrote a follow-up article in *M&G* (November 10 2000: 7), covering the bid by the pharmaceutical company, Aventis, to grow GM crops in South Africa. Their genetically engineered maize, known as StarLink, contains a pesticide gene, Cry9C, that is resistant to heat and difficult to digest. "It is this gene that is suspected to cause allergies", states the article, referring to the recent event where Aventis had to remove 300 food products from US supermarkets because they contained this allergenic maize.

> *South Africa does not require genetically modified food to be segregated from that which has not been genetically modified. Labeling is also not required, which means the consumer will be unaware that he is consuming contaminated foods that have specifically not been approved for human consumption,* said Mariam Mayet, a lawyer who specialises in legislation on genetic engineering (*M&G*: 7).

The StarLink scare in the US had raised the question about how practically possible it was to segregate approved crops from their unapproved counterparts, and the mix-up was thought to lie in the crop's tendency to cross-pollinate while growing. Aventis "acknowledges the distance may not be enough", with regards to the buffer zones of 22m around the fields.

> *This case clearly calls for South Africa to use the precautionary principle and ban the import of any genetically modified crop that may cause harm to human health or may enter the human food supply* (Mayet, *M&G*: 8).

The European Commission, which is investigating the possibility that StarLink products have been exported to Europe, said that it had invoked the precautionary principle. "Until we have a risk assessment, it's better to keep it out", said Wilfried Schneider, a representative of the European Union (EU) delegation to the US. The

EU has enforced mandatory labeling of GM products for the past two years (*M&G*: 7).

To follow up on the StarLink situation, in the *GE & IPR News (DirectAg.com by Farm Progress* (www.sustain.org/biotech/News/news.cfm?News_ID=2651) posted on 2 January 2001, the "USDA Asks Seed Producers to Test for StarLink". In the article, it is said that the "StarLink debacle will be with us a while longer", because the USDA had sent out, in the previous week, a letter to seed corn companies asking them to test all seed corn to be sold for 2001", because of the detection of Cry9C protein in the non-StarLink corn. Cry9C is the "active Bacillus thuringiensis protein" in this biotech line that protects corn from European Corn Borer.

The *Sunday Independent* (3 September 2000: 4) ran a story in its *Reconstruct* section challenging that Africa lacks the capacity to police GMOs. In a response to this, Andrew Taynton of the *Safe Food Coalition* (*Sunday Independent*, Letters to the Editor, 8 October 2000: 11) called for "the independent facts on GMOs". He speaks of the sophisticated marketing techniques being used to gain acceptance, in lieu of "sound science ... evaluated by independent scientists".

> *Farmers and consumers are not being objectively informed about these novel products either. South Africa is being targeted as the gateway to Africa by the giant multinational seed companies ... and should consider a moratorium on the release of GMOs similar to that of the European Union or New Zealand until this technology has bee properly evaluated* (*Sunday Independent*, Letters to the Editor, 8 October 2000: 11).

In *Reconstruct* on 3 December 2000 (*Sunday Independent:* 5), a positive slant was taken in "'Miracle maize' boosts food security in developing countries". Providing statistics on child mortality due to starvation as the introduction, the development of a genetically modified maize (containing twice the number of amino acids and much higher protein than its original counterpart) was lauded.

A representative of Mayford, a seed company operating in South Africa, has contested the anti-GM stance vigorously, saying that farmers are "extremely well-informed" about GM products, with "seminars and conferences" offering information about the technology (P. de Vries, Mayford: 12 December 2000: phone interview). He said that although the company he worked for had not "yet" implemented genetic engineering in its seeds, it remained "unquestionably the way of the future". Decrying the scare mongering he felt the media was committing, he stood firm that the technology was sound, and would prove itself as an "indisputable boon to agriculture".

Scare mongering... or whistle blowing? In the 5 January 2000 edition of *FAIRLADY*, an article called "What's in the stew?" was featured, where the debate over GE food was called "simmering" in South Africa as compared to "long boiling" overseas. Quoting Dr Terry Watson, manager of the Biotech Program at *CSIR Foodtek*, "so many genetically engineered enzymes have crept into our food that labeling them is an informative as saying electricity was used in the manufacture" (*FAIRLADY*: 31).

Referring to the FDA's intended role of "protecting people", the article uses excerpts from a speech that visiting molecular scientist Professor John Fagan gave to South

African audiences, where he explains that "normal testing by the FDA" is evaded because the products are considered substantially equivalent. He adds, though, that "substantial equivalence" has been dubbed "a license to kill" by the *Journal of Nutritional Therapy*.

FAIRLADY presents in a parallel column, "Another side to the story", a list was provided as an accompaniment to the article, excerpted from a pamphlet by the Pretoria-based *Food Advisory Consumer Service (FACS)*. It included the following:

1) *Consumers should be empowered to make informed choices about whether they choose to use GM products or not.*
2) *In SA more than 100 applications for the use of GMOs have been received over a nine-year period, which has led to only two commercial releases to date.*
3) *Long-life tomatoes in SA aren't genetically engineered. They're the result of ordinary breeding programmes that have resulted in a delay in the ripening of tomatoes.*
4) *The stable, long-term safety of GMOs and their products is a major issue in all safety assessments. Stability in crops is assessed over a minimum of six years.*
5) *To grow GM seeds without approval trangresses the GMO act, which could lead to prosecution. At present the import of GM seed, fresh fruits and vegetables requires biosafety assessments for GMOs. Imports are controlled with permits.*
6) *The US has been growing GM crops since 1992 and China since 1990. There hasn't been a single substantiated claim of GM food having caused death; nor is there any scientific data that such food could cause chronic diseases such as cancer.*

This insert is juxtaposed with the reference to breast- and prostate cancer statistics in South Africa, where the link is suggested between the GM hormone BST (that, injected into cows, boosts milk production by up to 30 percent), and the higher incidence of these cancers. She ends with a quote from Angus Durran, director of *The Safe Food Coalition*: "Genetically engineered foods should be subject to at least the same rigorous testing that pharmaceuticals are put through" (Hilary Bassett, FAIRLADY, 5 January 2000: 33).

On a similar note, in the *FEMINA* issue for January 2001, Dr Richard Broome cautions: "These foods should be treated with as much respect as pharmaceuticals". He is the South African representative for Genetic ID Inc (a company that supplies testing and certification services), and was asked about both the problems and solutions posed by genetic engineering of foods (*Femina*: 102).

University of Cape Town professor, and head of the Microbiology Department, Jennifer Thomson, addressed *The Genetically Modified Foods Debate in South Africa* on 4 April 2000. She referred the to debate as "heating up in South Africa during the past year", manifesting as numerous radio talk shows, TV programmes, newspaper articles, live debates, workshops and lectures." She was a guest speaker at the *World Economic Forum* held in Davos, Switzerland, in January 2000, and stated that by the end of the session 82 percent of those present voted in favour of GM foods.

A wonderful example of cartoon humour headed up her comments, by the cartoonist Tony Grogan, where two farmers stand (hands in pockets, apparently in the heart of the Karoo) talking about the pumpkin crop. "These pumpkins have been crossed with a camel so I don't have to water them", says the proud farmer to

his nonplussed neighbour, as they stand surrounded by a lush field of pumpkins with the parched desert landscape in the background.

Professor Thompson endeavoured to clarify the situation in South Africa, presenting a list of *FICTION* and *FACT*.

She covers a substantial number of the most frequently-asked questions regarding genetic modification, but sets a somewhat placatory tone, and a number of her "fact" responses are under fire from opponents to the rapid introduction of the technology both here and abroad.

"The Genetically Modified Foods Debate in South Africa"

FICTION: *Many GM crops are commercially available in SA.*
FACT: *Only insect-resistant cotton and yellow maize are commercially available. There are a number of GM crops undergoing field trials.*

FICTION: *The sale of herbicide resistant crops will result in a huge increase in the use of specific herbicide, which will be environmentally damaging.*
FACT: *Herbicide resistant crops allow farmers to spray before the crop is planted, or when it is very young. This results in the use of less herbicide. Data from the USA show that this will cause less soil erosion.*

FICTION: *South Africa has no legislation restricting the release of GMOs, which will result in multinationals "dumping" GM foods here.*
FACT: *The GMO act was passed by Parliament in May 1997 and the regulations in November 1999. The Executive Council, Registrar and Advisory Committee have all been appointed. Contravention of the Act can result in a fine or imprisonment of up to four years.*

FICTION: *Farmers, particularly small-scale farmers, will be forced to buy GM seeds.*
FACT: *Market forces will prevail. If the GM seeds provide a better yield, farmers will buy them – if not they will buy their seed from other companies.*

FICTION: *It would be easy to separate engineered from non-engineered foods.*
FACT: *Many food items on supermarket shelves contain soybean, from canned soups to baby food. America is one of the largest suppliers of soybean and some of their exported soybean may have been genetically modified ... however, all the soybeans are pooled. It is possible, but very expensive, to separate the GMOs from non-GMOs.*

FICTION: *It is easy to label GM foods on supermarket shelves.*
FACT: *The detection of GM foods in a given commodity is expensive and cannot be done at present in South Africa. Such labeling will also tend to demonise GM foods in the mind of the public, whereas it is the opinion of the vast majority of scientists, in SA and abroad, that GM foods are safe.*

FICTION: *Genes from GM crops can be passed on to other plants resulting in environmental havoc.*
FACT: *Plants can only be pollinated by closely related crops. Therefore the GMO Advisory Committee looks very closely at the potential of GM crops to cross-pollinate other plants, especially weedy relatives. Fortunately major food crops such as maize do not have weedy relatives.*

