The Politics of Precaution: An Eco-political Investigation of Agricultural Gene Technology Policy in Australia, 1992-2000

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List of Abbreviations

AAA	Agrifood Awareness Australia
AAS	Australian Academy of Science
AAT	Administrative Appeals Tribunal
ABA	Australian Biotechnology Association
ABC	Australian Broadcasting Commission
ACA	Australian Consumers Association
ACEL	Australian Centre for Environmental Law
ACF	Australian Conservation Foundation
AGEN	Australian GeneEthics Network
ALP	Australian Labor Party
ALRC	Australian Law Reform Commission
ANZFA	Australia/New Zealand Food Authority
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
BA	Biotechnology Australia
BAA	Backing Australia's Ability
BIF	Biotechnology Innovation Fund
BSE	Bovine spongiform encephalopathy
Bt	A plant variety with a gene inserted from *Bacillus thuringiensis* (a soil bacteria) that produces a toxin that makes the plant resistant to certain insect pests
CAFTA	Central American Free Trade Area
CC	Consensus Conference
CFN	Consumer Food Network
CGIAR	Consultative Group on International Agricultural Research Centres
CRC	Cooperative Research Centres program
CSCG	Commonwealth-State Consultative Group

CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAS	Department of Administrative Affairs
DDT	Dichlorodiphenyltrichloroethane
DHAC	Department of Health and Aged Care
DISR	Department of Industry, Science and Resources
DIST	Department of Industry, Science and Technology
DNA	Deoxyribonucleic acid
DPIE	Department of Primary Industries and Energy
DPIWE	Department of Primary Industries, Water and Environment
DSP	Dominant social paradigm
EDO	Environmental Defenders Office
EIA	Environmental Impact Assessment
EPA	Environment Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ERS	Economic Research Service (US)
ESD	Ecologically Sustainable Development
EU	European Union
FAO	United Nations Food and Agriculture Organisation
FoE	Friends of the Earth
FOI	Freedom of Information
FTAA	Free Trade Agreement of the Americas
GATT	General Agreement on Tariffs and Trade
GE	Genetic engineering
GEO	Genetically engineered organism
GM	Genetically modified
GMAC	Genetic Manipulation Advisory Committee
GMO	Genetically manipulated organism

GRDC	Grains Research and Development Corporation
GT	Gene technology
GTA	Gene Technology Authority
GTCCC	Gene Technology Community Consultative Committee
GTEC	Gene Technology Ethics Committee
GTIS	Gene Technology Information Service
GTR	Gene Technology Regulator
GTTAC	Gene Technology Technical Advisory Commitee
HRSC	House of Representatives Standing Committee
IBC	Institutional Biosafety Committee
IFAFS	Initiative for Future Agriculture in Food Systems
IFPRI	International Food Policy Research Institute
IGA	Inter-governmental Agreement on Gene Technology
IIF	Innovation Investment Fund
IOGTR	Interim Office of the Gene Technology Regulator
IP	Intellectual Property
IUCN	International Union for the Conservation of Nature and Natural Resources
MP	Member of Parliament
NABC	National Agricultural Biotechnology Council (US)
NACMA	National Association for Marketing Agricultural Commodities
NAS	National Academy of Science
NBS	National Biotechnology Strategy
NEP	New environmental paradigm
NFF	National Farmers Federation
NGAA	National Genetic Awareness Alliance
NGOs	Non-government organisations

NIH	National Institutes of Health (US)
NRA	National Registration Authority
NRC	National Research Council (US)
NZ	New Zealand
OECD	Organisation for Economic Cooperation and Development
OFA	Organic Federation of Australia
OGTR	Office of the Gene Technology Regulator
OTA	United States Congress Office of Technology Assessment.
PCBs	Polychlorinated biphenyls
PBR	Plant Breeders Rights
PP	Precautionary Principle
PR	Public Relations
PVR	Plant variety rights
R & D	Research and Development
r-DNA	Recombinant-DNA
RAFI	Rural Advancement Fund International
RCGM	Royal Commission on Genetic Modification (NZ)
RDMC	Recombinant-DNA Monitoring Committee
RNA	Ribonucleic acid
SAGFIN	South Australian Genetic Food Information Network
SCARC	Senate Community Affairs Reference Committee
SCARM	Standing Committee on Agriculture and Resource Management
SIAA	Seed Industry Association of Australia
SLAPPS	Strategic Lawsuits Against Public Participation
SSRC	Social Science Research Council (US)
TGA	Therapeutic Goods Administration
TNCs	Trans-national corporations

TRIPS	Trade-Related Intellectual Property Rights
UK	United Kingdom
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Program
US	United States of America
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
VLRC	Victorian Law Reform Commission
WCED	World Commission of Environment and Development
WTO	World Trade Organisation
2, 4-D	2, 4-Dichlorophenoxyacetic acid

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Abstract

Given the ongoing intense criticism of gene technology policy by a broad range of commentators, it is crucial to critically assess the most recent phase of regulatory negotiations in Australia, to ascertain whether it was a genuine attempt to rectify the existing problems through a process of genuine reform, or a means of continuing to strengthen biotechnology development and absorb protest on social and ethical issues as critics charge.

This research addresses Australia's gene technology policy terrain between 1992 (when the first Australian inquiry into GE was undertaken) and 2002. It seeks to find whether Australian gene technology policy is broad enough in its scope to facilitate a long-term sustainable future. Its primary purpose is to provide insights for environmentalists and policy-makers, particularly those engaged in debates surrounding the principles of ecological sustainability (ESD) and green ethics, including the precautionary principle.

In order to navigate a desirable path to a future in accordance with an ecological conception of ESD, an adequate 'map' and critique of the biotechnology policy terrain is vital. To accomplish this, a translation analysis of the gene technology policy processes in Australia was undertaken, underpinned by an eco-political theoretical framework. This approach facilitated a better understanding of the way in which the biotechnology policy terrain is socially constructed and also in identifying constraints to change.

The research revealed unequal power relations between GE proponents and environmentalists. The biotech-network operates from within existing structures of domination, supported by the dominant social paradigm that embraces capitalist ideals. The state received constant pressure from the biotechnology industry – which sought a more streamlined regulatory path for the commercialisation of GE and its products – and its role has remained one of continued support for the economic development of biotechnology. This is reflected in the final GT Act 2000 which is cautionary, rather than precautionary, legislation. Further, the inquiries that formed part of the policy process provided central conduits of power that empowered genetic engineering interests and disempowered its critics, further helping to secure a minimalist regulatory regime. Therefore, the recent policy processes were a continuation of previous manoeuvres by the biotech-network that functioned to strengthen biotechnology development and marginalise ecological, ethical and social issues.

Radical changes are, therefore, necessary to achieve precautionary policy. It is believed that this approach is warranted due to the growing evidence of environmental harm resulting from existing practices. Thus, the inclusion of broader eco-political issues and principles, including greater public participation and information, is an important challenge that must to be met in order to move towards a sustainable future.

Declaration

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no copy or paraphrase of material previously published or written by another person, except where due reference has been made in the text.

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Date: 20.08.03

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To the late John 'Papa' Risely

1

Introduction

It was a world half convinced of the future death of our species yet half aroused by the apocalyptic notion that an exceptional future still lay before us. So it was a century which moved with the most magnificent display of power into directions it could not comprehend. The itch was to accelerate – the metaphysical direction unknown (Norman Mailer, 1970: 5).

Modern agricultural biotechnology is seen by many as nothing short of a revolution in humans' capacity to manipulate nature and dictate the future of the entire food chain. While the term 'genetic engineering' was not well known a decade or two ago, most people today are familiar with the term which appears in news stories nearly every week. It is one of the largest technological growth areas and has sparked intense ethical debate. Known also as biotechnology or gene technology, those on both sides of the debate claim that it will change our lives in profound ways, possibly more so than any other scientific or technological advance. It has, therefore, been heralded as one of the two great technologies of our time, alongside information technology (Clarke, 1995, 1997).

In its simplest terms, biotechnology is the "… exploitation of biological materials and processes for human needs" (Aldridge, 1996: 183), or similarly, "… harnessing the natural biological processes of microbes, and of plant and animal cells, for the benefit of mankind [sic]" (Australian Biotechnology Association, ABA, 1998). According to this definition, biotechnology has been employed by humans for thousands of years, for example in the fermenting of beer, wine and cheese, and in the improvement of crops through selective breeding. However, more modern techniques for isolating, modifying, multiplying and recombining genes from different organisms emerged in the 1970s, two decades after Watson and Crick discovered the structure of the DNA double helix. Many believe these new biotechnology techniques, known as recombinant DNA (rDNA) technology (also known as genetic engineering, genetic manipulation, or gene technology) to be the most powerful tool for manipulating Nature that has ever been developed.

In short, it is now possible to create novel organisms whose genetic construct has been altered by the insertion or deletion of small fragments of DNA from the same or different species. The technical and ontological implications of this are such that, at the molecular level, the differences that distinguish and separate species effectively vanish. This ability has called into question conceptions of Darwinian evolution and even perceptions of 'God' and 'self', as well as humans' place in Nature (Merchant, 1992). Thus, the ability to cross species barriers and create organisms that are unlikely to occur in nature has sparked a worldwide controversy over the desirability, or not, of such technology. Further concerns have been raised by critics about ecological, ethical and social issues in the context of sustainable futures. They are calling for effective regulation of the technology, incorporating the precautionary principle as the foundation for all decision-making and policy processes – an approach that will be explored further in Chapters 2 and 5. As a result, ethical and policy dilemmas surrounding genetic engineering (GE) are increasing. These concerns are exacerbated by the disproportionate control of biotechnology research and development by trans-national corporations (those behind the push for the gene technology revolution) and the widespread commercial applications of gene technology and its products which are now becoming widespread.

Thus, to introduce the thrust of the thesis, this chapter looks at the promises and problems of the technology. It then explores the role that ecological sustainable development (ESD) plays in environmental conflicts and why environmentalists are increasingly calling for the precautionary principle to underpin regulation. Finally, it argues that GE policy does indeed need to change to become more 'reflexive', that is, more self-critical, broader in scope, flexible and open to change. This will be expanded in Chapters 2 and 3.

1.1 The Growing GE Controversy

In the words of Smith: "Today its ranks are divided between cosmic utopians who see in the potential powers of science and technology the total liberation of mankind, and the catastrophists who see the limits of the scientific imperative as having been met" (Smith, 1989: 1). Those subscribing to the dominant social paradigm (DSP) have faith in technology to overcome environmental problems. In this context, humans are seen as separate from nature and the environment is recognised only for its instrumental value to humans (Harding, 1998). The philosopher Rene Descartes (1596-1650) was responsible for this separation of humans from the world (Pratt *et al,* 2000) and it was also reinforced by Francis Bacon (1561-1626) who believed that nature was a resource to be exploited. This philosophy of Cartesian thought and the separation of humans from the external world will be discussed further in chapter 2.

The alternative paradigm is often viewed as 'emotional', while the dominant is supposedly based on the 'objective' analysis of 'facts'. In the words of Tribe (1993: 274) "Almost every specific issue, if fully explained will be acceptable I believe, to an open-minded, properly informed citizen". Thus, the view that opponents of biotechnology are uninformed, ignorant or 'emotional' and that education on the issues would change their positions is common among proponents of the technology (Davis, 1993: 74; Peacock, 1995: 231; Huppatz and Fitzgerald, 2000). There also appears to be a widely held belief that scientific issues can not be easily presented or understood by the general public (Rehm *et al.,* 1995: 102). Thus, there is a failure by many to recognise that each holds, in some cases, vastly differing worldviews.

The paradigms outlined above represent the extreme ends of the value spectrum – ecocentrics at the one end and technocentrics at the other, and there is of course a continuum of environmental values and ideologies (Harding, 1998) which are reflected in the intense public debate which has evolved over the implications for society, the environment and the future directions of agriculture (Tripp, 1999). The debate has engaged a wide audience around the world. Environmentalists claim that biotechnology has profound social, ethical, and environmental ramifications. In addition, many proposed biotechnological 'solutions' detract attention away from the difficult social and economic problems contributing to ill health, malnutrition and environmental degradation (Shiva, 1993). There is a growing emphasis on genes as the 'causes' of health and social problems, which tends to absolve us of the responsibility for tackling their root causes, and may suggest a 'genetic solution' or 'genocidal solution'. For example, in agriculture, the development of herbicide resistant crops ignores the root causes of insect infestation. Salt-tolerant crops are another example that would allow destructive agricultural practices to continue by allowing crops to be grown in soils that have been salinated due to irrigation-intensive industrial farming techniques (Scrinis, 1998). Failure to acknowledge and address these problems has been criticised vehemently by many concerned individuals, NGOs, feminists, and concerned scientists throughout the world (Hindmarsh, 1995: 8). In this context, fears have also been widely expressed about the failure of the self-regulatory process in use since the mid 1970s. The issue of regulation is inherently a political process, with a wide range of conflicting interests affecting decision-making. Establishing an effective regulatory process that is open and 'transparent' is widely considered essential for all countries (Tripp, 1999) if long-term sustainability is to be achieved.

Environmentalists assert that ultimately, the applications of genetic engineering must be "...part of a comprehensive re-evaluation of many of our environmental policies and uses" (Nossal and Coppel, 1989: 147). They believe that biotechnology should be promoted to serve human and environmental needs, rather than corporate profits. These applications raise the issue of setting research priorities and a need for discussion of the complex issues involved. Many critics rally for the public to have a voice in decision-making, with decisions being too important to be left to the 'experts'. In summary, critics believe that there are many social, ecological and environmental issues that are important, particularly in the context of long-term sustainability. They are opposed to the reductionist approach to solving complex problems, the marginalisation of the public, and the self-regulation of the bio-industry (Hindmarsh, 1993).

1.2 The Research Problem

Growing concern about gene technology among members of the public, some members of academia, and the scientific community forced a parliamentary inquiry in Australia into genetic engineering in 1992. Despite this process and the numerous recommendations resulting from it, there has to date been little resolution between critics and proponents about the adequacy of gene technology regulations. The criticisms raised at the inquiry have been ongoing and are continuing with the new regulatory arrangements that have emerged as an outgrowth of the 1992 Inquiry.

Environmentalists have expressed their concern to ensure long-term sustainable development in Australia and called for special legislation to address the wider issues of gene technology – including social and ecological issues. In 1996, the Australian GeneEthics Network stated:

> There is a failure of vision among ... policy-makers and regulators, focussing on each problem in isolation from the others. GMAC [Genetic Manipulation Advisory Committee] assesses gene constructs, the NRA [National Registration Authority]

registers chemicals, and the National Food Authority sets standards for content and residues in food. But no-one takes system-wide approaches to sustainable, non-chemical production, also considering environmental, social, economic and ethical issues (AGEN, 1996).

Thus, critics claim that instead of addressing ethical, social and environmental issues, there is an emphasis on technical safety issues. They have stressed the ecological uncertainties surrounding transgenic release, and the importance of these being adequately taken into account. Consequently, they have stated that the framework for the assessment of genetically engineered organisms (GEOs) should be ecological sustainability.

Environmentalists argue that gene technology regulation in Australia is not based on the principles of ESD and the precautionary principle, but rather on the assumptions of a 'business as usual' approach. It is the working hypothesis of this thesis that a business-as-usual approach is an inappropriate model for biotechnology policy in Australia. Current research and development focuses on amplifying conventional modes of agriculture – working on improving existing crops (monocultures) – rather than looking at alternatives and diversifying. There has also been a disproportionate focus on herbicide-resistant crops. Evidence suggests that such a model will lead to increased environmental degradation and strengthens the argument that agriculture under capitalist ideals is unsustainable in the long term. In addition, current modes of policy practice are not always democratic which further undermines the principles of ESD. Thus, environmentalists argue that ecological principles including the precautionary principle, increased public participation, and a greater focus on ethics should be part of the GE policy model.

In order to navigate a desirable path to a future in accordance with an environmental conception of ESD, it is prudent to develop an adequate 'map' and critique of the gene technology policy terrain. Given the ongoing intense criticism of GE policy, it is necessary to critically assess the most recent phase of regulatory negotiations in Australia. It is important to ascertain whether it is an appropriate attempt to rectify the existing problems through a process of genuine reform, or a means of continuing to strengthen biotechnology development and absorb protest on social and ethical issues as critics charge. In this context, a translation analysis of the gene technology regulatory and policy processes in Australia over time is undertaken. Specifically, this analysis will examine whether the concerns raised at the 1992 inquiry, and which have been ongoing since that time, have been addressed and whether the questions and concerns about it have been resolved.

The decisions made in the recent round of national regulatory negotiations will have an enormous effect on the future of biotechnology regulation, commercialisation and the environment, thus making it essential to implement policy that will promote long-term sustainability from the outset. It is hoped that this thesis may go some way towards this aim by facilitating an increased understanding of biotechnology policy – making power relations, epistemologies, and processes explicit and identifying areas of weakness and/or policy gaps for those responsible for decision-making as well as to public interest groups.

In this context, the central aims of the proposed research are:

1. To collate data through the investigation of policy documents from 1992 to 2000 to fill the research gap in this area and to better understand and analyse the policy context of this period, identifying and discussing gaps and trends.
2. To undertake a translation analysis of the gene technology change processes in Australia between 1992 and 2000 to establish whether Australian GT policy is broad enough in its scope to facilitate long-term sustainability.
3. To provide policy makers and NGOs with additional knowledge to enable them to effect informed policy and policy changes to secure outcomes towards a long-term sustainable future.

1.3 Procedural Methodology

This thesis develops a theoretical framework that recognises the important relationship between ecology, politics, ethics, precaution, sustainability, risk, and agricultural biotechnology. This ecological-political (ecopolitical) framework informs a power relations methodology, and is shaped from several important theories from both incremental and radical environmental critique.

There is a growing body of literature that emphasises the importance of addressing social and political values (and therefore the role of the state), categorised as 'post-positivism' (see for example Fischer, 1989; Fischer, 1993; Hawkesworth, 1988). This thesis embraces this theory, adopting a post-positivist approach, in recognition of the importance of political, ideological and value issues underlying the policy process. This approach also recognises that it is possible to use many methods to analyse power relations in environmental conflicts, discussed in chapter five, as they represent the broad spectrum of politics. Law (1991: 170) believes that there is no reason why power cannot be treated as a condition, a capacity, something that can be stored, as well as an effect or product.

A translation approach provides a useful tool for analysing the biotechnology 'text' and explaining strategic processes such as how agendas are set and decisions are made. This approach is useful as it recognises the need for fluid methodologies due to different visions, realities, truths, and ideals (Law, undated). According to this view, technological decisions are not about a single, functional vision based on logic to produce a predictable outcome. Rather, "... they become ... arguments about how to articulate the relations between different realities and different versions of the good" (Law, undated: 8). Thus, this thesis uses a translation approach to analyse the biotech-policy terrain in Australia, and also incorporates some discourse analysis. This method helps in understanding how the biotechnology policy terrain is socially constructed and how groups involved have been negotiated. This case study of biotechnology policy in Australia is analysed in terms of attempts to translate different knowledge systems (scientific versus eco-social).

1.4 Limitations on Research

Due to the interdisciplinary nature of the thesis in environmental studies, many challenges were encountered including the need for great depth and breadth of research in a field that is changing at an exponential rate. A thorough account of Australia's biotechnology policy agenda prior to 1992 has been given by Hindmarsh (1994). As a consequence, I have chosen to limit this thesis to the period following on from this between 1992 and 2000. Focus is also given primarily to this time frame due to the most recent policy manoeuvres that have not yet received adequate attention.

However, before proceeding to discuss the scope and structure of the thesis, we must first turn to look at the promises and problems of biotechnology, as a means to introduce the complex biotechnology terrain and to help the reader understand where the controversy and resultant policy dilemmas have originated.

1.5 Promises of Biotechnology

Dr David Tribe, a senior biotechnologist from the University of Melbourne, states that the two great successes of the 20th century are the treatment of infectious diseases by antibiotics and vaccines, and the Green Revolution and genetic improvements in crops which, according to Tribe, have helped to alleviate world famine (Tribe, 2000). Supporters believe that gene technology will lead to increased wealth, jobs, and health as well as providing a solution for pollution and famine[1]. The technology is thus heralded as a saviour, enabling the development of new technologies and strategies for sustainable agriculture (Burnside, 1996; Clarke, 1997). They claim that the technology can reduce negative environmental impacts and improve crops by increasing yields (Aldridge, 1996; Clarke, 1997; Huppatz and Fitzgerald, 2000; Tribe, 2000) through, for example, genetic improvement of the processes of photosynthesis and nitrogen fixation carried out by plants (Aldridge, 1996). It is claimed that gene technology will also increase yields by improving tolerance to extreme environmental conditions (such as cold, drought, salinity, and acidity). The most widely used genes in genetically engineered crops, however, are those that confer resistance to herbicides, particularly glyphosate or 'Roundup' (Kerr, 1999). Advocates claim that herbicide resistant crops will be a great benefit to farmers and reduce the amount of herbicide use, and lead to the use of more environmentally acceptable herbicides (Huppatz and Fitzgerald, 2000). Similar claims are made for Bt[2] resistant cotton, which will be discussed later in the chapter (Peacock, 1995).

While proponents promote the reduced use of agrochemicals as a distinct advantage of genetically modified (GM) crops, there also appears to be a widely held belief that agrochemicals are essential to save the human race from widespread starvation. Adams (1990: 52) for example states that "It seems to me inescapable that agrochemicals are essential to save us from the famines which plagued our forebears". Thus, proponents of biotechnology

[1] It is increased food productivity that is used as the primary justification for development of new food and agricultural technology (see, for example, Clarke, 1995; Taverne, 1991; Miller, 1997).

[2] Bt is a toxin formed from a soil bacteria called Bacillus thuringiensis. Plants are genetically modified to give them in-built insecticide.

generally do not support alternative approaches to agriculture, such as biological controls, organic production systems or general agro-ecological techniques (Busch *et al.,* 1990). Some (see for example Adams, 1990) argue that organic farming methods damage the environment more than agrochemical systems, asserting that organic farms could never become net exporters without damaging soil fertility. Such commentators also claim that organic farms are lower yielding and require more land for food production, putting greater pressure on the environment. Thus, proponents argue that the cultivation of transgenic plants is more likely to decrease the need to convert additional lands to agriculture in the future (Giddings, 1996). However, evidence from research in South Australia refutes these claims. In the case of viticulture, organically grown vines have proven to have lower costs and slightly higher yields than their conventionally grown counterparts (Crisp, pers. comm., 2002).

A further advantage put forward by proponents for Third World countries is 'functional foods', that is, the creation of plants with distinctive health benefits through GE (Peacock, 1995). Examples include rice engineered with enhanced levels of vitamin A and iron to correct nutrient deficiencies common in less developed countries (Huppatz and Fitzgerald, 2000). However, while proponents promote such applications, it must be questioned whether poor countries will be able to afford such products.

As well as promoting advantages for under-developed countries, proponents maintain additional advantages for world markets. Projected benefits include improved preservation and processing qualities as well as the increased nutritional value of food (House of Representatives Standing Committee on Primary Industries and Regional Services, 2000). To enhance consumer appeal, potatoes have been developed with an introduced gene that negates the activity of the enzyme polyphenoloxidase which causes dark pigment in cut potatoes, and this same approach may be used in other fruits and vegetables in future such as apples and bananas (Peacock, 1995). The CSIRO has been working on improving the textural properties in doughs produced from various flours by modifying glutenin, protein and starch (Appels, 1997). At the same time, scientists at the CSIRO have also introduced a new gene (from a sunflower) into lupin (used as animal feed) which produces a high sulphur amino acid content which is important for wool production (Peacock, 1995). Calgene's Flavr Savr tomato was the first genetically engineered food released onto the market, in 1994 (GMAC, 1995). The tomato had the gene responsible for fruit softening 'turned down', and would thus be left to ripen on the vine. However, as Calgene scaled up its production of the Flavr Savr tomatoes, there was a serious reduction in yields due to production problems with the original strain (Nottingham, 1998). Despite this, proponents continue to proclaim that it is a revolutionary way to gain greater efficiency in farming and food processing.

While food productivity has been the major focus of promotion, use of gene technology for environmental remediation purposes has also been widely used as an example of its benefits (Borowitzka, 1995). Marine microorganisms have been shown to degrade a range of compounds such as pesticides and hydrocarbons (Al-Hasan *et al.,* 1994). Other examples include the commercial application of bioleaching to a widening range of metals (Australian Academy of Science, 1980); the use of brown marine algae for the adsorption of heavy metals from industrial effluents (Roddick, 1997); decontaminating soils; and treating oil spills. It is also claimed that biotechnology can help convert waste products into useful products (Australian Biotechnology Association, 1998). An example is the potential for biomass production from the fungal waste associated with industrial fermentations (Roddick, 1997).

The use of biotechnology to aid biodiversity and conservation is also promoted by proponents as another of biotechnology's benefits. Taxonomic and ecological approaches are used in the selection and testing of microbes for particular properties (Roddick, 1997). It is therefore said to be useful in bringing new levels of understanding to patterns of biodiversity by providing insights into taxonomic boundaries and evolutionary relationships (Barlow and Tzotzos, 1995; Tribe and Meek, 1995). Similarly, it can be used as a tool for estimating levels of genetic diversity and identifying biological control agents (Beattie, 1995) as well as other bio-resources (Borowitzka, 1995). Biotechnology is also being used to manage breeding programs for captive animals (for example at LaTrobe University), for studies in population genetics, and rescue of species close to extinction (Tribe and Meek, 1995).

Given the predicted benefits outlined above, proponents believe that the risks are far outweighed, and that undesirable outcomes can be predicted and, with good planning and management, be avoided or minimised (Barlow and Tzotzos, 1995). The new techniques are proclaimed to be more precise, and therefore less risky (Taverne, 1991; House of Representatives Standing Committee on Primary Industries and Regional Services, 2000). Due to this, proponents assert that risk assessment should be undertaken based on the characteristics of the product rather than on the means of production (see for example Barlow and Tzotzos, 1995). Davis (1993) believes that the history of domestication can be used as a basis for predicting the effects of biotechnology. He claims that "... no domesticated strain has been shown to be *better* adapted than its parental wild type to the original environment, and hence to displace the wild type there" (Davis, 1993: 67). Rehm *et al.* (1995: 104) also claim that no "new" risks are associated with genetic engineering and that biological risks are clearly recognisable and can therefore be well controlled (Taverne, 1991; Miller, 1997). Thus, supporters of the technology believe that the disadvantages and risks of GE crops are very few (see also Kerr, 1999), and that GE may in fact be inherently safer than traditional cross-breeding practices (Taverne, 1991). Criticisms are therefore seen as 'hysteria' (Tribe, 2000). Peacock (1995) states that a minority group in the community (that is, critics) should not be able to determine applications of biotechnology which, in his view, holds so many promises[3].

In summary, it is claimed that gene technology will increase productivity and competitiveness in agriculture by increasing the value of primary products. This, proponents claim, will have immediate benefits to farmers, growers, the Australian economy, world food supply, consumers and the environment. Critics, however, disagree with these claims and their viewpoint will now be discussed.

1.6 Problems of Biotechnology

1.6.1 Temporal concerns

Environmentalists' concerns are fuelled in part by the uncertainties surrounding biotechnology, which are arguably enormous. Tripp highlights concerns about our ability to deal with new developments in biotechnology due to these uncertainties: "The fact that discussions about a set of technological changes initiated over 30 years ago are still characterized [sic] by an astounding lack of clarity bodes ill for our capacity to come to terms with the complex issue of GMOs" (Tripp, 1999: 19).

This in turn raises the important issue of the accelerated time frames involved in biotechnology development that has increased uncertainties and made pre-emptive environmental policy difficult. In 1996 Aldridge stated "... it will be many years before

[3] However, critics would claim that opposition to many biotechnology applications is increasing, and they no longer represent a minority group within the community, rather in some cases such as the European Union (EU), they form a majority.

transgenic plants are available to farmers on a commercial basis – although numerous field trials have been carried out" (Aldridge, 1996: 209). However, despite fears raised by environmentalists, in only two years numerous GE products had been approved in the US including: herbicide resistant canola, maize, cotton, and potatoes; virus resistant paw paw, potato and squash; canola designed to produce high concentrations of lauric acid; tomatoes designed to delay their ripening; and a bacterium designed to enhance nitrogen fixation in the soil (Anderson, 2000: 119). This trend follows the trajectory begun with the green revolution.

1.6.2 The Green Revolution

According to Tripp (1999) the controversy over the environmental implications and control of biotechnology is embedded in larger debates involving conflicting visions about the directions of agriculture. Tripp (1999) states the lack of focus of these debates is exemplified by the vastly differing interpretations of the term 'Green Revolution[4]', with proponents heralding it as the triumph of agricultural science, and critics declaring it as the cause of environmental destruction and the end of traditional agriculture. The Green Revolution was the prior agricultural 'revolution' to biotechnology in the 1950s and 1960s, which saw the transfer of western industrialised agriculture from rich industrialised nations to poorer developing nations. Proponents saw it as a remarkable achievement due to the 100 per cent increase in wheat production, through the planting of more productive varieties and improving cultivation techniques (Aldridge, 1996; Conway, 1997). This view is exemplified, even today, by the National Academy of Science's awarding of the prestigious Public Welfare Medal in January 2002 to agricultural scientist Norman E Borlaug, considered by many as the father of the Green Revolution (BioMedNet, 2002). The legacy of the Green Revolution, however, is that twenty species now make up 90 per cent of our food supply, out of thousands of potential food plants (Aldridge, 1996). Critics, therefore, saw it then, and continue to see it now, as the destruction of the environment and traditional agriculture, largely due to an increased reliance on chemical pesticides and herbicides to eradicate plant pests and weeds, and increased monocultures.

The mind-set adopted by the Green Revolution and perpetuated by the biotechnology industry continues to marginalise alternative approaches to agriculture such as organics and permaculture. It is therefore likely that gene technology will only intensify the problems

[4] The Green Revolution in the context of the new 'gene revolution' will be discussed in more detail in Chapter 6.

related to the industrialisation of agriculture (Hoy, 1991) such as "... increased hunger, malnutrition, landlessness, unemployment, cultural imperialism, dependency, corruption, corporate control, pesticide poisonings, ecosystem degradation, trade imbalances ..." (Hindmarsh, 1993: 103). This is despite increasing reports from ecologists that greater biodiversity leads to a greater carrying capacity and ecosystem viability (Ho, 2000). While the same mind-set leads proponents to deduce that biotechnology can alleviate world hunger, environmentalists believe that such an assumption is based on the flawed view that hunger is due to a gap between food production and human population, and that genetic engineering is the only way to increase agricultural production. Tripp (1999: 21) asserts that "... it is deceitful to argue that a technology currently aimed at US soybean farmers is part of a strategy to address poverty and hunger in the South", as many people in the Third World are too poor to buy the food that is available or lack the land and resources to grow it themselves (Lappe, Collins and Rossett, 1998). Hunger and malnutrition are thus not the result of food scarcity, but rather due to people being denied access to land to grow their own food crops, and/or adequate income to purchase food.

In summary, while proponents believe that the Green Revolution was an overwhelming success for global agriculture, environmentalists believe that it has caused the destruction of the environment and traditional agriculture. This leads to the important issue of the environmental risks of genetic engineering.

1.6.3 Risks to the Environment

Parallels have been drawn between GE and the litany of problems related to introduced species in Australia, including the rabbit, goat, fox and cane toad. Dr Mark Lonsdale from the CSIRO has stated that introduced plants and animals are a major threat to Australia's biodiversity, with up to 70 per cent of weeds intentionally introduced, and about ten new species establishing themselves each year (Lonsdale, 2000). This is consistent with the history of western agriculture which has shown that human interference in nature generally reduces biodiversity (Hallen, 1990), particularly through the promotion of monocultures (Shiva, 1993; Hoy, 1991), and gives basis to environmentalists' fears about the potential dangers of GMOs.

They argue that it is the complex network of interaction between genes that is responsible for species integrity and therefore maintenance of biodiversity. They believe that GE threatens this balance by interfering with these genetic processes (Ho, 1995). Ho and Tappeser (1996) assert:

> Biodiversity and species integrity are inextricably linked. Transgenic technology transgresses both species integrity and species boundaries, leading to unexpected, systemic effects on the physiology of the transgenic organisms produced as well as the balanced ecological relationships on which biodiversity depends (Ho and Tappeser, 1996:1).

A common fear is that genetically modified organisms, once released, may become established in the environment, out-competing native species and wreaking environmental havoc by seriously affecting wild plant populations and biodiversity (Tripp, 1999). While proponents assert that this is unlikely to occur and that GMOs pose little risk to endemic organisms, research has shown that clinical isolates of *Escherichia coli* grew more slowly than laboratory varieties, giving contrary evidence to the belief that bacteria in nature are more efficient than strains grown in artificial media (Dixon, 1992). Adding to people's fears about GMOs is that, unlike toxic chemicals, genes can replicate, recombine, mutate and move actively through an ecosystem in ways that cannot be predicted (Smit *et al.,* 1992; Coleman, 1997).

The transfer of genes to wild relatives may occur via horizontal gene transfer, that is, the transfer of genes to unrelated species by infection through viruses, DNA, being taken up into cells from the environment, or by unusual mating (Ho, 1998). Evidence of gene flow has been observed between rice (*Oryza sativa*) and perennial rice (*O. perennis*), maize (*Zea mays*) and teosinte (various *Zea* species), sugarbeet (*Beta vulgaris*) and wild beet (*B. vulgaris* subspp. Unknown) (Dale, 1994). Experiments have also shown that GM genes can transfer from soil fungi to bacteria (Gebhard and Smalla, 1999).

Thus, environmentalists argue that modified organisms could acquire additional genetic material that, in combination with the engineered genes could prove harmful, or the novel genetic material could be transferred to another organism with similar results (Amabile-Cuevas and Chicurel, 1993). Although biotechnology is designed to do this with specified targets, it has been shown that horizontal gene transfer can occur with non-target organisms and it is feared that this process may lead to the creation of, for example, 'superweeds' or novel pathogens (Rissler and Mellon, 1996; Ho, 1998; Tripp, 1999). Weed scientists have also warned that, despite whether resistance does indeed occur or not, population shifts to weeds that are more tolerant to a particular herbicide are likely (Holt, 1994). According to Holt and Le Baron (1990) there is also the potential for herbicide resistant varieties to become weeds in other crops. Ultimately the consequences of the release of GMOs into the environment are unpredictable, even when only one gene is introduced (Ho and Tappeser, 1996), as horizontal gene transfer is a multimodal phenomenon that scientists are only just beginning to understand (Amabile-Cuevas and Chicurel, 1993).

Another problem involving horizontal gene transfer is the possibility of targeted insects developing pesticide resistance, which some researchers claim is simply a matter of time (Alstad and Andow, 1995; Whalon and Norris, 1996; National Research Council, 1996). An example is the case of plants that have been engineered with the gene for Bt toxin, a toxin formed from a soil bacteria called *Bacillus thuringiensis* (Bt) to give them in-built insecticide. When Bt is engineered into the plant itself, the exposure of insects to the insecticide is increased dramatically, accelerating resistance (Gould, 1994). Recent evidence has indicated that rapid resistance evolution will take place in some cotton pests (such as *Heliothis virescens*) and become a serious problem in about ten years (Gould *et al.,* 1997). This may render the natural pesticide Bt, which is relied on by many organic farmers, useless within a relatively short time frame. Another identified problem is the effect of Bt crops on non-target insects such as the monarch butterfly (Losey *et al.,* 1999) and on beneficial insect predators that feed on the target pests (Hilbeck *et al.,* 1998).

With gene transfer also comes the risk to organic farmers and food companies of their crops becoming contaminated with airborne pollen from genetically modified crops. At least one example of this has already occurred. A US company, Prima Terra, had shipped 80 000 bags of corn chips to Holland which was later found not to qualify as organic due to GE contamination believed to have been from pollen drift from a GE farm blown into an organic corn crop (Barrett, 1999). With growing consumer concern about GE, there is a growing market for GE-free products (which will be discussed further in Chapter 6), however, such cross-contamination puts these businesses at risk and removes the opportunity for the public to choose between GE and organic products.

Prediction of horizontal gene transfer and possible harmful effects is difficult due to the fact that it has been impossible to accurately monitor and evaluate systems in their 'natural' state, let alone following the introduction of a GMO (Love, 1988). Adding to these problems, at present there appears to be a lack of independent research and monitoring relating to issues such as these. These concerns extend to human health issues.

1.6.4 Human Health Concerns

The bovine spongiform encephalopathy (BSE) epidemic, or 'mad cow disease', in the UK is often cited by critics as another example of the need for precaution when dealing with agricultural GT policy. While not involving GE, critics argue that the BSE epidemic is an example of the possible consequences when policy attempts to protect the interests of industry and override concerns about public health (*Nature*, 26 October 2000). Industry and public health ultimately suffered, but so too did science. As a result, the general public has become even more sceptical of science and see scientists as part of the problem.

There are further fears that horizontal gene transfer may lead to antibiotic resistance. There is evidence that antibiotic marker genes may be transferred between gut bacteria in mice (Doucet-Populaire, 1992), while transgenes and antibiotic-resistant marker genes from transgenic plants have also been shown to end up in soil fungi (Angle, 1994; Morra, 1994). If resistance spread to pathogenic bacteria via GM food, it could potentially cause great harm (Leeder, 1999), and has raised the additional fear that antibiotic resistance could be incorporated by bacteria in the human gut (Tripp, 1999; Carmen, 2000). While current research is moving towards less controversial markers, most currently available GMOs carry an antibiotic resistance gene.

In the area of food production, many environmentalists are also concerned about public health implications. The discovery of a brazil-nut allergen in a transgenic soybean (Nordlee *et al.*, 1996) demonstrated that proteins produced through GE could act as allergens or cause the food itself to produce new allergens or toxins, posing a real threat to public health. It is also feared that there may be unexpected effects, such as 'artificial' freshness, and a possible decrease in nutritional value. It is possible then, that the proposed 'functional foods'[5],

[5] Examples include foods with added vitamins and altered nutritional values.

designed to enhance health and wellbeing, also may not be as effective as the original product.

This raises the important issue of labelling and the rights of consumers to make informed choices about whether or not they wish to consume GM products. According to Carmen (2000), conventional foods go through six stages of clinical trials, while GE foods have not even gone past the first stage. This reductionist mind-set that sees such testing as unnecessary also allows the perpetuation of chemical-industrial agriculture.

1.6.5 Perpetuation of Chemical-Industrial Agriculture

Due to the industry's limited approach, critics believe that herbicide tolerant crops will have major environmental, economic and ecological impacts (Goldburg, *et al.,* 1990), disputing claims by many proponents that they will decrease the use of industrial chemicals. Rather, they believe, since most of the world's major food crops such as rice, soy, corn, oats, potatoes, and sugarcane have been modified to confer herbicide resistance, that it is likely that there will be increasing reliance upon herbicides for weed control (Owen, 1998). This is supported by Monsanto's recent permits for a threefold increase in herbicide residues on Roundup Ready soybeans in Europe and the US from six parts per million to 20 parts per million (Lappe and Bailey, 1998). A further fear of environmentalists is that weeds will develop resistance to Roundup, creating 'superweeds' discussed above, and therefore increased applications of the chemical, or a mixture of chemicals, will be required (Mellon, 1996).

Even some proponents of biotechnology, such as Kerr (1999), admit that herbicide resistant crops will lead to a greater use of herbicides, but go on to argue that the herbicides used (for example glyphosate, or 'Roundup'), are environmentally benign, and therefore less hazardous than other chemicals currently used (Kerr, 1999). This, however, is refuted by several studies. Two in particular have shown that the so-called inert surfactants in Roundup have detrimental effects on aquatic organisms (Cox, 1991; Pimental *et al.,* 1989). It has also been reported to be toxic to spiders, mites, carabid and coccinellid beetles (Pimental *et al.,* 1989). Laboratory tests have also indicated that some formulations of the herbicide bromoxynil (another widely-used and so-called benign pesticide) causes birth defects in animals and as a result its use has been restricted in the US and Canada (Keehn, 1992).

With weeds costing First World nations billions of dollars annually, the industry can further justify herbicide tolerant crops in economic terms. Kerr (1999) states that the benefit of herbicides is that they eliminate the need for soil cultivation, thereby preventing soil erosion which is one of the largest environmental problems in Australia. Again these claims are based on the worldview that chemical-industrial agriculture is the only way forward, and does not take into account more sustainable alternatives. Since the biotechnology industry views herbicide tolerant crops as an important source of profits, it is unlikely that alternative weed management strategies, such as biological controls or integrated pest management, will be used as claimed by proponents (Owen, 1998). Indeed, Holt (1994) has warned of a lack of research in developing alternative weed management strategies.

The economic viability of herbicide resistant crops has also been put into question by studies that have shown them to be more susceptible to insect pests and diseases. An example is maize treated with the chemical pesticide 2, 4-Dichlorophenoxyacetic acid, more commonly known as 2, 4-D, which tripled corn-leaf aphid infestation and attracted European corn borers, Southern corn leaf blight and corn smut (Pimentel, 1987). It has therefore been argued that the primary aim of most research currently being undertaken is to engineer crops that are better adapted to the requirements of chemical-industrial agricultural systems (Scrinis, 1998).

The applications of biotechnology discussed above contradict the aims and findings of a workshop that sought consensus for a national pesticide strategy, held in Canberra in 1997 by the Bureau of Resource Sciences (BRS). According to the Department of Primary Industries and Energy (DPIE, 1997), pesticide residues could be used as non-tariff trade barriers and thereby pose threats to Australia's rural exports. The workshop called for a reduction on the reliance on chemical inputs and a focus on reducing environmental and health risks. Critics argue that funds would be better spent on ecologically based agricultural research, as the problems biotechnology has promised to 'fix' can all be addressed by agro-ecological approaches (Altieri, 1996). Claims have been made that low-input technologies, such as integrated pest management and organic farming, promoted by NGOs and some farmers around the world are making a significant contribution to food security (Pretty, 1995).

Thus, critics assert that gene technology research and development is profit driven rather than need driven, facilitating the extension and intensification of this dominant form of agriculture

(Hindmarsh, 1993; Altieri, 1998). Thus, the new biotechnologies are also seen to facilitate the further commodification and corporatisation of agriculture (Scrinis, 1998).

1.6.6 Increasing Corporate Control

Vandana Shiva warns:

> The diverse seeds now being pushed to extinction carry with them seeds of other ways of thinking about nature, and other ways of producing for our needs … uniformity and diversity are not just patterns of land use, they are ways of thinking and ways of living … Monocultures spread not because they produce more, but because they control more. The expansion of monocultures has more to do with politics and power than with enriching and enhancing systems of biological production. This is as true of the Green Revolution as it is of the gene revolution or the new biotechnologies (Shiva, 1993: 6-7).

Environmentalists argue that the real push for biotechnology is not the improvement of Third World agriculture but rather to generate profits (Busch *et al.,* 1990). Scrinis (1998: 2) claims that rather than alleviating world hunger, "… genetic-industrial agriculture will … most likely exacerbate global poverty and malnutrition given the way it will favour large-scale producers over small producers and undermine local agricultural markets."

This view is supported by the fact that plant biotechnology research and development is heavily skewed toward crops with high commercial potential. One of the first GM products to be released was Monsanto's 'Roundup Ready' soybeans, which a European Parliament Report concluded was "… above all, developed for economic reasons, since development costs of a new herbicide are up to 20 times higher than those for a new (plant) variety" (European Parliament, 1986).

Thus, current research and development priorities have raised concerns over increased private sector take-over of public research facilities and, therefore, increased private input on the direction of research and development. There are of course also increased concerns over corporate control of plant breeding and the seed industry, and increased private ownership of genetic materials. Critics assert that genetic-industrial agriculture, following on from chemical-industrial agriculture, is enabling seed-chemical corporations to extend their control over farmers, and indeed the entire food chain (Scrinis, 1998).

The new technologies have enabled the extension of private ownership and patenting of life forms down to the level of the genetic makeup (Scrinis, 1998). Commercial rights under plant variety rights (PVR or plant breeding rights, PBR) legislation allow plant breeders to control the use and availability of specific plant varieties, restricting seed varieties which are sold and grown, thereby concentrating the control of the seed market by trans-national corporations (TNCs) (Hindmarsh, 1999). These intellectual property rights conflict with the rights of farmers to keep and reproduce seeds from year to year (Hobbelink, 1991).

According to Scrinis, patenting laws

> … will permit corporations to continue to freely appropriate unpatented seeds from around the world, to modify a single gene of these seeds, and then patent and acquire exclusive rights over them … [the] patenting laws are clearly designed to transfer the ownership and control of the world's seed diversity – most of which has been developed and maintained by traditional farmers in the Third World – into the hands of First World corporations (Scrinis, 1998: 3).

Thus, PBR creates a dependence upon agribusiness for both inputs and seeds and has led to the private takeover of plant breeding, facilitated by programs such as the Cooperative Research Centres (CRC) established in Australia in 1990 (Hindmarsh, 1999). Increasing mergers and acquisitions have also lead towards monopoly ownership of patents by a few major 'life science' companies (Hindmarsh, 1999).

By 1994, at least 90 releases of transgenic crops occurred in non-OECD (Organisation for Economic Cooperation and Development) countries, a third of which were owned by multinational corporations such as Monsanto (Ho, 1998). Many critics are troubled by the continued control of markets that herbicide tolerance offers companies when their herbicide patents run out (Keehn, 1992). Companies now sell their chemical herbicide and crop seeds as a pair, creating a demand for both products (Doyle, 1985) – an approach which is predicted to cause an increase in reliance on chemical inputs (Keehn, 1992). Seeds have also been modified to be sterile. The so-called 'terminator technology' has been developed to ensure that farmers cannot re-use seed the following year.

Thus, farmers are losing the ability and the legal right to save and replant their seeds,

> ... further extending the colonization [sic] and commodification of the seed. Techno-industrial agriculture colonizes the seed in the sense that it penetrates into and takes control of the functioning of the seed, and imposes its own logic upon it – the logic of accelerated productivity, in-built obsolescence, and private-corporate ownership (Scrinis, 1998: 4).

In short, the bio-industry wants to increase farmers' dependence on seeds, protected by patents, preventing farmers from reproducing, sharing or storing seeds (Hobbelink, 1991; Scrinis, 1998). This raises the important issue of power relations which will be discussed in more detail in chapter five.

1.7 Structure of the Thesis and Order of Argument

Chapter 2 provides the political context of the controversy over GE and the environment, encompassing the concept of ecologically sustainable development (ESD). Like so many other techno-scientific developments, gene technology is thought by its proponents to be the answer to ESD, while critics believe that it is inconsistent with this concept. Fuelling the controversy are the increasing uncertainties surrounding gene technology, and indeed many other areas of science and technology, which has lead to the notion of the precautionary principle.

Both concepts – ESD and the precautionary principle (PP) – are tied up in the wider debate about rational, scientific and economic progress and alternative, holistic visions. The concept of sustainability is often used to try to promote a 'shared value' between both sides of the debate. However it is clear that what each means by the term is contradictory – one is seeking to maintain the *status quo* while the other seeks radical structural and social change. Critics contend that the conceptualisations of ESD and the PP in common usage in the environmental policy terrain, based on western science, are insufficient for a long-term sustainable future, because they reflect modern science's reductionist epistemology. They call for a strong interpretation of the precautionary principle for gene technology (GT) policy, which incorporates a more socially responsible, or 'post-normal' science, which they believe is more suited to a long-term sustainable future. Embracing that view, chapter 2 points to the need for change to GE policy.

Chapter 3 outlines the background to environmentalists' calls for a post-normal approach, and why the green critique of the modern scientific epistemology has evolved. The long-standing view of science as an autonomous provider of objective, factual data for decision-making has come increasingly into question. Environmentalists strongly attack western science, claiming that it is reductionist, restricts other forms of knowing, and is inadequate for dealing with scientific uncertainties. A critical look at the history of western science highlights that the direction that modern science took was not inevitable, and that an alternative science, that is consistent with the PP, has always been accessible. The criticisms of the scientific method extend to biotechnology. It is the epistemology of genetic determinism that underpins the method and regulation of genetic engineering, and which is contested. Critics call for a more holistic, reflexive approach, which is offered by post-normal science and post-normal rDNA genetics. Unlike modern science, post-normal science does not pretend to be value-free or ethically neutral, and embraces uncertainty, which is an inherent factor in gene technology applications and therefore needs to be a central part of policy concerning genetic engineering.

Chapter 4 then looks at the theory which underpins change to such a post-normal approach, and which requires a firm emphasis on the ideals associated with the strong PP for gene technology regulation if we are to strive for a long-term sustainable future. It outlines the eco-critical theoretical framework adopted for the analysis of the GE policy terrain, drawing on insights from the radical green critique of deep ecology, social ecology, and eco-feminism. This includes Beck's concept of 'risk society' and the need to strive for reflexive modernity.

Given this better understanding of the theory for reflexive change, we then turn in Chapter 5 to look at the role of power and policy as a method to understand and analyse constraints to change. In order to understand the GE policy terrain, and why the PP has been marginalised, it is essential to go 'behind the scenes' and analyse the manoeuvres of power, in order to advance to a position of transformational change. This thesis provides a case study of

Australia's GT policy development, culminating in the GT Act 2000. This involves the inquiries that formed part of the process, providing central conduits of power that empowered GE and disempowered its critics. Thus, chapter 5 reveals a power relations methodology by which to inform the eco-critical theoretical framework put forward in the previous chapter. It looks at the circuits of power and the processes of translation, including closure of controversy, which are used in the following chapters to analyse and understand the GE policy terrain.

Before we turn to this analysis, however, it is important to place it in its global and local context. Chapter 6 therefore begins by looking at the global GT regulatory terrain, providing the context for Australian biotechnology development and regulation.

Chapter 7 builds on Hindmarsh's (1994) findings of this important period in Australia's GE regulatory development marked by the first public inquiry into GE in 1992, which helped to shape the current terrain and provides the link to the recent inquiries into genetic engineering in Australia. Particular focus is given in this chapter to the development of the Gene Technology Act 2000 which forms a case study to analyse the power relations processes in the policy terrain and to take a critical look at the role that the precautionary principle plays in this legislation. The analysis looks at the processes of translation, which is revisited in the concluded chapter through the concept of closure of controversy in both the government and public domains.

The analysis of the local terrain is continued in chapter 8, this time focussing on closure of controversy through the process of inquiry. The three recent inquiries into GE in Australia are used as case studies here and include the senate inquiry into GE, the Tasmanian inquiry, and the inquiry into primary producer access to GE. Comparisons are made between the recent Australian inquiries and the first Australian inquiry, to gain insights into how genetic engineering has been empowered, and environmentalists disempowered, by these processes. It is hoped that this increased understanding will assist environmental change actors to challenge the status quo through facilitative forms of power.

The role of the state is revisited in the concluding chapter which also further explores closure of controversy in the government and public domains. ESD, the precautionary principle, and their role in GE policy and regulation are reflected upon, and recommendations for future policy and research are also suggested.

2

The Politics of Genes and the Environment

Despite its problems, nationally as well as internationally, biotechnology has become a subject of ever-increasing social and economic importance (Kvistgaard, 1994; OTA, 1991; OECD, 1991, 1994). Research and development into gene technology has attracted significant investment from multinational companies, and the past few years have seen emerging commercialisation of its applications, with GM soy, corn, cotton and canola in the US (most with pest or herbicide resistance) making up a significant proportion of the total crops (Tripp, 1999). In 1998, the global area of transgenic crops increased to 27.8 million hectares from 11.0 million hectares in 1997 (James, 1999; Huppatz and Fitzgerald, 2000). The US represented 74 per cent of this global area of GM crops, Argentina 15 per cent, Canada 10 per cent and Australia 1 per cent (James, 1999). By 2001 the global area devoted to transgenic crops was 52.6 million hectares (James, 2001). In Australia, only one GM crop is currently grown commercially, namely insect resistant (INGARD) cotton, which accounts for 30 per cent of Australian cotton crops (Huppatz and Fitzgerald, 2000).

Agricultural biotechnology is therefore being rapidly introduced onto the market, yet there is widespread condemnation of its regulation and policy processes. Public concern about gene technology and the demand for public participation in decision-making and policy formation are also increasing (Martin and Richards, 1995). This, along with the huge uncertainties surrounding risk management of biotechnology and the economic basis of its application, emphasise the complexities with which biotechnology policy must deal. It also highlights the broader range of policy issues that now need to be considered with the rapid push towards commercialisation of GE products.

Thus, the genetic engineering debate has given rise to increased activity in policy making and is essentially a public policy issue. It is therefore timely to discuss the policy agenda that will ultimately shape the future of world agriculture. Public policy is concerned with how problems are constructed and defined and how they come to be part of the policy agenda. It is also "... how, why and to what effect governments pursue particular courses of action and inaction" (Parsons, 1995: XV). Like environmental studies, public policy is interdisciplinary. This thesis seeks insights into why debates about gene technology policy occur and how they can be used effectively for productive policy reform. As stated by Mazur (2001: 3) more time should be spent 'managing' human actions than 'managing' nature. Mazur (2001: 4) goes on to state that "It is … the inherent difficulty and political risks associated with understanding and managing human behaviour and organisations that require the bulk of our attention".

Along with the important concerns raised by environmentalists, new developments in the field of gene technology raise the questions of how far, and in which directions, society is prepared to let the technology develop and at what cost to society and the environment? The direction and rate of applications will depend on policy decisions. It also raises the critical question of who will decide. Ultimately, it is this issue of who controls biotechnology and the release of genetically engineered organisms (GEOs) that is of primary concern to this thesis. In order to understand the social agenda that has been constructed behind the development of biotechnology, it is essential to look at the issue of power (Hindmarsh, 1995: 9). Another concern of this thesis is the politics of the consideration of alternatives. This refers to a constructive form of politics which resists the techno-industrialisation and globalisation of world agriculture (Scrinis, 1998). This could include supporting agriculture and food production systems that allow individuals and communities to exercise greater control over all aspects of the food chain. Examples may include food co-operatives; supporting seed exchange networks; and purchasing organically and locally grown foods (Scrinis, 1998).

While examining genetic engineering as a policy issue, this chapter introduces the major constructs of power and the state which will be returned to for further elaboration in Chapter 5, and again revisited in the conclusions. This chapter is premised on the idea that modern biotechnology, like many environmental issues, represents a unique challenge for the liberal democratic state. It establishes the need to recognise two conflicting paradigms – the ecological paradigm with its environmental discourse, and the dominant social paradigm responsible for the legitimisation practices of the state and the unequal power relations between actors in the GE policy terrain. It is these conflicting paradigms and unequal power relations that have lead to political conflict in the area of modern biotechnology development.

This chapter also investigates the role that ecologically sustainable development (ESD) has played in Australian environmental policy and its implications for future policy. In addition it explores the precautionary principle in the context of planned releases of GMOs and the reasons environmentalists are calling for a more holistic, ecologically situated precautionary principle.

Finally, this chapter will argue that the administrative response to the gene technology controversy is limited, and therefore the public policy outcomes are in turn limited. Thus, it is argued that gene technology policy and regulation in Australia needs to change to incorporate the ideals of ESD, the precautionary principle, and participatory democracy.

2.1 Policy and its Analysis

While the importance of gene technology as a policy issue has been identified above, it is necessary to clarify what is meant by policy and its analysis before any meaningful analysis can occur. As stated by Wildavsky (1979: 15) "... there can be no one definition of policy analysis ... Policy analysis is an applied sub-field whose content cannot be determined by disciplinary boundaries but by whatever appears appropriate to the circumstances of the time and the nature of problem". Lindblom (1980: 5) views policy making as "... an extremely complex process without beginning or end and whose boundaries remain most uncertain". This supports Parsons' (1995: 73) assertion that no one theory or model is adequate to explain the policy process. Parson believes that policy analysis involves multiple constructions of the policy process and the problems policy-makers face. Adding to the complexity of the policy making process is that it inevitably takes time, whereas GE is advancing much more rapidly. It must, therefore, be asked how policy and the law will keep up with the technology. This is another reason that many environmentalists are calling for the implementation of the precautionary principle in GE policy.

Ham and Hill (1993: 12) assert that a 'decision network' may be involved in yielding actions, and involve a 'web of decisions' that may extend over a long period of time. According to Ham and Hill, 'non-decision making' (discussed further in Chapter 5) has become important in recent times and they argue that a great deal of political activity has focused on maintaining the *status quo* and resisting challenges to existing value systems. Thus, the study of policy involves looking at 'non-decisions' as well as decisions.

A key contribution to understanding the 'process' of policy making is Lindblom's concept of 'incrementalism'. In 1968, Lindblom proposed a model that took 'interactivity' and power into account. Here, account should be taken of bureaucracies, parties and politicians, interest groups, and also of 'deeper forces' (including business, inequality, and the limitations of analysis) that influence the policy process. The analysis of power, then, is vital to the interpretation of policy-making. This chapter will begin by looking at the major theorists on the constructs of power and the role of the state, before turning to look at the role of bureaucracy and administration in environmental politics.

2.2 The Role of the State

Defining the state is complex and is confounded by its institutional and functional dimensions (Mann, 1988). Wolfe states that: "If state power is ever to be understood, the term itself must be brought back into existence; to resurrect the state is to make a political declaration about the centrality of organised political power in modern societies" (Wolfe, 1977: ix; cited in Ham and Hill, 1993: 23). Ham and Hill (1993) share this view, believing that it is essential to give the state a central position in policy analysis, with the state defined in terms of the institutions that constitute it or by the functions these institutions perform. Along these lines, Jessop (1982) provides the useful concept of the state as a field of political struggle, in which the actions of the state are dependent upon the balance of power within the state.

It can be argued that there is also significant political power beyond the state. Foucault for example, asserts that significant parts of government work are conducted outside of state bureaucracy. For Ham and Hill (1993: 21) this informs the view that: "The effectiveness of policies and policy-making processes cannot be assessed independently of analysis of the distribution of economic and political power within political systems", as the activities of the state are "... inextricably bound up with economic developments within society" (Ham and Hill, 1993: 25). Buttel *et al.* (1990) have identified several gaps in the sociology of agriculture, including efforts to understand agricultural policy from comprehensive theories of the state. Within the agricultural biotechnology terrain, processes of change are largely controlled by "political-economic structural organisation" both locally and globally (Hindmarsh, 1994: 99).

Ham and Hill favour the type of approach where "… analysis of specific issues is combined with an analysis of the role of the state" (Ham and Hill, 1993: 21). Their views also support Lindblom's (1977) work, which points to the power of corporations in Western industrialised countries and their ability to block change induced by the state. Lindblom (1980: 71) asserts that business has significant control over government policy-making and that governments show constant concern over business performance. Thus, the state is often persuaded that its role is to provide business with what it requires to be profitable. The market can therefore constitute a significant constraining element on government policy. Lindblom (1980: 75) describes how big business often exercises its influence over the policy process through "… persuasion, exchange, and authority. Their privileged frequent communication with government officials makes persuasion easier than for other citizens". When such strategies are successful, government and business elites then try to persuade citizens that their hands are tied since business needs must be met for economic reasons (Lindblom, 1980). These persuasive processes can then remove issues not relevant to business from the policy debate (Lindblom, 1980: 79). Thus, advanced capitalism can form a significant obstacle to the realisation of environmental policy goals that do not conform to business goals (Crowley, 1992: 142). This is consistent with Dryzek's (1995) assertions that contemporary liberal democratic states are structured to respond to powerful forces of capitalism.

Another influence on GE policy relevant to the Australian situation is federalism. This system divides powers and responsibilities between tiers of government (Wilcox, 1989). In Australia, these tiers are the Commonwealth government and state and territory governments, as well as local governments. Doyle and Kellow (1995: 145, adapted from Wilcox, 1989) outline the five key characteristics of federalism: first, the formal division of government into two tiers; second, the maintenance of political and legal autonomy of each tier in certain areas of government activity; third, separate bureaucratic systems to administer the areas of government within each tier's jurisdiction; fourth, separate legislatures and executives for each tier; and lastly, recognition by each of the tiers of the jurisdictional autonomy of the other – all characteristics that are problematic for integrated and holistic environmental policy.

Federalism has long been recognised as problematic for environmental policy, as jurisdictional boundaries have for the most part not taken integrative ecosystems into account and there is no clear distinction between the responsibilities of different levels of government for environmental policy (Doyle and Kellow, 1995). A contemporary example is that of the salinity problems of the Murray-Darling Basin, an area of land that crosses over three state boundaries, and where it has been extremely difficult to implement an integrative approach. There has also been difficulty in getting the various states to agree on the nature of GE legislation in Australia, and this is discussed in greater depth in Chapter 7.

Any aspect of environmental policy in Australia, including gene technology, can then be considered in this context. Environmental issues have been a recent addition to the state's agenda – since the late 1960s or what Doyle (2000) refers to as the first period of Australian environmentalism – and there is an inherent conflict between economic and environmental pressures (Dryzek, 1995). Ultimately, if environmental imperatives are not compatible with business goals, then business interests will turn against the state. Free trade restrictions such as the General Agreement on Trade and Tariffs (GATT) allow capitalism to intrude even further upon environmental interests (Dryzek, 1995). From a shallow green perspective, Dryzek (1995) believes that any attempt to protect the environment would be taken more seriously by the state if it could be demonstrated that it was beneficial to economic interests.

The work of Stone (1988) is of also of great importance here, providing a very useful contribution to theories of the state. Stone identifies two opposing models that have competing ideas and values that underlie decision-making. The market model – based on 'rational' decision-making involving rational and scientific methods (such as cost-benefit analysis) – has dominated the policy field. Stone argues that this market approach is far too limiting as its focus on individuals maximises self-interest and, therefore, ignores political communities (the 'polis'). Unlike the market model, change in the polis occurs through group alliances, and the emphasis in policy analysis therefore shifts to how these alliances are maintained and represented, and how they influence policy.

While in the polis decisions are seen to be based on complete and accurate information available to everyone, Stone also recognises that much political activity is focussed on trying to control the interpretation of information (Stone, 1988: 21). Stone highlights that power in this context "... operates through influence, co-operation, and loyalty" (Stone, 1988: 24). Similarly, Yeatman asserts that "Political activity itself becomes pre-eminently a politics of contest over meaning" (Yeatman, 1990: 155).

This raises the important issue of the nature of power which will be explored in more detail in Chapter 5. However, before we can address these power relations it is important here to examine the different models of power and the state that are central to the understanding of power relations in the context of gene technology within the current capitalist system.

2.2.1 Pluralism

The pluralist approach to power emerged in critical response to elite theorists' claims about the unequal distribution of power in the US (Doyle and McEachern, 1998). It argues that power is not concentrated and no group is without power to influence decision-making (Ham and Hill, 1993; Doyle and McEachern, 1998). In a pluralist society, power is thus fragmented and diffused: there are no differences in the amount of power held by all individuals (Doyle and McEachern, 1998). Any individual's or group's abilities to obtain favourable outcomes is a result of their resources, organisation, the tactics of power they employ, and the effectiveness of their rivals (Doyle and McEachern, 1998). Society is thus made up of individuals all rationally pursuing their own goals. These individuals are considered to be apolitical and only get involved in politics when there is some sort of disruption or controversy (Doyle and McEachern, 1998). Martin (1984), however, disputes the latter assumption, arguing instead that dissent is the norm of society.

Bachrach and Baratz (1970) outline pluralist methodology as possessing four main parts. First, a number of 'key' political decisions are selected for study. The actors who took part in decision-making are then identified, and a full account of their behaviour analysed while the policy conflict was being resolved. Last, the specific outcome of the conflict is determined and analysed. Pluralist approaches, therefore, only account for 'visible' decisions and actions, and as a result, the state is rarely investigated (Ham and Hill, 1993). Overall, the state is considered to be unbiased and does what society tells it to. It is seen as an impartial arbiter among competing interests (Olsen and Marger, 1993).

There are many problems with the pluralist model, however. In advocating that every citizen has equal power, with no specific group having additional power, it goes unacknowledged that corporations have a privileged position, or can manipulate policy terms, or are sometimes indistinguishable from the state (Doyle, 1999). Roundtable decision-making, with 'stakeholders' is used to resolve problems, where all 'stakeholders' are assumed equal (Doyle, 1999). To assume that a general member of the public or a small-hold farmer has equal power to an industry representative is clearly unrepresentative of reality. For effective decision-making, instead power differentials among stakeholders must be clearly recognised and articulated. Another major weakness of the roundtable is that it is exclusive and often established by big business or by the state. As stated by Doyle (1999: 127) "... industry representatives are markedly over-represented; create agendas and bottom lines; set terms of reference; and simultaneously, receive acclaim as achievers of community consensus." Thus, the overall purpose of the roundtable is to reach total consensus. This of course is most easily achieved if the stakeholders are limited, creating an in-built bias in the roundtable.

Despite its problems, the pluralist model is the conventional view in Australia and is so dominant that it is rarely discussed (Doyle, 1998). Elite theorists, however do put up a challenge to the pluralists.

2.2.2 Elitism

Elite theory challenges the power distribution asserted by pluralists. Elite theorists such as Mills (1956), building on the work of classical elite theorists, state that political power is concentrated in the hands of a minority of the population who control the government and market economy (Lindblom, 1977: 20; Ham and Hill, 1993: 31; Cox *et al.,* 1985):

> [E]lite power may be based on a variety of sources: the occupation of formal office, wealth, technical expertise, knowledge and so on ... In the twentieth century, the growth of large firms, the establishment of trade unions, and the development of political parties – all institutions in which effective power rests with an oligarchic leadership – underlines the significance of organisational control and institutional position as key political resources (Ham and Hill, 1993: 32).

Thus, social power is an outcome of the control of organisations by elites (Olsen and Marger, 1993), with the majority of people having no input into the policy-making process. The state is therefore acting in the interests of powerful organisations and individuals, producing a centralised power structure (Olsen and Marger, 1993). As outlined by Cox *et al.* (1985), elite theory focuses on socio-political determination rather than economic determination. It is not concerned so much with "who governs?" but with "how is government maintained?" with the state firmly politicised (Doyle, 1998).

Yet another model of the role of the state in liberal democratic society is the Marxist derived structuralist model, to which we now turn.

2.2.3 Structuralism

As Cox *et al.* (1985) assert, there is as much debate within Marxism as there is between Marxists and non-Marxists. The two main schools of thought within Marxism are instrumentalist (see Milliband, 1969) and structuralist, with the former influenced by the early writings of Marx. According to instrumentalist accounts, power in capitalism is based upon a state that serves the interests of the ruling class who own the means of production. This theory suggests that the function of the state is to assist capital accumulation or, in other words, to promote conditions for profit. This economic base will then determine the political superstructure (government and social institutions) (Cox *et al.*, 1985: 49). The instrumentalist explanation argues, "... the true locus of change can only be understood in terms of the objective laws of motion and requirements of the capitalist mode of production" (Cox *et al.*, 1985: 49). It denies that individuals choose freely and that policy processes can be based on their subjective and value preferences (Cox *et al.*, 1985: Olsen and Marger, 1993). The state is seen as a "repressive instrument to ensure class domination" (Cox *et al.*, 1985: 52).

Today, capitalism is based on large multinational companies. Non-Marxists therefore argue that the structure of power is no longer in the hands of a capitalist ruling elite class, but rather it is pluralistic (Cox *et al.*, 1985). However, many Marxists disagree, claiming that the state still serves the interests of a ruling class – an international capitalist class made up of large monopoly and oligopoly companies, banks, and the state (Cox *et al.*, 1985).

In contrast, structuralist Marxists, following Antonio Gramsci, assert that the state may have a degree of autonomy from the interests of the ruling class (Cox *et al.*, 1985). This autonomy is only relative however, because, as Poulantzas (1973) asserts, structural constraints placed on the state by the power of capital explains the political force of the economically dominant class. Thus "... thought and action are conditioned to serve the interests of capitalism through ideological hegemony" (Cox *et al.,* 1985: 66). This hegemony perceives that the dominant capitalist world-view will prevail "... by distorting beliefs, values, common sense assumptions and popular culture" (Cox *et al.,* 1985: 67). Structuralist Marxists like Milliband (1969) and Poulantzas (1973) recognise that alternatives are undermined by the unconscious acceptance of the dominant ideology.

According to Cox *et al.* (1985: 73), one of the major strengths of Marxist accounts is their recognition that the most powerful individuals in society are often those who obtain their power because everyone accepts unconsciously that they should benefit (for example the case of Bill Gates and his computer software empire). Attention is now turned to the final construct of the role of the state, which is the corporatist model.

2.2.4 Corporatism

According to Schmitter (1974) and Winkler (1976; cited in Ham and Hill, 1993), industrial concentration, international competition and declining profits in the global economy have caused a shift towards corporatism. The state is not controlled by any particular economic class, but plays an independent role in relation to labour and capital. Panitch (1980: 173) states that corporatism is a political structure within advanced capitalism that "... integrates organised socio-economic producer groups through a system of representation and co-operative mutual interaction at the leadership level and mobilisation and social control at the mass level". Thus, the corporatist thesis is that the state has moved from supporting capital accumulation to directing that process. According to Ham and Hill (1993), the corporatist theory's emphasis on the state as a key actor is its most important contribution to the debate about power.

Neo-corporatists claim that this model usually relates to powerful 'economic producer groups' such as business associations (Panitch, 1980; Ham and Hill, 1993). However, in some instances in Australia, the government has treated environmental groups as part of the decision-making process (Economou, 1993). As Downes asserts:

> Neo-corporatist theory can be extended beyond its traditional concern with functional, production-based interests to include organisations with the capacity to disrupt the

production process and with the organisational maturity to negotiate in a neo-corporatist structure (Downes, 1996: 187).

McEachern (1993: 174) asserts that environmental policy is an area that is susceptible to corporatist interpretation. This approach can reveal a great deal about the strengths and weaknesses of such policy, as well as providing insights into the role of the state. According to McEachern (1993: 174), policy documents codify the way the relationship between economics and the environment should be approached by the government, business and community. Thus, it is important to look at the negotiated relations between business, environmentalists and the state. Similarities have been drawn between this kind of analysis and pluralism, as it is an investigation of the political process and the role of organised groups in competition (McEachern, 1993). McEachern (1993: 176) identifies three main processes involved in corporatist analysis. First, representation – who, or what, is organised and how they get into the political process – involves a reduction in the range of those involved to increase organisational coherence. Next, there are negotiations, which illustrate the importance of the role of the state and its associated institutions that set the policy agenda. Lastly, there is government intervention, which may involve market-like instruments. In a case study of the development of the *National Conservation Strategy for Australia* and the *Ecologically Sustainable Development Reports*, McEachern found that an ecological defence of economic development was common to them both, with negotiations promoting a sense that there was a consensus position on environmental issues. Dissidents of both the environment movement and business were constructed as dissidents against a shared and politically acceptable position. The process involved assimilation, whereby ecological concerns were turned into 'legitimate' and 'acceptable' discussions about existing economic practices (McEachern, 1993). According to McEachern, the process adopted the form that it did due to an already existing consensus among state and business interests on the over-riding importance of economic development. He argues that the forums held were a strategy to absorb the potentially destabilising influence of growing environmental concern and to promote economic growth and development. Thus, involvement of environmentalists in the policy process is seen as a move by governments to neutralise opposition. The relevance of this to Australia's GE policy terrain will be discussed in more detail in Chapter 7, and revisited in the concluding chapter of the thesis.

Thus, many diverse views inform constructs of power and the role of the state, all of which provide insights for analysis of the dimensions of the gene technology policy terrain, and which will be revisited in the final chapter of the thesis. With this in mind, we can now turn to the role of bureaucracy and administration in this socio-political context.

2.3 The Power and Politics of Bureaucracy and Administration

Public administration is another domain where the dispute over environmental and economic concerns unfolds. It is impossible to separate biotechnology from administration, both in theory and practice, since it is the regulators that shape the direction of biotechnology research and development. Administrative discourse both expresses and reflects the structure of institutions and practices (Ferguson, 1984). As Scott and Hart (1973: 415) argue, "... the deleterious effects of technology are the responsibility of those who control and administer the complex organisations within which it is embedded." Part of the present administrative problems may be technical in nature, but the important factor is the values of administrators (Scott and Hart, 1973) – what Weber (1978) refers to as the "administrative mind" – which remains unarticulated and therefore unexamined (Scott and Hart, 1973). Rarely are underlying values and assumptions made explicit and opened up for debate.

Bureaucracy is defined as the part of the state that administers government decisions. This description often implies that the bureaucracy administers these decisions in a neutral, rational manner. However, the view of bureaucracy as 'neutral' can be misleading as it may have its own interests that differ from the politicians in control. Environmental administration is therefore political in character, incorporating social and political forces. Its form as centralised and hierarchical dominates industrial society, due to the prevailing bias which sees this as the only possible arrangement (Paehlke and Torgeson, 1990).

As Paehlke and Torgeson (1990) suggest, bureaucracy involves a battle between co-option and transformation. One view holds that administration takes hold of environmental politics so that environmental concerns are harmonised with the dominant assumptions of economic growth. The alternative view holds that ecological rationality comes to influence administration and become part of the administrative mind, displacing economic rationality. (The principle of ESD can be used as a practical example to show how this works, and will be addressed in more detail later in this chapter).

Max Weber (1978) provides an important contribution with his analysis of the 'rationality' of administration. Weber believed that administration imposed 'rationality' to administrative practice, thereby rendering the interests and values of administrators irrelevant. He saw bureaucracy as an organisational form that reinforces the rationalisation and industrialisation of the world. Environmentalists are critical of this administrative form and seek an alternative, decentralised administration (Paehlke and Torgeson, 1990). However, the administrative state seeks to absorb such critique, reasserting the need for its current form which involves closed decision-making and seeks to structure and control public involvement (Paehlke and Torgeson, 1990).

Dryzek (1987; 1990) contrasts administrative rationality with an ecological rationality which has a set of assumptions that takes sustainability into account. He argues:

> The preservation and promotion of the integrity of the ecological and material underpinning of society – ecological rationality – should take priority over competing forms of reason in collective choices with and impact on that integrity (Dryzek, 1987: 58-59).

This approach recognises that ecological problems are inherently complex, uncertain, spontaneous, and collective in nature (Dryzek, 1987: 28). This 'new' rationality attempts to incorporate environmental/ecological discourse into the policy process, providing greater flexibility by recognising the uncertainty and complexity of environmental systems. This principle can also be used to assess whether policy decisions are ecologically sound, based on ecological reasoning.

Thus, due to the inherent problems of liberal democracy, there is continued disagreement between environmentalists on the form that an ecologically informed democracy should take, as comprehensively discussed by Hay (2002: 310-321). Eckersley (1996a) maintains that green principles are compatible with liberal democracy, and therefore that the challenge can be met within existing state structures, provided that a shift occurs to constitute ecological concerns. Application of the precautionary principle is one way that this can be achieved according to Eckersley (1996b), and adopted in this thesis. Others such as Beck (1992) and Dryzek (1996) believe that the battle must be fought and won in the public sphere, altogether separate from state structures.

In the context of bureaucratic processes, differences in credibility and perceived expertise, as well as sources of power in controversies, become crucial – issues that are often neglected in social constructivist accounts of scientific controversies (Beder, 1991). We therefore turn now to the issue of technocracy and expertise in the GE controversy.

2.3.1 Technocracy[1] and Expertise

Networks of experts have a disproportionate influence over the definition of public issues, as well as decision making about solutions to political problems (Fischer, 1990). Fischer (1990: 13) argues that "Our reliance on experts is now nothing less than a central component of a deep-seated transformation of the very form and content of advanced industrial society itself." Technocratic decision-making takes place in administrative settings, such as regulatory committees, shielded from public scrutiny. Technocrats argue that the lay public and politicians do not have the information and sophistication to deal with decisions about complex technical issues. Advocates of a technocratic society see the solution as simple – political problems must be redefined in scientific and technical terms – a 'job for the experts':

> Economic and political guidance becomes more a problem of planning and management than an issue for public deliberation and, as such, is seen as a job for which only the experts are uniquely equipped. It is a process that opens the door to an unprecedented extension of increasingly sophisticated forms of technocratic politics (Fischer, 1990: 16).

This approach is problematic for environmental policy because, rather than incorporating a broad range of views and expertise through effective public participation, it instead restricts decision-making to technical safety issues. The policy field has been dominated by 'black box' concepts which treat technology as autonomous and 'internally' unproblematic, or at best, the non-social domain of technical experts. In this conception, technologies are evaluated by their external effects or risks alone, and not by the relationships which may be intrinsic to them (Wynne, 1988: 149).

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[1] Technocracy refers to "… a system of governance in which technically trained experts rule by virtue of their specialised knowledge and position in dominant political and economic institutions" (Meynaud, 1969).

These technocratic elites reduce issues to the dominant paradigm of scientific and administrative rationality (Scott and Hart, 1973). Biotechnologists comprise an elite group, and therefore alternative concepts and unconventional views are often inhibited (Holman and Dutton, 1978). However, environmental issues are typically trans-disciplinary and cannot possibly be addressed by one form of knowledge alone. Therefore, critics challenge assumptions about the importance of technical expertise as the basis for legitimate decision making authority. When it comes to social and ethical issues, scientists are no better equipped than other citizens in forming views and making decisions, nor, according to Clarke (1997), should they be expected to. The reliance on expert knowledge sustains increasingly undemocratic decision making processes (Nelkin, 1977) and alienates many interested parties. Gross (1980) has defined this as 'friendly fascism', while Goodman (1970) describes it as the 'metaphysical emergency' of our time. Although experts agree to act in a socially responsible way, the mechanisms for ensuring this belong to the experts themselves. For the harshest critics this represents a 'conspiracy' against society at large (Fischer, 1990).

These divergent worldviews and unequal power relations have fuelled a world-wide controversy over GE. We now turn to look at this controversy in more detail, including the role of values, worldviews, and power relations.

2.4 The Gene Technology Controversy

2.4.1 The Role of Values and Power Relations

In order to move towards a new (broadly defined) ecological framework discussed above, it is important to question what values are, how we know facts and values, and to look for a value structure that is consistent with ESD. Accordingly "We need to learn how to dissect policy proposals for their implicit values and examine them to see if they are the values that are really important" (Milbrath, 1989: 84). Due to the highly emotional nature of the gene technology controversy, it is unlikely that a value analysis would resolve it, and it is also important to give equal attention to power relations. However, such an inquiry can stimulate people to re-examine their own value systems and be an important learning process.

Although the biotechnology debate involves technical questions, it also involves competing social values. Much of the controversy involving biotechnology and risk discourse is due to different understandings of nature and science, as well as the relationship between knowledge and nature (Moser, 1995).

In relation to environmental decision making, scientists are increasingly being asked questions of values rather than fact. Scientific and technical information cannot answer whether the impacts of a proposal outweigh the benefits, whether it is 'acceptable', or how uncertainties will be perceived and interpreted by the public (Harding, 1998: 96). Despite this, the dominant discourse of risk has been instrumentalist and reductionist, with risks defined as the probabilities of physical harm from technical processes (Beck, 1992). This practice of treating safety and social consequences as entirely separate issues has caused tensions (Centre for Biotechnology Policy and Ethics, 1994). According to Harding "Continued failure to read the 'bigger picture', beyond what scientists and engineers often consider to be the 'black and white, indisputable evidence', is likely to lead to continued disputes and confrontations ..." (Harding, 1998: 2), because risk defined as a technical and scientific process is divorced from ethics (Turnbull and Hindmarsh, 2001).

The view that science cannot make value judgements is a major part of what Rollin (1996) calls the 'ideology' or 'common sense' of science. It is historically based in the notion that science should not deal with unverifiable assertions. The language used by scientists, such as the description of non-scientific issues as 'aesthetic' concerns and the 'phobia' over genetically altered crops, shows that scientists have values like everyone else, and these impact on their work. At present, technical 'experts' are given the role of defining agendas and setting risk discourses (Beck, 1992). However, regulation of gene technology can not be done on a purely objective, technical basis – it will always be affected by the values of the regulators, power relations, and the political and economic pressures applied to the regulatory process (Tripp, 1999). Those working in technological areas with uncertainty must communicate potential risks to the public. However the public may perceive risks and problems differently. Even when a problem is agreed upon, individuals may have different reasons for drawing the same conclusion (Harding, 1998).

The perceived solutions to the 'problem' will also be influenced by social and cultural values:

> A number of factors influence how an individual perceives risk and what level of risk is "acceptable". Some of these factors include beliefs, attitudes, judgements and feelings as well as the wider social and cultural values and disposition that people adopt towards hazards and their benefits. As a result, people may not view "equal risks equally" (Harding, 1998: 192).

Thus, it is important to consider ways of handling differing risk perceptions in environmental decision making (Harding, 1998). Transparency in decision making is also very important because people have different views on how uncertainty should be dealt with in decision making and also different views on assumptions made (Harding, 1998).

Therefore, decision-making is not objective or value-free. Problems are identified according to values that, in turn, influence perceptions. As stated by Harding (1998), there is interplay between culture/technology's influence on values and how these in turn affect culture. Disputes are typically seen as arguments over 'facts', when really they are about differences in values (Harding, 1998) and power relations that determine what values become defined as 'true'. An example of this can be seen in the Terania Creek Inquiry[2] process in New South Wales, Australia, in 1979. In this case, Taplin (1992: 168) reported that Commissioner Isaacs made no attempt to differentiate between scientific knowledge and professional knowledge. Instead, Isaacs treated all of the information put before him as 'facts' to be evaluated to determine which ones were 'true'.

Too often facts and values are distinguished as two separate entities when they are actually very closely aligned. It is values and perceptions that cause scientists to ask certain questions which result in widely accepted 'facts', and so we need to try to understand how people believe things are 'true' (Harding, 1998). In the case of the GE controversy, this would involve trying to understand the values that lead proponents to believe that biotechnology is not only safe but essential, and on the other hand why critics believe that it is inherently risky and therefore requires precaution. Having outlined the importance of ethics and values in environmental politics, we now turn to analyse the GE controversy in more detail.

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[2] The Terania Creek Inquiry was conducted in 1979 to investigate the environmental aspects associated with proposed logging in the area, and whether or not it should proceed (Taplin, 1992: 157).

2.4.2 The Controversy over Values and Worldviews

As discussed above, the biotechnology controversy is fuelled by uncertainties, as well as the divergence in value assumptions between decision-makers and groups of society at large, outlined in Chapter 1. However, disagreement is not just between groups of scientists as it is in many scientific controversies, but rather also between the scientists involved in GE and groups from wider society.

The controversy over biotechnology research and development is characterised, in broad terms, by two competing paradigms, introduced in Chapter 1. First, there are those who believe that modern biotechnology is "… a source of novel and monstrous hazards linked to a fundamental shift in the human relationship to nature" (Crook, 1998: 132). From this viewpoint, genetic manipulation is seen as 'playing God' and interfering with the intrinsic value of nature and biodiversity by creating novel organisms that are unlikely to have occurred in Nature, and at a rate that is not seen in natural evolutionary processes. Secondly, there are those who believe that the new technologies in agriculture are a natural extension of age-old techniques (Taverne, 1991; Huppatz and Fitzgerald, 2000) and further claim that it is a natural process (Peacock, 1995).

GE is "nothing new"

Alan Kerr, Professor Emeritus of Plant Pathology from Adelaide University, uses the example of a soil-inhabiting bacterium named *Agrobacterium*, which is responsible for causing a plant disease called Crown Gall, to support the claim that GE is not new. During the disease process, *Agrobacterium* transmits some of its own DNA into a plant cell that then grows out of control, similar to a cancer cell. The gall cells produce nutrients that only *Agrobacterium* can utilise, under instructions from the bacterial DNA. Thus, Kerr claims, *Arobacterium* is a natural genetic engineer (Kerr, 1999). Similarly, Peacock (1995: 230) states that plants, animals and microorganisms share many gene sequences, and often the differences between a plant and animal gene is no more extraordinary than that found between gene sequences of distantly related members of the same species. He goes on to point out that both plants and animals have a haemoglobin gene, which was once thought to be the "epitome" of an animal gene.

However, those subscribing to the ecological paradigm do not agree with the argument by proponents, such as Kerr and Peacock, that gene technology is a continuation of previous processes. Instead they see it as an intensification of the techno-industrial approach to agricultural production, which will exacerbate existing problems such as social inequalities, concentration of power and wealth, and ecological problems. Proponents hit out at such critics describing them as,

> … zealots who push for governmental overregulation in the name of consumer or environmental protection, and sophists who spark fear in the hearts of the naïve with chilling predictions of 'Andromeda Strains' and dysphemisms like 'eugenics' and 'Frankenfood' (Miller, 1997: 1).

However, Biotechnology Australia, in its submission to the Parliamentary Inquiry into Primary Producer Access to Gene Technology (BA, 2000), acknowledges that the majority of current genetic modifications would never occur naturally. The new technology, therefore, enables scientists to reconstitute or reconstruct nature at the genetic level, thereby transforming humans' relationship to nature (Hindmarsh *et al.,* 1998). Environmentalists believe biotechnology poses novel hazards due to this significant shift in the relationship between humans and nature (Crook, 1998), and it introduces unique questions about the identity of Nature[3] and how humans value and relate to Nature (Merchant, 1989). Arguably, it also calls into question people's concepts of place and identity in the world. Adding further complications to environmental policy, nature and science remain contested concepts.

2.4.3 Nature and Science: Contested Concepts

This thesis recognises nature as a contested concept. As Macnaghten and Urry (1998: 95) state: "… there is no single 'nature', only natures. And these natures are not inherent in the physical world but are discursively constructed through economic, political and cultural processes …" Similarly Stratford (1993: 323) asserts "There is no unified, central, absolute and universal Nature". Evidence of this is found in the biotechnology debate, involving values, rhetoric, and issue framing, and the outcome is ultimately the result of power – translating one's own conception as the appropriate way in which to view the natural world.

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[3] Nature was traditionally characterised as feminine, and in the context of the material world it meant "a dynamic creative and regulatory principle that caused phenomena and their change and development" (Merchant, 1989: xxiii).

Therefore, Stratford further asserts that:

> … we need both to step outside the current system of binary thinking with all its cultural baggage, and to work towards plural understandings of phenomena. For example, where does nature end and culture begin? How are these boundaries determined? How do we modify the discourses about nature in ways that encourage multiple understandings of women, men and environments and that extend conceptualisations of environmental politics … (Stratford, 1993: 325).

In ancient and pre-modern times, nature was conceptualised as a living organism and identified with as a nurturing mother (Merchant, 1989). However, there was also a second image of nature as 'disorder' which initiated the important modern concept of power over nature. The organic world was soon overtaken by the ideas of mechanisation and domination over nature, which helped to remove social constraints and sanction increased commercialisation and industrialisation that continues today (Merchant, 1989). It is the latter conception of nature that is held by proponents of biotechnology. Many environmentalists on the other hand prescribe to the organic theory of nature outlined above. Again, these opposing ideas and values have helped to fuel the biotechnology controversy and cause policy conflict.

Just as nature is contested so, too, is the science that is used to understand it. It is both contested by alternative ways of knowing such as indigenous and local knowledge, and also within mainstream science. As introduced in Chapter 1, within the latter there appears to be a belief that debate over biotechnology will be resolved with a public relations and information campaign – that is, dissent is due to ignorance, and once the public has the information available to them, they will accept the technology as beneficial. At present both bio-proponents and environmentalists are vying for power to have their account become the dominant one (see Scott and Lyman, 1968) and which will form the basis of biotechnology policy.

Because of the many risks associated with science and technology, the public have become wary and even sceptical of science. Thus, many environmentalists now call for alternative approaches, or 'new science'. Examples include Funtowicz and Ravetz's (1994) 'post-normal science'; Fritjof Capra's 'web of life' that combines quantum physics and eastern philosophy; and James Lovelock's Gaia hypothesis, to name three which will be discussed further in

Chapter 4. Thus there are two discourses: one which frames risks in scientific and technical terms with scientific data, and increasingly economic data, which are seen as the only legitimate decision-making tools, and the other which recognises the broader ethical and social issues (Leiss and Chociolko, 1994).

It is the numerous problems discussed in Chapter 1, along with conflicting values, which have fuelled the conflict over GE. The persistence of the controversy suggests that current political processes for dealing with these value differences are not sufficient. Similar conflicts in the 1980s including the Franklin Dam in Tasmania, and continuing dispute over forestry resource management, for example, also raised concerns that the government was not effectively handling environmental issues (McCall, 2001). This undermined their agenda to be competitive in the global market, and so the government sought to institutionalise political conflict within the ESD process (McCall, 2001). Therefore, as ESD evolved to facilitate the government's economic goals, environmental ideals became marginalised. Why then do both sides of the debate call for ESD? Is it a shared value? What, if anything does ESD have to offer environmental policy?

2.5 Ecologically Sustainable Development (ESD)

The concept of sustainable development is an example of how alternative ways of knowing continue to be marginalised by power relations and ideals that shape discourse about humans' relationship to nature (Shiva, 1988). For proponents of GE, sustainability is about promoting and utilising gene technology and sustaining economic growth, while for many environmentalists the technology is one of the biggest threats to sustainability. As introduced earlier, the concept of sustainable development is often used to promote a 'shared value' between both sides of the debate. It is clear, however, that what each means by the term are in extreme contradiction to each other – one extreme is seeking to maintain the *status quo* while the other seeks radical structural and social change. Thus, the sustainability movement is very broad, including both mainstream and radical grassroots environmental organisations, scientists and individuals (Merchant, 1992) and increasingly, government and industry are adopting the term to justify their actions.

The term 'sustainable development' first appeared in the 1970s and re-emerged in the *World Conservation Strategy* (IUCN, 1980). The term evolved due to the realisation that the earth's resources are finite and cannot sustain society indefinitely, and was therefore seen to be anti-developmental by some. However, to others it was seen as an attempt to accommodate rising levels of environmental concern, providing rhetoric to allow continued economic growth (Beder, 1993; Doyle and McEachern, 1998) with technology as the means to this end. The term was reformulated in *Our Common Future* (The Brundtland Report, WCED, 1987) and further at the Rio Earth Summit (sponsored by multi-national corporations) and with the publication of Agenda 21 (1992) to emphasise the need for economic growth and dominance of human welfare over the needs of the environment. The definition given in *Our Common Future* is the most widely used:

> Sustainable development = development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1990: 87)

A major criticism of the Brundtland Report is the way it emphasises western scientific knowledge and marginalises indigenous ways of knowing. Humans are at the centre of sustainable development – the concept is purely anthropocentric and does not take other living things into account. The first principle of the Rio Declaration on Environment and Development states:

> Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature (UNCED, 1992: 1).

According to this principle, the quality of life of other organisms is only important in terms of their benefits to humans, a principle which is criticised by many deep green environmentalists (which will be discussed in Chapter 4). The report also did not acknowledge that research funded by large corporations would inevitably benefit western interests rather than those of Third World countries (Merchant, 1992). Similar criticisms have also been made about the Rio Earth Summit. Doyle (1998) states that the Earth Summit was shaped largely by Northern elites – governments in close association with transnational corporations and, therefore, it is not surprising that sustainable development has promoted economic growth and industrialisation at all costs.