FICTION: *Insects will rapidly develop resistance to the Bt toxin in insect-resistant crops, so planting crops containing this gene is a waste of time. In addition, organic farmers who spray their crops with Bt will no longer be able to use this form of biological control.*
FACT: *This certainly is a concern, and requires Integrated Pest Management. Whenever a Bt crop is planted farmers should plant a certain percentage of non-Bt plants to reduce the risk of the development of insect resistance. The best way is to require seed companies to sell a correct mixture of Bt and non-Bt seeds. This is what South African regulators are now investigating.*

FICTION: *Terminator gene technology – which results in seeds produced from a crop being sterile – will force small farmers to continue buying their seeds from multinationals, rather than being able to plant some of what they produce.*
FACT: *So-called Terminator technology has been patented, by the US Dept. of Agriculture and one commercial company. It has not yet been perfected, let alone used anywhere – any may never be used, thanks to public pressure.*

FICTION: *Genetically modified foods are inherently allergenic and/or harmful.*
FACT: *There is no evidence whatsoever that GM foods in general are any different to "normal" foods in terms of toxicity or allergenic potential. Many of the genes used to modify plants occur naturally in plants, or the viruses or the microorganisms that infect them or associated with them, meaning humans have already been exposed to them.*

FICTION: *Non-target, beneficial insects will be killed by eating insect resistant plants.*
FACT: *The opposite is happening. Because Bt crops are not sprayed, beneficial insects are returning, together with bird species. Data from the USA show an increase in insectivorous insects and a concomitant decrease in pests such as spider mites.*

FICTION: *Non-target insects will be killed by eating pollen containing insect toxins.*
FACT: *There was a glasshouse study in the USA in which Monarch butterflies were fed pollen from Bt-containing maize. Not unexpectedly they died as they are sensitive to the particular Bt used in the maize. However, the feeding was totally artificial with doses far exceeding those that would be encountered in the field. Field trials have recently been completed and it is clear that even inside maize fields the build-up of Bt pollen would not be sufficient to pose a threat to Monarch butterflies.*

FICTION: *There is enough food to feed South Africa and sub-Saharan Africa – it is just a question of distribution.*
FACT: *This is a naïve attitude considering transportation problems on the sub-continent, wars and corruption, to name but a few impediments.*

Due to the fact that Professor Thomson addressed the most generally asked questions regarding GMOs, and without necessarily presenting her "FACT" answers as being conclusive or entirely accurate, most of the transcript of her lecture has been included (www.uct.ac.za/microbiology/gmos/htm). From the issue of non-target insets being harmed, to that of GMO's ability to feed a starving world, many of these stand to be contested only on the basis of time and implementation.

The *Daily Mail & Guardian* (www.mg.co.za) also covered the following GM-related stories, retrieved on the Internet under the search for "GMOs":

1) *Getting to grips with modified genes* (17 March 1999)
2) *Bitter fruits* (21 September 1999)
3) *Are we ready for the food revolution?* (11 November 1999)
4) *South Africa sees GMOs easing rural hardship* (8 February 2000)
5) *SA receives bulk shipments of 'Frankenfoods'* (29 February 2000)

6) *Manna from hell?* (8 March 2000)
7) *Maize to the rescue* (5 June 2000)
8) *Genetically modified arguments* (4 August 2000)

Jonathan Margolis, of the *M&G*, wrote "And now for the forecast", a look back at the history of futurology, and offering some predictions of his own, the following: *Genetic engineering will, I strongly suspect, also fail to deliver a fraction of what its advocates promise* (22 December 2000: 37).

All of the above excerpts indicate a very strong awareness, as enhanced by the media's contribution to information on GMOs, by the South African public of this issue. The accuracy of the reports, and of the public's perception, remains subjective though, a by-product of vastly different information and claims made within the industry and by opponents.

CHAPTER 7:

GMO AWARENESS: LEGISLATION AND THE LABELING ISSUE, THE POWER OF THE CONSUMER, AND THE ORGANIC MOVEMENT

Labels, Laws and Libel

Labeling is an extremely complex issue. Straightforward cheese uses a yeast component that comes from a GMO source. Does that make the cheese a "modified' product? In an attempt to get to the mainstream of thought, perception, regulation and demands, extracts from various publications (Internet and print) will be used to gather evidence in the battle for and against labeling.

In a report by *Wired News* (www.wired.com/news.print) on 3 August 2000, it was said that the Swiss company Novartis, described as one of the world's largest providers of seeds for growing genetically modified food, confirmed that it had made its own products GM-free. This policy was revealed in a letter sent by Novartis to the *Greenpeace* office in Belgium, and interpreted as an attempt to persuade the environmental group to include Novartis on its list of GM-free food producers.

> *With the current sentiment among the population towards GMOs (Genetically Modified Organisms), we have decided to take all necessary practical measures to avoid using genetically modified organisms in our products worldwide* (*Wired News*: GM Food Fights at Full Boil: 1).

Time magazine referred to Novartis' decision in "Bad Seeds" (20 September 1999: 52), saying that the proposal for voluntary labeling was something biotech companies would "be free to honor or ignore ... in a demand-driven market, however, they would ignore it at their peril".

They followed by describing Novartis' decision to "give in to anti-GM sentiments" by announcing that their products would be GM free. The Novartis spokesman insisted that the decision was not a safety issue, "but rather a response to preferences expressed by our consumers" (*Time:* 52).

The issue of labeling GM foods is one that has placed many countries in a stranglehold of accountability, and the battle has been evident from sidewalk protests the whole way up the rungs of top government. In a move described as "bowing to overwhelming public pressure", health ministers from Australia and New Zealand rejected lobbying by the food industry and agreed on adopting a zero threshold standard for the labeling of GM foods (*Wired News*: GM Food Labeling Down Under: 1 August 2000, www.wired.com/news/technology : 1). Exemptions were listed, however, providing concessions to the food industry, where food sold at cafes and restaurants and also many food additives would not have to conform to labeling requirements.

A representative of the *Australian Food and Grocery Council* said that the decision met the "fundamental objective of providing consumers with meaningful information upon which they can exercise their right to choice" (*Wired News*: 3). The Australian Prime Minister, John Howard, had lobbied along with the food industry for a "far weaker standard", where labeling would have been required only for foods containing more than 1 percent GM content in each food ingredient.

Some opinion polls showed that 93 percent of Australians backed comprehensive labeling, with the *Australian Consumers Association (ACA)* arguing that "the proposed 1 percent threshold would in fact allow up to 70 percent of foods on sale to remain unlabeled (Wired News: 4). The *ACA* counteracted the argument that the financial cost to the food industry would reflect in the cost to the consumer, pointing out that the right to know "definitively what is and what is not gene modified" is what consumers want, despite implied cost, as demonstrated by the surveys conducted (*Wired News*: 3).

ENN, the *Environmental News Network*, ran an article by *United Press International*: "Analysis: Are GMO foods safe?", on 13 October 2000. It covered the "clamoring for tighter government controls and clear labeling of foods to spell out just what scientists have done", in response to the "uproar" following the discovery of StarLink in supermarket brands.

John Vanderveen, a 25-year veteran of the *Food and Drug Administration*, said that this "uproar is much ado about nothing", and that the methods used for selecting traits in GM foods are actually safer and more effective than older methods of hybridization.

In contrast, Larry Bohlen of *Friends of the Earth* said that biotech companies are aggressively and recklessly bringing these unlabeled novel foods to market, as proved by the contamination incident. "They're risking our health", he said. Bohlen is the director of health and environmental programs for the organisation (*Environmental News Network*: www.enn.com/enn-subsciber-news-archive/2000/10/10132000/upr_gmo)

The European Union has enforced mandatory labeling of GM products for the past two years, and in Japan GM maize is not approved even for animal feed (*M&G*, 10 November 2000: 7). In addition, the report states that in South Africa, the government pushed through the *Genetically Modified Organisms Act of 1997* on 1 December 1999, in "an attempt to tighten regulation of the fast-growing field of genetic engineering". According to this, South Africa has received 111 permit applications between January and October 2000 relating to GMOs, mostly from the US.

The applications are for a variety of activities, including "commercial releases, field trials, contained use and commodity imports for human and animal consumption – a total of 106 applications have been successful and five are under review". In addition, before the Act was passed, 165 field trials were approved and two commercial releases were authorised, for commercial planting of insect-resistant maize and cotton (*M&G*: 7).

Mariam Mayet, a lawyer specialising in GM legislation, said that the Act still falls short of international safeguards, as monitoring by civil society groups is extremely difficult, and information about foreseeable impacts and emergency measures in the case of an accident is not available. There was so much confusion in identifying the brand names containing the contaminated crops, and in Japan (where it is not approved in the first place) GM StarLink maize was found in snack food and animal feed, resulting in "consumer groups who insist on testing food for genetic modification". The concern was raised that in South Africa the NGOs "don't have the resources to do this" (*M&G*: 7), and the call for a global moratorium of five years on GM crops was reiterated.

Andrew Taynton, representative of the *Safe Food Coalition*, says that South Africa should consider a five-year moratorium, and follow the example of other developing countries such as Brazil, India and Thailand. In these countries, genetically modified crops were being rejected in favour of improving traditional farming methods, which were considered better for the environment and also a provider of jobs for the unemployed (*Sunday Independent*, Letters to the Editor, 8 October 2000: 9).

The *British Medical Association* has recommended that GE foods be labeled and the EU, Australia, New Zealand and Japan have required mandatory GEF labels. The European Union has clamped down on this technology with a defacto moratorium on new GEFs in response to low public confidence. In a January 1999 Time Magazine poll, 81% of respondents wanted GE food to be labeled. Kucinich introduced legislation H.R.3883, The Genetically Engineered Food Safety Act. (www.house.gov/kucinich/action/ge)

Questioning the "manipulative agenda" behind the "cry for labeling" is Richard North, formerly environmental correspondent on the British newspaper, *The Independent*, but now a firm critic of environmentalist arguments. He says:

> *...the people who want to stop GMO dead in its tracks know that labeling sounds completely reasonable and would completely kill the business ... you make somebody say this is GMO you are making them say 'this is Frankenstein food', watch out, leave it alone, don't touch it (BBC: The Rise and Fall of GM: 23).*

On 3 January 2001, *The New York Times* ran an article called "Eating Well: Labeling Foods with Designer Genes. The pun on "designer jeans" is irresistible, although the thrust of the story is around the resistance towards unlabeled GM foods on supermarket shelves. It revolves around a recent report recommending "mandatory labeling and testing of bioengineered foods" standing in contrast to current *FDA* regulations.

The report was generated by an international group, called the *European Union–United States Biotechnology Consultative Forum*, and was described by its co-chairman as "an honest effort to move past the people saying, 'You just don't understand,' and the other side screaming 'Frankenstein.'" The report was cited as coming at a time when Americans have been confronted with the StarLink GE corn in their supermarkets, which led to massive recalls and concern that food from the US was "not meeting guarantees of safety", said a senior scientist from the *Environmental Defense Fund*, who is a member of the committee.

The committee apparently represented everyone from those who are who opposed to agricultural biotechnology to those who think it will make feeding the world easier. The consensus was that stricter regulations would increase public confidence, and they recommended mandatory notification to regulatory authorities, as well as pre-market testing and approval, both of which aren't required by current *FDA* regulations.

"In order not to kill this technology we must gain consumer acceptance and we must aim for the common ground", said the co-chairman, Dr Garza, and giving consumers "an informed choice" is the motivation behind mandatory labeling. The underlying economic message is this:

> *The report implies that future U.S.-E.U. trade in genetically modified products will, in part, depend on the U.S. strengthening its regulatory system – a message that the Bush administration may find hard to ignore.*
> (www.sustain.org/biotech/News/news.cfm?News_ID=2653)

Current Lawsuits

In a "David and Goliath battle" being fought in on the Great Plains of Canada, a farmer named Percy Schmeiser has taken the GM seed company Monsanto to the country's Supreme Court (*Wired News*, 20 June 2000: Farmer's Plight Shows GM Trouble: 1). Monsanto accused the farmer of stealing its rape oil super-seeds, and Schmeiser is counter-suing the company for $6,5 million for polluting his GM free farmland without his knowledge.

> *The outcome of the landmark Schmeiser v. Monsanto case could influence how much control biotechnology companies like Monsanto and Advanta – the Canadian company which this year inadvertently distributed genetically contaminated rapeseed oil in Europe – have over the world's food supply in this century* (*Wired News*: Farmer's Plight Shows GM Trouble: 2).

Schmeiser, who has grown rapeseed oil (commonly known as canola) for 40 years, found that when he applied the powerful Monsanto weed killer, Roundup, some of

his rapeseed plants did not die. He had DNA testing done, and these plants tested positive for a gene Monsanto had engineered into rapeseed oil to produce a variety able to withstand their Roundup weed killer, aptly named *Roundup Ready canola*. It had been marketed with the slogan, "cleaner fields, higher yields", and guaranteed higher profit margins because their was no need for expensive herbicides.

This lawsuit is tied into one of the biggest controversies surrounding biotech companies, specifically Monsanto. Since the new gene has been patented, farmers who purchase the seed have to sign a "technology-use" agreement, which effectively prevents them from saving or replanting the seed, or selling it to others. In addition to having to buy new seed every year, they must destroy any leftover seeds and let Monsanto inspect their fields. Craig Evans, Monsanto's biotechnology manager, said the company has the legal right to enforce its patent.

> *The gene still belongs to Monsanto, and you need the technology agreement to use the gene, so we are effectively 'leasing' the seed to farmers. If we can't protect intellectual property, why would we make those investments?* (*Wired News*: Farmer's Plight Shows GM Trouble: 4).

The research done on this product, which took Monsanto 10 years to develop, is estimated to be a huge 250 million pounds, an investment requiring an equally massive recovery. This economic necessity could be seen to refute the philanthropic statements of solving world hunger.

Schmeiser's case epitomises the concerns being expressed with more frequency and intensity in countries all over the world. His claim against Monsanto is for crop contamination, and the question is raised about cross-pollination from fields within range where GM seeds are used. An estimated 75 percent of rapeseed oil on the prairies is grown from GM seed, and 20 000 farmers in Canada use GM seeds. His challenge to Monsanto has resulted in a gauntlet of sorts, and Monsanto reacted by initiating legal proceedings claiming he "stole" their seeds and infringed their patent. Monsanto has in turn demanded compensation to the entire value of his crop for the previous year, plus punitive damages, court costs, and his signature on a non-disclosure agreement requiring him to remain silent about the affair. The case is a critical one for Monsanto, because the protection of its patent rights is at stake (Wired News: 6).

In another lawsuit currently underway in the United States, the *FDA* is being sued for "failing to listen to its own scientists". Additionally, 44 000 pages of evidence have been introduced, claiming that they "blithely cleared foods for public release, and promoted the biotechnology agenda" (Dr Vandana Shiva: *The Tim Modise Radio Show* on *SAfm*, 2 August 2000).

This seems commensurate with the inclination to get involved in lengthy and costly litigation in the United States, as a means of conflict resolution. What the implications may be, with regards to the matter being tied up in court indefinitely, as the gathering of evidence seems to be problematic in itself, are uncertain. There is the possibility that this kind of action can effectively hold up progression and conclusion as to the questions of safety and potential contamination, as the outcome of the case is claimed to be one of such great potential significance.

"Go Organic" Grows

> *Organic farmers are artists and poets. They have a certain relationship with their land. I have farmers in India saying that we have placental connections with the earth. They have a love affair with their land. Peruvian farmers adopt plants into their gardens as family members.*

These are the sentiments of Dr Mae-Wan Ho, author of the book: *Genetic Engineering – Dream or Nightmare*, and university biology lecturer (*The Rise and Fall of GM,* 20 March 2000: 14).
This ties into some of the stronger arguments for organic farming, whereby it is an extension of man's harmonious relationship with nature, and his dependency on it as a source of food, water and life. Aldo Leopold wrote:

> *There is value in any experience that reminds us of our dependency on the soil-plant-animal-man-food chain, and of the fundamental organization of the biota. Civilization has so cluttered this elemental man-earth relation with gadgets and middlemen that awareness of it is growing dim. We fancy that industry supports us, forgetting what supports industry. Time was when education moved toward soil, not away from it* (1949: 178).

On the SAfm radio broadcast, "Pursuit of Health" (13 November 2000), a *BBC* correspondent said that organic awareness had grown to the extent that it represented an industry valued at 13 million pounds yearly. South Africa is proving responsive to personal initiative in the organic industry, and growing consumer command here and abroad. On 16 December 2000, the wine estate and conference centre, *Spier, introduced NOW (Natural and Organic Warehouse).*

According to the local Stellenbosch newspaper, *Eikestadnuus* (15 December 2000: 5), the warehouse has been established to "present consumers with a significant alternative to mass produced products which take little or no account of the health and wellbeing of consumers". They emphasised the need to communicate the "advantages of unpolluted foods and natural materials and raise awareness of ecological issues ... and sustainability".

Chris Laubser, an organic farmer and one of the initiators of *NOW*, said that "67 percent of British consumers are buying organic" and even though *Sainsbury's* (the major food market) had 310 different lines of organic produce, the "demand far exceeds supply". (Interview on *SAfm's Health News*, 14 December 2000).

The *Sunday Independent* (8 October 2000: 8) highlights, in "Intensive organic farming drive offers rich urban pickings", a project by *Feed the People* (a Durban-based organic farming project) to assist emergent farmers in a collective training scheme in organic agriculture. The CEO, Les Hutton, said:

> *We in South Africa are uniquely positioned to take advantage of the soaring world demand for organic produce ... the UK market grew 40 percent last year, and 70 percent of this volume needs to be imported ... the European and US market projections are equally astonishing: $58 billion and $100 billion respectively in the near future.*

A centrepiece of the project is *Feed the People*'s patented "vertical growing" organic technique and irrigation technology. It is designed to be "up to 16 times more prolific than open-field farming, and is thus ideal for urban farming". The implication is an alternative to the use of GM techniques to enable higher yields. The project is affiliated with the *Organic Agricultural Association of South Africa*.

Making an argument *against* organic farming, Luis Herrera-Estrella (the Mexican scientist introduced in Chapter 1, who played a pivotal role in the first GM studies), says the following of the promotion of organic farming in Third world countries:

> *Organic farming is a very old story. And many of the poor farmers practice organic farming not because they want, but because they have no option. But organic farming leads to very low productivity. And that implies that many children in the world cannot go to school because they have to stay on the farm and help their parents, because they have to go and pick weeds by hand, they have to eliminate insects by hand. So that's a major problem* (Rise and Fall of GM: *BBC* Transcript: 19).

He believes that there is a danger that middle class people in the affluent world are romanticising backward farming techniques and primitive ways of life in poor countries. He sees hypocrisy in wanting see people "living like 200 years ago, while they back at home have the luxury of all the technology, they have all the food" (Rise and Fall of GM: 21).