In Australia, the Hawke Labor Government moved to co-opt environmental concerns by adding 'Ecological' to the concept of sustainable development:

> Ecologically sustainable development means using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained and the total quality of life, now and in the future, can be increased (Commonwealth of Australia, 1990: preface).

However, ESD was characterised by a strong commitment to market environmental economics. According to Doyle and McEachern (1998: 36) "… like sustainable development, ESD was used as an indicator of the government's environmental concern but it did not interfere with its continuing promotion of economic development or the speeding up of project approvals". It has been claimed by critics such as Doyle (1998) that the environment movement, co-opted into the Agenda 21 process, remains "profoundly weakened" by its continued involvement.

Confusion about the concept of sustainable development has been created due to terms such as 'sustainability', 'sustainable development', 'sustainable economic development', and 'ecologically sustainable development' being used interchangeably. As stated by Hollick (1992), with such loose definitions, the term(s) seem to mean all things to all people. Conflicting interests and opposing worldviews also lead to varying interpretations (Wackernagel and Rees, 1996). Ultimately, what is meant by sustainability is a question of underlying values and ethics and it must be decided *what* is to be sustained (Bossel, 1998). It is argued by some that the term is deliberately vague due to power politics – it is seen as an attempt to blur the important issues and generate consensus that environmental protection can be achieved alongside economic development, enabling the perpetuation of dominant paradigms (Beder, 1994; Wackernagel and Rees, 1996). Redclift states:

> … the elusiveness of the concept is partly due to the fact that the notion of sustainable development is being proposed as the innovative solution to the environmental problems that have resulted from our modern frame of reference, which is diagnosed as inherently destructive to the environment, while at the same time an attempt is being made to fit this notion into that same framework in order to make it operational. It can be argued that the continued use of the term 'sustainable development' is due to

> the way it can be used to support varying political agendas (Redclift, 1994; cited in Verburg and Wiegel, 1997: 248).

Similarly, Verburg and Wiegel (1997) assert that the confusion surrounding the concept of sustainable development is due to the perception that it is a technical problem and as a consequence, the question of whether sustainability and economic growth are compatible is largely ignored. The Brundtland Report recommended a "new era of economic growth" based on the assumption that economic growth and ecological health can be combined. However, Shiva states:

> While development as economic growth and commercialization [sic] are now being recognized as being at the root of the ecological crisis in the Third World, they are paradoxically being offered as a cure for the ecological crisis in the form of 'sustainable development.' The result is the loss of the very meaning of sustainability (Shiva, 1992: 188).

The confusion over the meaning of ESD and why it is important has slowed progress towards achieving it in any semblance of an ecological interpretation (Wackernagel and Rees, 1996). ESD is expressed only in terms of broad goals. A fair criticism of the Brundtland Report, raised by Soussan (1992), is that its goals were so broad that they are impossible to disagree with and also too vague to be translated into firm actions.

The term 'sustainable', while subjective and determined by cultural values and ideas, is also dependent on temporal and spatial scales. Whether or not an activity is sustainable is directly related to the time frame adopted. Policy makers need to look at long-term as well as short to medium-term effects of decisions. This issue of time scale is a fundamental problem of the ESD concept. One of the most difficult challenges for ESD is policy-making in the face of uncertainty (Dovers and Handmer, 1995). At all scales policy-makers face uncertainty about the causes of environmental change and the severity of long-term effects. While the needs of future generations must be considered, it is impossible to know all of their needs and values. It can also not be predicted how far and in which direction science and technology will advance, although history can give us some possible indications. Thus, we can not truly know what is ecologically sustainable, and it is because of this that there needs to be a shift towards a precautionary approach.

The concept of sustainable development has succeeded at the level of government and business because of its central idea that environmental protection is not necessarily opposed to development. It accommodates economic growth, industry and business interests, as well as the free market, and therefore does not threaten the capitalist structure of western societies. Rosmarin (1990), however, believes that the two terms 'sustainable' and 'development' are in a strict sense contradictory, as sustainability implies long-term renewal, maintenance, minimal resource use and management of human needs. Development in its traditional sense, however, implies short-term planning, minimal maintenance, maximum exploitation of resources and emphasis on the individual (Rosmarin, 1990). Similarly, Daly (1991) regards 'sustainable growth' as a self-contradiction.

Others such as Beder (1994) believe that there is not a necessary contradiction between sustainability and growth, rather it is a matter of what sort of growth and how it is to be achieved. Beder asserts that there needs to be a shift from the idea of growth as increased economic activity and use of resources, to a more efficient use of resources. This approach is more constructive in the context of environmental policy, leaving options open for ecologically sound applications of GE. At the same time it recognises that many applications based on economic criteria alone are likely to be environmentally damaging or ethically unsound.

Many environmentalists believe that the original meaning of 'sustainability' advocated in the 1970s should be used (Beder, 1994). From the ecological point of view, 'sustainability' means the maintenance of the integrity of ecology and a harmonious relationship between all of Nature. Thus, they believe that the concept of sustainability needs a new frame of reference that is consistent with an ecological view. Advocates of the ecological viewpoint are opposed to continued economic growth and the maintaining of the status quo, which they believe is inherently unsustainable (Goldsmith *et al.,* 1972). Many also feel strongly that the environment should not be given a 'valuation' in economic terms, as this will merely perpetuate the central problems that have caused environmental degradation in the first place (Beder, 1994). Concerns are also raised that this type of valuation would allow the environment to be traded off for economic gains, thereby greatly underestimating the true value of the environment. Bossel (1998: 93) defines sustainability as "... maintaining a maximum of future options, and that requires maintaining the 'seed bank' of available systems and approaches for potential future use. In other words, sustainability means preservation and encouragement of diversity."

There is broad consensus among environmentalists that there needs to be a fundamental shift in societal values and the way human needs are met, through changes in resource usage (Wackernagel and Rees, 1996; Middleton, 1995). As stated by Wackernagel and Rees (1996), there needs to be a shift from managing resources to managing *ourselves.* Hollick (1992) optimistically advocates an economy based on the human spirit, while Merchant (1992) discusses the need for a systems approach and ecocentric ethic to achieve sustainability, including sustainable agriculture. Permaculture[4] is one example of sustainable agriculture which imitates ecosystems. Similarly, the underlying assumptions of biological control and integrated pest management are ecologically grounded, in contrast to the anthropocentric approach of chemical control, and are alternatives that should be considered in policy decisions.

Despite the elusive nature of the term, ESD has been successful in getting environmental issues on the political agenda and as such there has been resultant recognition of the inter-relationship between the environment and human activities. Although ESD has not been overly important for policy making, it is a good starting point to consider what ESD should be and how governments can implement it. The problems of the principle need to be made explicit, addressed, and an ecologically situated principle of ESD put in place.

Bossel (1998) discusses two future paths: one is the current path of development or 'competition' and the other is a shift to an ethic of 'partnership' discussed above. As sustainability incorporates physical, ecological, social, psychological and ethical dimensions, it must remain a dynamic concept (Bossel, 1998). Ultimately, it must be flexible enough to deal with the problem of uncertainty, which has also lead to the emergence of the precautionary principle.

2.6 The Precautionary Principle, Risk and Uncertainty

The problems caused by modern science and technology have called their assumptions and practices into question (outlined further in Chapter 3), and raised the issue of uncertainty which is an inherent factor in both science and environmental policy. There is also much

[4] Permaculture (permanent agriculture) is both a philosophy and practical technique which can produce food and use energy in a sustainable way. It is the conscious design and maintenance of agriculturally productive ecosystems which have the diversity and resilience of natural ecosystems.

uncertainty about the social consequences of new technologies which is increasingly driving the debate about gene technology and sustainable futures (Turnbull and Hindmarsh, 2001).

Brian Wynne (1992: 114) identifies four kinds of uncertainty: 1) risk: the behaviour of the system is basically well known, and the chances of different outcomes can be defined and quantified by structured analysis of mechanisms and probabilities; 2) uncertainty: we know the important system parameters but not the probability distributions; 3) ignorance: we don't know what we don't know; and 4) indeterminancy: when we do not know all the factors influencing the causal effects of networks. It must be noted, however, that the term 'risk' is often used in a much broader sense than that described by Wynne. It often has a more technical meaning, referring to a "... combination of the probability, or frequency, of occurrence of a defined *hazard* and the magnitude of the consequences of the occurrence" (Harding, 1998: 167).

Thus, in order to achieve ESD, policies need to be established to deal with these uncertainties constructively. One way to aid this is to incorporate a wider range of 'stakeholders' in defining and investigating 'problems' in order to take into account for different values, beliefs and disciplinary backgrounds (Harding, 1998: 98). Another, proposed by Turnbull and Hindmarsh (2001) in the context of planned releases of GMOs, is to adopt an environmentally ethical approach, incorporating the strong precautionary principle. This principle recognises that time must be taken to assess the possible risks of the technology and the desirability of certain biotechnology developments, rather than accelerating at a rate that makes risks and outcomes difficult to predict (Carmen, 2000).

The precautionary principle was first formulated in Germany to deal with activities causing environmental pollution. However, since the 1980s it has been incorporated into many national and international treaties and legislation. It emerged as one of the principles of ESD, to provide guidance in decision making where there is scientific uncertainty. The precautionary principle falls into two broad categories: strong – take no action unless there is certainty that no harm will result; and weak – lack of full scientific certainty is not a justification for preventing action to minimise environmental harm. Governments have invariably used the weak definition. In 1992 the United Nations Conference on Environment and Development (UNCED) adopted principle 15 which states that "... where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation." This weak version is highly pragmatic, allowing regulators flexibility in determining relevant factors and importance of environmental risks, and such formulations "… tend to be restricted to the most toxic and human life threatening substances or activities" (O'Riordan and Jordan, 1995: 197). As such, Saunders (2000) argues that at present an "anti-precautionary principle" is being employed, which lays the burden of proof with society, not those introducing the technology.

Thus, environmentalists are critical of existing environmental regulations, such as those based on risk assessment and cost-benefit analysis, which have failed to adequately protect human health and the environment because they give the benefit of the doubt to new technologies and products (Montague, 1998). The green movement, therefore, has increasingly promoted the ESD concept of the precautionary principle to be applied in all areas involving uncertainty and risk. They believe that it is appropriate, and indeed necessary, to counteract the risks associated with science reduced to serving the interests of trans-national companies (Meyer, 1999).

The strong version of the principle which green actors promote seeks to prohibit the commercialisation of novel technologies until they are proven safe, shifting the onus of proof in environmental policy from those who claim environmental damage may occur, to those undertaking the activity in question. Those undertaking the action need to provide evidence that their activities will not have serious or irreversible impacts on the environment (Harding, 1998: 187). Risk avoidance becomes an established norm for decision making (O'Riordan and Jordan, 1995), with the balance of decisions on hazards and risks in favour of safety (Saunders, 2000). Because of this, the precautionary principle has been rejected by some who believe that it may hinder continued economic and technological development by imposing an unrealistic burden of proof for safety (see for example Brunton, 1995). However, the precautionary principle does not require industry to provide absolute proof that an activity or product is safe. Rather, it places responsibility with innovators to prove beyond a reasonable doubt that a technology or product is safe (Saunders, 2000) and to consider alternative activities to those which may be potentially harmful (Turnbull and Hindmarsh, 2001).

As well as shifting the onus of proof, strong versions of the precautionary principle have a biocentric ethic, recognising the intrinsic value of non-human life and acknowledging complexity and dynamism. Critics of this approach believe that incorporating ethics into decision making causes unnecessary complications and view the precautionary principle as accommodating public protest and irrational fears (Apel, 2000). Others, such as Brunton attack the precautionary principle for not achieving the holistic approach that it promotes:

> Like some other principles championed by environmentalists, the credibility of most interpretations of the precautionary principle depends on a linear and fragmented view of the world rather than a holistic view. The principle evinces faulty ideas about the appropriate response to scientific uncertainty and the relation between safety and risk, and jeopardises our ability to manage the environment well (Brunton, 1995: 236).

Despite such criticisms, a growing number of environmentalists and members of the public are calling for the strong version of the precautionary principle to be incorporated fully into environmental policy processes (this will be discussed in more detail in Chapters 5 and 7). Several core elements of the strong precautionary principle have been identified: 1) people's duty to take anticipatory action; 2) burden of proof on the proponents of a technology; 3) examination of a full range of alternatives; and 4) open, democratic decision-making (Montague, 1998; Raffensperger, 2000). To these, O'Riordan and Jordan (1995) add: 5) cost-effective action: identifying social and environmental gains from a course of action that justifies the cost; 6) safeguarding ecological space; 7) legitimising the status of intrinsic value: this is consistent with strong formulations of the precautionary prinicple which has a bioethic; 8) meso-scale planning: taking into account the influence decision making may have 25 to 100 years from now; and 9) paying for ecological debt: burden-sharing responsibility for those not taking precaution.

Thus, applying the strong precautionary principle allows a shift in questioning from 'How safe is safe? What level of risk is acceptable? to 'How can harm be avoided while still maintaining necessary values? What are the alternatives to achieving the desired goal? Does society need this activity? (Hileman, 1998: 16-18). This being said, actually putting the precautionary principle into action has many difficulties. As mentioned above, the principle has many formulations from very weak that promote the *status quo* through to very strong that seek radical social and institutional change.

As a consequence, the PP has been heavily criticised for its loose definition, with many opposed to the principle expressing their concerns over when, where and how the principle should be applied. Opponents argue that the indeterminancy of the principle makes it an inappropriate regulatory decision-making tool. The PP has been used simultaneously as a belief, regulatory tool, ethical directive and overarching principle (Raffensperger, 2000) as well as an institution of governance which serves as the 'rules of the game' (von Moltke, 2000). Thus, like sustainability, the PP lacks definition and provides few operational guidelines for policy makers. Despite this, authors such as O'Riordan and Jordan (1995: 192) support it "... because it captures an underlying misgiving over the growing technicalities of environmental management at the expense of ethics, environmental rights in the face of vulnerability, and the facilitative manipulation of cost-benefit analysis". Also, as Ho and Saunders (2000) allege, those who assert that the PP is ambiguous or incoherent miss the point of the principle. They assume that the PP is a strict formula for environmental decision making, when it is actually a principle on which to base decisions. It provides guidance on how to respond to possible environmental impact in cases of scientific uncertainty, and this "institutionalisation" of the treatment of uncertainty in environmental decision making is seen by a growing number of environmental commentators as an important step in the right direction for environmental protection (Harding, 1998: 190) and therefore sustainable futures.

A further criticism of the PP is that it ignores the lower risks of GM products relative to the agrochemical risks of non-GM products and may suppress important benefits (Marchant, 2000). Holdren (2000) states his belief that it is a "prescription for paralysis", as it offers no guidance on the kinds of measures to be taken, and places health and environmental values over economic ones. Brunton (1995: 236) states that there are many examples "... of the way in which direct regulatory attempts to act *cautiously* and to reduce particular environmental and other risks can bring about the perverse consequences of increasing these or other dangers" (emphasis added). He cites examples such as farmers utilising more toxic pesticides since the banning of DDT. It is important to make the distinction here between a "cautionary approach" and the "precautionary principle". Often a cautionary, rather than a precautionary approach is put forward which would not solve the problems stated by opponents such as its ambiguity or restrictiveness (Turnbull and Hindmarsh, 2001).

It needs to be acknowledged that risk assessment, and indeed science itself, is sensitive to underlying assumptions. Assumptions are intrinsically subjective, such as the choice of research area, definitions of what constitute risks and hazards and how to measure them, and how to account for uncertainty (Levidow *et al.,* 1999a). Thus, the questions raised over the PP can be equally applied to risk assessment and other cautionary approaches. However, techniques such as risk assessment and cost-benefit analysis have become part of what is seen to be 'sound science', as objective aids to decision making, rather than a product of politics and social values. As Marchant (2000: 2) states: "... the ultimate goal should be the assessment of real-world risks using sound science and expert judgement." Precaution, opponents argue, is ambiguous and impractical and threatens 'sound science' by allowing subjectivity into decision making (Comstock, 2000). However, Levidow *et al.* (1997) assert that the focus on 'sound science' tends to conceal the normative framing of safety claims, involving socio-political influences, compared to the precautionary principle which acknowledges subjectivism.

It is clear that precaution challenges the established scientific method, however the tension between science and precaution is not inevitable. Saunders (2000) argues that the PP is a part of sound science as well as common sense. As science is always incomplete and uncertain, the responsible use of scientific evidence therefore requires precaution. The strong PP is about broadening science to include a wider range of values and possibilities and interpreting scientific evidence in socially responsible ways (Saunders, 2000). This has important implications for environmental policy in general, and gene technology policy in particular, with open and democratic decision-making being a core element of the principle. Ultimately, it seeks to be an ethical voice against the demands for 'progress'. Thus, when considering the precautionary principle, the role of the state is also very important and this will be revisited in the concluding chapter of the thesis.

Precaution, like sustainability, has been caught up in a clash of value positions which has lead to widespread debate. We now turn to consider the role such controversies play in the policy process.

2.7 Controversy and Participatory Decision-making Strategies

Doyle and McEachern (1998) have recognised the importance of conflict in bringing environmental concerns to the attention of Government and forcing it to respond. They go further to realise that it is this conflict, or controversy, that necessitates a response as much as the environmental problem itself. Public and environmentalist activism can be politically costly and so governments may seek a variety of ways to contain, incorporate or absorb protest.

Environmental legislation places controlled boundaries on public participation, thereby limiting but also legitimising such participation (Paehlke and Torgeson, 1990). It is argued by some, such as Paehlke (1988), that environmental regulation has lead to increased democracy in policy making, due to processes such as public hearings, calls for public comment in the form of submissions to formal hearings, and impact assessments.

Regulatory negotiations, Dryzek (1995: 303) argues, brings interests groups together in face-to-face dialogue. These 'discursive designs' are a concession on the part of the state that public dialogue and consent are required for legitimate decisions to be made (Dryzek, 1995: 303). Chapters 7 and 8 will explore whether, in the case of gene technology, recent regulatory negotiations allowed for greater democratic processes. However, it is necessary first to look in more detail at the role public inquiries play in environmental policy – with increasing calls from environmentalists for more open and participatory processes, the public inquiry has become a popular tool in Australia and globally.

2.7.1 Public Inquiries

Environmentalists seek the enhancement of opportunities for democratic participation, and one possible avenue is seen as the public inquiry (Paehlke and Torgeson, 1990) which is becoming an increasingly important part of Australian politics (Stone, 1993). According to Prasser (1985), this indicates a continuing desire of all governments to appear to be rational. Unambiguous recommendations and findings from inquiries can give the public assurance that "wisdom" and "objective scrutiny" have prevailed over "... increased irrational allegations on controversial issues of extreme uncertainty and technological complexity" (OECD, 1979: 8). The methodology of inquiries "...follow, almost to the point of parody, post-Enlightenment canons of knowledge construction" (Stone, 1993: 8; see also Ashforth, 1990). In this way, governments seek to control issues on the policy agenda through an inquiry's image of objectivity and freedom from politics.

For some, inquiries are used to create an illusion of action, concern and consultation, existing to take the pressure off the government, to show concern about a particular issue, or to legitimise government action in a politically sensitive area by emphasising an open, consultative approach (OECD, 1979; Prasser, 1985; Stone, 1993). Thus, in the words of Ashforth (1990: 6), inquiries act as "reckoning schemes of legitimation" through the reproduction of state power via the forms of communication organised. They may also seek to depoliticise an issue by narrowing the scope of discussion to the elucidation of 'rational' and technological facts and interpretations (OECD, 1979). Thus, according to Prasser (1985: 2), inquiries are "... all part of the political game of retaining and seeking power". Ashforth (1990: 5) affirms several reasons why inquiries may be held: they may be used to address the limitations of resources within the bureaucracy when addressing a complex problem; to appease discontent of interest groups with the power to destabilise the state; and to maximise gains for key interest groups, such as, in this instance, those with GE interests.

The articulation of views from centres of social power, and the emergence of new groupings, benefits the state by enabling it to gauge support and resistance to particular initiatives. This in turn reduces the number of representative decision-makers it must listen to in deciding a course of action, and securing adherence to an agreed compromise (Ashforth, 1990: 15). Inquiries also represent "...a system of intellectual collusion whereby...selected intelligentsia transmit forms of knowledge into political practices. The effect of this process is to replenish official arguments with both established and novel modes of knowing and forms of reasoning" (Burton and Carlen, 1979: 8). An example of this was found by Taplin (1992) in relation to the Terania Creek Inquiry. Dr Len Webb, an ecologist, gave evidence to indicate the level of uncertainty in ecological research. The Commissioner of the inquiry, however, saw this to mean that such research was not truly 'scientific' and therefore not of the same value as certain scientific 'facts', and so ecologists were treated as 'counter-experts'. This served to reinforce the myth that 'sound', 'rational', and 'certain' science is the only legitimate form of knowledge, or data, for policy decisions.

Thus, through the language of expertise, modern states transform social realities into an objective material world with observable laws of cause and effect in the domain of modernity (Ashforth, 1990: 17). Power is therefore understood as capable of achieving predictable results – problems can be solved. This helps to explain the reliance on risk assessment and risk management that are seen to be rational problem-solving tools. In the same way, GE is seen as a rational technological fix for agricultural, social and economic problems. Issues of ethics or alternative worldviews do not fit in this modernist framework.

It is therefore important for environmentalists, seeking the use of inquiries to improve public involvement, to recognise that the decision to hold an inquiry, and the fate of its recommendations, are shaped by the political priorities of the government of the day. Dryzek (1990: 105) recognises that such "discursive designs" may "fall victim" to the same constraints as the administrative state. They may be used, for example, as tools of agenda management including symbolism, tokenism, new organisations, postponement, co-option, and redefinition of issues (Stone, 1993). In this sense, inquiries may be used to co-opt troublemakers by giving them the illusion of participation (Dryzek, 1990) and can therefore produce significant symbolic benefits for government actors (Stone, 1993). Public hearings for example can be very valuable for public perceptions and are therefore largely symbolic, promoting the 'truth' that state power serves the interests of all citizens and is open to their views (Ashforth, 1990). By means of the terms of reference for the inquiry, the state structures the process of opinion formation through submissions and oral evidence. Thus, they may serve to transform contentious issues into discourses of "reasoned argument" (Ashforth, 1990: 9).

However, while inquiries may function to remove an issue from the government's agenda, it may in the process raise public awareness and generate public interest in a particular issue. This was found to be the case, for example, in the Terania Creek inquiry (Taplin, 1992). Despite the shortcomings of the adversary process used, the inquiry served to bring forestry conservation to public consciousness (Taplin, 1992). However, it must also be acknowledged that the publics whose opinions are shaped by inquiries are usually 'interested parties' (Ashforth, 1990). Thus, Dryzek concludes that discursive designs such as inquiries are not blueprints for an alternative administration but do offer a challenge to dominant institutional forms and offer hope of an alternative. In seeking public participation and open debate, inquiries also allow reflection upon the processes that give rise to them. At present, these processes are framed by modernity, and are therefore conservative and resistant to change. Hence, critical reflection allows for the consideration of alternatives towards a more reflexive modernity (see Beck, 1992; Rogers-Hayden and Hindmarsh, 2001). In addition, following the course of an inquiry can inform us about the complexities of the policy making process and power relations at work. Thus, as Prasser (1985) recognised, the continued use of inquiries deserves detailed study, and this will be the purpose of Chapter 8.

2.8 Conclusion: The Need for Reflexive GE Policy and Regulation

The many problems, both potential and actual, of GE have lead to a widespread public controversy. Like so many other environmental conflicts, the GE controversy raises concerns that governments are not effectively addressing the issues seen as important by the public and environmentalists such as the broader social, ethical, and philosophical aspects. Harding asserts:

> To overcome such constraints a new framework is needed which complements the present science but also attempts to deal with uncertainties and value differences through involvement of a wider range of stakeholders, knowledge bases, and value positions (Harding, 1998: 83).

The Federal Government in Australia has sought to institutionalise political conflict in the ESD process (addressed in depth by McCall, 2001), and industry too has increased their use of the phrase to describe their practices. The bio-industry claims that caution is needed in the imposition of 'excessive' regulation that they believe hinders biotechnology's ability to contribute to sustainable development.

Proponents promote GE as the way to help preserve biodiversity's resources for future generations and also argue that regulation must be based on 'sensible' science-based solutions to 'imagined' risks (Mycogen, 1997). The industry claims that biotechnology will become part of a 'sustainable solution' to the world's problems, promoting the 'significant benefits' such as higher productivity, flexible crop management, and a safer environment through the decreased use of conventional pesticides, all of which, they claim, will collectively contribute to sustainable agriculture (James, 1999). Robert Shapiro, Monsanto chairman and chief executive officer, stated that "... biotechnology poses the possibility of leapfrogging the industrial revolution and moving to a bio-industrial society that is economically attractive and environmentally sustainable" (cited in Mann, 1998).

The concept of ESD is problematic and has been adopted by both proponents of biotechnology to maintain the status quo (and marginalise alternative ideals) and environmentalists who seek radical structural and social change, thus supporting various political agendas. However, it is an incremental ideology that does not need to be adopted in one, or indeed all, of its formulations. ESD and the precautionary principle are examples of ecologically compatible principles that have emerged within the current system and dominant paradigm. Thus, there is still a lot in current practice that can be useful even without a paradigm shift, under the heading of ESD.

Ultimately, what is meant by ESD is a question of underlying values and ethics, and these must be made explicit. In the context of this thesis, it is the ecological formulation of ESD that is adopted. In other words, the preservation of the integrity of ecology and dynamic relationships between all Nature is at the fore. It opposes unhindered economic growth and the marginalisation of alternative views and technologies, and favours the encouragement of diversity. It embraces ecocentric partnership ethics and incorporates ecological, social, and ethical dimensions. It recognises the importance of the strong precautionary principle (also based on ecocentric ethics) in cases of uncertainty and acknowledges complexity and subjectivity. Similarly, the strong precautionary principle challenges modernity and the dominant scientific method and seeks a broader science that incorporates anticipatory action, places the burden of proof on proponents of a technology, consideration of alternatives, and open decision-making (Montague, 1998; Raffensperger, 2000). In order to reach a sustainable future, therefore, incorporation of the strong precautionary principle in GE policy is essential. Applied environmental ethics need to be repositioned from the periphery so they may occupy a central place within regulatory processes concerning the intersection of technology and nature, such as gene technology (Hindmarsh and Risely, 2001). I now turn to look at the history and critique of modern science, in order to better understand its social and political context. This is the first step in the search for a new approach to science and its regulation, based on eco-political principles, which will also be expanded upon in Chapter 4.

3

Western Science and Biotechnology: History and Green Critique

The aim of this chapter is to outline the history and worldview that provides the contextual setting for the politics of biotechnology and the environment discussed in the previous chapter. When addressing the environmental crisis, many blame modern science and technology, concluding that they cannot meet the needs of humankind, while others go further to claim that they are directly responsible for the environmental and social problems facing today's world (Truitt and Solomons, 1974: ix). The growing unsolved environmental problems and widespread criticism of dominant science provide good reasons to take a critical look at western science and technology to see whether they are adequate to address environmental and social problems.

Firstly, however, it is necessary to look at the fundamentals of science, and the history that shaped it, to gain a better understanding of the nature and importance of modern biotechnology, and how it came to take its current direction. This chapter will look at the rise of enlightenment science, the underlying mechanistic philosophy, and the dominance of the scientific method that remains today. The Romantic critique of modern science will be discussed, along with the rise of the new biology and its underlying philosophy and concomitant implications. We turn first to the earliest forms of Western science, with tensions between organicism (or holism) and mechanism (or reductionism).

3.1 A Living, Intelligent Cosmos

Biology, the study of living organisms, began with the Ancients although it has roots predating first civilisations. Its long history reveals an ongoing struggle between reductionist and holistic approaches to understanding Nature (Verhoog, 1994). In medieval times, Nature, and indeed the universe itself, were perceived as a living organism – a self-regulating whole that needed to be respected (Merchant, 1992). The Stoics, for example, who thrived in Athens in the third century BC and in Rome in the first century AD, held this view (Merchant, 1989). Within the ancient philosophies there were also hints towards ecology and holistic science. For example, Heraclitus (556-469 BC) believed that understanding humans was not separate from understanding nature, as the same materials and laws governed both. Similarly, Pythagoras (ca. 582-500 BC) believed that human souls could be reincarnated in the form of other animals, and therefore believed in the kinship of all living things (Magner, 1979). In those times, myths, superstition and religion were the means of relating to nature (Magner, 1979).

3.2 The Beginnings of Modern Science

Around 600 BC, however, a group of philosophers in Ionia moved away from the supernatural that formed a dominant part of the culture of that time and began an empirical movement that concentrated on the study of the world revealed through the human senses (Asimov, 1964; Farrington, 1974; Magner, 1979). Hence, natural science was born. The Ionian philosophers believed in the existence of causality, that is, that every event had a cause, and that any cause had a particular effect. They maintained that humans could understand all of the workings of the universe, through focussing on the discovery of regularities that they believed underlay changes in the world, and that this understanding, once achieved, would be permanent (Asimov, 1964). Thus, began the philosophy of rationalism (the belief that the workings of the universe could be understood through reason) which remains today[1].

The first century A.D. saw a retreat from rationalism (Asimov, 1964), followed in the second by the decline of culture and science, which some historians claim was caused by religion (Magner, 1979). The Emperor Constantine turned to Christianity, causing the State to turn against scientists, and the Western world became as it is described in the bible. Thus, the Dark Ages between the fall of Rome and the end of the tenth century lacked any scientific progress, with the era dominated by theological concerns (Magner, 1979). The belief that nothing existed for its own sake, but rather as a resource for humankind, became mainstream. This view fitted in with the growing Christian view that humans were superior to other living

[1] This type of rationalist thinking is clearly evident in the biotechnology program. One particular example is the Human Genome Project (HGP) which maps out the entire human genome. Scientists undertaking this research believe that it will reveal all the workings of the human body and allow for cures for human afflictions.

beings and helps to explain why these ideas have survived until the present day (Asimov, 1964; Magner, 1979).

Rationalism was revived, however, towards the end of the Roman Empire by Thomas Aquinas (c. 1225-74) who worked hard to marry Aristotelian philosophy with Christianity. He was a rationalist who believed that God created the human mind and so the reasoning of man could not be at odds with Christianity (Asimov, 1964). For many, this remains true today. Noble (1999: 4), for example, states that "... modern technology and modern faith ... are merged, and always have been."

3.2.1 Enlightenment Science

Similarly, the founders of modern science (Copernicus, Galileo, Kepler, and Newton) did not distinguish science sharply from theology or philosophy (Charlesworth, 1982). Newton in fact saw science as showing the ways of God to humanity (Charlesworth, 1982). According to Charlesworth (1982) even Bacon, who heavily criticised alchemists and magicians, was actually very influenced by them. However, in the late seventeenth century there was a strong push to separate science from religion and philosophy and from 'pseudo-science' (Charlesworth, 1982). This was largely due to the rise in prominence of the mechanistic philosophy (discussed further below) which displaced the need for theological hypotheses (Charlesworth, 1982). Science itself became seen as the 'new religion' and those involved gradually came to think of themselves as creating a world, or 'second nature' (Gorokhov, 1999).

Many scientific and social advances occurred during the Renaissance, and consequently the period became known as the rebirth of learning due to the revival of commerce, the growth of cities and new inventions (Magner, 1979). There were notable advances in anatomy and Leonardo da Vinci's (1452-1519) scientific studies of nature displayed aspects closer to today's scientific method than many of his contemporary 'scientists' (Magner, 1979). The year which is usually considered to mark the beginning of the scientific revolution is 1543, when Copernicus published his book *On the Revolutions of the Celestial Spheres* (1543) describing a new view of the structure of the solar system – with the sun, rather than the earth, at its centre. Although arguable, this period is generally considered to mark the establishment of the conceptual, methodological and institutional foundations of modern science (Henry, 1997).

While mechanistic science dominated this era, there were also mystics that focused on the ancient philosophies and techniques of alchemy. They believed that the whole universe was alive and so there was a large mystical and religious component to their activities (Magner, 1979). At the beginning of the sixteenth century, the dominant metaphor for society had been that of an organism, with people living in co-operative organic communities (Merchant, 1989). This metaphor had its philosophical roots in the ancient cultures discussed earlier. This organic metaphor of the earth as a 'living organism' and 'nurturing mother' had acted as a social and ethical constraint, preventing people from harming Nature (Merchant, 1989). According to Giordano Bruno (cited in Merchant, 1989: 25) everyone was "... a citizen and servant of the world, a child of Father Sun and Mother Earth". A central part of the organic world-view is that of nature as a nurturing mother. At the same time however, there was also an opposite image of a wild nature that was uncontrollable, violent and chaotic (Merchant, 1989: 2). As stated by Merchant (1989), the metaphor of 'wild nature' led to the modern idea of seeking control and power over nature and this laid the foundations for the mechanistic and atomistic world-view that would later come to dominate society.

By the sixteenth and seventeenth centuries, there was increasing tension between the organic world-view and technological development. The image of Mother Earth was effectively undermined by the expanding market economy and its move towards capitalism (Merchant, 1989; 1992). The shift to the mechanistic world-view acted as a sanction for environmental degradation, as nature was no longer seen as sacred or having intrinsic value. While the organismic theory did not die out completely, after the seventeenth century the atomistic and mechanical metaphors prevailed and came to dominate people's thinking, as they fit in with the new economic activities (Merchant , 1989; 1992).

3.2.2 The Scientific Method

With the growing economic activities, the social barrier between the methods of superior craftsmen and those of academic scholars eventually broke down, natural philosophy was changed beyond recognition and something closer to our conception of 'science' was born (Henry, 1997). Therefore, increasing awareness and appreciation of the practical knowledge of master craftsmen, once seen as of little significance, was a major factor in the development of the experimental method which became a feature of the Scientific Revolution (Henry, 1997).

One of the major contributors to this experimental method was Francis Bacon (1561-1626). It has been argued that he made no direct contributions to scientific knowledge, but that he did influence the philosophies of the institutions that directed the course of science (Magner, 1979). Bacon's *The New Atlantis* (1627) also paved the way for future transgenics, by viewing nature as a laboratory and introducing a technocratic approach, thereby further expanding the engineering thinking of Galileo. In addition, Bacon outlined the manipulation of organisms to create artificial species of plants and animals. This undermined the concept of an organic utopian community put forward by Tommaso Campanella in *City of the Sun* (1602) and Johann Valentin Andreas in *Christianopolis* (1619) which embraced the philosophy of holism and the religious framework of Christianity (Merchant, 1989). Thus, Bacon advocated the domination of nature for human benefit and devoted his time to establishing ways to understand and control nature through experimentation, thereby fashioning "… a new ethic sanctioning the exploitation of nature" (Merchant, 1989: 164). His definition of science was in terms of empirical observation and experiment. The 'Baconian method', or 'inductive method', became synonymous with the 'scientific method' (Magner, 1979).

All of the early philosophers of science believed that science had a single distinct scientific method that remained unchanged throughout its history (Charlesworth, 1982). Later however, the radically different stages of scientific development were recognised. This idea was expressed by Thomas Kuhn in his *The Structure of Scientific Revolutions.* A main feature of Kuhn's theory is his emphasis on the revolutionary nature of scientific change, where a revolution involves the abandonment of one theoretical structure or "paradigm" and its replacement with a new paradigm. This is an alternative to the cumulative progress described by inductivist accounts of science (Chalmers, 1982).

Kuhn (1962) held that each great scientific 'epoch' was dominated by what he terms 'paradigms' which reflect the dominant views of science at that time. Kuhn believed that there would be many distinct forms of science, working within distinct scientific paradigms and that there had been a series of 'revolutions' in the history of science. According to Kuhn, it is these paradigms which separate science from non-science, with mature science being governed by a single paradigm that sets the standard for 'legitimate' work within that discipline. The definition of science is subsequently determined by negotiation between scientists of the time. Kuhn, therefore, was one of the first to assert that scientists do not perceive the world in an objective way, but rather are influenced by the dominant theories of science that surround them (a sensory filter). In other words, scientists have their own sensory filter that influences their perceptions, and so they are not impartial arbiters of truth, but rather individuals who base their decisions on what they perceive to be 'true' according to their own value systems.

Kuhn (1962) goes on to state that part of the nature of paradigms is that they can not be precisely defined, although their typical characteristics can be described. Streelman and Karl (1997: 696), however, state that "... paradigms are slippery. There are no strict criteria to identify a paradigm, nor consensus usage of the term ... The paradigm concept is infinitely applicable and therefore potentially useless in a predictive and perhaps explanatory sense." This is consistent with the philosophy of Feyerabend who believed that there was no distinct method of science which distinguishes it clearly from any other form of inquiry (Charlesworth, 1982). Feyerabend goes on to claim that science has developed through the help of 'unscientific' beliefs such as mysticism. Charlesworth (1982) states that Feyerabend's view of science is a very sceptical one and does not believe that his 'anarchism' should be taken as the last word. Charlesworth believes that while it may be difficult to find a single clear definition of science, we should be able to at least demarcate what we call 'science' from other ways of knowing. He believes that Feyerabend confuses science with 'scientism' (the view that science is the only legitimate form of knowledge), and that there is no necessary connection between the two. In other words, it is possible to appreciate the benefits of science without ignoring other values – a position that is important in relation to the GE policy debate.

Thus, while pointing at a single, distinct experimental method is too simplistic, major contributions were made around this time with Bacon, William Gilbert (1544-1603), and Galileo (1564-1642). Like Bacon, Galileo was eager and willing to manipulate nature and paved the way for engineering thinking (Gorokhov, 1999). He combined the craftsman-like experimentation and measurement with mathematical analysis, which became the method of modern science. The predominantly instrumentalist attitude was replaced with a more realist outlook that asserted that mathematical analysis shows how things really are. Thus, it has been stated that one of Galileo's greatest contributions to the development of science was his mathematical approach to nature, although it is Newton with his *Mathematical Principles of Natural Philosophy* (1687) that saw the culmination of mathematics into the dominant world view (Henry, 1997). Newton demonstrated mathematically how observable macroscopic effects could be explained in terms of microscopic processes that were crucial to the mechanical philosophy to which he and many of his contemporaries subscribed (Henry, 1997).

Newton, therefore, was a major contributor to our modern conception of science. He retained Descarte's dualism between passive matter and external forces (Merchant, 1989). In Newton's era, experimental philosophers concentrated on reducing phenomena to simple laws, following on from those of the seventeenth century. The focus was on causal predictions and reductionist procedures based on reason which was believed to be the only path to pure knowledge (Haynes, 1994). Mechanists such as Newton believed that things rather than relations are what constitute reality, and relations are externally imposed by God in the form of natural laws (Merchant, 1989). Thus, from the seventeenth century, through the eighteenth with mechanists such as Newton, and to the present day, mechanical models have been used for the self and the universe and the mechanical philosophy which began in the seventeenth century has gradually become institutionalised in Western societies (Merchant, 1989).

3.2.3 The Mechanical Philosophy

According to Merchant, there are five underlying philosophical assumptions that evolved in the seventeenth century, but which remain today and influence decision making: first, matter is composed of particles (the ontological assumption); second, the universe is a natural order (the principle of identity); third, knowledge and information can be abstracted from the natural world (the assumption of context dependence); fourth, problems can be analysed into parts that can be manipulated by mathematics (the methodological assumption); and lastly, sense data are discrete (the epistemological assumption) (Merchant, 1989: 228).

Thomas Hobbes (1588-1679) asserted that all the processes of the universe could be explained in terms of masses of small passive particles. Atomism predominated Enlightenment thinking and allowed for the perception of nature itself as 'inert' and 'passive', giving way to the metaphor of the universe as a machine (Pratt *et al.*, 2000), which allowed for the rational control over nature (Merchant, 1989). Motion and change were believed to be caused by external factors only, therefore there was no spontaneity in nature or human behaviour (Merchant, 1989). The human mind was also believed to be inert, with ideas being passive mental 'atoms' (Pratt *et al.,* 2000). Other features of the Enlightenment included increased reductionism; reason, or unaided human thought (the period is often referred to as the 'Age of Reason'); and determinism, or the belief that every event or action has a cause (Pratt *et al.,* 2000). Based on the above assumptions, Enlightenment science was widely considered to be objective, value-free, context-free knowledge about the external world (Merchant, 1989). It "… rendered nature effectively dead, inert, and manipulable from without" and provided a justification for power and domination over nature (Merchant, 1989: 214). Thus, both order and power are important components of the mechanical philosophy.

The Cartesian system has been heralded as the most influential version of mechanical philosophy (Henry, 1997) and the current world-view has been heavily influenced by this mechanistic notion of Nature. The philosopher Rene Descartes (1596-1650), a modern classical rationalist (Chalmers, 1982), advocated the deductive, mathematical approach to science, writing a *Discourse on Method* in 1637. In Descarte's scheme, however, experimentation played a very minor role, which received criticism (Magner, 1979). He asserted the notion of the human body as a machine, but was careful to point out that the body-machine did not include the mind and soul (Asimov, 1964). According to the Cartesian framework, perception occurred due to an object emitting or reflecting a beam of light which impacted on the perceiver. This was a large shift from Scholastic thought which viewed perception as the perceiver coming to share in the form of the object perceived (Pratt *et al.,* 2000). Thus, Descartes was responsible for the separation of the human subject from the world, which is the separation of the experiencer from the experienced (Pratt *et al.,* 2000). Thus, an 'external world' was recognised, separate from humans, which then allowed for an exploitative attitude towards it (Pratt *et al.,* 2000). It is within this Cartesian framework that the Modern view of the world, with humans distinct from nature, was conceptualised. This Cartesian dualism has often been attacked by critics as the reason for exploitation of nature, since Nature (or the 'environment) is perceived as alien (Pratt *et al.,* 2000).

Foucault went even further to argue that the world had been split into two. He believed language and the world, which had previously been regarded as one, were divided, and that this was the defining feature of the seventeenth century revolution (Pratt *et al.,* 2000). Thus, it can be argued that the major characteristic of the revolution was a construction of nature that existed apart from humans and their perceptions, leading to the focus on objective science (Pratt *et al.*, 2000).

Merchant (1992: 48) claims that the removal of the organismic view of nature and its replacement with the mechanical philosophy, constituting the "death of nature", was the most far-reaching effect of the scientific revolution. The new conceptual framework of mechanism, with its values based on power, became the underlying model for western philosophy and science and was compatible with growing commercial capitalism (Merchant, 1992).

3.2.4 The Rise of Capitalism

The rise of science and technology and the idea of 'progress' (to which Bacon was a major contributor) are important features of the 'Modern Period' or 'Modernity' which saw the reorganisation of society into a capitalist framework (Pratt *et al.,* 2000). The characteristics of early capitalism (for example the centring of cultures in towns, the dependence on individual enterprise for economic success, and its rational nature) helped to extend science and technology and gave more importance to practical mathematical techniques (Rose and Rose, 1976; Henry, 1997). Rose and Rose (1976: 4) state that science "... appeared as critical knowledge, liberating humanity from the bondage of superstition..." Similarly, Marx (cited in Rose and Rose, 1976: 4) stated that under capitalism, science became a direct force of production and social control – "... the power of knowledge objectified", maintaining the capitalist order. As capitalism developed, mechanical materialism or 'scientism' or 'positivism' became the dominant ideology. Positivism holds that scientific knowledge is the only true form of knowledge, and other ways of knowing became viewed as irrational nonsense, thereby denying any other knowledge forms that are not legitimised by this ideology (Rose and Rose, 1976; Merchant, 1980). The first attempts to move beyond this world of capitalism were seen in the early nineteenth century in the form of Romanticism, which sought a new scientific paradigm.

3.2.5 The Romantic Critique

Romanticism put forward a vitalistic science as an alternative to dominant mechanistic science (Haynes, 1994). It rejected atomism, believing instead that the natural world and humans were one and 'alive' (Pratt *et al.,* 2000). The German philosopher Schelling, for example, proposed that Nature was one enormous living organism and that the spirit of humans and nature were continuous (Haynes, 1994: 76). Similarly, Goethe sought a spiritual unity with nature and a universal worldview, "... one embracing the intellect, the emotions, and transcendent experience" (Haynes, 1994: 78).

While atomism saw the mind as passive and inert, the Romantic view saw the mind as capable of taking initiatives (Pratt *et al.,* 2000). Romanticism emphasised the validity of emotion and subjectivity (Haynes, 1994) and saw feelings "... as the way in which nature manifests itself to us. Therefore, in heeding feelings people heed the promptings of nature" (Pratt *et al.*, 2000: 32). In other words, feelings guide people to behave in the right way. Thus, whereas supporters of the Enlightenment project saw reason as the basis for knowledge, Romantics saw feelings as the guide to behaviour, and humans as the initiators of activity. The Romantics reacted strongly against the alliance of science and technology, and the corresponding increase in industrialisation, as they saw it as responsible for the erosion of spiritual values (Haynes, 1994: 84).

The ideas promoted by the Romantics have helped to inspire the environment movement and can be seen in the ideas of, for example, Arne Naess, the founder of Deep Ecology. However, despite the Romantic critique, large elements of Enlightenment science remain part of the dominant view of the world today, including the philosophy of positivism and the myth of objectivity.

3.2.6 The Myth of Objectivity

Despite the writings of philosophers such as Kuhn (1962) that emphasise that scientists are influenced by 'sensory filters', and their decisions value-laden, the idea that scientific knowledge is objective – a passive representation of facts based on observations of the world – has been common. This way of thinking is linked to the realist theory of knowledge whereby humans know what there is in reality in a clear and objective way and science is a reflection of that knowledge (Charlesworth *et al.,* 1989). This myth of 'pure science' plays a central role in scientific culture, according to Charlesworth *et al.* (1989). According to this myth, science is morally and politically neutral, and therefore far removed from moral and social values. The argument goes that science itself is neither good nor bad; it is how humans choose to apply it. Thus, the application of scientific knowledge is viewed as a social and political decision that is not up to the scientist to make. In today's society, however, scientists are frequently required to make decisions regarding applications and are heavily influenced by the state and industry (which will be discussed in more detail in Chapter 6). Despite this, Western society has a long history of treating science as completely autonomous and therefore separate from the culture of which it is a part. As stated by Charlesworth *et al.* (1989) this poses great difficulties for appraising science, as any critique is seen to be anti-science. Scientists have been trained to believe that subjective factors are not relevant to their endeavours.