Mention is also made of the possibility of bacterial contamination of crops when using organic techniques, specifically E.coli, because of the practice of taking untreated manure and compost and spreading it around the crops.

It seems hard to refute the good sense behind organic farming. It seems to work in harmony with nature, with cycles of the land and seasons, and applies the principle of reusing, reducing and recycling. Arguments are offered by proponents that where it may be more labour-intensive, this in turn provides jobs in economies under strain with unemployment, while saving the costs of herbicides and pesticides.

The public seems to be growing weary of exposes after the fact, where they are confronted with irrefutable evidence that some scientifically acclaimed procedure or product has gone horribly wrong. Organic agriculture has, in its favour, the sense of security of utilising generations of knowledge, or non-invasive techniques, and there can really be no association of potential catastrophic damage should anything go wrong.

The Power of the Consumer

Woolworths notified the South African public in January 2000 that they would endeavour to have no GMO products on their shelves within three years, and if they could not succeed in this goal, they would be clearly marked as containing GMOs. *Pick 'n Pay* responded by calling this statement "irresponsible", and in turn released

a series of three leaflets with information pertaining to GMOs and their policy regarding them. In these they supply, in question/answer format, information provided by the *Food Advisory Consumer Service* (FACS). *Pick 'n Pay* does offer certain products labeled "organic" and "non-GMO", and acknowledges that "imported processed foods from the USA, Argentina and China may contain GM tomato, maize and soya ingredients" (*Healthy Eating Guide*: What is Genetic Modification? April 2000).

It is impossible to fully surmise the origin of these steps - whether the philosophy of the companies reflected the need to incorporate these changes and adaptations, or if it was simply a response to consumer demand. Regardless, the implication is, that along with the burgeoning awareness of GM foods and the accompanying reaction of either acceptance or rejection, of the impact felt on company policy.

The power of the consumer is legendary. In the online magazine, *Successful Farming*, Mike Holmberg writes that the GMO controversy is gaining strength, not dying out. He speaks of the "uncertainty about seed purchasing decisions", and the fact that fundamental changes were going to made in the way crops were marketed. He cites examples of anti-GMO feelings everywhere, and that "they may not be basing their decisions on sound science, but they don't have to". He says, with impeccable accuracy:

> *In the world of marketing to consumers, perception becomes reality.*

The problem is, he claims, that perception appears to be a moving target, and this holds some substantial implications for the farmers. In the past they did not worry about having a market for what they produced, even if the price was low. Now the concern arose about whether there would be a market for GMO crops.

> *The controversy is changing production decisions from agronomic issues (such as yield, herbicide choices and disease resistance) to marketing issues (What will I be able to sell?). That my be an uncomfortable transition, but you need to start thinking about what your customers want to buy rather than what you want to grow.* (*Successful Farming*, January 2000: 1)

In the June 15th edition of the same magazine, Holmberg again addressed the question of marketability, and inserting here that GM cotton had not produced any caution flags, because the "anti-GMO zealots haven't raised questions about GMO cotton – so far" (www.findarticles.com/m1204/1_98/59329570/p1/article.jhtml).

Offering somewhat of a contradiction to the above "perception becomes reality", the Canadian newspaper, *The Ottawa Citizen,* published a report about skepticism regarding biotechnology. Although the article (3 January 2001) indicated deep public suspicion towards GE food and pesticides from GE bacteria, and a complete aversion to the cloning of animals, the following observation was revealing:

> *When it comes to making decisions about the management and control of biotechnology products, a majority of Canadians see scientific evidence as more crucial than people's concerns and perceptions* (*GE & IPR News: The Ottawa Citizen*; 2 January 2001: www.sustain.org/biotech/News/news.cfm?News_ID=2652).

It remains irrefutable, however, that (as stated in *Newsweek's:* The Big Food Fight) "the customer is, indeed, always right" (13 September 1999: 9). Referring to the decision by ADM (agribusiness giant *Archer Daniels Midland* – known as "supermarket to the world") to get its suppliers to start segregating GM and non-GM crops:

> *ADM had noticed something new sprouting under the bright, warm sun of economic interdependence: a strange hybrid of cultural and economic fears. So it decided to act before the problem got any bigger* (Newsweek: 9).

So, the large and very successful companies are acting with prudence, choosing not to rely on the biotech stance that the consumer is uninformed and hysterical, but instead capitalising on the public mood and offering exactly what is wanted. Even if it is interpreted as a placatory gesture, the ripple effect is enormous, as precedents are set and smoke signals sent, and those who choose to disregard the mood may end up getting a financial lynching.

CHAPTER 8:

ETHICS AND TRUST – ARGUMENTS AND ADVERSARIES

The Right to Know

"The public's right to know" made an appearance in 1945 as a phrase. Meiklejohn said, (in *From Milton to McLuhan*: 253); "It is not that everyone shall speak, but that everything worth saying shall be said." The addendum is added, though, and pertinently so to the GM issue; "Still, not everything can be known and the great unanswered question, in any philosophical discussion that claims a public right to know, is this: the right to know *what*?"

> *Perhaps this is an obvious point, but the democratic postulate is that the media are independent and committed to discovering and reporting the truth, and that they do not merely reflect the world as powerful groups wish it to be perceived. Leaders of the media claim that their news choices rest on unbiased professional and objective criteria, and they have support for this contention in the intellectual community. If, however, the powerful are able to fix the premises of discourse, to decide what the general populace is allowed to see, hear, and think about, and the "manage" public opinion by regular propaganda campaigns, the standard view of how the system works is at serious odds with reality* (Noam Chomsky, *Manufacturing Consent*, Preface, Pg xi : ZNET: Quotes www.zmag.org.quotes – media).

Rebecca Goldburg, a senior scientist at the *Environmental Defense Fund*, an advocacy group in New York, points out that because transgenic crops are largely unlabeled and mixed in with the rest of the harvest, "the industry is depriving us of

one of our most important natural defense mechanisms: reading ingredients" (*New Scientist*, 31 October 1988: 45).

There is a sense of outrage at the implied condescension of not imparting full disclosure to the public, with information surfacing like flotsam and jetsam only after something serious has gone wrong.

When people start dying, and the cause can be traced to what they ate, the public collectively sits up and starts paying attention. The ongoing issue of BSE, or "Mad Cow Disease", which has now spread to Germany and much of Europe, also stimulated much heated debate about the ethics of what is being done to animals and the environment. Feeding animal protein to herbivores to add bulk essentially converted them (as unchallenging participants) to (sometime cannibalistic) carnivores – notwithstanding the health implications for humans – is now been viewed as being an inherently unethical practice.

Also citing an immoral trend, Christian callers reacting to the Tim Modise radio program covering GMOs (4 August 2000), said that churches needed to become involved in the public debate on this issue. "Life is either a corporate commodity or God's creation", said one caller, "and choices about halaal, vegetarian or what genes may have been added to our food are being denied to us".

Prince Charles drew a certain amount of ire in when he went public with his anti-GM views, but he also generated a great deal of speculation and dialogue. In *New Scientist*'s "The green man" (27 May 2000), it is said somewhat disparagingly that "invoking God and nature won't solve our problems with biotechnology". Many people responded to his views, though, standing in agreement that we should not be treating our entire world as some "great laboratory of life".

His belief that humans have a duty to God to be stewards of the earth brings to mind the scripture:

> *Hurt not the earth, neither the sea, nor the trees* (Bible, Revelations 7:3).

New Scientist, however, refer to his reasons for rejecting genetic manipulation as smacking "of New Age mysticism".

Taking another esoteric example of how some view the intrusive nature of man's relationship with nature, an excerpt from Benjamin Hoff's *The Tao of Pooh* seems appropriate:

> *The urge to grow and develop, present in all forms of life, becomes perverted in the Bisy Backson's mind into a constant struggle to change everything (the Bigoted Backson) and everyone (the Busy Backson) else but himself, and interfere with things he has no business interfering with, including practically every form of life on earth.*

Prince Charles is, however, not lacking in support or like-mindedness. Aldo Leopold wrote: "Individual thinkers since the days of Ezekiel and Isaiah have asserted that the despoliation of land is not only inexpedient but wrong" (*A Sand County Almanac*; The Ethical Sequence: 1945: 203).

Regarding the issue of vegetarians who oppose GM foods on the grounds that they contain animal genes, however, GM-pioneer Luis Herrera-Estrella presented the following contending viewpoint:

> *... some people say that it's not acceptable to have animal genes in plants ... for instance people who are vegetarian and don't want to eat animal products. So this plant now contains animal genes, they feel offended. But they should know that about 60% of the plant genes have very similar copies in animals. So having one more gene which shares something directly with an animal gene won't actually change anything. If people don't want to change anything which resembles animals they won't find anything to eat, because even bacteria shares a lot of genetic information with animals* (*BBC* transcript: Rise and Fall of GM: 11).

In an article called "Raging Hormones", excerpted from the New York publication, *A Real Life* (Spring 1999: 8), the question of the ethics is raised regarding the study that preceded recombinant bovine growth hormone (rBGH) being approved. Identifying a link between Monsanto and the FDA, who assured consumers that milk would be safe with this hormone, the following was stated:

> *Funny thing, though – the FDA's opinion is primarily based on results of a 90-day rat study that tested the safety of rBGH, a genetically-engineered hormone that increases milk production. I'm shocked that approval was granted on the strength of one short study. And I was bowled over, to say the least, to discover that the study was commissioned by Monsanto, the manufacturer of the hormone.*

Subsequently many issues were raised with regards to this practice, where questions were asked about endocrine changes in those who consumed these products, and the potential link to breast cancer. "According to the *New York Times*, 21 dairy-farmer associations and consumer groups are planning to file suit against the *FDA* for failing to require additional safety studies of the hormone" (*A Real Life*: 8).

In a *New Scientist* editorial (18 March 2000: 3), "Don't keep secrets – there's no alternative to being open with the public", the issue of consumer confidence and the "growing mistrust between scientists and the public" was raised, much of it being blamed on government secrecy.

> *Growing unease about the speed of advance, particularly in biotechnology ... reached a boiling point ... in the public's outright rejection of genetically modified foods. The House of Lords Select Committee on Science and Technology called for government and scientists to learn from the public.*

Questioned as to whether the public could be any good at judging these issues, the House of Lords said a resounding "yes", and that given the full story, people use their common sense to make sophisticated judgements about science.

New Scientist included a survey on trusting sources of information - the conclusions of which showed (in descending order!) doctors, teachers, professors, TV newsreaders, scientists, government ministers and journalists. The Lords recommended "absolute frankness" with the public regarding all scientific information in order to reestablish trust (Editorial: 3).

Conclusively, the public has a right to know. Having to resort to fighting for this right seems like having to regain ground already won. Yet as the scientific community forges ahead with technology increasingly incoherent to the general public, there is an accompanying attitude of protecting the privacy of information. The spin-off is a decline in trust, and as has been dealt with, the ramifications of this can spell disaster in public relations, stocks, shares, sales and policies. The genesis of genetic modification may contain, written up in its own DNA, the makings of its own demise.

There is a need for the vigorous pursuit of the "right to know". It is a fundamental democratic right. Whether or not genetic modification can ride out the storm it is currently at the centre of, remains to be seen. There is the question of feasibility, and where the call to ban GM foods is unrealistic and idealistic, demands for disclosure and public information are consistent with democratic principles.

The need to know

> *Public interest in news about science is not simply an idle fascination with the wonders of science ... science news provides basic, functional information necessary for living in the modern world. Nor is interest in science news confined to science buffs or an intellectual elite. Science news of greatest interest and value to the public are about developments in the are of personal health ... and news about the environment.*

This was the conclusion presented by *SIPIscope*, published by the *Scientists' Institute for Public Information* (Volume 20, Number 2, Spring 1993). They commissioned pollster Lou Harris to conduct a study revolving around the question: *Science News: What Does the Public Want?*

Discrediting the public's right to know, based its' emotive response to GM technology, is no argument. That concern manifests with a visceral and moral content does not refute its inherent right to exist and to question. Einstein made the crucial point:

> *It is of great importance that the general public be given the opportunity to experience, consciously and intelligently, the efforts and results of scientific research. It is not sufficient that each result be taken up, elaborated, and applied by few specialists in the field. Restricting the body of knowledge to a small group deadens the philosophical spirit of a people and leads to spiritual poverty.*

He added, in a commentary that can be applied very well to one of the practical and logical questions being posed towards the technology leaders:

> *Private capitalists inevitably control, directly or indirectly, the main sources of information. It is thus extremely difficult, and indeed in most cases quite impossible, for the individual citizen to come to objective conclusions and to make intelligent use of his political rights* (from *Monthly Review,* excerpted from *ZNET Quotes* www.monthlyreview.org).

So, there is a distinction between the "right to know" and the "need to know". As Einstein says, there is the by-product of a spiritual poverty in being deprived of the

"body of knowledge", and a sense of disenfranchisement. The public may be seen as having inadequate scientific comprehension, and for that reason sharing or revealing information regarded as redundant and even politically imprudent. However, aside from very practical considerations such as people who may suffer from certain allergies, where labeling may prove to be a lifesaver, there is an ethical consideration at the heart of the issue.

Science and Anti-Science

The British magazine *Prospect* ran a feature called "Against anti-science" in the December 1999 issue, written by Dick Taverne, the Liberal Democrat spokesman on the Treasury in the House of Lords, and described as having a long-standing interest in promoting the public understanding of science.

> *Encouraged by hysterical newspapers and irresponsible lobby groups, the public is turning against science. This is most evident in the GM food debate. I regard the public's growing distrust of scientists and its indifference to scientific evidence, especially in the debate about GM plants, as a trend with dangerous consequences* (www.prospect-magazine.co.uk/highlights/against_anti_science).

He makes the point that GM foods "act as a kind of lightening rod for the public malaise with science", and referred to disasters like thalidomide and BSE contributing to opinion that scientists are little more trustworthy than politicians.

He lashed out at *Greenpeace* who, as he claimed, "regard GM crops as so immoral or dangerous that they break the law, invade fields and destroy farmers' property". He also took a shot at Prince Charles, known for his anti-GM position, saying that he "prefers mysticism than science", with his stance that scientists are playing God and acting "against nature" (1).

Making the point that animals and plants have many genes in common, he used the rather startling example that human beings share 50 percent of their genes with bananas, which by implication refuted the "breaching the species barrier" argument.

> *...consider that between 1986 and 1997 about 25,000 transgenic crop field trials were conducted on more than 60 crops in 45 different countries involving ten different traits. No adverse effects on food safety of the environment have been found* (2).

Taverne cautioned a "surrender to alarmism", acknowledging that while "no one argues that no possible harm to the environment can result from GM crops", the "scope of these future benefits is almost unlimited". He lists the following purported benefits, in an attempt to introduce a better perspective:

a) *substantially increased yields*
b) *pest and disease resistance*
c) *quicker maturity*
d) *resistance to drought, heat or cold*
e) *controlling salt tolerance, so that crops can be grown in arid regions*

f) *fixing nitrogen in the roots of wheat, eliminating need for fertilizer*
g) *less need for chemicals meaning less pollution in ground water*
h) *GM crops contributing towards the campaign against disease and hunger, like the engineering of vitamin A and iron into rice plants*
i) *production of vaccines and pollution control measures within the plants*

He addresses the reasoning that distribution, not supply, is the problem in the feeding of the world's hungry millions. Countering that surplus American and European food is not the answer, he believes more efficient local agriculture is. Quoting Florence Wambugu from her "eloquent plea for GM crops in Africa" in the July 1999 issue of *Nature*, Taverne illustrates some of the realities facing African agriculture. The maize streak virus, which can cause total loss of the crop, was one of the targets of the new technology, Wambugu said, and because it was packaged into the seed, it ensured "benefits without changing local cultural practices" (5).

Taverne makes an important distinction in defending GM crops, where it appears that the technology is been attacked as a function of mistrust towards the intentions and ethics of the biotechnology companies. "A more substantial objection is that the present emphasis of GM research is not on developing new crops needed by the developing world, but on more profitable products for the developed world" (6).

Comparing the locations of the existing field trials (90 percent of which are in developed countries) to the development of new drugs, he finds a correlation between the profits implied and the focus of the research – that, he says, is not an argument against GM crops, but against their current application.

> *Public opinion can hardly be the arbiter of scientific truth*, he says. *In the case of scientific judgements there is a special problem – a conflict of cultures. It is not only that scientists are concerned with the pursuit of truth whereas the newspapers are primarily concerned with increasing circulation; but also that the press deals in absolutes. It needs clarity, not qualifications. In the biological sciences there are seldom, if ever, any absolutes. They cannot say food is absolutely "safe" and that there is absolutely "no risk". They are concerned that what they say is accurate, which means that statements must be qualified, not dogmatic. Often the qualification is the only thing reported. The possibility of risk is a more exciting headline than the probability of safety* (6).

Concluding that in its anti-science dogmatism, "Greenpeace is becoming the British equivalent of the religious right in the US", Laverne challenged the movement to re-evaluate its moral arguments. Throwing a gauntlet, he deems that any "rational person who cares about our environment and about feeding the world's hungry should *passionately* support the cause of GM crops".

Greenpeace: Science or anti-science?

Prospect ran "Who is anti-science?" in the May, 2000 issue, giving Greenpeace an opportunity to react to what they called "Taverne's forceful polemic" against the organisation. Stephen Tindale, the chief policy advisor at Greenpeace UK, neatly turns some of Taverne's accusations around. His comment that Greenpeace

represented the "equivalent of the religious right", whereby fundamentalism and environmentalism share an "anti-science dogma", shows that any alternative to science is "portrayed as superstition or paganism" and outright heretical. (www.prospect-magazine.co.uk/highlights/who_antiscience/index.html)

Tindale takes the anti-science label head-on.

> *Greenpeace has never based its campaigns solely on science. Cartesian science strips everything down to cold logic: there is no room for ethics or emotion. We believe, in contrast, that there is a moral basis for our defense of the natural world. Moreover, science has a record of overconfidence in the ability of the environment to withstand our assaults ... Scientific claims should be assessed rationally, not treated as beyond criticism* (1).

Tindale stresses that Greenpeace supports the important role science has to play in developing more sustainable agriculture, but calls GM agriculture a "misuse of science because it entails the release of unstable and potentially harmful life forms into the environment; once released, they cannot be recalled".

He also finds a double standard in Taverne's acceptance that some practices are objectionable on moral grounds; that turning cows into carnivores is unnatural, but putting fish genes into strawberries is not – Taverne had said that because animals and plants have many genes in common, objections to the latter were based on "ignorance". As Tindale poses: "If this is the only relevant question, why then does he object to feeding animal matter to cows?"

Tindale also addresses the claim of counteracting malnutrition with the "much-publicised vitamin A rice", and the impression that this technology is being held back by "selfish western environmentalists". He says that this rice does not, in reality, exist outside the laboratory, and has yet to subjected to independent health testing. He quotes the *World Health Organisation*: "health side effects are unknown: health tests have to be conducted". This, he said, could take several years, and that effective solutions to vitamin A deficiency are already available.