It is now largely recognised, however, that all observers approach the world with expectations and preconceived ideas for interpretation and without this observation would be impossible (Charlesworth *et al.,* 1989). As stated by Spangenburg and Moser (1994), few scientists assert anymore that they use a completely detached and objective scientific method, proposed by Bacon and others in the scientific revolution. Subjective factors must of course play a large role in scientific activity. The 1960s and 1970s saw the questioning and criticism of the realist theory of scientific knowledge and the emergence of constructivist accounts of science (where science is seen as the result of observation through the filter of interpretive frameworks) (Putnam, 1981; Charlesworth *et al.,* 1989).

Therefore the idea of pure science and pure data is unfitting:

> What we call the 'facts' or the 'data' are a product of the meeting between a framework of ideas, expectations, principles of interpretation on the one hand, and the observable world on the other hand, so that what the scientist observes is a 'construction' – something that is made up out of elements from our side, so to speak, and elements from the side of the external world (Charlesworth *et al.,* 1989: 9).

It can therefore be seen that Merton's (1942; cited in Charlesworth *et al.,* 1989) concept of a self-governing autonomous community of researchers is not an adequate description of how science is done and that it is not possible to draw a sharp distinction between pure and applied science/technology.

Cotgrove and Box (1970) identify three different types of scientists, namely public scientists (knowledge for its own sake), private scientists (private satisfaction) and organisation scientists (science as a 'job'). Due to the different motivations of each of these types of scientists, their outlooks are likely to differ markedly. In their book, *Life among the Scientists*, Charlesworth *et al.* (1989) identify sub-cultures of science, or as they term it –distinctive "life worlds" with distinct and complex beliefs, practices, and relationships. These sub-cultures are a part of the larger culture of science with a capital S (Charlesworth *et al.,* 1989). According to them, like the 'life world' that it attempts to explain, it is a construct, "... a literary construct, an example of a genre of writing which raises certain expectations in the reader" (Charlesworth *et al.,* 1989: 15). They purport a view of scientific knowledge which sees it as the result of construction and manufacture by scientists, not the passive representation of the facts of Nature. They state that, just as languages such as English are constructed, so too the scientific community constructs the language of science. Also, technological organisations and market forces dictate to a large extent what research is to be done. According to Queralto (1999) the search for scientific 'truth' is now subordinated to the possible technological use of its results.

Risk assessment is applied to the technology but not the science, with the mindset being that the technology may cause problems, but the science can not. As stated by Ho (1998a) ethics are seen to be socially constructed and therefore negotiable, while 'pure' science is seen as beyond reproach as it follows the 'laws of nature'. However, science is not only a part of social contexts, but is also shaped by them (Charlesworth *et al.,* 1989). In the case of GE, the science of rDNA research influences the sociology of agriculture through providing new options for technological applications. In turn, the science itself is shaped by its social context which involves state and industry interests setting the research and development agenda, which will be discussed in more detail in Chapters 6 and 7.

The history of science has shown that science cannot remain separate from the political, social and moral issues (Sangenburg and Moser, 1994). As discussed above, Kuhn, in *The Structure of Scientific Revolutions*, states that the areas of science that are investigated, the issues that are thought to be important, and what is considered to be scientific 'fact' are all based on the paradigms or models of science at the time. Therefore, as Kuhn asserts, scientists are not neutral observers of the world but rather they perceive it through the conceptual filter of the paradigm of the time. Science is therefore a social invention and it is scientists that define what science is, within their own distinct community.

Kuhn (1974) uses the term 'normal science' to refer to research firmly based upon one or more past scientific achievements, laying the foundation for the current paradigm. The term 'paradigm' closely relates to the term normal science. It was the paradigm of normal science with a focus on objective, rational investigation that led scientists to research ways to understand and control the genetic makeup of living things. This ultimately led to the birth of genetics as a discipline and its applications in modern biotechnology.

3.3 The Beginnings of Genetics

It was during the late nineteenth century that a new interest in the control of life emerged. As Pauly (1987: 4) asserts, many scientists of this era considered it their role to actively control organisms through manipulation, transformation and creation. Loeb stated that "... it is possible to get the life-phenomena under our control, and that such a control and nothing else is the aim of biology" (cited in Pauly, 1987: 5). This belief led Loeb "... to avoid such problems as evolution, the nature of life, the causes of biological organisation, and the value and limits of explanation of biological phenomena in terms of physicochemical concepts" (Pauly, 1987: 5). In 1904 he stated that the importance of discovering workings of heredity was in discovering whether "... it is at all possible to produce new species artificially" (Pauly, 1987: 148). Thus, Loeb was a major advocate for the engineering ideal in biology between 1890 and 1915, and was renowned for his development of artificial parthenogenesis[2] in 1899 (Pauly, 1987: 5). In 1915 Loeb underwent a radical transformation of his views, giving up the engineering standpoint for "mechanistic science" to conceptualise the workings of nature, and attacking "metaphysical romance" (Pauly, 1987: 131). Loeb later joined the Rockefeller Institute and became a major contributer to its intellectual directions.

The term 'genetics' was coined by Bateson (from the Greek for 'descent') at the beginning of the twentieth century, to replace concepts like 'generation', 'inheritance', or 'heredity' which had been speculated over for so long (Magner, 1979). Theories of inheritance date back to Aristotle who suggested that particles called 'pangenes' come together from all parts of the body to form the eggs and semen. This theory, known as pangenesis, prevailed until the mid-nineteenth century and was accepted by biologists such as Lamarck and Darwin. While this theory has now been discarded, the particulate basis of heredity remains and the basic units of

[2] Parthenogenesis refers to a type of reproduction in which females produce offspring from unfertilised eggs.

inheritance are now called genes, after the pangenes (Wexler, 1990). Wilhelm Johannsen (1857-1927) introduced the term 'gene' to replace terms such as 'factor' and 'character'.

The transmission of hereditary factors from parent to offspring remained a mystery for a long time. It was not until the middle of the eighteenth century that Pierre Louis Moreau de Maupertuis (1698-1759) advanced the theory that 'seminal particles' from both parents were passed on to the offspring, determining its characteristics (Asimov, 1964). Asimov (1964) states that it was the lack of understanding of the nature of heredity that was the weakest part of Darwin's theory of evolution. Darwin accepted the view of 'blending' inheritance – he did not realise the importance of sexual reproduction in re-assortment and recombination (Magner, 1979). One problem was that if traits from both parents were introduced by random variation, the useful traits would average out into an "indistinguishable middle ground" as a result of equally random mating, and therefore natural selection could not occur (Asimov, 1964: 71). The solution to this problem was found by an Augustinian monk named Gregor Mendel (1822-84) who undertook statistical studies of peas, which began in 1857, although his work remained largely ignored for over 30 years. From his study of peas he concluded that the male portion of the plant contained one factor for a particular character and the female portion contained the second. In pollination, the two factors combined and the new generation had a pair – one from each parent. In the case of each character he studied he found that crossing two extremes did not lead to a blending into intermediateness, but rather that each extreme retained its identity (Asimov, 1964). Carl Correns summarised Mendel's discoveries in terms of two Mendelian 'laws of heredity', including the 'law of segregation' and the 'law of independent recombination' (Magner, 1979: 417). In other words, the demonstration that parents pass on discrete heritable factors (genes) to their offspring can be attributed to Mendel. This finding was of vital importance to Darwin's theory of evolution, although Mendel himself never applied his ideas in that way.

The 'Mendelian laws', as they have become known, were independently rediscovered by botanists Hugo de Vries, Carl Correns and Erik von Tschermak in the early 1900s (Magner, 1979). These 'laws' became more significant at this time due to important new discoveries in biology, such as those of August Weismann. His theoretical work created a new framework which accounted for Mendel's 'ratios and numbers', enabling prediction of patterns of inheritance (Magner, 1979). Weismann stressed the importance of studying heredity at the level of the cell and individual, not just at the level of species. He believed that the connection between generations was due to distinct chemical entities, introducing a theory of the continuity of the germplasm and the reduction division of the chromosomes (Magner, 1979).

De Vries published his views on evolution as discrete steps called 'mutations' in 1901. This was contrary to the views of Darwin who believed in evolution through gradual change or blending. De Vries predicted that by using artificial methods to induce mutations there would be "... no limit to the power we may finally hope to gain over nature" (cited in Magner, 1979: 422). A year after de Vries' publication, Walter Sutton (1876-1916) found that chromosomes behaved like Mendel's inheritance factors and it became accepted that chromosomes carried inheritable factors governing physical characteristics. This concept is sometimes called the 'Sutton-Boveri hypothesis' to also honour Boveri who demonstrated, through quite different means, the individuality of the chromosomes (Magner, 1979).

In 1907, Thomas Morgan (1866-1945), who was sceptical of the Darwin's evolutionary theory of continuous variation, worked with small fruit flies called *Drosophila melanogaster*. By following generations of these fruit flies he discovered numerous cases of mutations, and further showed that several characters were linked, or inherited together. This meant that genes controlling such factors were on the same chromosome and that the chromosome was inherited as a unit, although there were sometimes exceptions to this rule when chromosomes crossed over. Thus in 1911 he proposed the 'chromosome theory of inheritance' which lead to a rush of experimentation in this area (Magner, 1979).

Most scientists at the time thought of proteins as the genetic material, however Erwin Chargaff had pointed to the significance of nucleic acids. Phoebus Levene (1869-1940) described a clearer picture of the nucleic acids in the early 1900s, distinguishing them from proteins. However, it was not until Watson and Crick's DNA model that scientists finally began to understand the activity of DNA. Thus by the early twentieth century a climax had been reached in evolutionary and genetic theory. This however was only the beginning of far more remarkable advances in the 'new biology'.

3.4 The New Biology

While the 'new biology' is usually associated with Watson and Crick's discovery of the structure of DNA in 1953, it was actually the culmination of numerous developments set in motion almost a decade earlier. For genetic engineering to later emerge, some important factors helped to shape the course of research and development, such as the influence of the Rockefeller Foundation – an institution informally associated with the petrochemical empire of the Rockefeller family (Hindmarsh, 1994). Warren Weaver, of the Rockefeller Foundation, coined the term 'molecular biology' in 1938 replacing 'experimental biology'. However, while Weaver conceived the discipline as studying all areas of the structure and function of living things at the molecular level, a more distinct discipline emerged in the 1950s that focused on the molecular basis of inheritance and reproduction. The focus was on macromolecules that promoted a molecular vision of life. Thus, it distanced itself from concerns such as the interaction between organisms themselves, between organisms and the environment, and processes within higher organisms (Kay, 1993: 5). This distancing has led many (see for example Fuerst, 1982; Wills, 2001) to the conclusion that reductionism was of central significance to the development of molecular biology. The scientists intended to create a new "science of life", which eventually led to the molecular study of the gene (Kay, 1993: 6). The debate between those that support this mechanistic view and others who support a teleological view still goes on today (Kay, 1993).

Molecular biology was essentially a continuation of the Baconian program with the aim of manipulation and control of nature, with one of the major goals of the Rockefeller Foundation being to ally biology with engineering. The Foundation was greatly influenced by the engineering focus promoted by Loeb, and their goal was to "... develop a mechanistic biology as the central element of a new science of man whose goal was social engineering" (Kay, 1993: 17). Erwin Schrodinger's famous book *What is Life?* (1944) is usually given a lot of attention in the history of the new biology. However, according to Charlesworth *et al.* (1989) and Yoxen (1979) the content of the book is difficult to reconcile with its reputation. It therefore appears as though there may have been political motives behind the embracing of Schrodinger by the molecular biologists. Since Schrodinger had a well-established reputation, being associated with him helped to legitimise their claims. Crick for example used Schrodingers's name to legitimate his reductionist approach to biology and to help promote his theory of gene replication as the solution to the secret of life (Charlesworth *et al.,* 1989). The appeal of the new approach was the simplicity of being able to control the whole from 'mastering' its parts (Kay, 1993). As stated by Kay, "... the molecular vision of life was an optimal match between technocratic visions of human engineering and representations of life grounded in technological intervention, a resonance between scientific imagination and social vision" (Kay, 1993: 18).

Thus, the rise of modern biotechnology was a result of the cooperative efforts of America's scientific establishment (Kay, 1993). The establishment of the National Research Council (NRC) in 1918 and the Social Science Research Council (SSRC) in 1923, both backed by the Rockefeller Foundation, marked the beginning of the alliance between science and private enterprise. The key to the Foundation's power was in establishing interdisciplinary cooperation focused on technology-based biology, and a liaison with industry (Kay, 1993) and the projects of the Foundation reflected this. According to Kay (1993) this form of cooperation was the result of the evolving corporate structures of post-World War I America. Thus, science began to mirror business, relying on management and interdisciplinary cooperation (Kay, 1993: 8).

Charlesworth *et al.* (1989) state that the emergence of the 'new biology' was anything but inevitable, as often claimed. They state that it could have taken a number of directions, but the one eventually taken was due to numerous political factors. There was a broad range of biological realities and therefore a number of different programs that could have been promoted by the Rockefeller Foundation, including the evolutionary, ecological and organismic views of life (Kay, 1993). However, it was the molecular vision that was promoted by the Foundation, due to an agenda of social control: "... the rise of the new biology was a process of consensus formation in which the Rockefeller Foundation and an academic elite reinforced each other's interests, forming a hegemonic bloc sustained by a system of incentives and power sharing" (Kay, 1993: 281).

Another significant influence came with the publication of Watson and Crick's research, funded by the Rockefellar Foundation, in their now famous book *The Double Helix*. The two determined scientists knew the importance of good public relations (PR), and told the public how they should view themselves and their findings. It can therefore be argued that this book was almost as significant as their actual discovery of the structure of DNA:

> … Crick and Watson not only discovered how genes replicate and laid down the foundations of molecular biology, but also succeeded in representing this discovery as being 'the central dogma' within the whole of biology and also as a final explanation of the 'secret of life' (Charlesworth *et al.*, 1989: 43).

3.4.1 The Central Dogma of Molecular Biology

In 1958 Crick established the 'central dogma' of molecular biology, that genetic information is strictly linear and goes in one direction, from DNA to RNA to protein, and never the reverse. Biological function is related to molecular structure, "… redefining the functional biological entity as a physico-chemical one" (Fuerst, 1982: 260). Thus, genetic determinism is based on a linear model of explanation, which is radically different to the ecological way of thinking where organisms cannot be understood purely from linear causality. Genes are believed to be the most fundamental part of the organism, which ultimately control and determine the characteristics of the organism. These genes are seen to be fixed and unchanging and each easily defined from every other (Ho, 1995). In discussions of this "new scientific revolution" in biology, the belief is often stated that it will ultimately lead to an explanation of the "mystery of life" (see for example Charlesworth *et al.,* 1989). Dawkins (1976) took this reductionist approach to its extreme, stating organisms were made up of a collection of 'selfish genes'. Essentially, in Dawkins' view the organism does not exist, it is just the means for propagating genes. In James Watson's now widely quoted dictum: "We used to think our fate was in the stars. Now we know, in large measure, our fate is in our genes." Similarly, Kevles and Hood (1992: vii) state that the human genome is "…the key to what makes us human, what defines our possibilities and limits…"

It is often claimed, therefore, that there was a 'revolutionary' shift in the life sciences in the 1960s, introducing a new paradigm or ideology that paved the way for genetic determinism (Charlesworth *et al.,* 1989). This supported the modern theory of evolution by natural selection at the molecular level. It was believed that any changes to the organism due to the environment were not passed on to future generations. Watson and Crick's model gained rapid acceptance, although some fine-tuning was necessary. According to them, the basic principle of how species reproduce had been discovered. It had long been suggested that proteins were produced by a single gene, and this idea re-emerged as the one gene, one protein hypothesis (Charlesworth *et al.,* 1989).

The new understandings of how genetic material is transferred, and new technology, led to the beginnings of genetic engineering. In 1969, Jonathon Beckwith and co-workers isolated a single gene (Spangenburg and Moser, 1994), paving the way for the real beginning of genetic engineering which occurred in 1973 when Stanley Cohen and Herbert Boyer combined the two newly discovered processes of locating restriction enzymes in plasmids and isolating specific genes (Spangenburg and Moser, 1994)[3]. Thus, due to the advances made in molecular biology, which brought the mechanist position to renewed strength and dominance, the late 1960s and early 1970s became hailed as the 'age of biology'. The mechanist viewpoint was further promoted by the Rockefeller Foundation and has persisted due to the push from commercial interests (Kay, 1993: 282). This can be seen in the language of genetics and biotechnology which is overtly mechanical. For example, Dyson states that one of the fundamental problems of genetics is, "... to understand the machinery controlling the development of higher organisms. Geneticists are already making rapid progress in exploring this genetic machinery, and the biochemical architecture of the development process is understood in general terms" (Dyson, 1997: 86).

This mechanistic, reductionist approach of genetic determinism has attracted widespread criticism from environmentalists.

3.5 Genetic Determinism and Evolution

Wills (2001), for example, believes that genetic determinism is more like an act of faith, that everything in the universe can be explained by the laws of physics and chemistry alone, and that all the physico-chemical processes of organisms are explainable in terms of their genes. This genetic reductionism, Wills claims, is assumed to be 'proven' because they explain Darwinian evolution. Wills, however, argues that there is sufficient evidence to show that both organisms and genes are interdependent, and that systems have emergent properties. This view supports a Lamarckian theory of evolution rather than the accepted reductionist

[3] However, these types of new experiments led to concerns among some scientists that the use of *E. coli*, found in the human gut, could create new pathogens that would be harmful to humans. This concern ultimately led scientists to convene at Asilomar to discuss what should be done, and will be discussed further in Chapter 6.

Darwinian theory of natural selection. Before this can be discussed any further, however, it is necessary to look briefly at the history of evolutionary theory.

3.5.1 Theories of Evolution

Linnaeus (1707-78) was the founder of taxonomy, the study of the classification of species. He believed that the task of biology was to continue the work of Adam – to name the plants and animals and to marvel at God's creations (Magner, 1979). His classifications began with extremely broad groups that divided into successively narrower groups – the 'tree of life'. From this, biologists began to wonder whether two closely related species had evolved from a common ancestor – starting the greatest controversy in the history of biology (Asimov, 1964).

Lamarck suggested that organs that were used a great deal during life grew in size and efficiency and degenerated if they were not. He also argued that these could be passed on to the next generation. Lamarck's theory of evolution was largely rejected, but paved the way for heated debate on the issue of evolution. Magner (1979) states that, while the idea of the inheritance of acquired characteristics is usually attributed to Lamarck, he did not invent the concept. Rather, he applied an old assumption about heredity in an original way as the mechanism for evolution. Lamarck believed that when the environment changed, animals were forced to behave differently which produced modifications over time. He believed that the increased or decreased usage of a part caused proportional changes to that part and that heredity preserved such characteristics acquired by species through extended usage (Magner, 1979).

Charles Darwin (1809-82) could not accept Lamarck's views. After studying a group of finches in the Galapagos Islands (now known as 'Darwin's finches') and discovering that at least fourteen species existed there that were not found on the mainland, he believed that the mainland finches must have colonised the island and then evolved into different species. Darwin believed that the principle of selection, which humans had used to breed cultivated plants and domestic animals, must be responsible for the changes in plants and animals in Nature. He believed that Nature itself would select the survivors as competition for food and other resources grew, through 'natural selection', causing an infinite variety of life (Asimov, 1964; Magner, 1979). At the same time in the Far East, Alfred Russel Wallace (1823-1913) was considering the same problem. It seemed to him that the mammals of Australia were more primitive and less efficient than their Asian counterparts. He believed that the reason the Australian mammals had survived was because the continent had split off from the Asian mainland before the more advanced species had developed. This led him to consider the possibility of evolution through natural selection. Wallace sent his manuscript of his theory to Darwin, seeking his opinion, not realising that he was investigating the same problem. Darwin's writings, together with Wallace's paper, were published in the *Journal of Proceedings of the Linnaean Society* in 1858, although Darwin is usually given credit for the theory, largely due to his publication of *The Origin of Species* in 1859. Wallace and Darwin were not the only ones thinking along these lines. Herbert Spencer (1820-1903), an English philosopher, had evolutionary ideas before Darwin's book was published and therefore greeted that book with gratitude. Spencer went on to popularise the term 'evolution' (which Darwin used sparingly) and the phrase 'survival of the fittest' (Asimov, 1964), and was founder of 'Social Darwinism'. Essentially, Spencer's philosophy was that the strongest and fittest should survive and flourish in society, as this was natural adaptation and selection, as it happened in nature. He took the view that society was evolving toward increased freedom for individuals and that governments should intervene as little as possible.

With these theories of evolution in mind, we can now return to the critique of genetic determinism which stems from Darwin's theory of evolution by natural selection and Mendel's theory of heredity, where organisms are atomised and considered as composites of individual traits (Holdrege, 1998).

3.5.2 Genetic Determinism: The Critique

Goldsmith laments that, since Darwin, the emphasis has been placed on the importance of individual genes, the random and discrete nature of mutations and the lack of influence of the organism on its environment. This extreme form of genetic reductionism has been rejected by many biologists as it fails to take into account the complex interactions between genes and their environments, and loses sight of the whole organism (Keller, 1992; Third World Network, 1994; Strohman, 1997; Holdrege, 1998).

Strohman (1997: 194-195) believes that the narrowly defined genetic paradigm of the Watson and Crick era has been revived into a "... thoroughly molecular form of genetic determinism ... we have taken a successful and extremely useful theory and paradigm of the gene and have illegitimately extended it as a paradigm of life." Nelkin (1996: 24) concurs: "... scientists have elevated it [DNA] to the eternal and fundamental basis of human identity; indeed, DNA is treated in many ways as a secular equivalent to the Christian Soul." Similarly, Ho (1998a: 61) states that genes are taking on the "symbolic significance of the soul".

Ho (2000a) contends that the danger of this reductionist approach, based on Darwin's theory, is that it promotes competition, exploitation and corporate capitalism by reinforcing the dominant worldview – undermining and preventing the necessary shift to a holistic, ecological approach. Dr Robert Haynes, president of the 16th Congress of Genetics reinforces this view:

> For three thousand years at least, a majority of people have considered that human beings were special, were magic...What the ability to manipulate genes should indicate to people is the very deep extent to which we are biological machines. The traditional view is built on the foundation that life is sacred...Well, not anymore. It's no longer possible to live by the idea that there is something special, unique, even sacred about living organisms (Haynes, cited in Kimbrell, 1995: 82).

Goldsmith (1990: 73) maintains that such views, based on the paradigm of science, provide a rationalisation and legitimisation of the paradigm of industrialisation – which he refers to as the 'religion' of industrial society. Thus, in both Ho and Goldsmith's views, the dominant scientific paradigm remains the dominant force because it suits economists, technologists and politicians by catering for their mechanistic needs. Ultimately, this means that social, ecological and spiritual needs are not addressed, and:

> To admit the existence of the latter needs, worse still to show that traditional vernacular cultures were perfectly designed to satisfy them, is to expose the terrible shortcomings of the modern State and the formal economy and must go a long way towards revealing that it is those two aberrant institutions that are ultimately responsible for the terrible problems we face today (Goldsmith, 1990: 73).

These institutions, argues Kimbrell (1995), recognise that current technology is incompatible with sustainability, and rather than looking at alternative technologies, see the solution as engineering life to survive in the current technological world.

Although criticisms of Neo-Darwinism have increased and its deficiencies become apparent, it remains the dominant and 'official' scientific explanation for evolution largely because it remains the only theory of evolution that is consistent with the 'Paradigm of Science'. As stated by Suzuki (1998), genetic determinism remains rife because it sells biotechnology. It is this genetic determinism that has led industry to claim that the new technology will provide solutions to hunger, disease, and other social problems, outlined in Chapter 1. However, many believe that such claims are unfounded and they have become disillusioned by the dominant paradigm. Consequently, they are actively seeking a shift towards more ecological ways of thinking, or an ecological ethic, which will be outlined in more detail in the following chapter.

Biologists' own discoveries within the last ten years also undermine neo-Darwinian evolutionary theory. There is a radical difference between the central dogma and the new genetics that sees the decoding of genetic information as a non-linear process. Research involving prions (protein molecules) has emphasised this, as they reproduce within a circular feedback loop (Wills, 2001). Thus, as stated by Ho (1995), the new genetics contradicts the assumptions of the old genetic paradigm that there is a simple proportional relationship between cause and effect. Molecular geneticists now talk of the 'fluid genome' since genomes are in a state of constant flux from mutations, recombinations, and so on. Thus, critics argue that Darwin's species 'fitness' cannot be applied in isolation from its dynamic relations with other individuals, species and populations (Wills, 2001). Ho (1995) therefore believes that modern biotechnology belongs within a holistic paradigm that embraces complexity – a paradigm which is emerging in many new areas of research and which she believes will be the true revolution of the twenty-first century.

Many green actors are therefore actively seeking a 'new science' that will be discussed in more detail in the following chapter – one that is reflexive, takes a holistic approach, and that is ethically and socially responsible.

3.6 Calls for a Broader Approach to Science and its Regulation

The implementation of such a 'new science' approach has been hindered by the norms of 'disinterestedness' and 'objectivity' of the 'old science' of modernity. Ethical issues have been increasingly marginalised by materialistic scientific thinking (Verhoog, 1994). This is significant to green actors, as science and technology are major forces of socio-economic change and therefore carry serious responsibility that should involve ethical and philosophical reflection. According to Ho (1998b) the moral responsibility of science is absolute, but is disregarded by political and business communities which are locked into the growth and profit paradigm.

Thus, at present there is an absence of reflective discourse and an ultimate lack of understanding of the strength and limits of science and the social responsibility of its practitioners (Suzuki, 1998). Callahan (1996) asserts that science can benefit greatly from an ongoing appraisal. He believes that in order to avoid scientism (science as religion) the view that science is the only valid form of knowledge must be viewed sceptically. The mechanistic approach to science that has led to the 'global economy, does not, for example, account for social or ecological costs, and has led green actors to declare that "Unless the world is restructured ecologically at the level of world-view and life-styles, peace and justice will continue to be violated and ultimately the very survival of humanity will be threatened" (Shiva, 1988: 37).

Similarly, Kutukdjian (1998: 7) states that "... today we can no longer close our eyes to the ethical issues implicit in science. It is no longer possible to envisage an ethical neutrality of knowledge that would be independent of its subsequent applications." While it is conceded that an ethical discussion does not solve all the problems, it does offer a normative approach and facilitates dialogue with 'the public'. According to Kutukdjian (1998: 7) "... science can no longer be regarded as the repository of truth ... it is in the balance between doubt and certainty that the ethics of science places its role".

Along with scientism, the notion of the market as religion also needs to be challenged. As Van Dijck (1998) asserts, the Dawkins model describes genes in analogous terms to business:

> Like business, the genetic make-up is ruled by policy-makers and executives. Genetic laws resemble financial laws, and the mechanism of prediction and speculation not only prevails in the stockmarket but equally dominates our genetic disposition. Dawkins extends the analogy even further by insisting that genes can be thought of as 'insurance underwriters': the currency used in the casino of evolution is survival or 'reasonable approximation'. These images convert the language of genetics to the language of business (Van Dijck, 1998: 94).

Modern science tends to take a pragmatic approach and leaves little room for philosophical reflection. This is in stark contrast to the great scientific thinkers such as Einstein, Schrodinger, Bohr, and Delbruck for example. Einstein stated that "... science without epistemology is – insofar as it is thinkable at all – primitive and muddled" (cited in Charlesworth *et al.,* 1989: 120).

With the issue of the social and moral responsibility of science effectively having disappeared, many green actors claim that the corporatisation of biotechnology and its reductionist methods are wreaking havoc on world economies and social structures. For example, in countries such as Kenya, the need to generate foreign capital to pay massive debts has lead to a dependence on cash crops which, in turn, has undermined local food security (Anderson, 2000). Ho lists 'Ivory Tower' excuses which has supported the ongoing authority of 'bad science' and lead to these consequences: a) you cannot impede scientific progress; b) science is never wrong, it is only its applications which may be bad; c) scientific inquiry is always objective, neutral and value-free (Ho, 1998b).

As a result of such 'bad science', the Scientists for Global Responsibility (SGR) state that addressing the responsible use of science and technology is probably the most important moral and ethical issue of present times (SGR, 1998). Russell (2000) states that scientists should accept a set of clear obligations to communicate, educate and be socially and ethically responsible.

Ihde (1997) points to the fact that there is no forum within science or technology for constructive criticism as in fields such as art and literature. Criticism is not welcomed in the field of techno-science and critics are either regarded as outsiders, or if the criticism arises from the inside, soon made to be 'quasi-outsiders' (Ihde, 1997). Therefore this resistance to criticism serves to keep the critics externally located as 'others' (Ihde, 1997). Bruno Latour's *Science in Action* (1987) argues that science-as-institution has created a social form, which contains its own form of critique into "carefully constructed modes of contestation". Scientific papers are often multi-authored, written in an anonymous/'objective' style and quantitative. Latour states that such texts are deliberately opaque and "puts off" any ordinary reader. Thus, there is an externalisation of criticism from within an institutionalised 'myth of expertise' (Ihde, 1997).

The aforementioned problems have led to what has been described as a crisis in the relationships between science and society. Trust in the ethical integrity and responsibility of scientists is declining and according to Kutukdjian (1998) researchers sometimes have a 'dehumanising' and reductionist view of the public and the public is becoming increasingly wary of science. Thus, the science world is very much like the corporate world, and much less like the church as the popular image may suggest.

Thus, it can be argued that social decisions are rarely made by scientists, but rather politicians and business interests. Scientists form a large intellectual base in big business and are a powerful internal force. They therefore have a social responsibility to advocate minimising harm as well as advocating socially beneficial outcomes. Westerholm (2000) therefore, states that the ethical review of techno-scientific developments should involve continuous open debate, and, in this way, different values can be weighed against each other to lead to greater understanding about desired outcomes.

3.7 Biotechnology Policy: Socially Responsible?

As discussed in Chapter 1, proponents of biotechnology claim that genetically engineered crops will provide great benefits to society in the form of healthier food, reduced chemical inputs, and the solution to world hunger. However, in the case of the two most common modifications (herbicide and pesticide resistance), genes are inserted for the benefits of agribusiness, not consumers (Anderson, A, 1998). This is evident in the financial gain to biotech companies, but the huge cost to consumers – particularly when farmers can no longer save seed stock. Further costs are incurred by a greater reliance on industrial chemicals in the case of herbicide resistant crops, and also from poor yields (outlined in Chapter 6). So far, very little field-testing involves modifications to crops important to Third World countries. Most of the populations in need of more food are too poor to afford the expensive products of biotechnology.

Technology alone cannot solve the problems that are embedded within frameworks of social and economic injustice. For example, at the height of the 1984 famine in Ethiopia, crops were being grown on prime agricultural land and exported as feed to the UK (Anderson, L, 1998). Many proposed biotechnological 'solutions' detract attention away from the difficult social problems contributing to ill health, malnutrition and environmental degradation (Ho, 1998a). Alternatives such as integrated pest management and organic farming are largely ignored and not funded by the state.

If biotechnology is driven by profit, it needs to be considered whether widespread benefits are likely (Hindmarsh *et al.,* 1998). Environmentalists argue that, as in the Green Revolution, benefits will go to those with power in wealthy First World countries (Hobbelink, 1991; Shiva, 1997). Already, there is evidence of this with the patent of the 'terminator' gene by Monsanto, which will be discussed further in Chapter 6. The company is using the control of plant fertility as the key to preventing growers from pirating their technology (Brookes, 1998). This has given multi-national seed and chemical companies a virtual monopoly on seed stocks. An Eco-critical approach, to which this thesis subscribes, sees the need for motives of profit to be replaced by ethical values as the primary focus of decision-making (Suzuki and Knudtson, 1989; Macer, 1990; Moser, 1995). Such an approach also calls for a 'new science' or 'post-normal' science that challenges the problems of modernity and Western science, which will be discussed in detail in the next chapter.

3.8 Concluding Remarks

Despite the contestation of GE policy and calls for a broader, more holistic and socially responsible approach to science/technology and its regulation, decision-makers continue to adopt the reductionist approach (as will be discussed in Chapters 6 through to 9).

This chapter has outlined how the mechanistic world-view that continues to dominate today and underpins reductionist GE policy, is the legacy of the Judaeo-Christian tradition that through Copernicus, Galileo and Descartes culminated in Newton's mathematical laws of mechanics (Merchant, 1989). Descartes and Bacon have often been cited as the cause of the 'separation of humans from nature'. Through their world-view Nature became objectified and materialised and through the application of the scientific method, humans' power over nature has increased (Verhoog, 1994). As described by Merchant (1989; 1995), the transformation of nature from an Earth Mother to inert, malleable matter was suited to the exploitation of growing capitalism: "Modern science ... has a world-view that both supports and is supported by the socio-political-economic system of western capitalist patriarchy which dominates and exploits nature, women and the poor" (Shiva, 1988: 25). Modern genetic engineers have added new goals, with similar values, to these early ones of Bacon and the scientists of his time. Thus, as asserted by Merchant (1989), the Baconian method has played a major role in the rise of Western science, constituting a set of attitudes about nature and science that reinforce capitalistic thinking.

This same era produced what Benjamin Farrington (cited in Magner, 1979: 28) termed the "propaganda of the enlightenment", or the belief that, through rational thought and practical techniques, mystery and ignorance could be eliminated and humans and nature understood. Socrates (470-399 BC) taught that there was only one good – knowledge, and only one evil – ignorance (Magner, 1979). Proponents of biotechnology are employing this same 'propaganda' today. There is a belief among many proponents that gene technology will reveal the secrets of life. Also, as discussed in Chapter 1 and further in Chapter 5, there is a strong belief among supporters of the technology that critics are ignorant or uninformed and that with education this 'nuisance' factor could be eliminated.

Thus, the reductionist, mechanical paradigm of western science that began with the scientific revolution excludes "... other knowers and other ways of knowing" (Shiva, 1988: 22). This exclusion of other traditions is largely political, with the reductionist tendency of modern science closely linked to the existing power structure (Verhoog, 1994). It is these power structures, and the paradigm of modern science, that has led to the growth of biotechnology, the reductionist approach to its regulation, and the increasing corporate control over research and development.

The shortcomings of modern (western) science discussed above, including the exclusion of alternative ways of knowing, the marginalisation of holistic approaches, and the resultant reductionist approach to biotechnology regulation, has led to a growing environmental critique. This critique began with the Romantic thinkers of the early nineteenth century which will be discussed in the following chapter and has influenced the modern environment movement[4]. We turn now in Chapter 4 to look at this critique, which underpins the development of an eco-political theoretical framework for the thesis, in more detail. The aim of this theoretical framework is to assist in the better understanding of the underlying power relations involved in the bio-policy terrain and to challenge the dominant social paradigm approach to ESD.

[4] Although as Hay (2002) asserts, the environment movement adopts essentially non-romantic values.

4

An Eco-political Theoretical Framework

It has become acceptable, even fashionable, in first-world countries to think of the planet as Gaia, to acknowledge the importance of the biosphere and begin using terms like sustainability and stewardship. While a shift in language and the use of metaphor can serve as a powerful conditioner to reorient life-styles and worldviews, if the fledgling biospheric consciousness does not lead to a green movement for fundamental institutional change, it may well end up as little more than superficial gloss, incorporated into the advertising strategies of the multinationals and the political slogans of world leaders.

Jeremy Rifkin, 1992 (Cited in McCoy and McCully 1993 *The Road from Rio)*

The primary aim of this chapter is to outline an ecological-political (ecopolitical) theoretical framework, which informs a power relations methodology, as related in Chapter 5. The theoretical formulation is shaped from several important theories from both incremental and radical environmental critique. These include ESD and the precautionary principle (discussed in Chapter 2), as well as radical theories of deep ecology, social ecology, eco-feminism, and political ecology.

The way in which we interpret reality influences our every action. There are many possible ways of knowing and different methodologies are implied by different epistemologies. Therefore, the methodologies chosen for this thesis reflect my understanding of the world and my relationship to it, as well as implying visions for the future. It is therefore important to inquire at the outset into the knowledge construction and interpretation which informs this analysis of socio-political mechanisms and decision-making processes, both in its theoretical framework and methodology.

Since we lack an 'absolute truth' on which to base our understanding of the world, we create an 'absolute reference point', or paradigm, via social consensus (Gummesson, 1991). To reiterate from Chapter 3, a paradigm is "... a fundamental model or scheme that organises our view of something" (Babbie, 1989: 47). In the context of this thesis it refers to what I believe are the important research questions and how I feel I should tackle them. A paradigm thus involves the basic premises and value judgements held by the researcher. A paradigm tells us where to look for answers. Thomas Kuhn states the importance of paradigms:

> One of the things a scientific community acquires with a paradigm is a criterion for choosing problems that, while the paradigm is taken for granted, can be assumed to have solutions. To a great extent these are the only problems that the community will admit as scientific or encourage its members to undertake. Other problems, including many that had previously been standard, are rejected as metaphysical, as the concern of another discipline, or sometimes as just too problematic to be worth the time. A paradigm can, for that matter, even insulate the community from those socially important problems that are not reducible to the puzzle form, because they cannot be stated in terms of the conceptual and instrumental tools the paradigm supplies (Kuhn, 1970: 37).

This concept of a 'scientific paradigm' which stems from the scientific revolution of the seventeenth century discussed in the previous chapter has been expanded to that of a 'social paradigm'. The social paradigm can be defined as "... a constellation of concepts, values, perceptions, and practices shared by a community, which form a particular vision of reality that is the basis of the way the community organises itself" (Capra, 1994: 335).

The methodology for this thesis has been chosen to reflect an ecological worldview that challenges the dominant social paradigm (discussed in more detail below). The research, due to the very nature of environmental studies and my position in the debate – that of the "third space as critical engagement" (Routledge, 1996: 399), is interdisciplinary and integrates a number of different theoretical perspectives in an effort to understand the dynamic interaction of socio-political mechanisms that impact on biotechnology regulation and policy as well as research and development directions. This approach crosses between academia and activism and addresses the interrelationships between the personal and the political:

> Critical engagement affects a "politics of articulation" involving an interactive process of collaboration between critical theorists and social movements as subjects working together to understand the questions under examination, the heterogeneous accounts of the world. Such a process implies social relations of conversation rather than

> discovery, the creation of political formations/assemblages between social movements and critical theorists as actants ... the potential exists to create new spaces of being and becoming, spaces of personal and collective communication, participation, and actualization [sic] (Routledge, 1996: 414-415).

It is hoped that such an approach will allow the research to be 'embodied', rather than separated from actual experience, involving the continued questioning of my own positions. I have also taken the liberty, through the influence of Gummesson (1991: 3), of writing parts of the thesis in a personal manner, in line with qualitative research where "the personality of the scientist [sic] is a key research instrument". We turn first to the green critique.

4.1 The Green Critique

4.1.1 Environmental Ethics

Merchant (1992: 61) outlines the three ethical[1] realms that underlie political disputes and conflicts of interests between interest groups – namely egocentric, homocentric and ecocentric ethics. According to Merchant, egocentric ethics, grounded in the self, is historically associated with *laissez faire* capitalism and liberalism, and is therefore the ethic of industrial capitalism today. Individuals are seen as separate but equal social entities. Underlying egocentrism is the assumption that competition and capitalism are 'natural', and the commons a marketplace (Merchant, 1992: 67). This ethic is rooted in seventeenth century mechanistic science, outlined in the previous chapter, and shares its underlying assumptions such as the whole being equal to the sum of the individual parts.

A homocentric, or anthropocentric, ethic is grounded on the social good and underlies social movements such as social ecologists and the mainstream sustainable development movement. Rooted in the utilitarian ethics of Bentham (1789) and Mill (1861), it advocates that society should act to ensure the greatest good for the greatest number of people (Merchant, 1992: 70). The biblical notion of stewardship is tied in with homocentric ethics, as humans must manage

[1] The term 'ethics' is derived from the Greek 'ethos' meaning custom, character, people or system. It is defined in the Oxford English Dictionary to be both the characteristic spirit of a community and the guiding moral principles for individuals.

nature for the benefit of humans and not for the intrinsic value of all species. Anthropocentric ethics also share the assumptions of mechanistic science, and see the meeting of human needs as the main priority. Shallow environmentalism is based on these anthropocentric ethics.

As Merchant (1992: 74) asserts, the main failings of both egocentric and anthropocentric ethics is that ecological changes and their effects remain outside the framework of these ethics. Thus, environmentalists maintain that materialistic scientific thinking has inhibited the development of appropriate ethical guidelines (Verhoog, 1994). One of the biggest dangers of these viewpoints, according to Plumwood (1999), is the denial of our dependency on nature. It is these dominant viewpoints (ego- and anthropocentrism) which prevent the transition to new revolutionary models of ecological thinking which see humans as continuous with non-human nature (Plumwood, 1999). As stated by De Quincey (1999), the dominant ideology has left us alienated from the universe and without a sense of place, while this new ideology or ecological account of the world offers us a place in Nature.

Deep green environmentalists such as Plumwood (1999) assert that the anthropocentric, self-enclosed outlook is not inevitable, as some claim: rather, the problem lies with the refusal to go beyond questions of human well-being. They claim that the environmental crisis requires us to rethink our conception of ourselves and the earth and, as a result, many are beginning to rediscover organicism in the form of a 'biocentric' or 'ecocentric' approach (Merchant, 1992), where Nature has intrinsic value, and challenge the reductionist approach of the dominant paradigm (Verghoog, 1994).

Thus, in reaction against anthropocentrism and reductionist science, many are now seeking an eco-ethic, or 'transpersonal' view to achieve ESD (Fox, 1990). Ecocentric ethics are grounded in holistic rather than mechanistic science, and every aspect of an ecosystem is believed to have intrinsic value. Modern ecocentric ethics were founded by Aldo Leopold in the 1930s, with *The Land Ethic*. It tries to overcome the dualism between humans and nature by viewing people as integral parts of the larger ecosystem (Merchant, 1989). People need to learn that nature is us and that we live *in* not *on* the Earth (Weston, 1999: 54): "Only in reciprocity with what is Other do we begin to heal ourselves." An environmental ethic includes looking at what 'should' be the case (Sylvan and Bennett, 1994). For example, Ho (2000b) asserts that intercommunication and participation are needed for true democracy, requiring both local autonomy and global cohesion. Such ecocentric ethics, grounded in whole ecosystems, underlie the ideologies of deep ecologists, some ecofeminists and indigenous movements.

Two main suggestions have been put forward in the literature to deal with the environment ethically. The first is to expand current ethics and apply them to human/environment relationships, and the second is to develop a 'new ethics' that involves both quantitatively and qualitatively different methods of dealing with the environment (Sylvan and Bennett, 1994). Many argue that the dominant Western worldview does not take environmental issues and values adequately into account, unlike a genuinely environmental ethic (Sylvan and Bennett, 1994).

These ethics are inextricably tied to philosophy, and so an ethics without philosophy is meaningless. Equally, ethics without regard to power relations is also fruitless. Increasingly, people are asking whether we are moving in the right direction, what alternatives there are, what should be happening, and how different paths to sustainability can be achieved. To achieve sustainability, an ethical framework with respect to the biosphere must be adopted, taking into account the decrease in biodiversity, ecosystem destruction, resource depletion and the destruction of cultural integrity (Bossel, 1998: 86). To Merchant's three categories of environmental ethics, Bossel (1998) adds a fourth: partnership ethics. He states that a holistic view "… is one of partnership with each other, the environment, other concurrent systems, and future systems. And 'partnership' means dealing with these system partners in a spirit of equity, fairness, and justice – not competition, not exploitation" (Bossel, 1998: 97). He believes that this partnership ethic is the only viable systems approach that includes a fair representation of the interests of all the systems within the total system and "… encompasses aspects of love, compassion, respect, and a 'sense of the whole'" (Bossel, 1998: 91). This partnership approach may go some way to closing the divide between those who argue that an ecocentric ethic ignores that everything we as humans see or do must be anthropocentric (Dobson, 1990: 62-72; Fox, 1990: 20-21) and that anthropocentrism is an unavoidable aspect of any political theory (Barry, 1994: 386), thereby avoiding arguments of 'human-based' or 'human-centredness' within anthropocentrism.

These broad ethical positions are useful for analysing the positions held by interest groups in the biotechnology debate, and also for perceiving what is both possible and desirable for a sustainable future. Ultimately, the problems caused by genetic engineering are not due to the methods used, but due to a particular mind-set or worldview where metaphysics or natural philosophy are pushed aside (Verhoog, 1994) and unequal power relations enable this to continue. Blame for the environmental crisis has been attributed by environmentalists not simply on this technological way of life, but on dominant 'ways of seeing' Nature. Many environmentalists believe that the mechanistic worldview and the ideologies of industrial capitalism, which began with Bacon and Descartes (as discussed in Chapter 3), are at the heart of the world's environmental problems (Merchant, 1992). Critics argue that biotechnology is embedded in this simplistic, mechanistic Enlightenment worldview established at the time of the scientific revolution. As discussed in Chapter 2, these worldviews are underpinned by values, and these can be transformed by social change and facilitative power (Merchant, 1992). However, it is important not to place too great an emphasis on individual values, but rather focus on societal change.