Again quoting *WHO*, he offers that it is possible to eradicate this deficiency through improved health education and hygiene practices.

> *WHO and Unicef have initiatives in place in 70 countries around the world, and the World Bank considers investment in these programmes among the most cost-effective forms of improving health. So GM rice could be an expensive distraction from the unglamorous task of tackling malnutrition through small-scale change. By the time GM rice is developed and tested, vitamin A deficiency could and should have been eradicated. If it has not, this will be as a result of the absence of political will, not technology* (2).

Reflecting the same sentiment, *New Scientist* writes "of course, while the modified rice may soon be available, the political will to implement the alternatives is currently lacking ("Deep Impact": 6 February 2000).

Tindale declares the need for "NGOs to raise awkward questions", and says prophetically (which could just get the "religious" accusations flowing again!):

> *Intellectual trends come and go. It won't be too long before politics and governments fall back into disrepute, and NGOs are again regarded as the standard bearers of the liberal conscience. In the meantime, Greenpeace can expect more than its share of criticism. We won't keep our heads down* (*Prospect:* 3).

These acrimonious positions do little to offer solace to those wanting resolution of the issue, as they indicate such irreconcilable and polar views.

Fragile ecosystems

In a study published at Cornell University in the United States in 1999, the potential threat of GE towards Monarch butterflies, which were killed or developed abnormally when eating milkweed dusted with the pollen of Bt-corn, a GEF, was brought to the worlds attention (*NERAGE*: Northeast Resistance Against Genetic Engineering, www.bckweb.com/nerage). This caused a public outcry, not only because of the extrapolation of the potential dangers humans could face when ingesting GE foods, but from the naturalist point of view, where losses of this sort could not be rationalised away.

The human body is also a complex ecosystem, and increasingly there are reports implying connections between problems with reproductive health and genetic engineering of crops. The problems encountered with endocrine disrupters, declining sperm counts, boys growing breasts, and girls starting to menstruate earlier, are all associated with first world countries, where technology is much more pervasive and invasive in ecosystems.

Aldo Leopold wrote:

> *The most important characteristic of an organism is that capacity for internal self-renewal known as health. There are two organisms whose processes of self-renewal have been subjected to human interference and control. One of these is man himself (medicine and public health). The other is land (agriculture and conservation)* (1949: 185).

The vulnerability of biodiversity has received unprecedented exposure through all the media genres during the past decade, and is highlighted poignantly in the special issue of *National Geographic*: Biodiversity – The Fragile Web (Millennium Supplement: February 1999). Edward O. Wilson, the Harvard biologist who is credited with popularizing the term "biodiversity", reinforces the connection so many people have with the creation around them. "They're biophiles: lovers of nature. I don't think that's an exceptional trait; I think humanity is biophilic" (1999: 28).

The inability to confine GM crops once they have been planted, should they prove to have inherent flaws, is the dilemma no one can provide a satisfactory answer for. Certainly, calculated risk is what science advancement has always encapsulated, but our understanding of the intricacies of ecosystems seems to be intrinsically limited. In an excerpt from his essay The Land Pyramid, Aldo Leopold states simply:

> *This thumbnail sketch of land as an energy circuit conveys three basic ideas:*
>
> *(1) That land is not merely soil.*
> *(2) That the native plants and animals kept the energy circuit open; others may or may not.*
> *(3) That man-made changes are of a different order than evolutionary changes, and have effects more comprehensive than is intended or foreseen.* (*A Sand County Almanac*, 1949: 218)

The *Mail & Guardian* ran an article called "'Green Gold' of the biotech century" on 24 November 2000. In it, Jeremy Rifkin uses the argument that when the chemical elements were first discovered in the periodic table, they were not considered "patentable as they were discoveries of nature, despite the fact that some degree of human ingenuity went into isolating and classifying them". He speaks of the "strained prevailing logic" whereby the US patent office allows that the "isolation and classification of a gene's properties and purposes is sufficient to claim it as an invention".

> *The way we eat, the way we have babies, the way we raise and educate children, the way we work, even the way we perceive the world around us and our place in it – all our individual and shared realities will be touched by the biotech revolution* (Jeremy Rifkin, in *Mail & Guardian*, November 24 2000: 36).

CHAPTER 9:

CONCLUSION

The mainstream media seems to show a consistent inclination towards questioning not only the ethics of biotechnology, but also safety for humans and countless other members of the food chain. Isn't this evidence that it is not limited to subversive and alternative press releases to alert consumers and the general public to the problems inherent? Either the media is fulfilling its role as watchdog and whistle blower, or it is paying lip service to the concerns expressed by readers.

Epstein (in *From Milton to McLuhan*, 1990: 20) says:

> *The problem of journalism ... proceeds from a simple but inescapable bind: journalists are rarely, if ever, in a position to establish the truth about an issue for themselves, and they are therefore almost entirely dependent on self-interested sources for the version of reality that they report.*

John Merrill saw journalists as paradoxes;

> *... accepting criticism badly, and talking of objectivity while reflecting the world through a prism, talking of news without really knowing what it is, and seeing themselves as adversaries of government without knowing just why they should be* (*From Milton to McLuhan*: 20).

GMOs will remain a hotbed of contending views, that much is certain. The argument of morality is one that is intrinsically linked to the contention of GM:

> *On the distortion and trivialisation of natural history, we now regard it as "a pseudoscience, like astrology, an assemblage of odd or amusing or romantic facts about life in exotic or romantic places ... it carries ... a certain anthropomorphic and xenophobic contentment with our own lofty superiority... Where do we fit in? What are our limits? Our responsibilities? Our debts to the rest of life? These are the real questions of natural history. They are, ultimately, questions of morality* (Paul Gruchow, *The Necessity of Empty Places*, 1981: 216).

Those who contest it on the grounds of morality struggle to provide the kind of arguments that the scientific community can accept, because the basis of their argument comes from the soul. "Why then does science stand so firmly as the skeptical gatekeeper who would deny us validation of our souls?" asks Deepak Chopra (*London Sunday Times*: Printed with permission in the *Sunday Independent,* 10 September 2000: 13). In "Genetics will uncover the soul", he postulates:

> *Will genetics grow by collapsing upon itself? It has erected its edifice of material knowledge, yet in one window there is a hole. Wind shrieks through that hole, anxiety pours out of it.*

Journalists and science writers are faced with somewhat of a daunting task, as the subject of GMOs is so vast and the pace of the technology so swift. Editorial constraints abound: time; space; policy; public inclination; personal motivation – there are many potential pitfalls to offering unbiased and objective reporting. Milton, quoted in *From Milton to McLuhan* (40) asserted:

> *What has come down to us as one of the most enduring elements in the belief system of journalists is that only by reading all sides of issues can the human being approach not only understanding but also decency and goodness* – "human virtue", as he called it.

The "self-righting principle" is a phrase created as symbolic expression of his argument that whenever truth and falsehood (or error) come to grips with each other, in what is described as "the marketplace of ideas" nowadays, that truth will always emerge triumphant. Thomas Jefferson, who believed in the Miltonian self-righting principle, qualified:

> *The truth is great and will prevail if left to herself ... she is the proper and sufficient antagonist to error, and has nothing to fear from the conflict, unless by human interposition disarmed of her natural weapons, free argument and debate, errors ceasing to be dangerous when it is permitted freely to contradict them* (*From Milton to McLuhan:* 118).

The truth about the ramifications of genetically modified organisms can only emerge fully with time - whether it will prove its claims of salvation for the world's hungry and sick, or sound the death knell for the earth's fragile ecosystems - biotechnology is here to stay. The Constitution of South Africa (Section 24) Bill of Rights proclaims: "Every person shall have the right to an environment that is not harmful to his or her health or well-being".

It is not unreasonable, therefore, to expect government to take steps to ensure this to the best of its ability. Bludgeoning an industry with legislation is not as effective as trying to engender cooperation and transparency. The use of NGOs to monitor progress, to sound alarms if necessary, and contribute to information, remains a vital part of the process.

The use of the Precautionary Principle seems to be an exercise in power and prudence, a system of checks and balances that the biotechnology industry would do well to regard. Dialogue is a function of democracy, and it engenders more information, and subsequent discernment. Instead of scrutinising the abstract, it would be more prudent to examine the particular. The expression, "understand truth by looking at the characteristics of its opposite", holds true. Bias and preconceived notions can only obscure the full picture, and as long as institutions can be upheld to provide objective and comprehensive information, there is nothing to fear "but fear itself".

The question as to whether the media has the power to derail genetic modification seems to be answered twofold. Firstly, the media has the potential for this power. The public seems to have responded to the warning signals as represented by a steady stream of articles and reports, and the general mood associated with the technology seems to be one of alertness and concern. The history of concealment and associated damage, to health and the environment, is in the collective unconscious, and by association GM appears to fall into the category of what is thought to be potentially dangerous, irrespective of the mantle of respectability.

Secondly, environmental awareness is an intrinsic part of the paradigm shift towards "holistic" health. The growth of the organic movement, as discussed, is a function of this shift, but only one of its representatives. Self-diagnosis, proactive lifestyles and health maintenance, alternative therapies, recycling, alternative power sources – there are numerous indications of a developing inclination towards healthier bodies, lifestyles and environments.

If GM is interpreted as a threat to this movement, it stands to be rejected and discarded. Therefore, the media can be seen as a reflection of this change, in tune to the general mood and growth of the public. The old saying: "Does art imitate life, or does life imitate art?" seems relevant, as the same could be asked of the media.

Does it represent the needs and desires and inclinations of the public, reflecting them? Or does it create the needs and desires and inclinations of the public, forging them? To try to answer would be an exercise in philosophy, and a fully objective conclusion would not be possible. Not to obfuscate the issue of the media and its role with regards to genetic modification, it remains a whimsical query.

The reality is, science and journalism are inextricably linked. The latent hostility and mistrust experienced between the two are at cross-purposes with the common denominator, the public. They are ultimately the provider of funds, the quality control, the recipient of technology, and in some cases, the victim of error. The onus is on the scientific community to provide unbiased data on genetic engineering, on the biotech companies to include a "triple bottom line" in their

corporate makeup, on the media to offer objective and accurate information, and on the public to be well-informed and make discerning and judicious conclusions.

All the adages can be applied, from "Don't throw out the baby with the bath water" to "Why shut the door once the horse has bolted"; from "He who hesitates is lost" to "Fools rush in where angels fear to tread". Scientific advances imply a price, and as any economist would advise, it is essential to have a clear understanding of the projected outcome before making the initial investment. With transparency and disclosure about GM, the public will be better equipped to deal with all the subsidiary questions, and the role of the media is tantamount to the guide book on how proceed from here.

The backlash of losing public trust is the potential for a complete rejection of the science. The media is the arbitrator in a many ways, providing interpretation with information, and holding the power to sway public opinion. The biotechnology industry is already facing the problem of regaining public confidence and the funding it ultimately provides, and having to resort to damage control after the fiasco of contaminated seed supplies and incriminating data about ecological damage.

If the industry continues to receive a barrage of negative publicity, it stands to succumb to the force of public rejection. By the same token, if it does not comply with the demand for disclosure and accountability, it will effectively be placing a noose around its own corporate neck. The media is responsible for the most basic of principles: fairness and accuracy. GM deserves a chance to prove itself, under controlled conditions. From the science-induced comfort zones that the saga is being watched, anything less would amount to sheer hypocrisy. Arrogance and complacency from the scientific echelons are no longer well tolerated, however. The public has become empowered through knowledge, much of it gleaned through the media. With the evolution of the genetic revolution, the media offers a system of checks and balances, the watchdog with the capacity to blow the whistle, who could perhaps end up shouting; "That's it! Everybody out of the (gene?) pool!"

RESOURCES FOR SOUTH AFRICAN SCIENCE WRITERS

There is no shortage of information available on GMOs, much of which can be obtained from Internet sites:

- OneWorld has a number of resources, with a guide on Biotechnology and Genetic Engineering, and extensive set of news articles, and a guide on Ethical Consumers.
- PSRAST, Physicians and Scientists for Responsible Application of Science and Technology, is a global scientific community that presents information and scientific articles about the potential dangers of GM.
- The Genetically Engineered Food section of the Globalissues.org web site discusses all these issues.
- The campaign web side from Consumer International has regular new updates and a page where you can submit your opinion to the Codex Alimentarius Commission, a UN agency that sets international food standards. You can also obtain a summary of poll results which shows how many people would like to see GE foods labeled.
- New Scientist magazine has a good and comprehensive section called A Genetically Modified World.
- Panos provides balanced and informative views on the GE issue.
- Genetix is a site with informative articles, scientific studies, essays, current campaigns etc to help people become more aware of GE foods.
- Go-Organic is part of the Envirolink Network and provides information on organic products.
- The Food and Drug Administration (FDA) in the United States has a section under biotechnology.
- Friends of the Earth also have a site on GE food, and numerous news articles can be found at the Pure Food Campaign web site.
- Cape Organic Growers Association (021) 864-1241
- Safe Food Coalition (011) 318-1399 /083-662-0411 – Andrew Taynton
- www.bigfoot.com/tildaorganicworld Sue @ (012) 650 0064 or www.wendsley.co.za
- Africa Biosymposium on GMO foods in August – organic
- Prof Bighton @ UCT GMO specialist (021) 4066530
- Spier Natural and Organic Warehouse Chris Laubser (021) 797-4680 or now@naturalorganic.co.za
- www.popularscience.com or www.wabcnews.com Science Category
- www.poynter.org
- www.newscientist.com
- www.healthnet.org.programs/promed/html
- South African Organic Agricultural Association (OAA) (012) 650-0064 Sue Jackson or Jurgen Dunkelberg
- Kommetjie Organic Seed Bank (021) 783-3433 Sylvia / Karen
- Biodynamic Association (011) 803-1688 (Box 115 Paulshof, 2056)
- SA Freeze Alliance Against GMOs (021)761-0549 safeage@mweb.co.za
- Feed the People (Durban-based organic farming project) (082)651-1111 or les@ftp.org.za

The GMO Crop (*mis*)Information Page

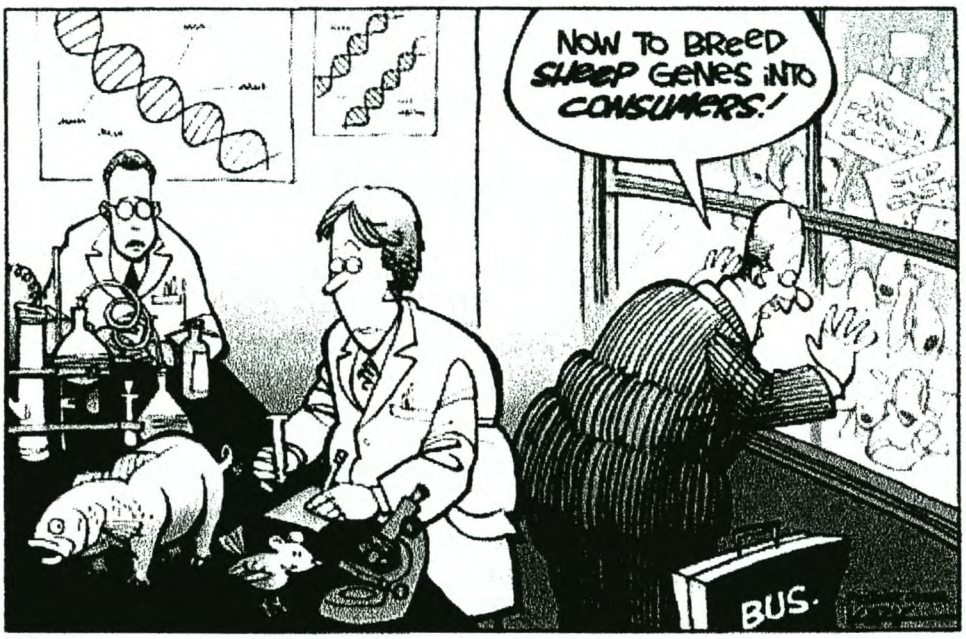
Assignment: Before the scheduled discussion, study a minimum of 5 links from each column.

Con

- **Against the Grain Biotechnology and the corporate takeover of your food**
- **Alliance for Bio-Integrity**
- **As You Sow**
- **BAN- Bioengineering Action Network of North America**
- **Campaign for Food Safety**
- **Campaign to label genetically engineered foods**
- **Center for Food Safety**
- **Consumers Union**
- **Council for Responsible Genetics**
- **Friends of the Earth**
- **Genetix from Enviroweb**
- **Genetic engineering and its dangers**
- **Greenpeace**
- **Greenpeace movie on GM soybean**
- **Hagelin 2000: Genetic Engineering Campaign**
- **Mothers and Others**
- **Mothers for Natural Law**
- **National Campaign for Sustainable Agriculture**
- **Natural Law Party**
- **One world**
- **Pesticide Action Network North America**
- **Rachel's Environment & Health News**
- **The Straight Goods Genetically modified spin**
- **Third World Network**
- **Turning Point Project**
- **Union of Concerned Scientists**

Pro or Neutral

- **Agricultural Biotechnology The story, as told by the USDA**
- **AgBioWorld A statement on GM crops made by several scientists**
- **Benefits and Risks of Roundup Ready Soybeans and Bt Field Corn by the National Center for Food and Agriculture Policy**
- **Better Foods**
- **Biotechnology, by the UN Food and Agriculture Organization**
- **Beyond Discovery - Designer Seeds**
- **BIO - Biotechnology Industry Organization: Food and Agriculture**
- **Biotechnology Global Issues, by the US State Department**
- **Biotechnology Knowledge Centre, from Monsanto**
- **CAST [Council for Agricultural Science and Technology]: Applications of Biotechnology to Crops: Benefits and Risks**
- **Center for Global Food Issues**
- **Council for Biotechnology Information**
- **Food for our future**
- **Information Systems for Biotechnology- The official list of engineered plants, regulations, etc.**
- **Living in a GM world, from *The New Scientist***
- **Presentations by Peggy Lemaux**
- **Transgenic Crops: An introduction and resource guide by Colorado State University**



by Kirk Anderson

THE GENETICALLY MODIFIED FOODS DEBATE IN SOUTH AFRICA

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22nd May 1999, February 2000

From the UCT Monday paper:

"These pumpkins have been crossed with a camel so I don't have to water them." (Fish genes in strawberries - news report).
Acknowledgements: Tony Grogan. Cape Times.

The debate has been heating up in South Africa during the past year. There have been numerous radio talk shows, TV programmes, newspaper articles, live debates, workshops, lectures etc. I was invited by the World Economic Forum to participate in a debate on the subject at their January meeting in Davos, Switzerland. At the end of the session 82% of the people present voted in favour of GM foods (see here).

I thought it might be helpful to spell out the South African situation and I will do so under the headings of FICTION and FACT.

REFERENCES

A Real Life (Spring 1999: no 17). Raging Hormones by Barbara McNally.