4.1.2 Worldviews

The dominant social paradigm (DSP) affecting the world today involves science, technology, economic growth, capitalism, bureaucratic rationalism, consumerism, expertise and social insulation. It sees the advance of society coming about by scientific reason and technological advances. It implies continuous growth and economic development. It assumes that the universe is a natural order governed by predictable rules, regulations and laws (Merchant, 1992: 49) and sees nature in terms of utility for humans.

The decision-making processes of government and business within Western society are largely dominated by the criteria of this dominant social paradigm. Technical information and economic factors consistent with this world-view have become important instruments in persuading decision-makers. Ecologically sustainable development (ESD) is to be achieved by the 'rational' use of science and technology, using 'facts' and not emotions. This way of thinking has become so embedded in society that it has been described as a "culture of positivism" (Giroux, 1981) and has been cited as the cause of major environmental problems (see for example WCED, 1987) and a major contributory factor to "... the concept of humans as separate from nature and to our domination and exploitation of nature" (Gunnell, 1994: 12).

The counter-paradigm, sometimes referred to as the 'new environmental paradigm' (NEP) attributes intrinsic value to the environment and holds that a radical shift in thinking is required (Cotgrove, 1982). Some, such as Callicott (1989: 3), believe that what is needed is "… nothing less than a sweeping philosophical overhaul – not just of ethics, but of the whole Western world view." Similarly, Shiva asserts: "Unless the world is restructured ecologically at the level of world-view and life-styles, peace and justice will continue to be violated and ultimately the very survival of humanity will be threatened" (Shiva, 1988: 37).

Table 1: Value Differences Between the DSP and NEP and Contrasting Policy Processes (Milbrath *et al.*, 1994: 438-439)

Dominant Social Paradigm (DSP)	**New Environmental Paradigm (NEP**
Priority on economic growth and development	Priority to ecosystem viability, focus on long-term sustainability
Continuation of economic growth justifies the dangers of disrupting ecosystems	Disruption of ecosystems is rarely, if ever, justifiable
Accepts risks to ecosystems to maximise wealth	Avoid risks to ecosystems and overall societal well-being
Reliance on markets to encourage growth to ensure a desirable future	Reliance on foresight and planning to ensure a desirable future
Emphasis on immediate material gratification	Emphasis on personal enrichment
Emphasis on hierarchy and authority	Emphasis on horizontal structures
Centralised decision-making and responsibility	De-centralised decision-making with greater personal and local responsibility
Emphasis on private over public goods	Emphasis on protection of public goods

Excessive faith in science and technology	Critical evaluation of science and technology
Mechanistic cause/effect thinking	Holistic/integrative thinking
Emphasis on competition, domination, patriarchy	Emphasis on cooperation, partnership, egalitarianism
Subordinate nature to human interests	Place humans in ecosystemic context
Emphasise freedom as long as it serves economic interests	Emphasise freedom as long as it serves ecological and social imperatives
<u>Policies/Strategies</u>	<u>Policies/Strategies</u>
Encourage excessive consumption	Discourage excessive consumption
Use whatever resources needed to maximise economic growth	Conserve and maintain resources for future generations
Emphasise profitable use of non-renewable resources; rely on markets to resolve resource shortages	Emphasis on renewable resources; plan for resource shortages
Encourage development and virtually unrestricted use of science and technology	Critically evaluate and restrict use of science and technology where needed
Use hard/large-scale technology	Use soft/appropriate technology
Sacrifice other species for economic gain	Protect other species even at economic cost
Encourage monocultures to maximise output and wealth	Restore/preserve ecosystem diversity
Emphasise high-yield (intrusive) agriculture	Emphasise regenerative/appropriate agriculture

Thus there is conflict between green worldviews and that of liberal democratic politics (Hay, 1994). The struggle between these two paradigms, the first based on holism and the second on reductionism is evident in the history of science and technology and continues today. As discussed in Chapter 3, around 1800 Goethe recognised the 'wholeness' of organisms. His approach placed faith in sense perception and intuition. He stated that matter cannot exist without spirit and spirit cannot exist without matter (Verhoog, 1994). However, Goethe's method was forgotten with the breakthrough of the experimental, reductionist methods in biology in the 19^{th} century, and from this time onwards, Western culture lost touch with 'ecological wisdom'. It should be noted however that, as Hay (2002) asserts, the Romantic approach was not truly ecological.

Radical environmental critique evolved from the desire for an ecological approach, reacting against dominant Western ways of thinking and conceiving nature. It was also spurred on by disillusionment with the ability of established political parties and policy processes to adequately deal with environmental issues (Eckersley, 1992). Thus, radical environmental change actors are involved in paradigm struggles, challenging powerful existing paradigms (Doyle and McEachern, 2001). This struggle is between ecological (cooperation, conservation, partnership) and economic (competition, expansion, domination) thinking, between ecologists and biotechnologists, with industrial interests over-riding the ecological. Kimbrell (1995: 79) laments that "... technique has insulated us from the rest of our natural Milieu and ... mediated nature for us" and the environmental costs of this have been far-reaching. The technological way of life, he states, has affected the planet in ways that may be irreversible.

Ho lists 'Ivory Tower' excuses associated with the DSP around which 'bad science' is conducted: a) you cannot impede scientific progress; b) science is never wrong, it is only its applications which may be bad; c) scientific inquiry is always objective, neutral and value-free (Ho, 1998). Goldsmith (1990: 73) maintains that this paradigm of science provides a rationalisation and legitimisation of the paradigm of industrialisation, which he refers to as the 'religion' of industrial society. Ho states that the dominant Western world view,

> ... takes hold of people's unconscious, making them act, unthinkingly, to shape the world to the detriment of human beings, how that science is used, often without

> conscious intent, to intimidate and control, how it is used to obfuscate, to exploit and oppress (Ho, 1998: iii).

While the mechanistic approach prevails in decision making, the organic perspective still remains:

> It has remained as an important underlying tension, surfacing in such variations as Romanticism, American transcendentalism, German Nature philosophers, and the early philosophy of Karl Marx … The basic tenets of the organic view of nature have reappeared in the twentieth century in the theory of holism of Jan Christian Smuts, the process philosophy of Alfred North Whitehead, the ecology movement of the 1970s … (Merchant, 1992: 59).

4.1.3 Embodiment of the Ecological Paradigm

The ecology movement, which began in the 1960s, evolved from the knowledge framework historically associated with the organic theory of nature and society to address the issues stemming from the dominance of the mechanistic paradigm (Merchant, 1989; 1995). Eckersley (1992) outlines three major stages in the development of ecopolitical thought from the 1960s to the 1980s. It began with participation, then focussed on survival, and finally with emancipation. This last phase is the most thorough conception of the new 'ecological' paradigm discussed above that recognises the interdependence and complexity of ecological systems and focuses on the whole of the organism and living processes in the wider context: Earth is a network, or "web of life" (Capra, 1997). As asserted by Eckersley (1992: 56), the emergence of the Green movement and Green philosophy in the 1970s and 1980s represents this third emancipatory phase.

A number of eco-radical theories share similar ecological values, although each argue different causes for the environmental problem: deep ecologists see anthropocentrism as the problem, social ecologists claim that it is hierarchy, and certain eco-feminists believe that patriarchy is to blame for social and environmental destruction (Doyle and McEachern, 1998: 38). These radical green critiques will now be explored in more detail.

4.2 Ecophilosophy

4.2.1 Deep Ecology

Deep ecology is one theory that has emerged from the environmental crisis and involves a new ecological rather than mechanistic paradigm. The name was coined by Norwegian philosopher Arne Naess in a 1973 article *The Shallow and the Deep, Long-Range Ecology Movements: A Summary.* Naess states that the essence of deep ecology is to ask deeper questions involving the 'why?' and 'how?' which are often ignored. Similarly, Fox (1990) states:

> This sense of deep ecology is predicated upon the idea of asking progressively deeper questions about the ecological relationships of which we are a part. Naess holds that this deep questioning process ultimately reveals bedrock or end-of-the-line assumptions, which he refers to as *fundamentals*, and that deep ecological views are derived from such fundamentals while shallow ecological views are not (Fox, 1990: 92).

Thus, according to these theorists, it is the level of questioning that is fundamental. It focuses on change at the level of consciousness and worldviews, questioning attitudes of nature, particularly those held by Western societies (Devall and Sessions, 1985). Deep ecology sees humans and nature as a part of the same whole, rather than humans above and in control of nature:

> Ecological consciousness and deep ecology are in sharp contrast with the dominant worldview of technocratic-industrial societies which regard humans as isolated and fundamentally separate from the rest of nature, as superior to, and in charge of, the rest of creation … For thousands of years, Western culture has become increasingly obsessed with the idea of dominance: with dominance of humans over non-human Nature, masculine over the feminine, wealthy and powerful over the poor, with the dominance of the West over non-Western cultures. Deep ecological consciousness allows us to see through these erroneous and dangerous illusions (Devall and Sessions, 1985: 65).

Thus, the emphasis is on maintaining the integrity of ecosystems, not on modifying them for the benefit of humans. It draws on Aldo Leopold's 1949 'land ethic', which was an ecocentric ethic that saw humans as dependent on the environment for survival and so could not afford to exploit it. It recognises that the resources on which humans depend are finite, and that the two are interconnected. It also draws on the science of ecology, recognising the importance and complexity of all Nature, and also on philosophies from indigenous communities and eastern traditions. It subscribes to two fundamental norms, namely "biocentric egalitarianism" and "self realisation", the latter which has been coined "transpersonal ecology" by Fox (1990). Self-realisation is, according to Naess, the development of the wider Self by a process of identification whereby the individual 'identifies' with the interests of another being as their own interest. In this way, Bill Devall (1988: 43) states that "... we will naturally respect, love, honor [sic], and protect that which is our self." This concept of self-realisation was inspired by the metaphysics of Ghandi, of whom Naess claims to admire (Naess, 1988).

Biocentric egalitarianism claims that all living things (defined broadly to include non-living things such as rivers, rocks and so on as well) have intrinsic value, or equal moral worth, thereby challenging the anthropocentric approach of the Western worldview. As stated by Merchant (1992: 87) "Modesty and humility and an awe of evolution take precedence over an assertion of power over the biosphere." Eric Katz (1991: 84) also states that advocates of deep ecology see it as a "re-shaping and re-direction of human consciousness." Thus, according to Devall and Sessions (1985: 65), deep ecology is founded on "... the basic intuitions and experiencing of ourselves and Nature which comprise ecological consciousness."

Earth First! has been called the activist wing of the deep ecology movement, with its founder, David Foreman, believing that too many environmentalists act like bureaucrats, compromising their values (Foreman, 1984). Deep ecologists such as Foreman, however, have received a great deal of criticism for their radical ecocentric views. Foreman has argued, for example, that viruses such as smallpox and HIV AIDS have intrinsic value and naturally control the world's population, and therefore should not be treated. Foreman has been quoted as saying,

> When I tell people how the worst thing we could do in Ethiopia is to give aid – the best thing would be just to let nature seek its own balance, then let the people there just starve – they think this is monstrous ... Likewise, letting the USA be an overflow

> valve for problems in Latin America is not solving a thing. It's just putting more pressure on the resources we have in the USA (Foreman, n.d.: 43; cited in Doyle and McEachern, 2001: 43).

Understandably, there is not a great deal of support for such extreme views.

Deep ecology is a radical philosophy in that it "... would entail new metaphysical, epistemological, religious, psychological, sociopolitical, and ethical principles" (Merchant, 1992: 85). De Quincey (1999) believes that philosophy needs to go even deeper than feminist and ecological critiques, proposing an ontology of "radical naturalism" that sees matter as intrinsically sentient, and which restores a sense of sacredness to the human body, the Earth and the universe. He extends the ideas of Giordano Bruno (1548-1600) that the universe is composed of 'intelligent matter' which is self-organising and self-directing. In his alternative view, matter and consciousness are not separate, but rather mutually complementary realities. He believes that the healing of the mind-body split requires that we see matter as intrinsically meaningful. De Quincey (1999: 22) outlines ten elements of the new worldview: complementarity rather than dualism; organicism rather than mechanism; holism rather than reductionism; interconnectedness rather than separateness; process rather than substance; synchronicity as well as causality; creativity rather than certainty; participation rather than objectivity; matter is inherently sentient; matter, including nature and the cosmos, is inherently meaningful, purposeful, and valuable in and for itself. De Quincey (1999) presents an invitation:

> We must engage the paradox. Paradox means "beyond" (para) "opinion" (doxa) – beyond opinion or belief. Paradox, then, takes us beyond belief – into that mode of knowing that is experience itself. It invites us into the ambiguity of being – an ambiguity that is neither this or that, nor this and that, neither either/or nor both/and, but all of these together (De Quincey, 1999: 24).

Table 2: The 8 Points of Deep Ecology

1. The flourishing of human and non-human life on Earth has inherent value. The value of non-human life forms is independent of the usefulness of the non-human world for human purposes.
2. The richness and diversity of life forms are also values in themselves and contribute to the flourishing of human and non-human life on Earth.
3. Humans have no right to reduce this richness and diversity except to satisfy vital needs.
4. Present human interference with the non-human world is excessive, and the situation is rapidly worsening.
5. The flourishing of human life and cultures is compatible with a substantial decrease of human population. The flourishing of non-human life requires such a decrease.
6. Significant change of life conditions for the better requires change in policies. These affect basic economic, technological, and ideological structures.
7. The ideological change is mainly that of appreciating life quality (dwelling in situations of inherent value) rather than adhering to a high standard of living. There will be profound awareness of the difference between big and great.
8. Those who subscribe to the foregoing points have an obligation, directly or indirectly, to participate in the attempt to implement the necessary changes.

Source: Naess, A and Rothenberg, D (1989)

Deep ecology, however, remains a shifting and contested concept. Richard Sylvan and Val Plumwood, for example, developed what they termed Deep Green Theory, in Australia in the early 1970s. This theory provides a philosophical approach to environmental problems and issues, and rejects the religious underpinnings of some forms of Deep Ecology. It has been proclaimed as an alternative to such theories (Sylvan and Bennett, 1994), however it shares many of its characteristics, such as the rejection of human-centredness and the realisation that prevailing ethics is not adequately equipped to deal with environmental matters, and opposes the technocratic, industrial paradigm. While deep green theory accepts the 8 main principles of deep ecology, it does not endorse holism, biospherical egalitarianism or maximising self-realisation (Sylvan and Bennett, 1994). The theory holds that humans do not have a privileged position in the world, which they term *eco-impartiality,* according to which "... there should be no substantially different treatment of items outside any favoured class or species of discriminatory sort that lacks sufficient justification" (Sylvan and Bennett, 1994: 142).

Like deep ecology, deep green theory promotes an 'ecological outlook' in which,

> … man [sic] is seen as part of a natural community, part of natural systems seen as integrated wholes and with welfare and interests bound up with the whole, and not as, in the typical Western view, a separate, self-contained actor standing outside the system and manipulating it in the pursuit of self-contained interests (Sylvan and Bennett, 1994: 148).

It rejects both the extreme holism of Naess's version of Deep Ecology and the reductionism of the dominant technocratic paradigm. Rather, deep green theory promotes impartiality and moderate holism and there is a major shift in the *onus of proof* from homocentric ethics (Sylvan and Bennett, 1994). Thus, responsibility lies with those who interfere with the environment, which is consistent with the precautionary principle discussed in Chapter 2 and which will be revisited throughout the thesis.

Deep green theory, like other forms of deep ecology, has taken a pluralistic turn to increase its constituency:

> There does not have to be, does not need to be, any general agreement; a wide diversity of opinion can flourish. That is, adoption of eco-pluralism renders many green tasks and problems much easier … As long as an end concern is acknowledged, combined concerted action to that end can be marshalled from interested groups, irrespective of divergence between groups outside the setting of that end. In this way, that major obstacle for radical groups, *ideological correctness* and political and other variants thereupon, can be defeated (Sylvan and Bennett, 1994: 152)

However, deep ecology continues to receive much criticism.

Critiques of Deep Ecology

While both deep ecologists and social ecologists see humans as part of Nature, deep ecologists see humans as equal to all other organisms, while social ecologists give humans a higher position in the evolutionary chain. Bookchin (1988) criticises deep ecology for failing to recognise the social roots of the environmental crisis:

> In failing to emphasize [sic] the unique characteristics of human societies and to give full due to the self-reflective role of human consciousness, deep ecologists essentially evade the *social* roots of the ecological crisis … we not only lose sight of the social differences that fragment "humanity" into a host of human beings – men and women, ethnic groups, oppressors and oppressed – we lose sight of the individual self in an unending flow of eco-babble that preaches the realization [sic] of self-in-Self where the 'Self' stands for organic wholeness (Bookchin, 1988: 232).

Thus, criticism has been raised over some deep ecologists' sole focus on ecocentrism, placing greater emphasis on wilderness areas and not including humans (Doyle and McEachern, 2001). Also, they have been criticised for failing to recognise that ecocentrism is as much of a human construct as anthropocentrism which they criticise (Merchant, 1992). Barry (1994: 383) criticises deep ecology for avoiding the social dimension that is the "… primary context for the elaboration of intrahuman moral and political principles". Barry (1994: 369) asserts that to reconcile green philosophy and politics, it has to be recognised that green politics includes concern with the human social world and its organisation, as much as moral concern with the non-human world: "If deep ecology represents what greens are really after … then we may end up with a political theory largely devoid of the politics" (Barry, 1994: 370). Thus, Barry believes that we need to look at how a sustainable society may be achieved, through institutional transformation, and to do this we need to look at the social principles and values associated with such a society.

Barry (1994) believes strongly that the distinction between anthropocentrism and ecocentrism is increasingly artificial and that it needs to be transcended for future development of green political theory. Deep ecology is seen as deficient for this purpose at it is primarily metaphysical and not political: "… green politics requires … more than metaphysical grounding, otherwise it stands in danger of simply being green spirituality by other means" (Barry, 1994: 381). Barry maintains that green political theory needs to be seen in its wider perspective, extending democratic processes, restructuring the relationship between state and civil society, and creating a more egalitarian, humane world (Barry, 1994: 376). However, deep ecology ignores the role of the state "in their rush to found pastoral utopias" (Barry, 1994: 180), and therefore bypasses the possibility of developing a theory of the green state that is decentralised and democratised. Thus, we now turn to power relations-based green theories that acknowledge the human dimension.

4.3 Power Relations Based Theories

4.3.1 Social Ecology

Murray Bookchin is recognised as the leading figure of social ecology which provides one of the most vigorous critiques of deep ecology and is strongly aligned with anarchism. Bookchin claims deep ecology is the domain of "privileged white male academics" and further criticises Deep Ecology for taking on the characteristics of a religion and for its biological treatment of the population problem, based on "prophets" such as Malthus, Vogt and Ehrlich (Bookchin, 1988). Social ecology sees the roots of the ecological crisis in the hierarchical structures of domination and draws from radical decentralist thinkers such as Peter Kropotkin, William Morris, and Paul Goodman (Bookchin, 1988). Bookchin believes that hierarchies in both human and non-human societies are socially constructed and that once these hierarchies and forms of domination are disposed of, the separation between humans and nature will disappear and be replaced by interdependence and cooperation (Tokar, 1988). Bookchin advocates an 'Ecotopia' where capitalism is disposed of and individuals are free to reach their full potential in a society where ecology and anarchy are bound together (Bookchin, 1980).

Social ecology sees nature and society as intertwined, with a first or 'biotic nature' and a second or 'human nature' (Bookchin, 1995). According to Bookchin, second nature is the way in which humans inhabit the natural world. However, rather than fulfilling human potentials, this second nature, according to Bookchin,

> ... is riddled by contradictions, antagonisms, and conflicting interests that have distorted humanity's unique capacities for development. It contains both the danger of

tearing down the biosphere and, given a further development of humanity toward an ecological society, the capacity to provide an entirely new ecological dispensation (Bookchin, 1995: 250).

James Sterba (1995) attempts to reconcile the anthropocentric ethics of social ecology and the non-anthropocentric ethics of deep ecology by proposing what he terms a Principle of Human Defense, Principle of Human Preservation, and Principle of Disproportionality. These principles essentially state that it is acceptable to defend oneself against harmful aggression and preserve one's basic needs or the needs of other human beings, even if this results in harm to animals or plants. However, the Principle of Disproportionality states that non-essential needs are prohibited when they harm the basic needs of animals and plants.

While social ecology recognises the problems caused by social structures, it has been criticised, like deep ecology, for failing to recognise the problems caused by patriarchal societies which ecofeminism seeks to address.

4.3.2 Ecofeminism

Many ecofeminists argue that there is an important connection between the historical domination of women and the domination of non-human nature, rooted in a patriarchal conceptual framework (see for example Warren, 1990; Mellor, 1992; Kheel, 1995; Warren, 1995). Both Leopold's land ethic and deep ecology have been criticised for not eliminating the aggression evident in patriarchy, but rather simply containing them (Kheel, 1995; see also Zimmerman, 1987). Thus, the founding of ethics on human needs and reasoning is itself seen by Kheel to be an act of violence – by denigrating instinctive and intuitive knowledge, we separate ourselves from the natural world. Ecofeminists claim that deep ecology focuses too much on anthropocentrism, rather on androcentrism (or male-centredness) which they see as the crucial issue (see Zimmerman, 1987) and further criticise it for having a masculine bias that works against their aims. For example, Deep Ecology has been criticised for its assertion of the need for population reduction, as once again it is distribution and power relations that are at the heart of resource problems, in need of social rather than deep ecological transformation (Merchant, 1992).

Plumwood (1991) criticises environmental philosophy for employing the rationalist philosophical frameworks that are gender biased and also biased against nature. She argues against rationalist conceptions of the self and nature, as they perpetuate damaging dualisms such as human/nature, mind/body, masculine/feminine (to name just a few), the supremacy of reason and block alternatives such as the feminine, emotional and so on. It is on this count that Plumwood (1991) criticises deep ecology which she claims fails to reject rationalist assumptions and often asserts its own rational versions of self and the discarding of particular connections. Kheel (1995) also rejects the 'reasoned defense' of many environmental ethicists as it objectifies nature by assigning 'values' to it. Kheel (1995: 221) asserts that "The conferral of value in ethical deliberation is conceived as the conferral of power. 'Inherent value' or 'inherent worth' (the highest values) accrue to nature to the extent that nature can be rescued from the object world." Reason is granted higher status than natural instinct, with feelings being considered irrelevant to decision making. Ecofeminism argues that some of the most important connections between the domination of women and the domination of nature are due to certain conceptual frameworks, involving basic beliefs, values and assumptions (Warren, 1995: 232). Thus, Warren argues that hierarchical frameworks and value dualisms per se are not problematic, but rather it is the way they have been adopted in oppressive conceptual frameworks. Ecofeminists, therefore, argue for a relational-intuitive sensibility to create a new *ethos* in which harmful dualisms are overcome (Zimmerman, 1987).

Plumwood (1991) argues against theories of fusion between humans and Nature, where no boundaries remain. She believes that we need to recognise our continuity with nature but also recognise the distinct needs of both. Plumwood also argues for a richer understanding of ethics and of environmental philosophy, based on feminist theory, which allows for both continuity and difference and kinship with nature, rather than increasing detachment from relationship. Warren (1995) shares these beliefs, asserting that ecofeminism can create a shift from "arrogant perception" to "loving perception" of nature – recognising the relationship with nature, but also acknowledging it as independent and different to humans.

Before current destructive processes can be addressed, the worldview that has brought it into being must be fully understood (Kheel, 1995). The prominent view of nature throughout Western history has been that of something 'alien'. It has been seen both as a 'beast' to be subdued and conquered and as 'mindless matter' which exists to serve the needs of 'Man' (Kheel, 1995). As described in Chapter 3, this notion of nature as inert was supported by both Aristotelian and Platonic philosophy and also the Judeo-Christian tradition. Both of these conceptions of nature are due to the patriarchal world-view, rather than the alternative vision of Mother Nature that preceded the modern age (Merchant, 1980). As Kheel (1995: 228) asserts: "… until the entire diseased worldview is uprooted, we will always face moral crises of the same kind". We need to look carefully at the environment in which these ethical dilemmas came about – thus, we need to pay as much attention to the ethical landscape as we do the biological one. Ecofeminists such as Kheel call for broader voices, such as those of women and nature, to be heard. This raises the important issue of power relations, which political ecology seeks to understand better.

4.3.3 Political Ecology

Looking at the positions of environmentalists, it can be seen that many, such as Weston (1999), recognise the environmental crisis as a cultural and philosophical condition as well as a biological and social one. Gene technology is not just about GM products, it is about extending and promoting the dominant mechanistic paradigm which serves corporate interests and promotes globalisation.

The political ecology movement, sometimes referred to as part of the 'New Left', emerged in Western Europe in the late 1960s, calling for ecological and social concerns to be addressed above economic objectives (Doyle and McEachern, 2001). In the 1970s the movement also provided a critique of science and technology and called for participatory politics, with the focus primarily on a 'human ecological approach' (Doyle and McEachern, 2001). Political ecology is interdisciplinary and investigates the political, economic and cultural patterns influencing the relations of humans to the environment and each other (Walker, 2002). It sees environmental problems as socially and ecologically constructed and framed by relations of political economy (University of California Berkeley, 2002).

Blaikie's *The Political Economy of Soil Erosion in Developing Countries* (1985) identified the political forces surrounding environmental degradation, and now in more recent commentaries, such as Bryant (1992; Bryant and Bailey, 1997), the political underpinnings are given primary focus.

Atkinson's text *Principles of Political Ecology* (1991) explores the notion of humans as 'alienated' from nature, and seeks to overcome this by moving away from capitalism and towards an 'ecological paradigm' (1991: 194). Like deep ecology, Atkinson's view of political ecology has been criticised for being reactionary, adopting uncritically Malthusian and Neo-Malthusian concerns of population growth in the Third World (Stott and Sullivan, 2000; Turton, 2000). Thus, Stott and Sullivan (2000: 16) state that there is an "anti-science humanities" that portrays an old view of science that is "unreflexive" and ignores new models and ways of thinking in the natural sciences.

One of the future challenges of political ecology, therefore, is to enable alternative narratives to dominant science to be heard (Stott and Sullivan, 2000). As Potts (2000: 59) asserts, economic interests tend to be more successful in influencing environmental policies, by translating their needs into political outcomes, than those with less economic 'clout'. Thus, political ecology attempts to understand unequal power relations (to be discussed further in Chapter 5). Stott and Sullivan (2000: 2) outline the dominant questions as: "Who currently holds power over influential narratives? How is this power employed and for what political purposes? What is the 'science' within defined narratives? And what are the ideas of morality infusing narratives and their supporting 'science'?" These questions are addressed in Chapters 6 through to 9.

In a further attempt to have alternative narratives to western science and modernity to be heard, numerous new science approaches have been put forward.

4.4 New Science Approaches

4.4.1 Risk Society

One key writer on the critique of modernity is Ulrich Beck (1992), who in his book *Risk Society* (1992) outlines three periods of societal transition – modernity, second modernity (risk society), and reflexive modernisation. Modernity refers to the period of industrialisation; risk society is the current, transitional stage between modernity and reflexive modernisation; and reflexive modernisation refers to an 'ideal-type' future in which society reflects on the failings of modernity. Beck claims that a broad public has begun a critique of science, it is not just the Green Movement, and he believes that these critiques are as 'rational' as modern science. Beck's work is important here in the context of gene technology and paradigmatic change. Beck recognises the shift in focus from industrial society's focus on the production of material goods, to a parallel focus on the production and generation of risks. Importantly, the current transitional period to risk society calls into question the ideologies and practices of modernity such as progress, economic growth and western science and technology, and represents a paradigmatic change towards a more ecological society (Rogers-Hayden and Hindmarsh, 2001). The gene technology debate exemplifies Beck's transitional period between modernity and reflexive modernisation (Rogers-Hayden and Hindmarsh, 2001).

4.4.2 The Web of Life and Quantum Physics

Fritjof Capra has promoted his own theory of science that he believes offers a holistic worldview. In *The Tao of Physics* (1975) he examines the new physics and eastern philosophy, in *The Turning Point* (1982) Capra calls for a new worldview, and in *The Web of Life* (1997), he again looks at an alternative way of viewing the world as an organic whole or 'web of life', where Nature is more than just the sum of its individual parts.

As physics has evolved, new paradigms have emerged that move away from mechanism, discussed in Chapter 2, developing complexity. In 1972 Philip Anderson discussed the concept of "broken symmetry" which involved a large collection of simple objects abandoning its own symmetry to exhibit an "emergent property" (Anderson, 1972: 393). Quantum physics has lead to a better understanding of the context dependence of matter, which is consistent with the organic worldview. It has shown that subatomic physical events are not causal but rather inherently uncertain and unpredictable (de Quincey, 1999). Quantum theory also states that there are many 'gaps' in the world, forming quantum voids, thereby challenging mechanism which requires continuity to transmit energy between objects. Events, not things, are said to be at the core of physical reality, and so the cosmos is a verb and not a noun. If this is the case, reality can not be wholly objective or mechanistic, with sentience being fundamental (de Quincey, 1999). Uncertainty is built into the structure of reality itself, and is why the precautionary principle discussed, discussed in Chapter 2, is so important. Quantum events are interconnected, so reality is an undivided whole (Bohm, 1980). Thus, as held by deep ecologists as well, everything is connected to everything else. Similarly, chaos theory has also signalled the limitations of linear differential equations and pointed to the importance of patterns of complexity that allow greater understanding and prediction of global occurrences.

4.4.3 Gaia

The Gaia hypothesis developed by James Lovelock and Lynn Margulis also challenges the mechanistic model of the earth, with the entire planet seen as an interconnected living system with internal feedback loops that keep the environment suitable for life (Lovelock, 1979; Lovelock, 1988). In simple terms, the environment on Earth creates a system that is, in itself, alive and able to self-regulate environmental conditions. The hypothesis has been criticised for being teleological, although Lovelock went to lengths to assert that self-regulation can emerge automatically, without a form of consciousness or teleology, using a model planet called 'daisyworld'. On this planet which circles the sun, there are two species of daisies – black and white. As the planet warms up, due to the ever-increasing output of energy, the black daisies proliferate as they are more efficient at absorbing the sun's energy. The black daisies help to raise the planet's temperature, allowing the white daisies to grow. As it gets even warmer, the white daisies survive better as they reflect the sun's energy and avoid over-heating, and help to cool the planet's temperature. Over time, the temperature of the planet is automatically regulated by fluctuations in the populations of black and white daisies. The theory has been further criticised for being tautological, as the notion that biological processes regulate the physical environment, maintaining favourable conditions for life, is untestable and unfalsifiable (Kirchner, 1989). Despite these criticisms, the Gaia hypothesis became a popular concept in the 1980s and, like the other approaches to science mentioned above, is consistent with deep ecology's call for a new ideology.

4.4.4 Post-normal Science

From the critique of modernity discussed above, it can be seen that many now believe that our technological culture must change fundamentally if we are to address existing environmental problems adequately. Funtowicz and Ravetz (1994) share some of these views and have adopted the term "post-normal science" for their new scientific method which does not claim to be value-free or ethically neutral. This is a reaction to modern science that they believe fails to take into account the broader methodological, societal and ethical issues raised by its practices.

Funtowicz and Ravetz assert that when uncertainties are low but decision stakes are high, then traditional 'problem-solving' science will be insufficient for the decision process. If uncertainties are high, post-normal science is also required. Thus, they believe a new role for scientists will be to manage the uncertainties – including technical, methodological and epistemological – that are at the centre of their new conception of science. They claim that due to these uncertainties, "… science cannot proceed on the basis of factual predictions, but only on policy forecasts" (Funtowicz and Ravetz, 1994: 87).

Narrowly defined problems should be integrated into larger issues in order to understand better the 'big picture'. When scientists try to deal with the implications of their research, including ethics, they are amateurs in this area. According to Funtowicz and Ravetz:

> There is a need for a new, more pluralistic strategy of inquiry, where the power embodied in quality assurance is more equitably shared among those with a legitimate concern for the consequence of scientific and professional work (Funtowicz and Ravetz, 1994: 110).

Those trying to block technological progress on the basis of non-scientific arguments have dismayed many scientists and engineers. Functowicz and Ravetz (1994) believe that conceptual structures and political institutions whereby creative dialogue can take place is essential, and they believe that post-normal science is a foundation for this.

Strand (2000) joins in the call for post-normal perspectives to improve our understanding of uncertainties and also the quality of claims made by the molecular life sciences. Strand believes that there is excessive faith in biotechnology and that this is a form of 'naivety'. From this unquestioning faith, Strand asserts, one can argue for policy decisions that are favourable to biotechnology development. He believes that the role of post-normal science is to spread "epistemological disillusion" or, in other words, to create an awareness of the foundational problems of the life sciences. In the life sciences, focus is drawn away from uncertainty and ignorance. Strand and others such as Funtowicz and Ravetz are interested in developing an understanding of science that avoids the political simplicity of both the traditional philosophy of science and sociology of scientific knowledge, coinciding with actor-network studies, such as those of Latour (1987) which will be discussed further in

Chapter 5. Thus, post-normal science embraces the strong precautionary principle outlined in Chapter 2.

4.5 From the Theoretical to the Contextual

The preceding discussion exemplifies the multitude of environmental groups and positions. Such ideas are simply ideas, unless they are considered in the context of political action. A series of open-ended interviews was undertaken with selected individuals to provide a contextual basis for the research. A brief review of three environmental groups involved in the GE debate, one national and two local, will be presented here to provide a 'real world' context.

4.5.1 The Australian GeneEthics Network (AGEN)

Despite strategies of the well-resourced pro-biotechnology network to promote the technology and quiet dissent, the anti-GE movement in Australia has maintained its momentum as part of a growing global movement, and has had some level of success.

The Australian Conservation Foundation (ACF) began its campaign against genetic engineering in 1988 with royalties from album sales of the rock band Midnight Oil (Phelps, 1998: 196). The ACF moved to strengthen their position in the GE debate by forming the 'Australian Gen-ethics Network' (now the Australian GeneEthics Network, AGEN) in late 1991 and a federal government grant was issued to support the campaign. The goal of the Network was to promote informed public debate on GE and secure genuine public control over all aspects of GE and its applications, rather than token participation that had occurred in the past (Phelps, 1998). With the election of the Liberal-National Party Coalition in 1996, the network's funding ended abruptly and as a result, it now relies on donations from a wide range of supporters to continue its campaign.

Participants in the network included the ACF, Australian Consumers' Association, Australian Federation of Consumer Organisations, Australian and New Zealand Federation of Animal Societies, the Biotechnology Policy and Research Assessment Team (Griffith University), United Scientists for Environmental Responsibility and Protection, state environment centres, many individual scientists, members of the public and many more (Phelps, 1999, pers. comm.). Later, other groups became involved such as Fitzroy's Friends of the Earth Anti-Genetic Engineering Collective which focuses on environment and social justice; the Consumers Federation Food Group which develops food policy; EcoConsumer which focuses on industry programs and policies became involved (Phelps, 1998). The Network also liaises with groups engaged in sustainable agriculture such as the Biodynamic Research Institute, Permaculture, Biological Farmers of Australia, the Diggers' Club, the Heritage Seed Curators Association, the Seed Savers Network, as well as allergy and sensitivity groups, feminist groups, animal rights groups and many others (Phelps, 1998: 197). It also has extensive links with many international groups such as Greenpeace International, the Third World Network, the Rural Advancement Foundation International, to name just a few. These and many other groups have organised Global Days of Action, focusing on opposition to GE foods and life patents (Phelps, 1998).

The GeneEthics Network maintains email networks of over 2000 names. In a hearing before the Community Affairs Reference Committee on the GT Bill in late August 2000, Bob Phelps, director of AGEN, expressed his desire to see these kind of networks, which are community based become part of official information dissemination.

The Network has undertaken a number of lobbying and activist activities including lobbying policy-makers and government departments, conducting public awareness and education campaigns, liaising with the media, participating in public forums, staging protests, and linking activists around Australia through extensive networking (Phelps, 1998: 197). In addition to this national network, there are many smaller groups throughout the country working towards similar goals. One such local group is the South Australian Genetic Food Information Network.

4.5.2 The South Australian Genetic Food Information Network

The South Australian Genetic Food Information Network (SAGFIN) was formed in 1998 when a group of six individuals got together because of their belief in the need to inform the public about the negative side of gene technology.

Members summed up the feeling behind the formation of the group:

> *This issue moves people in a profound way. It is new and there are no ethical or moral authorities. The entire community is challenged to decide for themselves.*
>
> *It doesn't take as many people to create change as you think it would. Every little bit counts.*
>
> (SAGFIN members, 2001)

Several members of the initial group were members of the Natural Law Party and others had been put in touch by Bob Phelps, director of AGEN. Many of the members did not know each other before the issue brought them together. They were a small but mixed group representing a broad cross-section of the community: a real estate salesman, a married couple who taught transcendental meditation, a freelance journalist, an organic shop owner and a general practitioner. There was an even mix of both males and females. The structure and running of the group was very loose to begin with, with meetings held at the residence of one of the members. From early on, the group networked with other groups such as the Soil Conservation Society, the Heritage Seed Curators and AGEN.

The name South Australian Genetic Food Information Network (SAGFIN) was developed at the second or third meeting so that correspondence could be seen as legitimate. The term 'network' was used due to the major goal of providing information and resources to the public. For similar reasons, a president, secretary and treasurer were 'elected' on 5 July 1998 to provide legitimacy in the eyes of the public and others, and so that money could be handled for future events and actions. It was felt that a committee structure was necessary to be responsible to the membership. Two years later, for legal reasons, a constitution was discussed and the group became incorporated on 27 September 2000. Members hoped that by being constitutional, they could speak out, while avoiding potential strategic lawsuits against public participation (SLAPPS) from the bioindustry. The objective was deliberately very broad to allow for flexibility: "... to gather and disseminate information on all aspects of genetic engineering of organisms and their products". Public liability insurance was also needed for public events. Group meetings grew to around 20 people at the height of the original campaign and it was thought that a formal structure would give greater efficiency to these meetings. A membership fee of $15 for employed individuals and $10 for students or unemployed was brought in to cover some of the costs for activities, and later a monthly newsletter.

The goals of the group were limited in the beginning. They did not see themselves as connected to the environment movement as a whole. Their reasons for forming the group ranged from concern about their children's health, a desire to preserve organic and small-scale farming, and a desire to inform other members of the public about the negative impacts of GM foods. All were united in their resolve to protect the food supply from industry take-over. While the group initially formed due to concern over food issues, the focus has since shifted to the national level and encompasses broader issues:

My focus is broader than just food safety ... I'm concerned about the environment, sustainability, and have an environmental ethic.

I started off with a narrow focus concerned about food. When I joined SAGFIN I also became concerned about environmental issues and realised that this was a bigger issue.

I tend to focus on issues that others [in the group] haven't. For example the ethical and moral dimensions. Whether it is right to re-engineer life. I also try to promote an awareness that GE depends on patenting – 'no patents, no profits, no GE'.

(SAGFIN members, 2001)

Members are divided on the issue of whether to push for a moratorium or a ban on GE:

> *There should be a moratorium, because a ban would say that there is never going to be anything good about the technology. But when done properly, and with public money, there may be some useful applications for it.*
>
> *If we are seen to be too radical, we will alienate sections of the community. Therefore we say that until GE food is proven to be safe to eat and safe to grow we shouldn't be eating or growing it. No one can argue with that.*
>
> *When man has the wisdom of a god, then that's the time to use GE.*
>
> *Nature is like a religion to me – I have a strong belief in nature. I don't want it to change too much. GE won't create a perfect world with improved nutrition etc., we have to accept so-called 'imperfections'. I personally would like to see it [GE] banned.*
>
> *This technology is so new and there is so much still being discovered, much showing negative effects, that there should be an embargo on the release of GM products until they can be proven safe.*
>
> (SAGFIN members, 2001)

The group's initial focus was to provide information to the public and so it encouraged individuals to become members of their organisation and to become informed about GE issues. In line with this goal, the first project was a public meeting in July 1998 at the Radio City Ballroom in Burnside. Despite the extremely cold and wet weather, SAGFIN was proud to boast that 325 people attended. Presentations were delivered by Dr Phil Davies, plant scientist; Dr Guy Hatcher of the Natural Law Party NZ; Dr Kate Clinch-Jones a local GP; Mr Bill Hankin, director of the Heritage Seed Curators; and Mr Bob Phelps, director of the Australian GeneEthics Network. Well-known local restaurant owner Maggie Beer acted as facilitator.

In September 1999 the group decided to start up a petition to make SA a GE-free state. There was wide circulation throughout the state and around 17 thousand signatures were received and tabled in parliament in February 2000 by the Honorable Dean Brown, Minister for Human Services. A "No Patents on Life" petition was also generated. One member in particular wanted to portray the message that GE depends on patenting – without patents there is no profits and therefore no GE: "The idea that living things can be intellectual property has a wrongness about it. People have a gut feeling that it's wrong." Both petitions are now continuing with their own momentum.

The most successful activities of the group have been those involving the general public. At least 350 people attended a talk at Adelaide University organised by SAGFIN in March 2001, with American 'expert' Steve Druker as guest speaker. While the audience that attended the first forum in Burnside was described by organisers as largely "alternative" with some level of involvement with organic farming or a similar field, the audience at the Adelaide University forum was largely "mainstream". Druker is a US lawyer and director of the Alliance for Bio-Integrity which has been engaged in a law suit with the US Food and Drug Administration, regarding the inadequacy of the US biotechnology regulations. Speakers such as Dr Kate Clinch-Jones and Dr Judy Carmen spoke of the health risks associated with GM foods and the non-existence of any human health tests, while Mr Bill Hankin reminded the audience of the ethical issues surrounding the modification of living things.

The success of the Druker event inspired the members of SAGFIN and led them to believe that they had the opportunity to create a "groundswell" effect. Thus, to maintain the momentum they organised a protest rally *Say NO to Frankenstein Foods* just weeks later. A crowd of approximately 200 people marched from parliament house to the central market in inner-city Adelaide. Numerous guest speakers gave brief presentations on issues relating to the health risks of GMOs, the new legislation, and community empowerment. The opportunity was also seized to collect signatures for their on-going petition against GMOs at the rally and information leaflets were also distributed to members of the public. The response from stall holders at the central market was very positive, with the majority supportive of SAGFIN's efforts regarding GM. According to the group's members (SAGFIN Members, 2001, pers. comm.), protest marches have been very effective in getting a public reaction and prompting them on to get involved. Rob Kerin reacted to the march in a television interview stating that it was "hysteria". SAGFIN and others were pleased with this response, believing that it was proof that they had "got him worried" (SAGFIN Members, 2001, pers. comm.).

Dealing with the public has always been very productive. When we started, very few people knew about GE but now most people have heard about it and are aware of the concerns. There has been a huge shift in consciousness.

(SAGFIN member, 2001)

Targeting businesses and government has been less successful. One member expressed the futility of lobbying governments because business interests have got in first, priming governments to expect tremendous benefits from GE and to be wary of the 'ignorant cranks' who speak of any risks or problems. Businesses have lobbied governments before the issue became well-known and told them that they are the scientific experts on the matter. According to members, corporations are not interested in discussing the issues. A talk was organised by SAGFIN for business interests but only 35-40 people attended: "Manufacturers supply a market and that's all they're interested in. The multi-nationals think they can do what they like."

After writing to local councils on two occasions, approximately six months apart, suggesting that they consider passing by-laws to ban GE crops and offering to send speakers for meetings, only one request for a speaker was made. It is the group's intention, once the Environmental Defenders Office gets advice to councils about GE crops in their boundaries, to write to councils again and include guidelines. They will use a different approach by trying to find rate payers prepared to lobby councils. However, there are 69 councils with all their residents, so it is a tall order. Thus, there is a belief in the need to lobby local members of parliament, and also to work with local councils. The GTR is supposed to liaise with a number of people, including local government representatives, and so this may give anti-GE groups a 'toe-hold' if they can get councils to adopt precaution.

Thus the main activity of the group is public education and mobilisation. Lobbying elites has taken a back seat, due to past disappointments with this approach. Petitions have been ongoing and public meetings held to educate the public. In the pipeline is an information kit for the state's high schools, to provide another side of the story to that given by Biotechnology Australia's school information kits. As stated by one SAGFIN member: "Students have been asking for information about hazards because they can't find it anywhere." Members of the group have also given talks to a wide range of community organisations, and have worked in collaboration with members from Greenpeace.

The main mode of contact between group members and other groups around the nation is through email correspondence. There is a loose affiliation with the GeneEthics Network in Victoria, and they are currently looking into being affiliated with the Conservation Council of South Australia. The advantages of this are both financial, to be able to use a meeting space free of charge, and also political, to be able to raise the issues of GE with a larger environmental organisation. There is some level of phone contact between committee members and monthly newsletters are posted to members. There are anti-GE groups in every state, with emails sent between state contacts. The lack of funds however, does not allow for a central co-ordination point which some feel would be desirable. Individuals from the group, however, also have their own informal, fluid networks.

While it can be argued that SAGFIN is an environmental organisation due to its constitution and committee of six individuals with a president, secretary and treasurer, the gathering displays more of the characteristics of an informal group. The core group that meets regularly is small in size, although there are 44 members in total, and there are no employed professionals – rather, like a group, it is voluntary. Resources therefore come in terms of personal commitment. The group survives on a very limited budget, with a lot of expenses covered by individuals themselves. Costs of photocopying and compiling a newsletter, postage, and materials for rallies are high in relative terms. The group is very similar to a network, both being issue-orientated, however, while the initial reason for the existence of the group has not ceased to exist, other issues have emerged which have increased its reason for being. The community feeling which developed from the initial formation of the group also remains and there is a core of committed individuals that form the hub of the group, giving it greater permanence than a network. Given the absence of political introspection, SAGFIN is similar to many non-introspective groups as they have made no conscious effort to promote participative decision-making processes. Like the majority of other non-introspective groups, women occupy positions of authority. Doyle and Kellow (1995) state that women have been socialised to fill this role of community conscience, while men tend to seek out organisations which are dominated by economic concerns and seen to be more politically active. This group is slightly different to many other non-introspective groups, however, as they have come to recognise broader environmental issues, although they do not have any goals for the environment movement as a whole.