About AfricaBio (no date given): by Dr Jocelyn Webster (accessed on 8 January 2001) www.up.ac.za.academic/tab1/africabio/about.html

Abrams, M.H. (1981). *A glossary of literary terms*. New York: Holt, Rinehart and Winston.

Altschull, J. Herbert (1990). From Milton to Mcluhan – The ideas behind American Journalism. New York: Longman.

Ayre, R. (23 October 2000). *Consumer protection: Rebuilding consumer confidence in food in the wake of BSE and GM furores*. (From email to Beth le Roux IMCEACCMAIL-africain+40ai+2Eorg+2EZA+20at+20SMTP@nrf.ac.za – Richard Ayre is a Board Member of the *British Food Standards Agency*).

BioDemocracy and Organic Consumers Association: Dangers of Genetically Modified Food (12 April 2000): (accessed on 19 July 2000). www.purefood.org/ge

Blum, D. & Knudson, M. (1997). *A Field Guide for Science Writers*. New York: Oxford University Press.

Chomsky, N. *Manufacturing Consent*. Excerpted from *ZMAG* quotes (accessed on 25 July 2000). www.zmag.org/quotes/quotesResults.cfm?topic1-Media

Current Biology (11 March 1999 Volume 9, No. 5). Potato hash by Bernard Dixon (accessed on 8 January 2001). www.uct.ac.za/microbiology/dixon.htm

Daily Mail & Guardian: Results Page search for GMO (accessed on 8 January 2001). www.mg.co.za

Dawkins, R. (1986). *The Blind Watchmaker*. London: Penguin Books.

Eikestadnuus (15 December 2000). Exciting lifestyle alternative opens at Spier.

Environmental News Network (ENN) (13 October 2000). Analysis: Are GMO foods safe? by *United Press International* (accessed on 28 December 2000). www.enn.com/enn-subscriber-news-archive/2000

Equinox: Channel 4 Television (UK) (20 March 2000). The Rise and Fall of GM – Transcript: (accessed on 28 September 2000). www.agbioworld.org/articles/channel4.html

Farm Progress: GE & IPR News (2 January 2001). USDA Asks Seed Producers to Test for StarLink (accessed on 8 January 2001). www.sustain.org/biotech/News/news.cfm

FAIRLADY (5 January 2000). Genetically engineered food: What's the stew? By Hilary Bassett (30).

FEMINA (January 2000). Environment: (2) Biodiversity, (3) GM Foods and (5) Agribusiness (101).

Genetix Alert (8 April 2000). Resistance is Fertile (accessed on 19 July 2000). www.resistanceisfertlecom/action

GENTECH archive 8.96-97: Monsanto/Calgene News: RR Cotton Problems & Flavr Savr Tomato Dead (accessed on 27 December 2000). http://data.free.de/gen.free.de/gentech/1997/Jul-Aug

GENTECH archive 8.96-97: EU Gene Engineers Worry About Industry Image (accessed on 27 December 2000). http://data.free.de/gen.free.de/gentech/1997/Jul-Aug

Gruchow, P. (1981). *The Necessity of Empty Places*. New York: St. Martin's Press.

Health Canada Information (October 1999). The Safety of Genetically Modified Food Crops (accessed on 19 July 2000). www.hc-sc.gc.ca/english/archives

Hoff, B. (1971). *The Tao of Pooh*. New York: Penguin Books.

Hoogervorst, A. (1999). *Environment Diary 2000*. Durban: Enviroprint.

International Herald Tribune (10 November 2000). Monsanto Puts Itself Up for Sale.

International Herald Tribune (16 November 2000). Meanwhile, the Soybean Connection by Lester R. Brown.

International Herald Tribune (4 August 2000). Genetically Modified Trees: A Blessing or Danger for the World? by Rick Weiss.

ISIS (Institute of Science in Society) Paper (14 July 2000). The use and abuse of the precautionary principle – submission to US Advisory Committee on International Economic Policy (accessed on 19 July 2000). www.purefood.org/ge/precaution

Kucinich, D.J. (January 2000). Genetically Engineered Food (GEF) (accessed 19 July 2000). www.house.gov/kucinich/action/gef

LandbouBurger (19 May 2000). Honderd miljoen oorleef al GM voedsel.

Leopold, A. (1949). *A Sand County Almanac.* New York: Oxford University Press.

Mail & Guardian (3-9 March 2000). GMOs are not Frankenfoods – Letters to the editor.

Mail & Guardian (5-11 May 2000). Of mice and men by James Meek.

Mail & Guardian (10-16 November 2000). Bid to grow harmful GM crop in SA by Fiona Macleod.

Mail & Guardian (17-23 November 2000). Dangers in GM food – Letters to the editor.

Mail & Guardian (24-30 November 2000). The great gene race by James Meek.

Mail & Guardian (24-30 November 2000). Your life in their hands by Tim Radford.

Mail & Guardian (24-30 November 2000). 'Green Gold' of the biotech century by Jeremy Rifkin.

Mail & Guardian (1–7 December 2000). First World biogreed – Letters to the editor.

Mail & Guardian (22 December 2000 to 4 January 2001). And now for the forecast by Jonathan Margolis.

National Geographic Millennium Supplement (Volume 195, No. 2: February 1999). Biodiversity – The Fragile Web.

Nelkin, D. (1995). *Selling Science: How the Press Covers Science and Technology*. New York: W.H. Freeman and Company.

New Scientist (31 October 1998). Special Edition: Living in a GM world.

New Scientist: Genetically modified world – Latest Developments – 9 October 1999 to 9 September 2000 (accessed on 12 October 2000). www.newscientist.com/gm/gm/jsp

New Scientist (Editorial: 18 March 2000). Don't keep secrets – There's no alternative to being open with the public.

Newsweek (13 September 1999). The Big Food Fight by Kenneth Klee.

New York Times (3 January 2001 - Posted on GE & IPR News). Eating Well: Labeling Foods with Designer Genes by Marian Burros (accessed on 8 January 2001). www.sustain.org/biotech/News/news.cfm?News_ID=2653

Ottawa Citizen (2 January 2001 - Posted on GE & IPR News). 70% Oppose Cloning: Canadians Skeptical About Biotech by Chris Cobb (accessed on 8 January 2001). www.sustain.org/biotech/News/news.cfm?News_ID=2652

Pick 'n Pay (April 2000). Healthy Eating Guide – What is Genetic Modification?

Pick 'n Pay (April 2000). Healthy Eating Guide – Genetic Modification and Food Safety.

Pick 'n Pay (Volume 3). Healthy Eating Guide – Concerns about the Genetic Modification of Food, www.picknpay.co.za

Prospect (December 1999). Against anti-science by Dick Taverne (accessed on 28 December 2000). www.prospect-magazine.co.uk/highlights/against_anti_science

Prospect (May 2000). Who is anti-science? by Stephen Tindale (accessed on 28 December 2000). www.prospect-magazine.co.uk/highlights/who_antiscience/index

Scientific American (April 2000). Rules of the Game (Technology and Business Section) by Tim Beardsley.

SIPIscope (Published by the *Scientists' Institute for Public Information*), (Sprint 1993 volume 20, Number 2). Science News: What Does the Public Want? by Lou Harris.

Successful Farming (January 2000). The GMO controversy is gaining strength, not dying out by Mike Holmberg (accessed 28 December 2000). www.findarticles.com

Successful Farming (15 June 2000). Going slow with GMO by Mike Holmberg (accessed on 28 December 2000). www.findarticles.com

Sunday Independent (7 May 2000). US creates genetically modified menagerie by Mary Dejevsky.

Sunday Independent (from London Sunday Times) (10 September 2000). Genetics will uncover the soul by Deepak Chopra.

Sunday Independent (8 October 2000). We must have the independent facts on GMOs – Letters to the Editor (by Andrew Taynton: *Safe Food Coalition*).

Sunday Independent (8 October 2000). Intensive organic farming drive offers rich urban pickings by Stan Winer.

Sunday Independent (3 December 2000 – Reconstruct). 'Miracle maize' boosts food security in developing countries by Stan Winer.

Sustainable Development (22-23 September 2000). Biotechnology in the Global Economy, Kennedy School of Government at Harvard University (accessed on 28 December 2000). www.iisd.ca/sd/biotech/parallel.html

Taylor, C.W. & Barrow, F. (1966). *Scientific Creativity: It's recognition and development*. New York: John Wiley & Sons.

Thomson, J. (22 May 1999). The Genetically Modified Foods Debate in South Africa. (Head of the Microbiology Department, University of Cape Town) www.uct.ac.za/microbiology/gmos.htm

TIME (5 July 1999). Hard to Swallow by Rod Usher.

TIME (20 September 1999). Bad Seeds by Jeffrey Kluger.

TIME (8 November 1999, in Visions 21: health & environment). Will We Still Eat Meat? by Ed Ayres.

TIME Special Edition Earth Day 2000 (April/May 2000). How to Save the Earth?

TIME (29 May 2000, in Visions 21: our work, our world). What will be the 10 hottest jobs? by Julie Rawe.

TIME (3 July 2000, in Visions 21: our technology). Will Frankenfood Feed the World? by Bill Gates.

Wired News (3 August 2000). GM Food Fights at Full Boil (accessed on 12 October 2000). www.wired.com/news/print

Wired News (1 August 2000). GM Food Labeling Down Under (accessed on 12 October 2000). www.wired.com/news/technology

Wired News (20 June 2000). Farmer's Plight Shows GM Trouble (accessed on 12 October 2000). www.wired.com/news/technology

ZNET: Quotes Search Results (accessed on 25 July 2000). www.zmag.org/quotes/quotesResults.cfm?topic1-Media