4.5.3 GE-Free Australia Inc.

After the March rally organised by SAGFIN, a few members were frustrated by an alleged lack of organisation within SAGFIN and some personal disagreement occurred. As a result, a new group called GE Free Australia Incorporated was formed. There is a degree of collaboration between the two groups as they are "on the same side", however division remains due to "politics and personalities". Sandra Russo, founder of GE Free Australia, stated her reasons for branching out:

> I became frustrated with SAGFIN because things were too slow. I need to see things happening fast. I saw that we could work on different levels and create a groundswell. I am still a member of SAGFIN and support them. At the end of the day, we all want the same thing (Russo, 2001, pers.comm.).

GE-Free Australia has moved away from lobbying governments. After looking into countries that were either GE-free or heading in that direction, for example Italy, the UK, Germany, France, Thailand and Burma, the common link was seen to be public resistance to purchasing GM foods. In the UK for example, Mad-Cow disease has lead to public fear of food contamination. In other countries, such as Thailand, food is seen as sacred. According to Sandra Russo, it was always about the people, not governments. Thus, the focus of GE-Free Australia is on public education, with the goal to stop them from buying GE food.

We are trying not to appear radical. We want to recruit as many people as possible. It needs to be Australia-wide.

We're not appealing to politicians because they don't act. Neither Labor nor Liberal will fix this problem.

We want to remain on page 3 or 5 of the newspaper. You have to pull stunts to be on page one.

(GE-Free Australia members, 2001)

A fundraising dinner was organised by GE Free Australia for August 2001, with prominent South Australian chefs to promote fresh, GE-free food and wine. The event was seen as very successful by its organisers. Around 400 people attended and according to Sandra Russo, many came along simply for the entertainment, but after listening to anti-GE speakers, were convinced at the very least not to take GE food for granted any more.

An education package titled *A New Generation of Food?* has also been produced by GE-Free Australia. Unfortunately, there was no communication or collaboration with SAGFIN who has been working on a similar package and has different ideas on what form such a package should take. Thus, duplication of effort may well be inevitable now that these two groups have separated and there is limited networking between them.

4.5.4 Influence on Policy

Some traditional theorists see 'successful' political activity as the result of common goals, leading to effective policy. However, the social movement approach, involving informal politics, has had some advantages in Australia's policy terrain. As stated by Rootes (1987:3): "… social and political change is more often the product of the many pin-pricks of uncoordinated protests than it is the deliberate achievement of a self-conscious social movement…"

According to members of the anti-GE movement, the development of the Gene Technology Act (discussed in detail in Chapter 7), along with the limited number of commercially grown GE crops in Australia is a tribute to the Movement (Hankin, pers. comm., 2001; Phelps, pers. comm., 2001). According to members, they believe these groups have been fairly successful, by "slowing things down". As stated by a SAGFIN member: "No other country has put up a GT Act – it is pioneering." However, while they are proud of these successes, several acknowledge that, compared to Europe, still not enough is being done: "There is still a lot more media attention and public education about GE in Europe."

Biotechnology proponents have unlimited financial resources from companies, governments and private sources. As discussed earlier, however, the GeneEthics network on the other hand had its funding withdrawn on 1 July 1997.

The SAGFIN has similar funding restraints:

Anyone who wants to show the hazards of gene technology has a really long road to hoe because of the lack of funding and it is difficult finding people with time to devote on a regular basis.

There are a lot of state contacts, with groups in every state involved in informing the public about GE issues, but lack of funding does not allow for a reasonable level of central co-ordination.

Bob [director of AGEN] *is essentially running a 'one-man show' and is in a tight financial situation. He does get some money from donations.*

In addition, arguably due to the lack of financial resources:

There isn't enough people-power to apply the pressure that is necessary on corporations, the government, public and the media.

(SAGFIN members, 2001)

Ultimately all anti-GE groups in Australia share the desire to create options that challenge a genetically altered future, ensuring that people have the option of a GE-free future if they choose. Most groups want to see a minimum five-year freeze on GMO releases, to assess them for safety and desirability and to explore all options. They are also working to promote ecologically sound products and sustainable production systems for the present and all future generations.

4.6 Synthesis

While the radical green critiques discussed in this chapter are all controversial and have some problems, they also provide valuable insights for an eco-political theoretical framework. Similarly, they provide insights into how science could be broadened, creating a 'new, 'holistic' science on which to base policy decisions.

This thesis embraces Hay's position that: "We do not need a single theory. We need instead the dynamism of conflict, and the evolutionary unfolding made possible by the continuous injection of the new" (Hay, 1992: 28). And Sylvan and Bennett's (1994) assertion that there does not need to be general agreement, and that diversity of opinions is a good thing. Thus, to formulate an ideological and theoretical framework that critiques modernity and challenges the DSP, I have drawn upon the major schools of green thought. The term 'ecopolitics' is adopted to represent a synthesis of the ideological and practical aspects taken from these. Despite the shortcomings of some theories and the opposing views of, for example deep ecology and social ecology, common ground can be found, and the best of each used in a more pluralistic ecological theory.

Deep ecology recognises the role of anthropocentric ethics in environmental problems and encourages deeper questioning about ecological relationships. It also recognises the intrinsic value and interconnectedness of all things. Social ecology recognises and identifies the issue of structural control and the importance of social hierarchies. In reality, both are interrelated, encouraging people to change their attitudes towards Nature. However, legitimation is exercised through structural and agency power, and it is social ecology that recognises this dimension which is essential for understanding the power relations involved in the gene technology controversy. This understanding is also essential for aligning the ecological paradigm to liberal democracy and for controlling the agenda for ecopolitical interests.

Both deep ecology and social ecology, however, fail to recognise patriarchy as a powerful and harmful force against women and nature, and it is ecofeminism that brings this to the fore. Agricultural biotechnology is obviously a human issue and therefore must include some level of human focus. The issue must be addressed from the perspective of human welfare, but also the whole earth. Political ecology theory adds the human political dimension.

From these perspectives, an ecopolitical approach embraces Bossel's partnership ethic which represents the interests of all system partners, involving equity and justice. It recognises the intrinsic value of Nature, interconnectedness, complexity, and uncertainty. From Bossel and ecofemist writings, the importance of feelings and intuition is also accepted, as the 'green' position is ultimately an 'emotional' position. Thus I prescribe to Dryzek's ecological rationality rather than the economic, technological rationality of biotech proponents who view this emotional position as 'unscientific' and therefore 'weak' or 'invalid'. Ecopolitics also recognises the social and structural dimensions of environmental issues, and political, economic and cultural influences. It rejects economics as the most important value, as well as the growth paradigm of capitalism. It argues for decentralised decision-making and control, as well as cooperation and partnership.

It has a critical approach to science and technology, and prescribes to new forms of holistic science, rather than being anti-science. Post-normal science is a development from, and extension of, traditional science, with uncertainty as an essential principle and with a more pluralistic method of inquiry. It is a complement to traditional problem-solving strategies in circumstances where this approach is not effective. It aims to look at the 'big picture' of how science and technology affect the entire planet and therefore focuses on long-term consequences.

As stated by O'Riordan and Jordan (1995: 209) "The search … is on for a more meaningful relationship between precaution, sustainable development and global citizenship." An ecopolitical approach is consistent with this goal. It encourages people to re-examine their value systems and look at what should be happening, but not just at the level of the individual but rather the overall social structure of society. This includes the use of 'soft' technologies and appropriate small-scale agriculture. Science is ultimately subjective and socially constructed and, therefore, like Ulrich Beck (1992), Ravetz (1999), and Strand (2000) suggest, an alternative science is always possible, allowing for creative dialogue and broad critique.

The green critique outlined in this chapter is also a critique of the failings of modernity (Barry, 1993: 45-58; Beck, 1992). The biotechnology issue highlights the difficulties in accommodating green perspectives in the working assumptions of liberal democracy, as recognised by Hay (1994) in the case of Tasmania's world heritage areas. Thus, like Beck, this ecopolitical framework sees the need for the liberal democratic state to become more reflexive.

It has been argued that there is too much emphasis on ideas and metaphysics and not enough on structure (Hay, 1992; Barry, 1994). Thus, this thesis has been researched and written with the premise that we need to focus on both. We need to look at ideas and values that lead to controversy and shape agendas and then also to structural issues and how to create a green state with an administration able to deal with environmental issues and incorporate green principles.

Thus, it seeks to wed ecological principles with the functioning of the liberal democratic state, in accordance with Eckersley (1996a), Dryzek (1996) and Hay (2002) who all believe that institutions of liberal democracy are adaptable to ecological principles. This could involve the strong precautionary principle and ecological forms of sustainability, while Eckersley (1996b) also finds the rights discourse as another way of extending consideration to non-human entities. Thus, it prescribes to Dryzek's (1996) notion of 'ecological democracy' whereby the challenge is seen as one of removing barriers to communication and transcending human interests.

While both Beck and Dryzek call for a shift of democratic practice from state institutions to groups in the public sphere, the ecopolitical framework adopted here sees a need to focus on both state institutions and the public sphere equally, while seeking strong democracy in both realms, extending opportunities for effective participation.

Both radical and more mainstream environmental theories provide valuable insights for environmental policy, and biotechnology policy in particular, however, it is not simply a matter of incorporating these into written policy and regulations. As Young (1992) asserts, the ideological roots of green parties are from the deep ecology school, but they must function in the context of government. Hay (1992: 231) also argues that environmentalists must contest issues within the terms of the old paradigm itself. This is because the shift from the DSP to NEP has not progressed far enough for concepts of NEP to enter public discourse (Milbrath *et al*, 1994: 443). Therefore the problem of being understood is made difficult because the NEP profoundly challenges the central assumptions of the DSP.

The ecopolitical framework developed in this chapter is helpful to address the biotechnology issue, providing an enabling framework for the case material explored, and analysis of the decision-making processes, including an exploration of the power relations involved. Ultimately, an 'eco-praxis', or theory of social change according to green principles, must be underpinned by a power-relations analysis (Barry, 1994; Hindmarsh, 1994). Thus, before we move on to deconstruct the biotechnology policy terrain, it is necessary to look at the major theories of power which the following chapter outlines.

5

Power, Policy-Making, and Public Participation: A Methodology

The task of this chapter is to outline a power relations methodology, by which to inform the eco-political theoretical framework put forward in the previous chapter. Doyle and McEachern (1998: 22) argue that "… what happens in any given environmental conflict is the result of the creation and the successful deployment of forms of power". Theories of power therefore are central to understanding and analysing conflicting values and ideals, as well as the constraints on the realisation of alternative values and interests, in the gene technology policy terrain. Understanding the nature of the construction and control over policy processes is important for green actors to set up alternative outcomes to corporate biotechnology (Hindmarsh, 1994). It must be noted though, that due to spatial constraints, only a general overview of the classical and modern theorists' accounts can be given here.

Social power is found in all areas of policy-making and conflict. Doyle and McEachern (1998: 20), however, point out that both academics and political activists contest the very definitions and characteristics of power. Some authors, such as Latour (1986a), believe that the concept should be abandoned altogether because of the poorly defined nature of the concept. However, others, such as Law (1991: 185), assert that while power may be a 'slippery' term it is still a useful one. Doyle and McEachern (1998: 29) also recognise that more work needs to be done on how alternative conceptions of power – such as Foucauldian interpretations where power is seen as strategic – can be applied to environmental conflicts and policy making. While no theory of power alone is capable of explaining the full extent of power (Cox *et al.,* 1985: 224-7; Ham and Hill, 1984: 61), each provides useful insights at different levels of analysis. Democratic pluralist accounts dominate Australian politics and have come under increasing scrutiny by green groups, as evident in studies of environmental conflict involving dominant capitalist economic ideals (Crowley, 1992). Those studies have identified widespread constraints to the realisation of environmental goals. They support the 'mobilisation of bias' viewpoint put forward by Schattschneider (1960), and adopted by Bachrach and Baratz (discussed below). Strategies of mobilising bias include consultative processes that suppress consideration of environmental concerns; manipulative participation processes (Paehlke, 1989); control over policy-making; the suppression of access to information; corporate resistance to the regulation of environmental hazards; a constructed limited effectiveness of environmental controls (Schrecker, 1985); and, legislation that is designed to absorb environmental conflict (Dempsey and Power, 1973; cited in Crowley, 1992: 131-132). These strategies are often used to shape decision-making and policy processes (Crowley, 1992).

Biotechnology development must be viewed within this wider cultural and political setting, shaped by social power and the mobilisation of bias. It is therefore important to examine the various theories and models of power and to determine their usefulness for environmental policy analysis in general, and, in the case of this thesis, gene technology policy analysis.

5.1 The Nature of Power

The concept of social power is a contested concept (Cox *et al.,* 1985). Parsons (cited in Lukes, 1977: 9) states that power is value dependent, and thus any definition of power is determined by a set of value assumptions which may go unacknowledged (Burrell and Morgan, 1979; cited in Crowley, 1992: 133). Thus, a wider ideological debate exists that embraces the definition and methodology of power.

While there is no agreed clear separation between the different accounts of power, there is a distinction between those which treat power as a quantity or resource, and those which do not (Doyle and McEachern, 1998). Hindess (1996: 1) points to two conceptions of power which dominate Western thought, namely power as quantitative – or the simple capacity to act – and power as not only the capacity to act, but also which has the *right* to act. Power in the latter sense may therefore be used as a tool of domination.

Robert Dahl, a pluralist, states that the focus of analysis must be on actual decisions in order to discover whether a ruling elite has power over other groups. Power to pluralists means "participation in decision-making" and can be analysed only after "careful examination of a series of concrete decisions" (Laswell and Kaplan, 1950: 75). Dahl defines power in the following terms: "A has power over B to the extent that he can get B to do something that B would not otherwise do" (Dahl, 1957: 203). Thus, actors whose preferences prevail are those who exercise power. Dahl promotes a behavioural-science oriented approach based on a mechanical mechanistic and behaviourist view of the world (Clegg, 1989). He is reluctant to consider intentionality – a factor criticised by Lukes (1974). Rather, the focus is on the measurement of power as a quantitative and cumulative phenomenon. Hobbes' conception of sovereign power, according to Hindess (1996), can be regarded as an early conception of this view of power in a simple quantitative capacity. Hobbes (1928: 26; cited in Hindess, 1996: 24) states that, "... power is simply no more, but the excess of the power of one above that of another". Mann expresses power in similar terms, stating that in "... its most general sense, power is the ability to pursue and attain goals through mastery of one's environment" (Mann, 1986: 6). Hobbes' main concern was with causality, or power as the negation of power of others.

Machiavelli (1958) on the other hand focussed on organisation and strategy. Thus, Hobbes discussed what power is while Machiavelli was concerned with what power does (Clegg, 1989). Hobbes' positivist conception of power as directly observable and measurable, based on the mechanical philosophy that was consistent with mainstream modern science and technology prevailed. It can be argued, however, that Machiavelli's approach of interpreting strategies of power is of more use to the meaningful analysis of power relations and policy today.

In pluralist accounts, power is seen as an inherent condition of human agency. Lukes (1974) describes this as episodic agency – the one-dimensional view of power, derived from the premises of Hobbes' sovereign power (Clegg, 1989: 187). Hindess states that,

> ... for all its problems, the treatment of the sovereign as the single most important power in society, and as a power that works primarily by means of decisions which its subjects normally accept is binding, has dominated much of the discussion of power in the modern period (Hindess, 1996: 15).

Hindess (1996: 27) asserts that the appeal of this view lies in its simplicity. The investigation of the distribution and uses of power becomes a simple empirical matter. However, he criticises the quantitative view as it does not allow for the indeterminancy of conflict to be addressed.

The pluralist approach has been strongly criticised due to "the blatant unreality" of its' explanation about the distribution of power and its effects (Doyle and McEachern, 1998: 24). Bachrach and Baratz's (1962; 1970) criticism stems from the pluralist neglect to acknowledge that power does not only involve actual decisions and actions, but also "non-decisions", defined as "… the practice of limiting the scope of actual decision-making to 'safe' issues by manipulating the dominant community values, myths, and political institutions and procedures" (Bachrach and Baratz, 1962: 632). These authors assert that,

> … power is also exercised when A devotes his energies to creating or reinforcing social and political values and institutional practices that limit the scope of the political process to public consideration of only those issues which are comparatively innocuous to A (Bachrach and Baratz, 1962: 948).

This "mobilisation of bias" (a term coined by Schattschneider, 1960: 71) confines decision-making to "safe issues". In other words, some issues are organised onto the political agenda while others are deliberately marginalised (Bachrach and Baratz, 1970). This is the structure 'behind' an episode of power.

In short, Bachrach and Baratz (1970: 9) assert that an extremely important 'face' of power is the ability for individuals or associations to limit decision-making to non-controversial matters by influencing community values and political procedures. The political system develops "rules of the game" that operate systematically to the benefit of certain individuals or groups at the expense of others (Bachrach and Baratz, 1970: 43; Offe, 1976). Ideological and procedural selection mechanisms act as "a system of filters" (Offe, 1976: 39), which narrow the scope of policy processes. According to Ham and Hill (1993: 15), "through the manipulation of language and the creation of crises the authorities may impose their own definitions of problems and help to frame the political agenda". Challenges can be deflected by steering them through time-consuming processes that are built into the political system, such as access through the Freedom of Information Act (Bachrach and Baratz, 1970). Edelman's (1971) work suggests that political demands may be manufactured by leaders and, through the manipulation of discourse, define the problems to be addressed and therefore set the political agenda. Edelman also points to the symbolic purpose that policies may play in giving the appearance that governments are taking action. Dahl recognises this in his study of

New Haven: "... leaders do not merely respond to the preferences of constituents; leaders also shape preferences" (Dahl, 1961: 164).

Bachrach and Baratz emphasise the importance of values and biases, not just issues. This approach therefore suggests "two faces" of power, with the second providing the structural dimension, involving conflicts over issues and non-decisions or the mobilisation of bias to limit debate. Thus, according to Bachrach and Baratz, the distribution of power may be less equal than asserted by Dahl and other pluralists, and they criticise pluralists for ignoring this important aspect of the structure of power (Clegg, 1989). Moreover, pluralist methodology provides no objective criteria for distinguishing between 'important' and 'unimportant' issues.

Authors such as Bachrach and Baratz (1970) and Saunders (1980) also argue that it is who benefits from policy decisions that must be the central question of power research. However, in response, pluralists such as Polsby (cited in Ham and Hill, 1993) argue that while this is an important question, who *benefits* and who *governs* are two different things. Individuals or groups may benefit from policy-making unintentionally. However, a number of studies lend support to the argument that some sections of the community have greater access to power, making it easier for them to dominate decision-making processes than others (Ham and Hill, 1993: 76). Bachrach and Baratz argue that those who benefit are those in a privileged position to defend their interests, which usually makes up an elite group (Lukes, 1974). In accordance with Bachrach and Baratz, as well as Lukes, Schrecker (1985) firmly believes that issue suppression is an active pursuit of corporations. He claims that corporations restrict access to information as well as participation in the policy process in order to keep their interests and dealings confidential, which acts to minimise their identification and contestation.

Lukes (1974), in turn, also rejects the 'liberal' view of power put forward by Dahl and other pluralists. He argues that pluralism absorbs the bias of the political system under observation and does not acknowledge how the political agenda is controlled. Thus, power in the pluralist sense is too narrowly defined – restricted to concrete decisions and events – and therefore, according to Cox *et al.* (1985: 219), of limited explanatory value to describe social power relations. Thus, Lukes rejects the pluralist account of power on three grounds. First, it ignores the cultural biases of society that may be institutionalised; second power is also exercised when there is neither overt nor covert conflict, but rather *latent* conflict; third, the dominant ideologies of societies may prevent certain types of power conflicts emerging (Lukes, 1974: 23, 24).

Thus, Lukes (1974) describes power in terms of three 'dimensions'. There is the one-dimensional view of the pluralists, the two-dimensional view of Bachrach and Baratz, and his own self-termed 'radical' third-dimensional view, which aims to extend power theory further, giving it a structural dimension. The third dimensional view allows for the consideration of how certain issues are kept out of the political arena, and asserts that there may be instances where individuals fail to recognise their own interests. Therefore, they may be subject to the influence of power without even being aware of it. Lukes (1974: 27) states that: "A exercises power over B when A affects B in a manner contrary to B's interests", and that: "To assume that the absence of grievance equals genuine consensus is simply to rule out the possibility of false or manipulated consensus by definitional fiat" (Lukes, 1974: 24). In other words, power can be exercised even when there appears to be no opposition and no observable behavioural change. An example of this is provided by Gramsci (cited by Hindess, 1996: 6), whereby the acceptance of bourgeois rule by the popular classes is only possible because they are not aware of "... their interest in the overthrow of capitalist domination". Lukes claims the most significant instances of power are those aimed to induce "... socially structured and culturally patterned behaviour" (Lukes, 1974: 22).

Lukes' third dimension is criticised by Clegg (1989), however, as being a continuation of Hobbes sovereignty power, and therefore not as 'radical' as Lukes claims. Hindess (1996) is also critical of Luke's view, as it describes power only as a simple capacity – a conception of power that has been prominent in academia since the 1950s. The contention is that Lukes fails to develop power's structural dimension (Isaac, 1987; cited by Crowley, 1992: 136). Giddens (1984) has been criticised on similar grounds with his general theory of 'structuration', whereby social structure is produced by agents and in turn acts upon the agents (Clegg, 1989: 15). Power, Giddens claims, has a duality of structure – the capacity of agents to 'make a difference' (Giddens, 1984: 14) on the one hand, and the structural 'property of society or the social community' (Giddens, 1984: 15) on the other. Thus, the conception of power not only constrains actions but also provides resources that can be used in interactions with others. Thus, Giddens sees power as a capacity – as the capability of individuals to 'make a difference' – and is therefore aligned with Parsons and Foucault.

Both Parsons (1967) and Foucault (1982) express the notion of facilitative power – that power can be an enabling phenomenon. Rather than focussing on 'power over' like Lukes (1974), these authors are interested in 'power to' (Law, 1991), promoting the connection between power and modes of resistance. Thus, they reject conceptions of power as 'zero-sum' that suggest power is finite – for any actor to gain power, another must lose power. Parsons argues that focussing on the distribution of power in this way detracts attention from other important areas such as how power is produced and what social conditions are required for its continued existence (Hindess, 1996).

Foucault provides a critique of most of the conventional views of power and does not fit in neatly with those from Hobbes to Lukes (Clegg, 1989). He is critical of the sovereign view of power as, in his view it provides an incomplete account of the politics of modern government (Hindess, 1996). Foucault too was more concerned with the means whereby the *effects* of power are produced (Hindess, 1996). Rather than seeing power as a quantitative capacity like the pluralists, Foucault asserts that power is strategic and interactive (Doyle and McEachern, 2001). He perceives power as a 'structure of actions':

> [Foucault's] reference to 'power as strategic games between liberties' suggests that in Foucault's view there is an intimate relationship between power and liberty. This is, in fact, the core of Foucault's understanding of power in general. Power, as Foucault presents it, is 'the total structure of actions' (Foucault 1980: 220) bearing on the actions of individuals who are free; that is, whose own behaviour is not wholly determined by physical constraints. Power is exercised over those who are in a position to choose, and it aims to influence what their choices will be (Foucault, 1980: 121).

It therefore follows from this that power relations are unstable and reversible (Hindess, 1996). Thus, it can be said that Foucault is more closely aligned with Machiavelli than Hobbes, as they share an analytical focus on shifting alliances and the belief that there is no single distinct centre of power (Clegg, 1989). Foucault distinguishes between power in general, and domination and government as specific modalities of the exercise of power. He sees domination as a particular form of power where those who dominate have the ability to impose their will on their subordinates, despite resistance, since the subordinated persons have little room to manoeuvre (Hindess, 1996: 102).

Similarly, both Barnes (1986) and Law (1991: 168) argue that 'power over' and 'power to' are linked, and can not be separated. Barnes (1986) identifies a fourth level of power – the potential to use discretion, to choose between courses of action, or not to act. It is therefore important, in Barne's view, to look at actors, their actions, their relations, and to look at the methods they use and extent to which they secure power to and power over, as well as the effect of discretion. Thus, power-over and power-to are relational, or in other words, are a function of a network of relations. Law (1991) tries to remove the agency/structure dualism by tying agency to power and relations: agents are a series of power effects embodied in a series of different materials and likely to be strategically organised (Law, 1991: 173).

Clegg (1989: 219) proposes a reformulation of causal power in agency terms, with the purpose of developing a formal model for analysis of power "irrespective of substantive content". Clegg's model provides a useful basis for the conceptualisation of a power relations methodology for the analysis of the biotechnology text, which will be explored in more detail in Chapters 7 and 8.

5.2 Circuits of Power

According to Clegg, structure is underpinned by three circuits of power, or "circuits of social and system integration" (Clegg, 1989: 211). Power can be understood as moving through these three distinct circuits, carried by the organisation of agencies (1989: 239). The circuits are defined by episodic, facilitative, and dispositional power.

The episodic agency, or one-dimensional view of power (or 'power over') described by Lukes (1974), forms the first. This is the most apparent and accessible 'circuit of power', recognised from Hobbes through to Lukes (1974). Clegg (1989: 211) asserts, "… power, viewed episodically, may move through circuits in which rules, relations and resources that are constitutive of power are translated, fixed and reproduced/transformed". Episodic power, Clegg maintains, is derived from agents' capacities to control resources. In other words, whether an agent's causal powers are realised or not will depend upon their ability to access and utilise resources, which are unequally distributed (Clegg, 1989: 217). Existing social relations constitute the identities of agencies (Clegg, 1989: 215). Clegg is reluctant to claim people as the only forms of agency, asserting that agency may also pertain to non-human entities such as machines or organisations. The causal powers of agencies will be realised through their organisation and power stays within the episodic circuit, it automatically reproduces existing structures of domination (Clegg, 1989: 220). Potential for transformation only arises when existing rules or practices of domination are challenged in the other circuits of power.

While circuits of episodic power are always open to challenge and transformation through resistance, this remains abstract. For example,

> … if the organization of concerted action cannot be attempted or envisaged as a feasible form of resistance, routine relations, agencies, means, standing conditions, resources – in a word, powers – will be likely to endure. The resources will be judged all too frequently and accurately to be unavailable or insufficient to overwhelm extant circuits of power (Clegg, 1989: 222).

In addition,

> … formal rituals, myth and ceremony serve to reinforce and make meaningful the routines of everyday subordination, just as those of resistance may seek to ironicize [sic], distance or undercut the more formal instances. In this way the formal rituals of power may be endured (Clegg, 1989: 223).

The circuit of dispositional power or social integration, where power has a 'capacity' to control, is conceptualised in terms of relations of meaning and membership (Clegg, 1989: 224). Social change may occur due to overt struggles over meaning and membership, but may also be a function of changes in innovation that pose potential transformations.

The third circuit involves facilitative power (power as the ability to achieve things) or system integration conceptualised in terms of 'material conditions' of techniques of production and discipline. This circuit is concerned with agencies' empowerment or disempowerment due to transformations based on changes in techniques of 'production and discipline'.

Clegg states:

> ... it functions as a potent source of resistance to the stabilization of existing memberships and meanings by generating new techniques of production and new modes of discipline, which, if they are not already present within existing rules of practice, have the capacity to transform these (Clegg, 1989: 224).

Thus, to summarise:

> Episodic power's achievement will consist, first, in constituting a relational field by 'enrolling' other organizations and agencies; second, in the 'stabilizing' of a network of power centrality, alliance and coalition among agencies within the field; third, in the 'fixing' of common relations of meaning and membership among the agencies within that field, such that they are reflexively aware of their constitution as a field (Clegg, 1989: 225).

Of relevance here is Mann's (1986) concept of 'organisational outflanking', which describes why the dominated consent to their subordination by others. According to Mann, they lack the collective organisation to object. Organisational outflanking may occur due to ignorance of the workings of power from a lack of knowledge resources, or it may occur due to a lack of knowledge of other similar powerless agencies with which alliances could otherwise be formed. In this case, resistance remains isolated and uncoordinated, and therefore ineffective as it can easily be overcome. In short, social change is inhibited due to organisational outflanking.

A central issue of the circuits of power framework is, therefore, what becomes institutionalised. Translation is a process of agency power that offers both dispositional and facilitative power. Clegg maintains that the link between power and structure is best approached through this post-structuralist approach which forms a part of actor-network theory.

5.3 Actor-Network Theory and the Sociology of Translation

Social constructivist approaches such as actor-network theory from the sociology of science can be useful because, as has been discussed earlier, environmental controversies have significant social and political dimensions. Actor-network theory extends the argument that scientific knowledge is inherently social and political – as Latour (1983: 168) asserts, science is politics by other means.

This approach to the study of power seeks to demonstrate how networks of interests are constituted and reproduced through the "sociology of translation" (see for example Callon *et al.,* 1986a; Callon and Law 1982). The method of this approach seeks to either explain how, or to operationalise how, agents 'translate' phenomena into resources and resources into organisation networks of control.

Translation is the mechanism by which the social and natural worlds progressively take form. The result is a situation in which certain entities control others. Understanding what sociologists generally call power relationships means describing the way in which actors are defined, associated and simultaneously obliged to remain faithful to their alliances … It also permits an explanation of how a few obtain the right to express and to represent the many silent actors of the social and natural worlds they have mobilized (Callon, 1986a: 224).

According to Latour (1986b: 26), translation builds an actor-world from entities and defines the roles of actors – "it speaks for others but in its own language".[1] The success of translation depends on the effectiveness of actors in reinterpreting the interests of others into their own, creating an actor-network (Callon, 1991; Burgess *et al.,* 2000; 123).

Callon (1991: 132) asserts that science and technology are the result of the interaction between a large number of diverse actors. According to Callon (1991: 142), all groups and actors describe a network, which define and relate to other groups and actors. Thus, the term

[1] An actor-world is defined by Callon *et al.* (1986b: xvi) as "… the world of entities generated by an actor-network. Emphases that, for any given actor, there is nothing beyond the network which it has created, which constitutes it, and of which it forms a part." (Thus an actor-network is the structure and operation of an actor-world). The term 'actor-world' is distinguished from a single actor "… by its structure which is an arrangement of constituent elements that has been translated…The term actor-world emphasises the way in which these worlds, built around the entities that create them, are both unified and self-sufficient. The term actor-network emphasises that they have a structure, and that this structure is susceptible to change" (Latour, 1986b: 33).

'actor-network' theory which talks of representation in terms of translation. This theory looks at heterogeneous networks and describes how they are linked. It looks at the changing roles of the networks and its actors (both human and non-human) which are all equally able to act upon one another, and the phenomenon of translation that creates new relations (Law, 1997). Actors are not fixed entities, but rather are defined in terms of their relation to other actors in the system (Law, undated). Thus, actor-network theory is a methodology that explores relations and relationality and how they are brought into being.

Callon (1986a: 196) outlines four 'moments' in the translation of phenomena. The first is problematisation where actors seek to define the problems of other actors and make them believe that their solution is 'indispensable'. This is achieved when the other actors pass through "obligatory passage points" [2] of practice (Callon, 1986a, b; Rip, 1986; Callon *et al.*, 1986b). Law (1986: 81) states that scientific papers represent, "... a network of problematisations which stand for an actor-network, define the problems that must be overcome, the way these should be tackled and the location where this is to be properly attempted".

The second moment of translation is termed interessement "... which involves one entity attracting a second by coming between that entity and a third. Interessement is thus a transaction between three entities. It may be seen as the elementary form of translation ..." (Callon *et al.,* 1986: xvii). Essentially it is the process of imposing a structure upon others (Law, 1986). The third moment is that of enrolment: a set of strategies an actor employs to define and affiliate the roles assigned to other actors. It is the negotiations and manipulations that accompany interessements and enable them to succeed (Callon, 1986a: 211). Actor-network theory recognises that maintaining networks is a difficult process and that enrolment is an erratic process (Law, 1997).

Finally, there is the moment of mobilisation: the strategic process where agencies try to ensure that the representation of interests by other agencies are fixed and are not undercut by the agencies in question (Callon, 1986a; Clegg, 1989). It is the process of rendering entities mobile that were not so beforehand – actors are displaced and reassembled elsewhere (Callon, 1986a: 216).

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[2] In simplistic terms, an obligatory passage point refers the terms of reference that the enrolling actors fix. It is also referred to as issue definition.

Translation thus provides a tool to describe the mechanisms by which actor-worlds are constructed (Latour, 1986b). The approach provides an empirical sociology of power by addressing how agents seek to constitute agencies, interests, structures, and to map out how agents 'translate' phenomena into resources, and resources into organisation networks of control, of alliance, of coalition, of antagonism, of interest and structure (Clegg, 1989: 204). Translation refers to the methods by which these are accomplished. The three major strategic processes of translation are goal displacement; restriction of emergent issues through non-decision making; and agenda setting. Within these approaches, several strategies may be used including domination, avoidance, compromise, collaboration, manipulation, and closure of controversy.

While actor-network theory was developed to understand 'science in action' (Latour, 1987), it can be "... extended beyond the production of science to contests that lie outside of, but intersect with scientific networks" (Burgess *et al.,* 2000; 123). Importantly, Callon (1986a) claims that his method can be applied when the society under observation is uncertain and disputable. This is the terrain of the intense recombinant-DNA debate – translation has been used historically as a central tool of power in the global biotechnology policy terrain (Hindmarsh, 1996). One area of translation that deserves more attention here in the context of the biotechnology policy terrain is closure of controversy.

5.3.1 Closure of Controversy

In order to better understand the roles of various knowledge and value claims characterising controversies, it is necessary to look at the ways closure can be reached. Engelhardt and Caplan (1987) characterise five forms of closure for scientific controversies, by merging those put forward by Beauchamp and McMullin. The first is closure through a loss of interest which includes Beauchamp's natural death closure and McMullin's abandonment. A controversy may end when participants lose interest and the issue is no longer the focus. Another category is closure through force where the controversy is ended but without a rational basis for resolution. This may occur by the use of state power or through the loss of funding. A third category is closure through consensus, where there is consensus agreement that one position has outweighed all others. The fourth category is closure through sound argument which occurs when participants agree that a particular solution is the most appropriate one because they agree on the 'facts'. The final category is closure through negotiation, which may involve compromise. To these, Beder (1991) adds another category, that of closure by redefinition by selective use of data to support the desired definition of the issue. Beder (1991) also characterises three levels of closure, namely the organisational level, the decision-maker level, and the community level. It is on the latter two levels of closure that this thesis concentrates.

In actual cases one or more of the modes of closure described above may be involved. One problem of applying categories such as those outlined by Engelhardt and Caplan (1987) is that there may be pretence that one mode is being used, when in fact another is in being applied (Beder, 1991). Beder uses the example of the state using closure by force, but attempting to portray closure by sound argument. It is therefore essential to examine power relations, although as Beder (1991) recognises, no definitive accounts are possible. Discourse analysis provides an additional tool to help explain the strategic mechanisms of agency and contextual power involved, and it is to this that we now turn.

5.4 Discourse Analysis

Like the analysis of translation, discourse analysis offers another perspective for the theoretical and empirical inquiry into socio-political activity (Habermas, 1987). Discourses are expressions of power, so their analysis is another method for revealing the power relations between competing actors. The language used, both written and spoken, by policy actors is important in framing policy problems and legitimising behaviour and outcomes, and is an important part of the political process (Wright, 1988). Within the analysis of the gene technology policy process it is important to address how policy problems are 'framed' and the role that discourse plays. It addresses the importance of the framework of the policy debate, not just the outcomes. Discourse analysis refocuses on the importance of ideas and values in 'texts' and can therefore help to focus on contentious issues and assumptions of policy debates (Hawkesworth, 1988). In the case of gene technology policy, this is particularly useful given the clash between the competing paradigms of ecology and biotechnology.

Much of the current literature on policy analysis focuses on what Fischer and Forester (1993) term the 'argumentative turn' in the policy process and its analysis. This approach looks at how language helps shape the way we make sense of the world. The focus is on agenda setting and problem definition, and so it is important to look at the belief and value systems of decision-makers and how they seek to legitimise these beliefs and practices based upon them. We need to look at the underlying values, outlined in Chapter 2, to broaden policy analysis and look beyond the modernist framework. Discourse analysis is one tool to shed light on these important issues.

Discourse, however, is a difficult concept because of conflicting definitions stemming from various theoretical standpoints (Fairclough, 1992). Foucault used the term 'discourse' to refer to different ways of structuring knowledge and social practice. According to Foucault (1979), power and knowledge are linked, and power is intrinsic in the production of discourse: "There is no power relation without the correlative constitution of a field of knowledge, nor any knowledge that does not presuppose and constitute at the same time power relations" (Foucault, 1979: 27). Thus, according to Foucault, power not only produces knowledge but also reality, and therefore discourse (Sheridan, 1980: 30). Fairclough (1992: 55-56) identifies five major insights into discourse provided by Foucault: discourse constitutes the social, including objects and social subjects; any discursive practice is defined by its relations with others; the practices and techniques of modern biotechnology are to a significant degree discursive; discourse is political – power struggles occur both in and over discourse; and, social change is discursive.

Fairclough (1992: 4) seeks to draw together language analysis and social theory, treating discourse as a discursive event, a piece of text, and an instance of social practice. He terms his approach a 'social theory of discourse'. The social dimension takes into account the institutional and organisational setting of discourse and their effects. Fairclough contends that language is extremely important in social and cultural change. Moreover, those seeking to control discourse are increasingly seeking to change language practices as part of the engineering of social and cultural change[3] (Fairclough, 1992: 6, 8). Discourse analysis is therefore not just concerned with power relations in discourse, but also with how power relations shape and transform discursive practices (Fairclough, 1992: 36). Ultimately, discourse sustains and changes power relations, as well as naturalising certain power relations and ideologies. Gramsci's concept of hegemony is important in the analysis of social practice, as a mode of domination based on alliances, the incorporation of subordinate groups, and the generation of consent (Fairclough, 1992: 9, 67). Fairclough (1992: 86) places discourse within

[3] For example, the use of the terms 'genetic modification' and 'gene technology' instead of 'genetic engineering'.

this view of power as hegemony that helps to produce, reproduce or transform relations of domination (Fairclough, 1992: 87).

Discursive practice is revealed in 'texts', a term which I will use to refer to both written and spoken language, following Halliday (1978) and Fairclough (1992). Discourse analysis therefore focuses on text production, distribution and consumption (Fairclough, 1992). Fairclough (1992: 198) argues that texts must be interpreted in the context of wider social practice and that analysts themselves are within this wider social context and need to be aware of this. Ultimately, discourse analysis is multidisciplinary, involving many disciplines such as sociology, psychology and politics, and is therefore not restricted to practitioners with a linguistic background (Fairclough, 1992).

This thesis argues from the perspective of discourse as a social practice in line with Fairclough (1992) and Skillington (1997). Public pressure emerging from the politics of resistance has compelled state actors to take environmental issues seriously, and has also forced them to take participatory discourse seriously (Skillington, 1997). However, as argued by Skillington (1997), recent forums for so-called discursive democracy have allowed the transmission, or indeed translation, of productivist, corporatist interests. Skillington, on investigating a 'new' participatory arrangement in relation to the field of political power, found that relations of traditional power asymmetries were reasserted. This thesis also seeks to investigate whether this is the case in the bio-policy terrain, or whether the participatory forums provide adequate public involvement and empowerment in the bio-policy process.

This again raises the important issue of public participation in environmental policy, and gene technology policy in particular, as introduced in Chapter 2. One of the stated aims of the thesis is to examine whether Australian gene technology policy is broad enough in its scope to facilitate a long-term sustainable future. This includes whether or not it embraces the precautionary principle and one of its major tenets: open, transparent public participation. It is therefore necessary to explore the strong precautionary principle in the context of power, policy-making and public participation in more detail before we can move on to a meaningful analysis of the gene technology policy terrain in Australia.

5.5 Public Participation: Towards Precautionary Decision Making

To reiterate from Chapter 2, the strong precautionary principle shifts the focus in decision-making – it changes the questions asked by decision-makers, including asking whether or not the public has been given a choice. This new way of thinking about decisions also challenges the authority of traditional science by extending science to encompass a broader scope, consistent with 'post-normal' science that embraces uncertainty, and incorporates ethics as well as science, as discussed in Chapter 4. Facilitation of public participation and the adoption of a post-normal science approach are ways that the precautionary principle can promote policy that will lead to long-term sustainability.

Public participation, in its simplest form, is the process of involving members of the community in decision making (Harding, 1998). It "... provides a means of counteracting biases resulting from reductionist strategy" (Holman and Dutton, 1978: 1514), and should "... undermine the power of bureaucracies and better inform the political decision-maker as to what constitutes the people's will" (Messer, 1992: 416). This is not a simple process, however. Attaining the 'right' level of public participation and achieving set objectives is difficult (Harding, 1998). One concern is that involvement of individuals with a diverse range of opinions may make decision making unmanageable and must therefore be weighed up against the need for efficiency in decision making (Nelkin, 1977).

Nevertheless, people have the right to participate in and influence decision-making of governments and to make free and informed choices. However, as stated by Gellman (1996: 11) "... there will continue to be a contest between the bureaucratic interest in controlling and exploiting information resources and the public interest in open access to government data." The only way to increase transparency is to allow public access to the documents on which discussions and decisions are based (Freivalds, 1996). It is important to affirm however that people should not just have the rights to documents, but to meaningful information and to be kept fully informed. Thus, for the process of public participation to be effective, it must be two-way. There are many symbolic forms of public participation that give the overall illusion that the public is involved when really they have just been manipulated or informed of decisions that have already been made, as discussed in Chapter 2 in the context of public inquiries. To help address this shortcoming, the precautionary principle should be included in the terms of reference of public inquiries where scientific uncertainty exists, also recognised by Deville and Harding (1997: 67). In addition, for democratic public participation, consultation, education and negotiation must occur at an early stage of the policy process (Deville and Harding, 1997). As Bob Phelps, Director of the GeneEthics Network, stated in a submission to the 1992 HRSC report:

> The setting of research priorities is a very fundamental issue. It is no good, it seems to us, to start evaluating projects when they are at the stage of readiness for release to the environment. The public has to know what is being proposed in the way of research. We need to start right at the proposal stage (HRSC: 111).

Cost-benefit analysis and risk assessment tend to follow reductionist methodologies that give the benefit of the doubt to new products and technologies and are frequently undemocratic processes, with those likely to be affected rarely asked for their views. They are also not value free as often claimed, based on 'sound science'. Decisions involved in the risk assessment process in fact involve value and moral judgements. In further defence of public participation, policy decisions in the area of gene technology are ultimately normative because they involve social, ethical, economic and political judgements about technical issues (Nelkin, 1977; Holman and Dutton, 1978). Therefore, in these areas the biotech-network has no special authority and the public could provide valuable contributions, as according to Sylvan (1994) governments generally make poorer decisions when people are 'locked out' of such decision-making. Also, where uncertainty exists, decisions based solely on expert advice may not be in accordance with important democratic principles (Myhr and Traavik, 1999). Both scientific and value-based judgements are needed and this is where the precautionary principle offers a more satisfactory approach than risk assessment. It recognises subjectivity and uncertainty and allows for more democratic public participation to occur. Risk assessment can still be used, but in conjunction with the precautionary principle to better understand possible hazards and to develop ways to prevent harm and to assess alternatives.

Effective public participation may result in better informed decision making by broadening the range of factors considered at each stage of investigation (Holman and Dutton, 1978). It may also lead to enhanced citizen understanding of science and technology, and "... as science becomes more powerful and its impact on society more pervasive, the need for full disclosure of the uncertainty inherent in scientific investigation increases" (Holman and Dutton, 1978: 1519).

Some are concerned that the acknowledgement of uncertainties could undermine the experts and engender more public caution about technological development generally. Nelkin (1977a), for example, suggests that increased knowledge contributes to uncertainty and indecision because people are unwilling to accept the uncertainties inherent in technical areas. Wynne (1988), however, believes that public acceptance of uncertainty as a general principle could be achieved. It is the responsibility of scientists to communicate the uncertainties of research and development to policy-makers and the public (Myhr and Traavik, 2002). The strong precautionary principle calls for a more effective dialogue between experts and the public which would allow for negotiation of these uncertainties, rather than leaving all the responsibility with the experts, behind closed doors. It allows all activities and decisions to be scrutinised (Deville and Harding, 1997). In this way, public participation can provide a 'watchdog' function – community members may identify issues that 'experts' had not considered (Harding, 1998) and they can be involved in monitoring and feedback. By involving all potentially affected parties, it allows for a broad range of perspectives and alternatives to be considered, including no action. It therefore encourages decision-makers to be more open-minded (see Deville and Harding, 1997). Genuinely transparent and open public participation in decision-making is essential for the precautionary principle to be applied in the spirit that it was originally intended – that of *vorsorge*[4], meaning 'foresight' or 'taking care'. This creates an opportunity to fundamentally change the policy process. We do not have to accept a 'business-as-usual' approach.

At present, however, existing decision mechanisms do not assure adequate representation of the public interest, as will become evident Chapters 7 and 8. However, there is still room for optimism that the precautionary principle can serve as an overarching principle or 'ethos' (Deville and Harding, 1997) in decision-making to guide us towards sustainability.

5.6 Concluding Remarks

This thesis adopts a power-relations methodology, based on a translation approach, to analyse the biotechnology policy terrain in Australia, and also incorporates some discourse analysis. This method helps in understanding how the bio-policy terrain, and the controversy surrounding it, is socially constructed and how groups involved have been negotiated. The case study of biotechnology policy in Australia is analysed in terms of attempts to translate

[4] The precautionary principle first emerged in the 1970s in the former West Germany. The concept held that the state should avoid environmental damage through careful forward planning (O'Riordan and Jordan, 1995: 193).

different knowledge systems (scientific versus eco-social). As discussed above, the process of translation transforms the strategies of the actors involved in the negotiations over the future of a socio-technological network (Callon, 1986a and b).

It is argued in this thesis that Australia needs to move towards strategies of decision making which lead to effective means of public participation, transparency and access to information. We need to find ways to reduce the alienation of the public and interest groups from the decision making arena and find ways to facilitate the free flow of information and two-way communication. Most importantly, we need to find ways to empower communities and keep the power of corporations in check. This will be a difficult challenge, however, without action multinational corporations will have free reign over agriculture, health and the global food supply.

Having developed a method of analysis embedded in the ideological framework of eco-politics, and discussed the significance of public participation and the precautionary principle in the GE policy process, we now turn to the primary aim of the thesis. This is to undertake a translation analysis of the gene technology policy process to better understand the power relations that underlie policy decisions and to understand the production and reproduction of the social system that supports biotechnology enterprise. As Hindmarsh (1996) has recognised, a focus on deconstructing bio-translation processes is an important step towards empowering ecological/social interests. Organisational processes and strategic mechanisms of translation will be identified where relevant, in relation to gene technology regulation and development/commercialisation. This will be done in conjunction with a general description of the issues.

6

Recent Global Biotechnology Development: Contextualising Australian GE Policy

6.1 Introduction

Having outlined the epistemological and methodological approach of the thesis in Chapters 4 and 5, this chapter seeks to outline the global context of biotechnology policy development within which Australian policy is embedded. It must be emphasised that it is not an international comparative study, but rather a discussion of issues of global concern in the area of biotechnology policy and development. This global context is essential for the understanding and analysis of Australia's biotechnology policy terrain which is presented in Chapters 7 and 8.

Despite widespread and growing criticisms of the self-regulatory process; misinformation from the biotechnology industry; and marginalisation of the public (among many other issues), proponents have successfully blocked opposition. Today ideals of the free market dominate – access to food and health is now subject to the forces of the free market system (RAFI, 1999a). Thus, as predicted by Williams (1985), in terms of research and development, we are seeing more of the closed style of the market and less of the openness of universities. Many universities and public research institutions are now heavily reliant on private funding and have essentially been 'captured' by industry, and will be addressed later in this chapter.

Modern biotechnology will have a profound effect on the production of necessity products, and those in control of these resources will exert considerable political influence. Inevitably then, there will be both winners and losers (Doyle, J, 1990). The recent history of biotechnology development shows emerging trends that give an indication of the direction in which it is going. Thus, a historical perspective is the first undertaking of this chapter – building on the insights from the earlier historical context discussed in Chapter 3 – to show

how biotechnology got to be what and where it is today, and to give an indication of its future as well as the future of alternatives. Following this, emergent issues and themes in global biotechnology development will be discussed.

6.2 The 1970s: A New Era of rDNA Research

In 1971, Paul Berg, a biochemist at Stanford University in the US, was the first to combine DNA from two viruses, however, the techniques that he used to achieve this were cumbersome. One year later Herbert Boyer, a bacteriologist at the University of California, and Stanley Cohen, a biochemist at Stanford University, discovered the complementary nature of their research involving DNA. Cohen was working with DNA in bacteria, with a particular emphasis on using plasmids to transfer new genes into bacteria. This research, combined with Boyer's ability to purify restriction enzymes which could cut DNA at precise locations (termed 'chemical scissors') led in 1973 to the successful use of plasmids to clone genes in bacteria and move genes between two species of bacteria (Doyle, J, 1990).

Throughout the 1970s, major laboratories and start-up companies competed zealously to achieve new breakthroughs in rDNA research and to obtain the most media coverage (Doyle, J, 1990). Companies sought to promote the rapid development of the technology and so began to promote ties between industry and the scientific academy (Wright, 1994). In the later part of the decade, a few major corporations began to invest large amounts of money into molecular biology research and development in universities. For example, Monsanto gave Harvard University a twelve-year, $25 million contract for research in 1975 (Doyle, J, 1990).

In the US, the Ford, Carter and Reagan administrations were all responsive to the needs of industry. The establishment of the Office of Science and Technology Policy in 1976, which was comprised of science and industry leaders to advise on science and technology policy, demonstrated President Ford and Vice President Nelson Rockefeller's support of industry interests (Wright, 1994). However, with the rapid development of modern biotechnology came concerns over its regulation.

6.2.1 Regulatory Debate

The regulatory debate over biotechnology has been well described in the literature (Krimsky, 1982; Nossal and Coppel, 1989; Yanchinski, 1985; Hindmarsh, 1994) and so will not be described in full detail. Rather a brief overview will be presented to give a historical context.

In 1973 it was the scientists themselves who were the first to raise concerns about the safety of rDNA research at the Gordon research conference in New Hampshire. Participants of this conference expressed their concerns about the potential risks of biotechnology publicly, in a letter sent to the Presidents of the United States National Academy of Sciences and the National Institute of Medicine. An Academy Committee was set up to examine the potential risks, with Paul Berg as Chairperson. This committee published some of its key recommendations in *Science* magazine in July 1974 (Berg, *et al.,* 1974). This letter became famous as the 'Berg Letter', representing the first time that scientists called for a voluntary halt to experiments. As a result of the Committee's findings, the National Institutes of Health's (NIH) DNA Molecule Advisory Committee was set up in the US, in October of 1974, with the role of drafting regulatory guidelines. During this period, however, the public was not given a voice in the debate over biotechnology (Krimsky, 1982).

A second conference was held in February 1975. It saw the convergence of 150 scientists from sixteen countries at the Asilomar Conference Centre in California to discuss the moratorium. Social and ethical issues were absent from the discussions (Krimsky, 1982). The conference eventually recommended that the partial moratorium be lifted and replaced with guidelines for GE research (Wright, 1994). Consequently, the media reported a positive image of an international community of scientists moving towards safe and reflexive research. However, as Wright (1994) asserts, this ignored the fact that the proceedings for the conference had been consciously designed to allow the technology to move forward. With the goal of the conference specifically to allow GE research to continue and to recommend appropriate policy, participation was by invitation only and each participant was carefully selected (Wright, 1994). There were no participants that may have questioned the future of GE research, rather most were from industry and one had a military affiliation (Wright, 1994). With social and ethical issues marginalised, the agenda was restricted to benefits and costs.

While some participants were reticent about being regulated by their peers, the possibility of outside controls provided strong incentive to reach consensus. Sydney Brenner from the Cambridge Laboratory for Molecular Biology argued that, in the context of safety procedures, "… we have not only to say we are going to act, but we must be seen to be acting" (cited in Wright, 1994: 154). As Wright (1994) recognises, this idea of "being seen" to act has been an ongoing theme of the GE controversy.

The final conference report maintained that while there were uncertainties, hazards could be adequately managed with containment precautions, and so research should continue. A voluntary code of practice was seen as the best form of control (Wright, 1994). The Asilomar statement provided the conceptual basis for the NIH guidelines for rDNA research that were developed directly after the conference (Wright, 1994). While some claim that the legacy of the Asilomar conference was to place the burden of proof on scientists to show that their research was safe, this ignores the forces which acted to shape perceptions and control the institutional and decision making processes, restrict participation and limit the scope of issues addressed (Wright, 1994: 157). Both the conference and the events surrounding it led to the limited scope of hazard evaluation and placed moral, social and ethical concerns on the periphery. In other words, the problems of GE were reduced to issues of safety that could be addressed with technological solutions (Wright, 1994). As Wright (1994) asserts, this view was so powerful that it soon became dogma and continued to frame the discourse of policy processes around the world.

The most direct confrontation between scientists and the lay public occurred a year later in Cambridge, Massachusetts, over the proposal to build a P3 laboratory and concerns over the safety of research[1]. The result was a three month moratorium on genetic engineering, imposed by the city council. A Local Review Board was established to monitor the situation, setting up its own safety and health standards (Nossal and Coppel, 1989) and reported that the public wanted to be represented in the decision-making process. This incident marked the entry of green groups, such as Friends of the Earth and the Environment Defence Fund, into the biotechnology debate (Chedd, 1976), however, it was not until 1987 that the first Australian opposition to GE was actively expressed by the Australian Conservation Foundation (ACF).

[1] The American guidelines state four levels of containment, P1-P4, with P4 being the highest level of containment.

While in the early to mid 1970s governments made efforts to accommodate public concerns – to 'be seen' to be acting on these concerns – by the end of that decade in the US and UK there were already moves to roll back regulations due to pressures from industry to develop new export markets (Wright, 1994). Corporations began to involve themselves more actively in the formation of government regulatory policy to try and address what they saw as excess regulation and democracy (Wright, 1994). This resulted in the long-standing 'product' versus 'process' debate. The first can be seen as a business-as-usual approach to biotechnology which is driven by quick-fix thinking and focussed on securing patents. The second, however, recognises the distinctness of the process of GE. While the controversy over biotechnology regulation continued, private investment further increased in the 1980s.

6.3 The 1980s: The Beginnings of Commercialisation

Jack Doyle (1990) points to two important events that occurred in the 1980s that propelled biotechnology into the realm of trans-national corporations (TNCs). The first was a Supreme Court decision in 1980, *Diamond v. Chakrabarty*, ruling that a genetically altered bacterium – an oil-digesting *Pseudomonas* created through the cell-fusion of plasmids – was "patentable subject matter". The second was the listing of Genentech, a new biotechnology company, on Wall Street in October 1980, and the subsequent substantial rise in the company's stock prices. The combined effect of these two events was to lead America to rush in to biotechnology development (Doyle, J, 1990).

Thus, throughout the 1980s, the pace of scientific advances in the area of rDNA gained great momentum, and GE products began to be marketed globally. The first herbicide-resistance genes were cloned in 1982 and multi-million dollar research centres were revealed by Monsanto and Du Pont in 1984, indicating their commitment to commercial biotechnology. The seed industry also became entwined with GE companies throughout this period. In 1986, the UK's largest company, Imperial Chemical Industries, acquired the Garst Seed Company, one of America's leading hybrid corn companies (Doyle, J, 1990). This started a trend that has seen hundreds of seed companies acquired worldwide in the last two decades.

6.4 The 1990s and Beyond

6.4.1 The Australian Context: The 1992 Australian Inquiry into GE

With increasing research and development, controversy over both the technology and its regulation continued, and rising public concern led to the issue of a press release by the Minister for Science in September 1989 requesting Parliamentary Committees to examine any ethical and environmental concerns arising from agricultural genetic engineering (Jones, 1989). Consequently, the HRSC released its Report *Genetic Manipulation: The Threat or the Glory?* in March 1992 (HRSC, 1992). While the Australian Biotechnology Association (ABA) endorsed the report, environmental groups such as the Australian GeneEthics Network (AGEN) condemned what it saw as a pro industry report, declaring that it was "... a blueprint for fast tracking engineered products into the market place..." (Phelps, 1992: 2). Director of the GeneEthics Network, Bob Phelps, maintained that under the Report proposal, the responsible minister and the Release Authority would have wide discretions to "... short circuit environmental assessments, deny public access to information, and minimise public participation" (Phelps, 1992: 2). Criticism also came from university researchers:

> The report is seriously flawed and biased towards industry. It reads like a case for industry self-regulation, and argues for making biotechnology companies answerable to an authority which supports the general thrust of genetic engineering ... (Hindmarsh and Hulsman, 1992: 4).

In their final summation of the Inquiry Report, Hindmarsh and Hulsman (1992: 4) concluded "... in the current consultation on genetic engineering, the public appears to have, for the moment, lost out."

However, in March 1999 the first Australian consensus conference *Gene Technology in the Food Chain* was held, sparking hope that the public may at last gain greater influence on policy decisions. Only a small group of the general public was allowed to participate, however. A lay panel of 14 individuals chosen to represent a broad cross-section of the community met to discuss GE issues with a panel of experts in the field. The aim was to allow the public to become involved and to inform decision-makers about the public's opinions and concerns. The consensus conference format was first developed in Denmark where citizen panel reports have directly influenced the course of legislation[2]. This has not been the case in Australia, however: few of the lay panel report's recommendations were implemented and this will be revealed further in Chapter 7.

The beginning of the 21st century, therefore, saw continued and increasing public disquiet over biotechnology globally. In Australia, three new inquiries into genetic engineering that will be explored in more detail in Chapter 8, were commissioned, and across the Tasman, New Zealand was also holding a Royal Commission into gene technology due to enormous public opposition. Despite the overwhelming opposition to the technology however, the majority of the inquiry reports supported ongoing gene technology research and development, illustrating the success of the biotechnology proponents in translating their interests. One of its successful manoeuvres was a redefinition of GE issues.

6.4.2 The Redefinition of GE Issues

The products of modern biotechnology are referred to as genetically engineered organisms (GEOs), although more recently industry has redefined the term as genetically modified organisms (GMOs). Green interests assert that this redefinition is a strategy of power whereby proponents have endeavoured to gain greater public acceptance by distancing themselves from the term 'genetic engineering' which has had its share of bad media attention and therefore negative public perception. The industry appears to be aware of widespread fear of science in Western society (as discussed in Chapter 3), due in part to its representations in literature (Haynes, 1994) and is aiming to alter such perceptions through a change of discourse.

Industry has manoeuvred to redefine GE as 'in the public interest', both in the developed and the developing world. They claim that transgenic crops will be an essential component of a global food security strategy (US Department of State, 2002; Green Nature, 2002; www.uspolicy.be, 2002). Rice research sponsored by the United Nations Development

[2] The consensus conference is a method of assisting the community to participate in the debate in an informed way, and in turn help form public policy about complex issues like gene technology. The format brings together a panel of citizens and a panel of experts in a balanced range of fields. It functions like a 'citizens' jury', with the citizens deciding the key questions for the experts and the experts 'give evidence' (which may be conflicting). After this process the citizens develop recommendations on the key questions and come as close to consensus as possible, delivering their 'verdict' in a written report.

Program (UNDP) and the Japanese government is claimed to have enormous potential to improve food security in Africa, Asia and South America (Agrifood Awareness Australia, AAA, 2001). The industry claims: "If we are to banish hunger, famine and pestilence from this planet, we must become missionaries on behalf of scientifically based realism and tireless opponents of unfounded and divisive rhetoric" (Mycogen, 1997).

Therefore, any objections to the technology are claimed to be 'unfounded', 'divisive', and 'anti-science'. Proponents of the technology go even further to argue that opposition to agricultural biotechnology will mean continued starvation in poor countries: "Denial of the new technologies to the poor is synonymous to condemning them to continued suffering from malnutrition which eventually may deny the poorest of the poor their right to survival" (James, 1999: 5).

In addition, the United Nations *Human Development Report 2001* states that opposition in richer countries to genetically modified crops may set back the ability of poorer nations to feed growing populations and criticises governments for pandering to 'affluent' dissidents instead of addressing the needs of the world's poor (Agrifood Awareness, 2001). The report goes so far as to state that the objection to using DDT in poor countries was hypocritical as it had been used to eradicate malaria in the US and had the same potential in the Third World. Proponents claim that countries such as Asia must guard against "... the luxuries of the radical environment movement – an unwanted export from its former colonial rulers" (Prakash, 2001: 1).

However, as discussed in Chapter 1, environmentalists challenge the industry's claims of 'feeding the world'. They assert that there are already sufficient resources to provide food for the world, but that hunger is the result of political and economic factors (Brown, 1985). The choices of crops, markets and technologies are decided by profits rather than need (Centre for Applied Science, 1976). They argue that the techno-industrial agricultural systems directly create food scarcity and transform the culture and structure of food production and distribution (Scrinis, 2000). As argued by the Centre for Applied Science (1976: 15), attempts by industry and governments to increase agricultural productivity in Third World countries are made "... to ensure the development of capitalist relations in the agricultural sector and to improve their balance-of-payments situation, not to ensure that the masses of the people eat better". Green actors therefore call for states to support more effective and sustainable agriculture, encouraging food sufficiency (which will be discussed further below).

In their manoeuvres to define the issue as one of 'in the public interest', proponents have also pointed to increased yields. While a recent UK study found that the main reason farmers adopt GE crop technology is to increase crop yields, studies have shown that farmers growing GE crops have actually experienced decreased yields (USDA, 1999; Lean, 2000; Soil Association UK, 2002). The UK study found that yields from Roundup Ready soya were six per cent less than non-GM varieties and 11 per cent less than high-yielding non-GM soya varieties. Roundup Ready canola was also found to have lower yields than non-GM canola. Bt Maize produced a yield increase of around 2.6 per cent, but this was countered by higher production costs. Farmers were also found to have experienced declining profits, increased dependence on herbicides, contamination to neighbouring farms, and difficulty in marketing their products due to declining consumer confidence in GMOs. In this context it should also be acknowledged that the HRSC stated in its inquiry that "… the benefits of using GMOs in agriculture are not yet widely apparent", further contradicting proponents claims (HRSC, 2000: 15).

Opponents of genetic engineering technology are quick to point out this failure. Part of the problem may be due to the multi-gene nature of traits such as increased yield or for increased nitrogen fixation, to name just two (Anderson, 2000). In the US, GE crop failures have been common. In 1996 Monsanto's Bt cotton suffered heavy bollworm infestation, to which it was supposed to be immune, with damage estimated at around $1 billion (Nature Biotechnology, 1996). In Mississippi in 1997, 30 000 acres of GE herbicide-resistant cotton recorded major losses costing some farmers $500 000 to $1 million (Union of Concerned Scientists, 1997). While Monsanto's research showed that in 1998 its Roundup Ready soybeans yielded 4.5 bushels more than conventional varieties, other studies did not support this finding. One study showed that, on average, the yields of GE soybeans were 4 per cent less than conventional varieties (Holzman, 1999).

There has also been a realisation of the fears of GE contamination from transgenic crop plants, discussed in Chapter 1. Indigenous farmers' maize in Oaxaca and Puebla, Mexico, has been shown to be contaminated by GM maize. In Canada, the escape of transgenes from GM canola has also been devastating for organic farmers who cannot certify their canola crops as

GM free (ETC Group, 2002a). Another example of such contamination involves Aventis Crop Science's StarLink corn which was genetically modified to contain a bacterium gene that makes it toxic to some insects. The company was responsible for ensuring that StarLink corn was only used for animal feed because of unresolved questions about whether it could cause allergies in humans. However, it did not meet that responsibility – in 2000, the GM corn had contaminated over 300 brand name food products, causing a massive recall (Cummins, 2001). In 2002 traces of the StarLink corn were also found in Australian and Japanese food products imported from the US (Young, 2002; Organic Consumers Association, US, 2002).

To counter these problems experienced with the first and second generation GM plants, the industry is quick to promote its third generation GM crops, again in an attempt to redefine the issue as one of 'improving the human condition' (see for example US Department of State, 2002). These products, they claim, will offer direct health and nutritional benefits for consumers, for example edible vaccines and vitamin-fortified foods such as AstraZeneca's "Golden Rice" that is fortified with vitamin A. Environmentalists describe 'generation 3' as the "disassembly of the food chain" and argue that the practical and policy impacts for civil society organisations, farmers and governments are enormous and far-reaching (RAFI, 2000b). Vandana Shiva, an Indian environmental activist, argues that applications such as the vitamin A fortified rice deepens the genetic reductionism that began with the Green Revolution (Shiva, 2000). Natural sources of the vitamin are found in native green vegetables and fruits that are produced without irrigation. The GM rice, however, requires a water intensive system where water resources are scarce (Shiva, 2000). Thus, important insights into whether or not biotechnology developments are indeed in the public interest or not, can be gained from looking at this example of Golden Rice. The original research was funded by the Rockefeller Institute (USA), the Swiss Federal Institute of Technology, and the European Union. These bodies raised concerns that the GM rice could contravene between 70 and 105 patents, licenses and material transfer agreements, discovered by a Rockefellar study commissioned by the ISAAA (a bio-broker). The two researchers that had developed the rice, Potrykus and Beyer, then struck a deal with AstraZeneca turning over the future development of the rice to the multinational – nine years and millions of dollars of public funding were surrendered to the commercial interests of the biotechnology industry (RAFI, 2000c).

Environmentalists continue to challenge the industry's definition of the issue, trying to redefine it as one of the industry aiming to genetically engineer crops to make them better adapted to the conditions of chemical-industrial agriculture, thereby making possible the extension and intensification of this system of agriculture (Scrinis, 1998). This is supported by the fact that the most common area of research and field-testing is in herbicide resistant crops, and consequently, similar criticisms have been raised over biotechnology as were levelled at the Green Revolution.

6.4.3 The Two Revolutions: Green and Gene

Parallels have been drawn between the Green Revolution discussed in Chapter 1 and the current "Gene Revolution" (Anderson, 2000). First, both 'revolutions' have involved a limited number of commercial crops. During the Green Revolution, the focus was on wheat and rice, and now with GE applications the focus is on crops like soya, cotton and canola. Dependence on export markets for cash crops has undermined local food security and disadvantaged local subsistence farmers (Anderson, 2000). Second, hybrid seed varieties locked farmers into a dependent relationship on seed companies. Now, with control of seed markets by a few companies, and technologies such as Terminator, farmers will continue to be controlled by such monopolies. Third, the new technology will further concentrate ownership of agricultural resources (Robinson, 1989: 76).

As previously discussed, gene technology has been promoted by the industry as essential to feed the growing global population, claiming that any calls to restrict the technology are acting against the interests of those who are hungry. However, representatives from third world countries have strongly objected to this tactic used by industry as they believe that it will destroy biological diversity, local knowledge, and sustainable agricultural systems that have been developed over millennia (Anderson, 2000: 68). Promoting biotechnology as a technological fix to complex social problems allows governments and industry to avoid the issues of political structures and social inequalities that cause starvation (Anderson, 2000).

Research into 'Terminator Technology', or 'suicide seed', belies industry's claims that they are trying to aid third world farmers. The top five biotech seed companies have their own versions of this technology which genetically disables plants to make them infertile. A chemical inducer is used to turn on and off a plant's genetic traits, including fertility in terminator plants. This development of chemically-dependent plants has been labelled "traitor technology" by its critics (ETC Group, 2002c).

Terminator technology has received enormous opposition, and in October 1999, Monsanto bowed to public pressure and stated that it would not commercialise Terminator seeds (RAFI, 1999c). However, according to RAFI, unless it is banned by governments Terminator technology is inevitable and is likely to be implemented quickly (RAFI, 1999b). It appears that this is indeed the case. Professor Drew Kershen from the University of Oklahoma College of Law in the US has been quoted as stating: "Delta and Pine Land Company continues to develop trait protection technology" (Ascribe Newswire, 2002). Dupont (Pioneer Hi-Bred International) was issued US Patent 6,297,426 in October 2001, involving terminator-type technology that entails the chemical control of female plant fertility (ETC Group, 2002a). Similarly, Syngenta, the world's largest agribusiness firm, was granted US Patent 6,228,643 in May 2001 which involves the control of rapeseed (canola) fertility. The Syngenta patent states that the purpose of this patent is to prevent unwanted gene flow from transgenic varieties. Scientists and Purdue University in the US have claimed that genetic plant sterilisation technology is needed to protect the environment from possible GE cross-contamination (AScribe Newswire, 2002).

This seems to present its own conundrum – on the one hand proponents of the technology are claiming that it is safe, while on the other they present the case that the planned release of GM crops is in fact dangerous and that the terminator technology is needed to prevent such danger. Further, green groups believe that it is irresponsible to promote genetic sterilisation techniques as a way of managing industry's 'genetic pollution' problem:

> The promotion of Terminator seeds as a "green" solution to GM pollution is the Trojan Horse of biotechnology. If Terminator technology wins market acceptance under the guise of biosafety, it will be used as a monopoly tool to prevent farmers from saving and reusing seed (ETC Group, 2002a).

This fear is supported by the USDA's[3] claims that without this process there is no way to protect US seed patents (ETC Group, 2002a). Also, industry commonly refers to genetic seed sterilisation technology as TPS, or *Technology* Protection System, which indicates that it has always been the technology, and not the environment, that they have been concerned to protect (ETC Group, 2002b). The technology also means that the companies can sell GM seed to farmers without needing to enforce a user's agreement and avoiding court cases that are

[3] It should be noted that the USDA has a five per cent stake in Delta and Pine Land's version of the technology.

costly and bad for their image. Thus, the purpose of the technology is to facilitate monopoly patents with agribusiness as the sole beneficiary.

Many environmental and consumer groups are concerned that, with seed saving being fundamental to many countries, such as India, any threat to the practice will be a threat to the society itself (Christian Aid, 2000). Genetically Modified cropping systems, which seek to maximise market control and assert proprietary rights, will increase farmer's dependence on external agents – farmers will be dependent on access to company seed and inputs for their livelihood (Heilbroner, 1985). This will undermine self-reliance, and the focus on commercial crops with unstable prices threatens food security (Christian Aid, 2000). We now turn to look at such issues arising from patent laws in more detail.

6.4.4 Patent Issues

By the end of 1998, more that 475 farmers in the US and Canada were awaiting lawsuits for breaking their contracts or had already been sued by Monsanto (Anderson, 2000). Monsanto also went so far as to set up a free phone line for farmers to inform on others they believed might be growing patented seed without a license. One of the most reported cases was that of Percy Schmeiser, a Saskatchewan farmer, who was sued by Monsanto and found guilty by the Federal Court of Canada of growing Monsanto's Roundup Ready ® canola without a licence. Schmeiser claimed that the presence of these plants in his fields must have been the result of cross-pollination from neighbouring GE oilseed rape crops. Expert witnesses at the trial, however, claimed that cross-contamination could not account for the high level of herbicide tolerant canola found on Schmeiser's farm (Agrifood Awareness, 2000) and so Schmeiser is currently appealing his case.

Another example is US-based company POD-NERS that is suing Mexican bean exporters. The company claims that the exporters are infringing POD-NERS patent on a yellow bean variety called 'Enola' which originated from the popular 'Azufrado' or 'Mayocoba' bean seeds that the company purchased in Mexico in 1994 (RAFI, 2000a). These beans have been grown and bred by traditional means in Mexico for centuries. Thus, many environmental and consumer groups, including RAFI, believe that the plant intellectual property system infringes on the rights of indigenous people and their farming communities. Groups such as RAFI believe that this is part of systemic bio-piracy that threatens to block agricultural imports, destroy export markets for Third World farmers, and legally appropriate staple food crops and medicinal plants.

In a similar case, US-based RiceTec was granted a patent on Basmati rice lines in September 1997. This could lead to a situation where RiceTec could claim that Indian farmers growing Basmati rice were infringing on the RiceTec patent. According to Chaudhry (1998: 9) "... the patent is a direct appropriation of traditional knowledge of Indian farmers. It reduces years of informal research, breeding and innovation to a pirated product patent".

A 1994 UN report found that developing countries lost an estimated $5.4 billion annually in royalty payments on pharmaceutical and agricultural products derived from indigenous plants (UNDP, 1994). AgrEvo's best selling herbicide, Basta, was developed from a soil bacteria derived from Cameroon, and no compensation has been offered to the donor country (Christian Aid, 2000). Four crop plants developed through the Consultative Group on International Agricultural Research (CGIAR) network – rice, wheat, maize, and beans – contribute $4.8 billion annually to economies of First World nations, which has donated only $78 million to the relevant research centres.

The CGIAR is an informal network of 16 international agricultural research centres which manages approximately 600 000 agricultural seed samples and is the most influential agricultural research body in the developing world (ETC Group, 2002c). Hindmarsh and Hindmarsh (2002) believe that biotechnology interests, through the CGIAR system, are laying the groundwork for GM rice throughout Asia. These researchers assert that the CGIAR is being increasingly overtaken by corporate interests, and that the organisation represents a public sector 'front' for the extension of industrial agriculture in developing countries.

Further promoting the industry's cause, the Trade-Related Aspects of Intellectual Property Rights (TRIPS) was signed in 1994 by the World Trade Organisation (WTO), despite widespread protest, including around 500 000 Indian farmers (Anderson, 2000). Under the agreement, all countries are obliged to bring their patent laws into line with the industrialised countries, removing barriers to 'free trade'. This agreement essentially sanctions what environmentalists call 'bio-piracy' or what the industry calls 'bio-prospecting', where companies send researchers to biodiversity-rich third world countries to seek out valuable plants and organisms whose genetic information can be sequenced and patented, with no prior consent needed, or any requirement to share the benefits with the country of origin. On March 10, 1999, India succumbed to international pressure and agreed to a WTO ruling on legal protection for patents (Christian Aid, 2000). However, in May 2000 India had a patent victory when the European Patent Office withdrew a controversial patent on a chemical formulation derived from the Neem tree, used as a bio-pesticide and medical agent for generations by indigenous farmers in India (Cummins, 2000).

In summary, looking at the history of global biotechnology development, begun in Chapter 3 and continued in this chapter, several trends emerge that have helped to consolidate corporate power, resulting in the increasing temporal scale of rDNA research and development and a strong corporate focus. These include state support for applied rDNA research; monopoly patents; mergers, acquisitions, and inter-corporate collaboration; research and development collaboration between universities, business and governments; and social insulation of research and development.

6.4.5 Consolidation of Corporate Power

The above trends pose problems as they present a powerful new economic and political combination with the potential to influence public policy; blur the traditional roles and responsibilities of the state in regulating the technology; and raise questions about the traditional checks and balances on economic power (Doyle, J, 1990: 184). We now turn to look at these in more detail.

State Support for rDNA Research

In 1998, the UK government spent £54.2 million on agricultural biotechnology research and development, compared to £1.8 million on organic farming research (Anderson, 2000). In the US, the 2002 Farm Act replaces specific dollar amounts with "… such sums as are necessary to carry out" agricultural research (ERS, 2002: 1). Funding levels for the Initiative for Future Agriculture and Food Systems (IFAFS) have been raised to US$ 120 million in fiscal year 2004 (ERS, 2002), although the estimate for spending on agricultural biotechnology specifically "does not exist" (Day Rubenstein, pers. comm., 2002; Shoemaker, pers.com., 2002). Competitive grant funding has increased and has tended to go to top-ranked biology and agricultural science programs (ERS, 2002). In Australia, the Federal Government committed $17.5 million to fund Biotechnology Australia (within DISR) and the Office of the Gene Technology Regulator (OGTR) to "… ensure that Australia captures the benefit of this emerging technology" (Minchin, 1999). The 2000-2001 budget provided a further $31 million over four years to support biotechnology research and development, which will be discussed further in the following chapter.

Support for free trade of biotechnology has been most notable in the US – globally through the WTO, regionally through the Free Trade Agreement of the Americas (FTAA) and the recently proposed Central American Free Trade Area (CAFTA), and bilaterally through agreements with Chile and Singapore and potentially other countries including Australia and New Zealand (Green Nature, 2002: 1). The Under Secretary for Farm and Foreign Agriculture Services, J B Penn, has been quoted as saying that "This strategy creates a competition in liberalization [sic.] with the United States as the driving force" (Green Nature, 2002: 1). It is therefore not surprising that the US has been critical of restrictive policy initiatives in the EU, Japan and China (www.uspolicy.be, 2002).

The US is also keen to aid the uptake of biotechnology in developing countries and has moved to increase the US Agency for International Development's (USAID) budget for that purpose (Green Nature, 2002). The European Commission has also shown similar support by declaring that a nation may only reject an application for a GE organism on scientific grounds (von Schomberg, 1998). The priority given to trade was similarly demonstrated in 1999 when the US and a small group of other grain-producing nations, blocked the Biosafety Protocol, an international treaty designed to regulate the trade and risk assessment of GE organisms. There has also been significant pressure placed on liberal democratic states by multinational corporations to simplify the regulatory process[4] (1999) and this is supported by the findings discussed in Chapter 7.

With the growing lack of public acceptance of biotechnology becoming one of the biggest problems facing the biotechnology industry (Ho, 1998), both governments and industry have also invested large sums of money on 'education' campaigns to try and gain public acceptance. The European Commission set up the European Federation of Biotechnology

[4] Regulatory capture is therefore common as competing interests vie for control of the regulatory process (Tripp, 1997).

Task Group on Public Perceptions on Biotechnology to specifically address public resistance (Anderson, 2000). Nation states such as the US and Australia have also embarked on their own education campaigns, which will be discussed in more detail later in the chapter.

Intellectual property protection laws have also illustrated continued state support for biotechnology, and have helped to increase TNC's control over all aspects of the agricultural sector.

Monopoly Patents

There has been a significant race to gain patent rights, with some companies attempting to establish exceptionally broad patent protection (Tripp, 1999). Tripp (1999: 21) states "… the current bout of predatory patenting and legal manoeuvring threatens to deliver excessive privileges to a handful of companies". Williams (1985: 61) agrees, stating that "… knowledge is becoming increasingly the property of one class: the powerful." Commercial interests are promoted through these monopoly patents, giving companies the legal right to determine who will get access to plant genomic material (and at what price), thus exercising power through the control and manipulation of information. The mega-firms are competing in a race of plant genomics, which they hope will enable them to gain rapid access to genetic information and allow them to secure their research and development through patents (Joly and Lemarie, 1998).

There is a growing belief that monopoly patents will work against the interests of farmers, consumers and the environment (Lawrence, 1988). For example, plant variety rights (PVR) legislation allows for monopoly rights over the use and availability of specific plant types, and such ownership issues have not received adequate attention (Hindmarsh *et al,* 1991).

Hindmarsh *et al.* (1991: 237) assert that the move to control biotechnology constitutes the most recent and significant stage in agribusiness restructuring. It began with the integration of the pharmaceutical and pesticide sectors and later the plant breeding sector. The new genetic technology "… offers the next step for further integration because of its capacity to forge interconnecting links between chemistry, pharmacology, energy, food and agriculture" (Hindmarsh *et al.,* 1991: 237). A direct causal relationship between the strengthening of intellectual property rights and merger activity has been identified (Leibenluft, 1981; Lesser, 1998), and so it is to this that we now turn.

Mergers, Acquisitions, and Inter-Corporate Collaboration

In 1957 Queensland's Department of Primary Industries produced some of the first hybrid seed in Australia, leading to the transformation of farmers into plant breeders. As the technology required for breeding processes increased, most farmers chose to buy their hybrid seed from companies, effectively handing over control of the seed supply (Cowley, 1999: 66). Now, multi-national chemical companies, mainly based in the US, own the technology. As stated by Lawrence (1988: 14) "... agribusiness is an organisational structure through which corporate firms progressively integrate family-farm agriculture into the wider urban-industrial economy".

In the last five years, globalisation of markets has seen the creation of 'agricultural industrial complexes' formed by the linkages between agriculture at the farm level and a broad range of downstream industries (Shimoda, 1998). Strategic players include: AgrEvo, Calgene, DEKALB Genetics, Delta and Pine Land, Dow AgroSciences, DuPont, Monsanto, Mycogen, Novartis, Pioneer Hi-Bred, and Zeneca (Shimoda, 1998). These firms expect to see annual sales in the range of US$5-US$10 billion (Joly and Lemarie, 1998). These companies believe that patent monopolies will provide greater profits than physical assets (Bratic *et al.,* 1998) and so there has been a proliferation of mergers and acquisitions in the seed industry by a few large biotechnology and agrochemical companies, creating several "mega-firms" (Joly and Lemarie, 1998; Hayenga, 1998; Tripp, 1999) or "Gene Giants" (RAFI, 1999a), also known as the "Life Science" industry, which has control over the expansion of agribusiness.

By the third quarter of 1998, Monsanto had been involved in 18 acquisitions (Lesser, 1998) and other multi-nationals such as Novartis, DuPont and Pioneer, Dow Agrosciences, AgrEvo (Hoechst/Schering) and Zeneca have all been involved in similar efforts (Hayenga, 1998). The mergers coincide with the commercial introduction of the first generation of biotechnology products such as herbicide and insect resistant crops including soybeans, cotton and corn which are now widely available (Hayenga, 1988; Kimle and Hayenga, 1993; Carlson, *et al.*, 1997). Herbicide resistant crops accounted for 77 per cent of the global planted GM area, Bt[5] made up 15 per cent, and 8 per cent of the total area comprised of a combination of the two traits (James, 2001).

At present, five major gene giants – Monsanto, DuPont, Syngenta, Bayer and Dow – dominate agricultural biotechnology. Monsanto's acquisition of DeKalb means that Monsanto and Pioneer combined will either own or significantly influence over 90 percent of the seed corn market in the US (Hayenga, 1998). In 1998, Monsanto controlled up to 40 percent of seed for that year's soybean crops (Lesser, 1998). As a result of these mergers and acquisitions, Shimoda (1998) states that in the end he expects that there will only be between three and five global agricultural biotechnology/agricultural chemical complexes. Freiberg (1998) agrees, stating that they will own and control the crops through the entire life cycle:

> Big companies will be 'taking over' much of agriculture, in somewhat similar fashion to the way Microsoft and Intel pretty much control the personal computer industry. As a result, both seed companies and farmers will become increasingly 'contract growers' for these giants. And it is going to happen, whether we like it or not, because that is simply the way our capitalistic, patent-driven system works (Freiberg, 1998: 1).

Recent events support these beliefs. A merger between DuPont and Monsanto would surely be seen as objectionable by even the US government. To overcome this obstacle it seems, DuPont and Monsanto released a statement in April 2002 claiming that they would agree to swap their key patented technologies and dismiss outstanding patent lawsuits. These two companies control 41 per cent of significant agricultural biotechnology patents and share about 93 per cent of the GM seed market globally (ETC group, 2002).

For many, this corporate consolidation raises concerns about increasing market concentration and power, leading to the displacement of rural farming communities and the possibility of the corporate take-over of the entire food chain (Lawrence, 1988). Jack Doyle (1990: 185) stresses that these "life science" conglomerates are "... unprecedented entities that will use genes just as earlier corporate powers used land, minerals, or oil".

[5] Bt is a plant variety with a gene inserted from a bacterium (*Bacillus thuringiensis*) that, by producing a toxin, makes the variety resistant to certain insect pests.

It can therefore be seen that agro-biotechnology has begun to have significant structural impacts on the agrifood chain. As stated by Scrinis (2000: 4) "It is not only biological processes, but also social structures and power relations that are being re-engineered through this new technology." Farmers are being forced into dependent relationships with agribusiness by the purchase of new technologies. As stated by Lawrence (1988), there is a 'technological imperative' built into the consciousness of modern farming, making farmers feel that there is no alternative to the latest chemicals, machinery and seeds. The top five biotechnology companies account for 60 per cent of the global pesticide market and 23 percent of the commercial seed market (Anderson, 2000). Monsanto in particular has made significant profits from biotechnology by enacting restrictive contracts whereby farmers must sign a contract guaranteeing that they will not reuse the seed (Tripp, 1999). Seed and chemical package deals often come with a discount on the technology fees, with the idea being to tie the customer to the chemical product (Hayenga, 1998). The 'terminator' gene developed by the corporation Monsanto, discussed earlier, destroyed the process that let farmers sow their own seeds and subsistence farmers were too poor to buy new seed. Thus, in Third World countries it has become a political issue, with India and Zimbabwe banning the technology (Vidal, 1999).

Environmentalists are concerned about corporate concentration and technology monopolies because they destroy diversity (ETC Group, 2002b), and this has lead Ho (1998; 2001) to conclude that the corporate takeover of science is the greatest threat to democracy and the survival of the planet. With ownership of key technologies increasing, biotechnology development is likely to require further partnerships among companies, as well as public-private partnerships (ERS, 2002). This raises the important issue of private-public collaboration in research and development.

Corporate-State-University Collaboration

Many researchers continue to believe in the tenets of enlightenment science discussed in Chapter 3 – that science is supposed to be shared, impersonal and developed for its own sake and is continually open to peer scrutiny. As already outlined, however, scientific and technological advances do not occur in a political and social vacuum (Rose and Rose, 1969). As discussed in Chapter 3, the establishment in the US of the National Research Council (NRC) in 1918 and the Social Science Research Council (SSRC) in 1923, both backed by the

Rockefeller Foundation, marked the beginning of the alliance between science and private enterprise. Now, the public sector seeks collaboration with the private sector to transfer technologies to the marketplace and to supplement limited public research and development resources (Klotz-Ingram and Day-Rubenstein, 2002). In the US, public funding for the agricultural sector in 1996 was US$3.15 billion, around US$800 billion less than private sector expenditures (Klotz-Ingram and Day-Rubenstein, 2002: 3).

Thus, there is now unprecedented corporate control and the use of corporate funding means that the free exchange of scientific data is discouraged (Tangley, 1986). According to the Rural Advancement Foundation International (RAFI, 1999a), a radical transformation of the global economy is well underway. The neglect of the public sector good is inevitable when the research agenda is determined by the private sector in pursuit of corporate profits. Access to food and health care, once considered a fundamental human right, will be subject to the 'whims' of the free market system (RAFI, 1999a). Ho (1998a), therefore, argues that genetic engineering is reductionist science working together with big business for short-term economic gains, against the public good and against the morals of society.

Government policy in Australia, and globally, has often resulted in closer collaboration between universities, business and government, forming a university-industrial complex. In recent years, large corporations have had the opportunities to fund research and education (Montague, 1998). Novartis, for example, provided the University of California at Berkeley with US$25 million over five years for research in agricultural genomics (University of California, 1998). Environmental and public interest groups believe that corporate funding has constrained the directions of scientific research and development and so the role of universities as places of neutral inquiry and as sources of alternatives and social conscience has been lost (Doyle, 1990). Critics such as the Conservation Council of South Australia (1999) are therefore increasingly concerned that a new ethos framed primarily by business and the state is emerging that will favour research that is likely to have a direct commercial application. Rather than true dialogue about desired goals and acceptable risks, there are experts "… acting as cheerleaders for the chemical companies biased justification for taking huge risks to the entire global system … We are told this is the future and we should accept it" (Dines, 1996).

In addition, The New England Journal of Medicine (*NEJM*) reported a study that found that there was a strong correlation between funding sources and scientific and medical opinion. Researchers examined 70 articles on calcium-channel blockers. It was reported that 96% of authors supporting the drug had financial relationships with manufacturers, compared to 60% of neutral authors and 37% of critical authors (Stelfox *et. al*, 1998). In the same journal, a scathing review by Jerry Berke was printed of Steingrabers's book *Living Downstream: An Ecologist Looks at Cancer*. It was later revealed that Jerry Berke is director of toxicology for W R Grace, one of the world's largest chemical manufacturers, and well known for polluting the drinking water of Woburn, Massachusetts. In the words of Montague:

> … if you want to understand 'objectivity' in the science and medicine of environment-and-health these days, the same advice applies as it does in politics: follow the money. Increased corporate funding of science and medicine has the potential to corrupt almost anyone (Montague, 1998: 7).

As scientists are increasingly pressured to align with industry and become more dependent on them for funding, the more inhibited they will be from disclosing information that may be against the interests of industry. Hindmarsh (1993: 101) states that "Institutional networks have mediated conflict among members of the biotech coalition. Internal dissent among the gene scientists, concerning both the safety and applicability of GE, has been camouflaged." Ho and Mathews (2001) also raise the issue of corporations, the state and the scientific establishment working together to suppress scientific dissent. They assert that as corporations grow bigger and more powerful, scientific dissent will be suppressed in more sophisticated and subtle ways. This raises the issue of commercial secrecy, censorship, and the misrepresentation or exaggeration of results (Williams, 1985). According to Ho (2001) those scientists within public institutions whose work showed evidence of horizontal gene transfer and who warned of the risks of GM crops have either lost their funding or their positions. Thus, according to Ho, too few scientists are prepared to be critical of biotechnology for fear of reproach. The amount of money put into research and development of a product is enormous, so there is a lot at stake if the results of monitoring or safety testing are unfavourable (Bridgstock, 1998). Even if so-called independent researchers are brought in to do the testing, they may well be reliant on the industry in question for funding (Bridgstock, 1998). Directly connected to this is self-regulation, a problem of GE regulation that has been heavily criticised by environmentalists.

In Australia, government funding for research was slashed in 1996 with the conservative government – a trend that has marginalised the role of public sector research in both OECD countries and the developing world. This means that universities have had to compete relentlessly for corporate funding and university researchers are more frequently claiming that industry has sought to manipulate or suppress research findings (Ho, 2001). A now widely reported example is that of research conducted by Dr Arpad Pusztai, a senior scientist at the Rowett Institute. His research found that GM potatoes were toxic to rats in the laboratory. As a result of releasing his findings publicly, Pusztai was fired from his position at the Institute, denied access to his data, and banned from discussing the subject. Fellows of the Royal Society accused Pusztai of not using 'sound science' and worked to publicly discredit his work. Pusztai and his colleague Dr Stanley Ewen published part of their findings a year later in *The Lancet*. Despite this, there are no serious efforts being made to undertake independent research into the safety of GM foods. Industry, industry-funded scientists and governments are working together to suppress scientific debate and to promote biotechnology (Ho and Mathew, 2001).

It has been recognised by many that a socioeconomic analysis is a necessary tool for decision making and priority setting for biotechnology (Cohen *et al.,* 1999). However, funding for research into the socioeconomic implications of the technology remains difficult to obtain (Cohen *et al.,* 1999). Similarly, funding for alternatives to GM agriculture, such as sustainable agriculture systems and organic farming is almost non-existent. These applications are seen as a threat to corporate agriculture as they reduce farmers' reliance on chemical inputs (Ho, 2001). Corporate scientists have launched an open attack on organic agriculture (for example, Agrifood Awareness Australia has issued a number of papers with this view) and instead seek to promote gene technology. It can be argued that governments should intervene by putting legislation in place to support independent science.

In summary, while in 1907 Hugo de Vries (an influential biologist) realised that what is profitable affects, or even determines, what is 'scientifically true' (de Vries, 1907; cited in Berlan and Lewontin, 1998), there is an even more complex issue – the profound attack on science by business interests. I would argue that scientific data is no longer the primary focus, but rather economic data related to the interests of 'big business'. The marketplace is increasingly determining the direction of biotechnology research and development, with Australian bio-development "... intricately entwined with global bio-industrialisation" (Hindmarsh *et al.,* 1998: 10). There is an increasing push towards deregulation and the contracting out of data collection (Crook, 1998) which, together with globalisation, are undermining the power of the state and placing the power of corporations beyond the reach of public accountability (Ho, 1998). A major criticism by environmentalists is the lack of scientific research into the long-term effects of GM foods on human health and the environment. Therefore, environmentalists argue, the reason for proponents' claims that there is no data to suggest that GM products may be dangerous (see for example Prakash, 2001) is because there is no data at all (Vint, 2000). Most OECD governments claim to be 'pro-science' and yet they have not commissioned any scientific studies into these effects. This further highlights the business take-over of the scientific terrain, and raises the issue of the increased social insulation of research and development as a result.

The Social Insulation of Research and Development

Back in 1985 it was said that we were entering a new era of 'secret science' (Williams, 1985). It is evident that such an era is now well and truly upon us. Leon Wofsy stated that the main priority is to make money, and this is achieved through the control of information and research results (cited in Williams, 1985). Research and development is, therefore, conducted in social insulation due to reductionist strategies used to quieten opposition, and billions of dollars being invested in laboratory research.

The insularity of the research community and the committees regulating them adds to the controversy over biotechnology. Critics argue that many of the problems relating to constructive ethical discussion of biotechnology arise due to this distance from the general public (Rollin, 1996). The Centre for Biotechnology Policy and Ethics (1994), for example, state that closed processes assert an arrogance which contributes to a loss of public confidence in scientists' ability or willingness to protect them from hazards. The first Australian release proposal should have provided a unique opportunity to engage the community in a dialogue concerning the new directions in which recombinant DNA technology was proceeding, but instead it was shrouded in secrecy, alienating the community (Bartels, 1984: 183). The House of Representatives Standing Committee on Industry, Science and Technology (HRSC) stated in its 1992 report:

> ... as a general principle the public's right to know should need no justification in a democratic society, although it is rarely made explicit in legislation or regulation ...

> Openness is clearly desirable in order to assure the public that the correct procedures are being followed (HRSC, 1992: 115).

However, despite this apparent recognition of the need for openness and transparency (although for the purposes of public appearances and opinion) it has not been put into practice. Perhaps, then, it is necessary to make these criteria explicit in legislation and regulations. There is also the potential for information technology to expand the principle of openness – the internet could provide an easy and convenient means of access to information[6]. While privacy is important in this context, it should not be emphasised too much and at the expense of freedom of information (Seipel, 1996).

In Australia, the state and industry have not chosen to implement any such strategies for openness, choosing instead to carry out their practices in a less than transparent manner. Also, rather than provide the public with unbiased, factual information on which to base their own views and decisions, they have undertaken a public 'misinformation' campaign.

6.4.6 Public Misinformation

The state and industry in Australia have embarked on a lavishly funded public 'education' campaign aimed towards improving biotechnology's public image. Biotechnology Australia, Agrifood Awareness Australia (an industry organisation) and the Australian Biotechnology Association have been at the forefront of this campaign, which we will now explore.

Biotechnology Australia

Biotechnology Australia (BA) was set up in 1999 by the Commonwealth Government in an attempt to provide a 'whole of government' approach to biotechnology. It is composed of five Government departments including Industry, Science and Resources; Education, Training and Youth Affairs; Agriculture Forestry and Fisheries; Health and Aged Care; and Environment Australia. One of the portfolio's stated aims is to support a public awareness and information program (DISR, 1999). Trans-national public relations firm Porter Novelli, which advises the

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[6] It must be noted however, that when technology is viewed as a new means to participate in intellectual, social and political life in an information society, a lack of access would be problematic (Rodota, 1996).

global chemical industry, is managing BA's public awareness strategy. Part of the strategy involves the Gene Technology Information Service (GTIS) which operates as a partnership between Biotechnology Australia and the University of Melbourne. This service sends out information kits made up of material from the Australian and New Zealand Food Authority (ANZFA) and the CSIRO (Biotechnology Australia, 2000). The service has also produced a postcard that operates on a mail-back system where individuals can select the type of information they want and the GTIS in turn mails out general information packs on the subject. The front of the postcard carries the provocative catch-cry "Don't be fooled by the hype. There are no such things as … KILLER TOMATOES!" Given that the aim of the service is to allow people to make an "informed choice", this use of emotive language gives credence to critics' claims that the Government is supporting "PR posing as education" (Phelps, 2000a). Information sheets also show a bias in favour of the technology. For example *Questions and Answers on the Gene Technology Act 2000* states the contested idea that "Gene technology is a lot more precise than previous techniques." Several studies have shown that the technique is not as precise as is often claimed, as discussed in Chapter 1. While the fact sheet does list both the potential benefits and risks of the technology, many risks that have been identified are noticeably absent from the list.

Unfortunately, while the stated aim of the Government's community education program is not to promote the technology but to provide adequate information for people to reach their own conclusions, certain underlying assumptions undermine a truly effective discourse. For example, Fact Sheet 3 *Frequently Asked Questions* states, "Industry is acting responsibly and trying to inform the community. These new technologies can provide cheaper, safer products for the community's benefit." This is part of the so-called 'balanced' information. There is no discussion of whether or not the community wants the technology or whether it is in the national interest. Interestingly, there is a waiver at the end of each fact sheet stating: "The Federal Government agency Biotechnology Australia gives no warranties and makes no representations whether express or implied that the information provided is accurate, current or complete …"

A schools package entitled *The Biotechnology Revolution*, sponsored by Biotechnology Australia also reads as a pro-biotechnology publication. While it does mention the arguments 'for' and 'against' agricultural and medical applications, the bulk of the publication discusses the 'pros' with sections such as "Smart Farming: improving crops", "Smart Farming: Growing better yabbies", "Smart Farming: Making better wool", "Bacteria fight malaria", "Conserving animal species" and so on. It is also interesting to note the list for "Further information about biotechnology" which includes Biotechnology Australia, the Australian Biotechnology Association, GMAC, the IOGTR, CSIRO and the Curator of Biotechnology at the Powerhouse Museum in Sydney. All are examples of proponents and users of the technology.

Public briefings were held in late September of 1999 in each State, however advertising of this process was so poor that even the Australian GeneEthics Network and others actively involved in the biotechnology debate were not aware of it until after the event. One advertisement was placed in the public notice section of *The Australian* on 2 September 1999. The heading was: "Discussion Paper on Developing Australia's Biotechnology Future: Call for Submissions". In the fourth paragraph, it was stated that public consultation forums would be held in state capitals during the month of September. This 'one off' advertisement is clearly insufficient for genuine public consultation. At the very least, the public meetings should have had a separate heading. Better still, it should have been in every major Australian newspaper over a number of weeks leading up to the meetings.

This is just one example that supports the assertion that there has been extensive exclusion of public participation, dialogue and debate: community interests not connected to elite groups are neglected (Bammer, Green and Martin, 1986). The form of 'transparency' that the biotech-network claims to adopt is very different to democratic public participation. This is significant, as, again, without effective discussion and dialogue, the public will be distrustful of scientific information, and effectively become alienated from it (Boardman, 1987).

The Government's 'misinformation' campaign continued in January 2000 with the distribution of an information leaflet in Australian supermarkets. Entitled "Genetically Modified Foods: Information and answers to your questions", it was produced by Biotechnology Australia as part of its 'public awareness' program. Three quarters of the leaflet provides balanced information. The last quarter however is a blatant promotion of the technology, stating that "Genetic modification has the potential to provide foods that are healthier, safer, cheaper, better for the environment and more efficient to grow." It goes on to state that the Federal Government "... seeks a can-do country where Australian jobs can be kept at home". It also states that we must embrace the technology in order to be internationally competitive. The 'pros' listed are not balanced by the 'cons' that many believe form a real part of gene technology applications.

A series of community forums organised by BA were also held in rural Australia during 2000. The stated aim of these forums was to provide adequate information to rural communities, enabling them to make informed decisions about applications and uses of GM products. However, critics believe that, following in the wake of Aventis's unauthorised GMO releases, they were held to calm public disquiet (Phelps, 2000). This is supported by the fact that PR company Porter Novelli were heavily involved in the organisation and running of the forums. Biotechnology Australia's Public Awareness Program Manager, Craig Cormick (2000), stated: "… the forums are not about promoting biotechnology or particular products *as such*, rather they will aim to provide factual information about both the pros and cons of the technology, and the full scope of its implications for agriculture, health and the environment" (emphasis added).

Bullying Tactics?

The opinions expressed above are not welcomed by the state or industry. In March 2001, SAGFIN received a letter from the head of Biotechnology Australia, Patricia Kelly, requesting that "errors" present in the group's public information leaflets not be repeated. Objection was taken to the statement that Biotechnology Australia is a "… government-funded agency that only portrays the positive side of the technology." According to Ms Kelly, Biotechnology Australia aims to provide "… balanced and factual information about biotechnology issues to allow the Australian community to make informed decisions about the use of the technology" (Kelly, 2001). Exception was also taken to the assertion that the reference material provided to schools, *The Biotechnology Revolution*, promotes biotechnology. Ms Kelly stated that the booklet explores the social and ethical impacts of the technology, alongside the technical information.

There appears to be a conflict of interest to have the Government Department (Industry, Science and Resources) responsible for promoting and developing GE also being responsible for the public awareness program. Despite this, the IOGTR believed that information allowing informed choices was provided by Biotechnology Australia, the CSIRO and ANZFA. However, critics assert that none of this information adequately discusses the hazards being exposed. They believe that there should be equal space given to alternative viewpoints and they would also like to see links to other anti-GE websites, and the inclusion of both the pros and cons in school education materials (Arnold Ward, pers. com. 2000). However, the interests of the heavily resourced biotech-network continue to dominate the policy process.

Agrifood Awareness

The biotech-network's misinformation campaign has been further advanced by Agrifood Awareness Australia (AAA) which is an industry initiative launched in May 1999, originally under the name Agrifood Alliance Australia. The industry group is an alliance founded by six main bodies: the Australian Biotechnology Association (ABA), Avcare (the national association for crop protection and animal health), the Grains Research and Development Corporation (GRDC), the National Farmers' Federation (NFF), the National Association for Marketing Agricultural Commodities (NACMA), and the Seed Industry Association of Australia (SIAA). The intentions of the group are illustrated in a press release of 25 August 1999:

> While it will be important to meet the public requirements for increased transparency and independence it is also very important that the new measures do not result in prohibitive costs to obtain timely approval for commercial release. Gene technology is a new tool for modern agriculture with enormous potential benefits. Australian agriculture must capture those benefits in order to remain internationally competitive (AAA, 1999).

In another press release of 15 December 1999, AAA states that its independence is critical if it is to be seen as a source of credible information. Given its membership, however, it is difficult to see how AAA could claim to be unbiased. Avcare, for example, is a self-proclaimed "voice of the industry". In its published material, Avcare rejects organic farming stating that its yields are significantly lower compared to conventional farming. This sets up biotechnology as the only viable alternative. One of Avcare's stated obectives is to obtain "... government and community recognition of industry's contribution to society ..." and to "...continue to make its industry voice heard" (Avcare, 1999). Gaining community acceptance, therefore, appears to be one of Avcares primary activities, focussing on consumers, governments, industry stakeholders and NGOs. This is easily achieved as Avcare has a full-time professional secretariat of eight people that represents the interests of its members. Another important stated aim is to "... positively influence the regulatory decisions of governments, so as to provide a transparent and predictable business environment for members" (Avcare, 1999). Thus, industry supports legislation in order to provide this 'fast track' to market, and has actively lobbied governments to achieve this. The last thing they want however is legislation that restricts their activities. This will be discussed in more detail in Chapter 7.

In 1999 Avcare conducted consumer research into public attitudes towards GM foods. A focus group was then held, providing information on biotechnology, and the survey taken again. Not surprisingly, acceptance towards the technology increased after the focus group session. In the same year Avcare relocated its offices to Canberra in order to increase their ability to lobby government. They seek to ensure that sound science is used to determine which policies are enacted by Government. Avcare holds regular seminars discussing regulatory issues, run by Avcare's Biotechnology Committee (ABC) (Avcare, 1999).

Avcare therefore has abundant resources, both financial and in terms of people-power, facilitating a well organised campaign to sell the technology to the public. They have numerous councils, committees and taskforces to tackle issues facing the industry, including a biotechnology committee, public affairs committee, and an antibiotic working group, just to name a few of the total 17 committees which meet on regular basis (Avcare, 1999). Along with other activities, Avcare has a website which is updated daily, providing a summary of media issues affecting the industry. According to Avcare (2000) this website has a weekly average of 13 500 hits). Updates are also faxed to members weekly. They actively lobby Government and other political parties on gene technology legislative issues through face-to-face meetings and submissions.

Industry interests have been further empowered by the support of the State, for example, through financial support of the Australian Biotechnology Association.

Australian Biotechnology Association (ABA)

On 29 March 2001 the Federal Government announced funding of $450 000 to assist the ABA to become a strong national voice for the biotechnology industry (ABA, 2001). The government identified the need to develop a strong network within the biotechnology industry in its National Biotechnology Strategy (NBS) launched in July 2000. According to Senator Minchin "It is now responding to the needs of our growing biotechnology industry by developing a more industry-focused organisation." It is intended that the funding will go towards fostering links between industry and researchers and "... increasing awareness of biotechnology with potential investors, researchers, governments and the broader community." The ABA is also developing information databases to assist Government on policy development. This goes some way to demonstrate the State's support of the biotech industry which will be explored in more detail in Chapter 7. While many may try to turn to the Freedom of Information Act to gain the information they require, in reality the Act does little to increase the transparency of biotechnology policy and information.

6.4.7 Freedom of Information (FOI) in Australia

In 1996 the Australian Law Reform Commission released a damning review of the implementation of the *Freedom of Information Act* and made 106 recommendations. Despite these recommendations for strengthening the Act, the Howard government has downgraded the FOI unit and failed to act on most of the recommendations. In 1998, the Attorney-General's Department announced that the ALRC's recommendations were still under consideration (Hepworth, 1998).

The people in charge of the FOI legislation are also responsible for national security and privacy (Hepworth, 1998). Snell (cited in Hepworth, 1998: 32) states: "It's an Orwellian outcome that something committed to openness would be in the same division dealing with security intelligence issues." According to Hepworth (1998) there is a "psychology of secrecy" in the Australian public service. This is not restricted to governments, however, with corporations also moving to increase secrecy through declaring most company information as 'commercial-in-confidence' (which will be demonstrated further in Chapter 7).

The *Sunday* web site (http://sunday.ninemsn.com.au) describes the exemptions in the FOI legislation as "… holes big enough to drive a truck (full of particularly grubby secrets) through." In the case of gene technology, due to the sensitive nature of the debate, there is a fear by government representatives that information will be misconstrued or taken out of context. However, it should not be difficult to provide clear information with the context outlined if necessary. If the information were made widely available, there would also be less chance of misinterpretation, as others would quickly pick up on any contextual or factual errors. Of course, the information could also be widely discussed and debated, again leaving less room for misunderstandings. However, biotech proponents want to enclose the discussion between government and industry representatives, out of view from the general public. This supports Sylvan's assertion that there are two classes of citizens: "… the companies and the rest of us" (Sylvan, 1994: 14). This of course means that companies have significant privileges, one of them being the ability to label documents 'commercially confidential' even if the material is clearly in the public interest. In this way, important information is kept out of the public domain.

In the context of this thesis, information regarding CSCG negotiations was not released, because it "… may reasonably hinder on-going negotiations with the States and therefore not be in the public interest. Exemption outweighs the public interest of disclosure" (Ellis, 1999, pers. comm.). Other documents are refused because their release "… may mislead the public and encourage ill-informed speculation" (Ellis, 1999, pers. comm.). It is interesting that they chose the word "ill-informed" – if they allowed the public proper access and kept them fully informed of the decision-making processes, this of course would not occur.

The cost of FOI applications also effectively closes many people out of decision-making. The ALRC (1996) found that many government agencies produce exaggerated estimates to deter applicants from proceeding with FOI requests. My own request (for documents dealing with public submissions, Commonwealth-State Consultative Group meetings and the database list of major stakeholders for gene regulation) initially had a charge of $3830. Decision-making time accounted for $3620 of this amount. After a lengthy process of arguing that the information was in the public interest and unaffordable, the amount was eventually reduced to $500. Not surprisingly, only limited information was eventually disclosed. I was unable to convince DISR that the release of a substantial amount of the requested information was in the public interest.

The trends and problems of recent global biotechnology research and development outlined above have lead to growing and active resistance worldwide.

6.4.8 Growing Resistance

Due to declining consumer confidence in GE, high premiums are now being paid for GE-free products. In January 1998, Australia exported its largest shipment ever of canola to the EU, and by 2000 Australia's grains export industry was profiting with a non-GM price premium (Byrne, 2000). In contrast, Canada lost $300-400 million in canola sales to the EU in 1998 because they had failed to segregate GE and non-GE canola and so could not guarantee the GE-free status that the EU was demanding (Anderson, 2000). The following year, major supermarkets and food companies in countries such as Europe, Japan, Australia, New Zealand, Thailand, Brazil, Canada and others, were bowing to consumer pressure to remove GE ingredients from their home-brand products. These included Unilever, the largest processed food company in the world. By 2000, hundreds of organisations and individuals around the world were demanding a moratorium or outright ban on the environmental release of GE organisms. On July 3, the European Parliament moved to tighten labelling laws for GE foods, lowering the threshold for mandatory labelling from one per cent to one-half per cent (Anderson, 2000).

The public's desire for GE-free has also resulted in direct action. In June 2001, a thousand protesters took to the streets in San Diego California, challenging industry leaders gathered for the annual Biotechnology Industry Organisation (BIO) convention (Cummins, 2001). In 2002, green groups continued this campaign. On June 8, the Organic Consumers Association, Greenpeace, and the Genetic Engineering Action Network held coordinated protests in over 100 cities against major US supermarket chains (BioDemocracy News, 2002). In the same year, officials in Zambia refused to accept more than 40 000 tonnes of food aid, mostly from the US, because it was genetically modified (National Post, 2002). This was despite the fact that nearly three million people are starving in Zambia. In July of that year, Monsanto was forced to announce that it had ceased plans to commercialise herbicide resistant Roundup Ready wheat 'indefinitely' due to mounting opposition from farmers, consumers, and some food companies (Biodemocracy News, 2002). This growing consumer and activist concern raises the important issue of alternatives, and it is to this that we now turn.

6.5 Alternatives to Capital-driven GM Agriculture

Lawrence (1988) states that the path of agribusiness is not inevitable, but rather conditioned by social, economic and political dimensions of the Australian and global economies (Lawrence, 1988: 20). Similarly, Anderson states:

> 'Genetic engineering' is not just a laboratory technique. It is a tool shaped by a particular worldview, supported by a particular political and economic framework. Some suggest that to challenge genetic engineering is to stand in the way of scientific progress – but the nature of progress depends on your point of view (Anderson, 2000: 142).

Thus, increasingly people are beginning to question the way in which our food is produced, the global economic system, and growing corporate power. They are beginning to see the importance of examining whether this is the direction that agriculture should take to benefit society and the environment, and if not we should be encouraging the development of alternative agricultural systems.

Environmentalists are eager to explore the aforementioned ecologically based agricultural systems as a means of addressing the existing social, political and agricultural problems (Anderson, 2000). Such systems promote local production, biological diversity, reduction in erosion and nutrient losses, and increased nutrient cycling (Anderson, 2000). A world census on agriculture undertaken by the UN in 1980 showed that small diverse farms in countries such as Ethiopia, Sudan, Tanzania, India, and Thailand, were more productive than large farms (FAO, 1980). A World Bank study in Brazil also showed that if land was redistributed in the form of smaller farms, output would increase by around 80 per cent (cited in Anderson, 2000). These practices have been successfully implemented in Cuba which has gone from predominantly large-scale industrial agriculture to small-scale, largely organic agriculture with local food production that is adequate to feed a growing population. Thus, the biotech industry's claim that GE is essential to feed growing populations is clearly false and such claims have only helped to increase resistance.

6.6 Concluding Remarks

While proponents promote a 'bio-utopia' where biotechnology will 'feed the world', provide healthier foods produced with fewer chemicals, improve health care through prevention and treatment of disease and clean up the environment, to name a few examples, environmentalists are concerned about the political and socioeconomic structures in which gene technology is embedded.

A lot of attention has been given to the impact of technological change on agriculture. According to Shimoda (1998: 3), technological innovation has been the key driver in the growth of industrial agriculture, stating that "... this new developing technology-base will not only create products that will help improve farmers' productivity, but more importantly, will dramatically expand the value creation potential of agriculture and the linkage of agriculture with our industrial-based economy." Thus, agribusiness has become part of a strategy of corporate rationalisation and control (Lawrence, 1988) with corporate visions dominating and supported by the governments of industrialised nations because it is said to be 'in the national interest'. According to the National Agricultural Biotechnology Council (NABC), New York, this century's economy will shift from one based on fossil fuels to one that is bio-based (Baker, 1999).

However, as the technology becomes increasingly an economic resource, driven by corporate profits, and with the consequent social insulation of research, it will allow less time for broader problems to be anticipated (Wynne, 1988). It also raises the question of whether such research and development will provide for public needs. In the race for profits, will there be time to address social, ethical and environmental issues? The history of biotechnology so far indicates that these issues will remain marginalised in the race to remain competitive in a global market.

In an attempt to circumvent such important and complex issues, the biotech industry has manoeuvred to make the acceptance of GE crops a moral issue – that of feeding starving communities in poor countries. They also seek to redefine the issue of terminator technology from one of preventing seed saving, and therefore protecting patent profits, to one of a protection strategy to contain gene flow from transgenic crops. However, this is betrayed by Delta and Pine Land and the USDA's earlier announcement in relation to their new patent on genetic seed sterilisation in March 1998: "Our system is a way of self-policing the unauthorized use of American technology. It's similar to copyright protection" (USDA, 1998).

While it may be argued that some biotechnology applications have the potential to provide great benefits to society and the environment, the current research focus is on applications with the best economic returns, not those in the best interests of society and the environment. This is evidenced by the translation processes of the biotechnology network, which will be explored further in the Australian context in Chapters 7 and 8. There has been an unprecedented rate of corporate mergers and acquisitions, as well as corporate-state-university collaboration which has lead to the increased social insulation of research and development. With the corporate takeover of seed and plant breeding companies and broad patent protection, a few multinationals have a monopoly over the entire food chain. All of this causes great problems for the effective regulation of the technology at the national, state and local level in Australia.

Given the escalating environmental and social problems that our society, and indeed that the planet is suffering, appropriate policy is urgently needed in Australia that incorporates ethical and social issues, as well as transparency and openness and active public participation. Without effective discussion and dialogue, the public will be distrustful and alienated from science and decision making (Boardman, 1987). Ultimately, corporations need to be placed in a position of public accountability, with a shift from profits as the primary motive for research.

As discussed in Chapter 5, the current policy agenda, however, does not allow for adequate public participation and scrutiny, which is essential to counter industry bias in decision-making processes. This is despite growing resistance from overseas markets such as the EU, UK and parts of Asia. There has been extensive exclusion of public participation, dialogue and debate with community interests that are not connected to the elite biotech-network being neglected (Bammer *et al.,* 1986). This has been supported by an extensive public 'education' campaign which could be more accurately described as 'misinformation' or even 'propaganda'.

In general, biotechnology decision-making is surrounded by secrecy, hindering public debate over ethical, social and environmental issues. This situation is encouraged by industry, which opposes public participation in regulatory mechanisms, preferring a self-regulatory approach dealing solely with safety and product quality (Hindmarsh, 1994). This is the context of Australia's biotechnology policy development, to which we now turn.

7

The Gene Technology Act 2000 and the Precautionary Principle: A Green Ethic for Policy Reform, or Green Co-optation?

This chapter further explores the shaping of Australia's regulatory agenda, following on from the earlier phases addressed in Chapter 6, and utilises the multi-disciplinary methodology outlined in Chapter 5. The first section provides a general discussion of the issues surrounding calls for legislation as well as the policy processes involved in the development and implementation of the Gene Technology Act 2000 (GT Act). The second section provides a translation analysis of these policy processes to gain insights into why the biotech-network has been so successful in translating its interests, and why green interests have not achieved the same success – largely due to a political environment of unequal power relations.

Regulators in the EU have responded to public protest challenging the basis of approval decisions based on a framework and discourse of conventional risk assessment and cost-benefit analysis, by implementing a more holistic and precautionary approach (Open University UK, 2000). This trend is not paralleled in Australia, however, and this chapter examines the forces preventing this shift towards a more reflexive modernity (see Beck, 1992) that incorporates a precautionary ecological approach. A useful approach to conceptualise these translation processes is through closure of controversy, outlined in Chapter 5, and this will be addressed in the final chapter of the thesis.

The empirical analysis is based on the extensive collection of materials related to Australia's recent regulatory negotiations including government discussion papers, policy documents, legislation, articles in journals and the popular press, parliamentary evidence, inquiry reports, public submissions, and open-ended interviews and discussions with actors involved in the GE controversy. The analysis is not intended as a complete treatment of the Australian controversy surrounding GE policy and regulation, nor does it identify all actors in the controversy. Rather, the focus is mainly on human and organisational actors involved in the policy processes in the lead up, development and implementation of the GT Act 2000.

We turn first to look at why there were calls for change to the voluntary system of GE regulation in Australia, and how this set the scene for later regulatory manoeuvres.

7.1 Calls for Changes to the Voluntary Regulatory System

The Victorian Law Reform Commission recommended statutory regulation of biotechnology as early as 1989, however it was not until three years later, following the 1992 Senate report on genetic engineering, *Genetic Manipulation: The Threat or the Glory?*, that the Federal Government formed a Commonwealth-State Consultative Group (CSCG) to negotiate a national regulatory framework. The consultative group developed a draft bill for a Commonwealth statutory Gene Technology Authority (GTA) and associated Inter-Governmental Agreement (IGA) by mid 1995. The process came to a standstill in that same year, however, due to strong disagreement between the various states. Disagreement occurred over the 'complementary adoptive' form of legislation proposed for the Commonwealth and State GTA Acts. Western Australia did not want to agree to legislation that could be changed without the opportunity for its Parliament to fully consider those changes (Agriculture and Resource Management Council of Australia and New Zealand, ARMCANZ, 1997). In 1996, Petrice Judge, manager of federal affairs for the WA Ministry of the Premier and Cabinet stated,

> The Western Australian position reflects: (i) the need, noted by the Western Australian Parliament's Standing Committee on Uniform Legislation and Intergovernmental Agreements, for State Parliament to have the opportunity to debate all legislation and amendments; and (ii) the concern of Cabinet that Western Australia does not participate in legislative schemes involving the ceding of State powers to the Commonwealth (Judge, 1996).

It was only in 1997-8, when industry was ready to commercialise the products of GE and sought a streamlined path to market, and the public were increasingly voicing their concerns about the technology and its regulations, that the process of developing legislation again began in earnest (Hindmarsh, 2001). The approach sought by WA – complementary rather than adoptive legislation – was eventually taken up by the Federal Government. On 30 October 1997, the Ministers for the federal agencies of Industry, Science and Tourism (DIST), and Primary Industries and Energy (DPIE), and the Environment, released a joint statement expressing the Federal Government's plan to introduce "... a package of measures designed to provide appropriate regulation of gene technology" (Joint Ministerial Statement, 1997). The statement outlined that the Government would:

- Amend current legislation and introduce new legislation to ensure that gene technology is covered by uniform laws and that compliance is compulsory;
- Establish a Gene Technology Office to administer a national regulation system which will ensure that comprehensive scientific analysis and risk assessment are undertaken before genetically modified organisms (GMOs) are released. (The Office will coordinate the release of GMOs by existing bodies, make decisions on the release of GMOs not covered by existing bodies, and regulate gene technology research);
- Establish consultations with, and a communication plan for, the public and the State and Territory Governments; and
- As an interim measure, establish a Gene Technology Liaison Committee to provide advice on urgent issues which are not able to be addressed under current regulatory systems (Joint Ministerial Statement, 1997).

These measures reflect the Government's focus on a risk assessment approach, underpinned by a modernist epistemology and approach to science.

A main concern of state bureaucrats about the voluntary system was the lack of transparency of the Genetic Manipulation Advisory Council's (GMAC) decision-making processes and its inability to ensure that companies complied with conditions placed on field trials. They were quick to point out, however, that this was not a concern in terms of risks to human health or the environment – as they continued to argue that GMOs posed no additional risk than conventional crops – however it was problematic in terms of public acceptance in a climate where public objection was on the increase.

In addition, a number of GMOs were in the pipeline that did not fall within the mandate of existing regulators, creating so-called 'gap GMOs'. The importance of the gap GMOs being covered by the regulatory system and the need for legislation had been recognised for some time (see for example the Victorian Law Reform Commission, 1989; Bita, 1995). It became imperative that a regulatory system that covered these GMOs be in place before general releases became common, again largely to reassure the public. The Government recognised the need for regulations to meet the community's calls for transparency and openness and their desire to be involved in regulatory decision making (see for example the ACF's submission to the 1992 inquiry).

Following calls for a more robust regulatory system, the Interim Office of the Gene Technology Regulator (IOGTR) was announced in May 1999, following budget decisions, as an Office within the Therapeutic Goods Administration (TGA) of the Commonwealth Department of Health and Aged Care (DHAC). The role of the IOGTR was to work with State and Territory Governments and stakeholders to establish the Office of the Gene Technology Regulator (OGTR) and the related legislation. It can, therefore, be seen that the state's role in the policy process was significant. Thus, in order to understand the true nature of the policy processes involved, it is important to look more closely at the state's role in setting the policy agenda.

7.2 Setting the Agenda: State Support for Gene Technology

From the outset the federal government had been faced with a dilemma. On the one hand, it embraced the idea that biotechnology had the potential to boom in the new millenium and therefore wanted to support and encourage it. On the other hand, faced with intense public distrust, it was placed under pressure to heavily regulate the technology. The government therefore had two conflicting guiding principles – providing an enabling framework for industry and addressing public concerns.

On 11 March 1996, the GMAC secretariat was transferred from the Department of Administrative Services (DAS) to the Department of Industry, Science, and Technology (DIST) on the change of government, showing the conservative government's leanings towards promoting the technology rather than taking public concerns seriously. Later, responsibility for GMAC was transferred from the Department of Industry, Science, and Resources (DISR) to the Health Portfolio as a result of Federal Government decisions on gene technology regulation announced in conjunction with the 1999 Federal Budget (Interim Office of the Gene Technology Regulator, IOGTR, 1999). The IOGTR (1999: 9) stated that this move "... reflected the Commonwealth Government's commitment to separate the regulation of gene technology from the promotion of the gene technology industry" and that it also reflected "… the Government's concern to protect human health and safety and the environment." Although GMAC has now been replaced with the GTTAC, responsibility for gene technology regulation remains within the Health Portfolio. However, while responsibility for regulating and promoting the industry may now be separated, responsibility for community education and information and the promotion of the technology still lies within the same department, DISR, through Biotechnology Australia. From the very beginning, NGOs such as the GeneEthics Network have called for the main regulatory body to be situated within Environment Australia, to give the necessary attention to environmental issues. However, due to the state's support of biotech development, these NGOs have been unsuccessful in promoting this change.

The Federal Government's support of the biotech industry has been clear from the beginning. The joint ministerial statement of 30 October 1997 outlined the benefits of gene technology and further stated that: "The application of gene technology is essential for Australia's future international competitiveness in pharmaceuticals and as a food and fibre producer." The role of both Biotechnology Australia (within DISR) and the Office of the Gene Technology Regulator (OGTR) is to "… ensure Australia realises the potential gains being offered by biotechnology" (DISR, 1999a). Added to this, the federal government committed $17.5 million to fund these two agencies and to "… ensure that Australia captures the benefit of this emerging technology" (Minchin, 1999), signalling its intention to move forward with biotechnology in agriculture (DISR, 1999a; Wynen, 1999).

In the lead up to the consultation process on biotechnology regulation, DISR stated that it would release a Biotechnology Issues Paper addressing,

> … how to ensure Australia maximises its private and public sector investments in biotechnology research; what strategies need to be adopted to encourage greater commercialisation of biotechnology research; identification of impediments to private sector investment in biotechnology research; and, the effectiveness of Australia's present management of biotechnology intellectual property (DISR, 1999b).

The 2000-2001 Commonwealth budget provided a further $31 million over four years "… to further support the development of a strong biotechnology industry – an industry of the future in which Australia has a strong research foundation, and an industry with the potential to provide significant economic returns and health benefits." The budget also allowed for a Science and Technology Awareness Program which "… encourages public understanding and acceptance of science and technology, and innovation more broadly, and is part of the Government's strategy for turning Australia into the 'can do' country" (Commonwealth Government, 2000). Thus, the policy issue became how best to manage the technology, not whether or not it was desirable or whether alternatives existed. This set the tone for the conduct of the IOGTR.

Further, the Government's *National Biotechnology Strategy*[1] (Commonwealth of Australia, 2000) also signalled the Government's vision and support for biotechnology in stating:

> Biotechnology is a key technology of the future. It presents enormous opportunities as well as great challenges. Biotechnology holds the promise of improved health and welfare for all Australians through better understanding of disease, improved diagnosis, and treatment with more specific biopharmaceutical products. Biotechnology, including the genetic modification of agricultural and food products, also has the potential to deliver productivity, competitiveness and sustainability benefits to Australia. The technology offers improved resistance to herbicides, insects and disease, new uses for agricultural products, improved food qualities, improved environment protection and bioremediation are all possible … Through biotechnology we are developing innovative products, building fast growing enterprises, attracting international investment and creating high value employment (Commonwealth of Australia, 2000).

The strategy goes on to portray biotechnology as a powerful enabling technology that is important for Australia's industrial competitiveness. In stating, "A challenge for Australian biotechnology will be to work with the community and earn its confidence as consumers and

[1] The stated aims of the strategy are to:

- Capitalise on our existing advantages in biotechnology
- Aim for sustainable growth for established and new industry sectors
- Strengthen coordination among Commonwealth Government activities and partnerships with State Governments
- Build on industry commitment and active participation
- Develop a catalytic role for government
- Provide a basis for ongoing consultation and strategy development.

(Commonwealth of Australia, 2000)

investors" (Commonwealth of Australia, 2000), the focus is not on providing unbiased factual information, but on winning over the public to the benefits of the technology. This has been reflected in the so-called public education campaigns of the state and industry, discussed in Chapter 6. Key strategies include 'managing' risks effectively, promoting the responsible uptake of biotechnology, attracting foreign investment, collaborating with international research centres, and encouraging entrepreneurship. As part of the National Biotechnology Strategy, a Biotechnology Innovation Fund (BIF) was also set up by the federal government to encourage biotechnology companies to proceed to commercialisation.

The Minister for Education, Training and Youth Affairs, Dr David Kemp, also stated in a media release on 28 March 2000:

> Biotechnology is the way of the future. It is an enormous growth area for Australia and will continue to be a key driving force in our economic growth and employment over the next decades. It is vital that we focus on this area and direct our efforts into ensuring that our next generation of young people are equipped with the skills and knowledge to keep pace with this global revolution ... It is good to see industry collaborating with universities to provide input on the directions of scientific development so that universities can be commercially responsive to market needs ... (Kemp, 2000).

This again re-iterates the notion of the changing role of universities discussed in the previous chapter. Researchers are increasingly encouraged to undertake commercially-driven research. In support of such sentiments, the then deputy premier of South Australia, Robert Kerin stated,

> If biotechnology is handled properly and if it is not sent off the rails by some of the emotional debate occurring with GM foods, the benefits are enormous. One of the real problems we in Australia face with genetically modified foods is that the debate is going somewhat off the rails (Kerin, 2000).

The Federal Environment Minister, Senator Robert Hill, also joined the proponents – stating in a 21 January 2000 Press Release that:

> … the Government places a high priority on the development of a prosperous and innovative biotechnology industry that will generate wealth and employment for Australians. We also understand that the successful development of a world class biotechnology industry must be underpinned by a transparent regulatory regime which ensures that dealings with GMOs will not compromise public health and safety or the environment (Hill, 2000).

The discourse of 'wealth' and 'employment' here is important. This issue framing means that any protest from environmentalists is in turn framed as a threat to job security and therefore against the interests of society. In such a way they are defined as a minority group of 'hysterical' radicals and ecological issues are effectively marginalised.

The ALP appears to hold a similar, although more conditional, position than that of the Government. Alan Griffin, Parliamentary Secretary to the Shadow Minister for Health, stated in a Press Release on 2 June 2000:

> The potential benefits of this technology for Australian agriculture, exports and medical technology are significant, however, these will not be realised until Australians know that there is a strict regulatory regime in place that ensures public health and our environment are protected. Industry also needs some level of certainty in order to invest in the research and development of these technologies and until they can see what is proposed, such investment will be lost (Griffin, A, 2000).

This again illustrates the bias of the state in favour of the modernist notion of progress, rather than a more reflexive precautionary stance. The interests of the state are therefore directly aligned with those of industry actors: Avcare for example – a self-proclaimed voice of the industry – states that the precautionary principle is "…yet another attempt of modern Luddites to prevent the desirable, indeed inevitable advance of science and technology" (Avcare, 2000b: 1). Changes to the regulatory system are thus largely proposed to assist Australia's biotech development, and allay public concerns so that commercialisation can run smoothly.

It is the Government's position that there is no doubt that biotechnology is 'here to stay' and has many benefits, limited only by the imagination, and holds great potential for both the Australian and global economies. They have also heralded it as the answer to sustainability and argue that it is more precise and predictable than previously used plant breeding techniques and therefore poses little risk. Any views to the contrary are seen as examples of hysteria, scaremongering, misinformation and ignorance (Macfarlane 2000; Secker 2000). Macfarlane states that, "In the same way as motor vehicles, once the advantages, convenience and safety of GMOs are demonstrated, we will all be left to wonder what all the fuss was about" (Macfarlane, 2000). Given the number of accidents involving motor vehicles and their environmental impact, this is an unfortunate choice of analogy.

In a further attempt to fast-track biotech development, the Prime Minister John Howard went against the Health Ministers who had sought a strict labelling model requiring full disclosure of any GM ingredients. In June 2000, the Prime Minister wrote to the State and Territory governments calling for a watering down of mandatory labelling laws for GM food (ABC, June 2000). He recommended that products with less than one per cent of GM ingredients be exempt from labelling laws, as he was apparently concerned about the cost to small business, exporters and the poor (Crabb, 2000). Thus, foods with traces of GM ingredients or highly refined products such as sugars and oils would be exempt from labelling. The New South Wales Health Minister Craig Knowles criticised the Prime Minister's involvement and called for a structured community response, rather than the closed sectional approach of the Federal Government. Consumer and environmental groups expressed their outrage over the Government's rejection of full labelling of GE foods, especially since they claim that over 90 per cent of Australian consumers want such labelling (Consumer Food Network, 2000).

On 29 January 2001, the Federal Government continued its support of GE commercialisation with the launch of its Innovation Action Plan, *Backing Australia's Ability* (BAA). At the launch, Prime Minister John Howard stated that the purpose of BAA was to "foster innovation" so that "... talented Australians can have a go in the field of science and technology" (Prime Minister Howard, 2001). Part of the scheme involved research and development (R & D) tax concession arrangements, as well as doubling the Biotechnology Innovation fund to $40 million. Another goal of BAA was to accelerate the commercial application of ideas and to "... bring together the skills of those in business, universities and governments" (Commonwealth of Australia, 2001), thereby promoting further industry ties, the problems of which were outlined in Chapter 6. Another major scheme from BAA is the allocation of $46 million to develop Centres of Excellence in Biotechnology, again to encourage and increase biotechnology commercialisation (Minchin, 2001c).

According to the Prime Minister, the Cooperative Research Centre concept "… has tremendous potential to further the spin-off opportunities from industry research collaboration. The Australian biotechnology industry will benefit from this scheme with funding of $66 million" (Minchin, 2001a). This is in addition to the $30 million National Biotechnology Strategy announced in the previous year, and represents the Government's ongoing support of the industry. Minchin (2001a) states that "Biotechnology is an increasingly significant driver of economic growth, wealth creation and high value jobs for Australia." Again the issue is framed as one of job creation and progress. Despite a growing body of evidence to the contrary[2], Minchin (2001b) also stated in parliament that "We recognise this as a great Australian industry and we are backing it all the way." As discussed in Chapter 6, in March 2001 a further $450 000 was given to the Australian Biotechnology Association to become a strong national voice for the industry and to develop a more industry-focused organisation (Minchin, 2001c). This strong pro-GE position of the Federal Government has helped to shape the biotechnology regulatory agenda, including the consultative process, whereby the public has been offered only token participation.

7.3 The Consultative Process: Containing Debate

In late 1998, a Federal Government discussion paper, *Regulation of Gene Technology*, followed on from an earlier paper called *Regulation of Genetically Modified Organisms and their Products in Australia*, and was released by the Commonwealth State Consultative Group (CSCG) for consultation with 'selected' stakeholders. The intention of the discussions was clear. The initial discussion paper stated,

> Commercial applications of gene technology are rapidly increasing and are expected to have a significant impact on a number of industries, including medicine, agriculture and food production. Potential risks from the deployment of the technology need to be properly assessed and managed, and controls put in place if needed, while further

[2] see Chapter 6 for a discussion of the evidence that biotechnology has not lived up to its promises such as increased yield and productivity.

> development and realisation of potential benefits need to be encouraged (Commonwealth of Australia, 1998a).

The Federal government thus saw biotechnology as a *fait accompli* and made a normative judgement that the risks were identifiable and "manageable". This was further evidenced by the invitation for submissions on the Commonwealth's legislative proposal and "... more generally on the need for and requirements of gene technology regulation, the form such regulation should take, and principles that should be applied in any regulatory framework" (CSCG, 1998).

The policy principles used to frame the public consultation process that began in the same year, further restricted the debate. The inclusion of selected environmental and consumer groups (such as the GeneEthics Network) by invitation only were seen by the IOGTR to be "public participation", and criticism has therefore been levelled at the lack of community discussion on a wide range of issues. McLucas (2000) accused the IOGTR of hindering public discussion through the overuse of 'commercial-in-confidence' claims. He asserts that the public's distrust of GMOs is to a large extent due to the attitude of the IOGTR and the proponents of the technology. Non Government Organisations and other interested individuals have long expressed their strong concern for community input into the development of gene technology legislation, meaningful debate and consultation.

The aim of the follow-on meetings, in parallel with the second discussion paper, according to the CSCG, was to seek comments on the proposed regulatory approach and again "road-test" key components of the proposed legislation (Ellis, pers. com., 1999). Again the intentions of the discussion were clear. The first policy principle listed in the Discussion Paper was,

> To realise the benefits of gene technology for the Australian community, industry and the environment, while ensuring human safety and environment protection, through regulation that is timely, science-based, consistent with Australia's international obligations and takes account of ethical and socioeconomic concerns (Commonwealth of Australia, 1998b).

Thus, the discourse of the document is informative. It further states, as part of its purpose that,

> Gene technology is one of a number of modern biotechnologies with the potential for exciting prospects: higher yielding crops, improved quality of foods, more effective pharmaceuticals, reduced use of agricultural chemicals and new approaches to managing our environment. As with any technology, there are risks to be managed … (Commonwealth of Australia, 1998b).

Again, the environment is something to be "managed", as are the potential risks of the technology.

The reason for the narrow selection of what the State and Territory governments saw as 'major players' was due to the "initial" and "discursive" nature of the meetings (Ellis, pers.com., 1999). Industry, not surprisingly given the history of industry dominance in the biotechnology policy terrain, was the largest represented group. The reason for not allowing the public access at this stage was that they would require details of the structure and process; it would be a costly and time-consuming process; and it would be "difficult" (Ellis, pers. com., 1999). Instead, consultations termed "Major Stakeholder Round-Tables" by the CSCG, were held with 'selected stakeholders' only. Thus, there is the notion promoted by the Government that the stakeholders are independent of any constituency. This of course is untrue, as they were selected for their 'stake' in the issue. Bill Hankin, director of the Heritage Seed Curators, commented on this notion of 'stakeholder':

> The concept of 'stakeholders' in this context is curious. Isn't everyone in the community a stakeholder in this issue, because everyone will be affected. So to infer that some have a greater interest than others is curious. What the term really means is 'vested interest' – that's what makes them 'stakeholders'. The public are the ones who have to wear it (Bill Hankin, 2001, pers. comm.).

Another overview paper entitled *Current Regulatory and Administrative Arrangements for Controlling Genetically Modified Organisms in Australia* and a discussion paper entitled *Proposed National Regulatory System for Genetically Modified Organisms – How Should it Work?* were distributed to stakeholders in October 1999 and submissions invited. In general, the 131 submissions to the discussion paper represented two polarised positions: pro gene technology (approximately 34 per cent) and critical (approximately 44 per cent). Eleven per cent held the middle ground, while a further 11 per cent were inconclusive[3].

7.3.1 The Proponents' Views

Proponents – including, multi-national corporations, Australian companies, biotechnology industry associations, university and research scientists and institutional biosafety committees (IBCs) – believe that gene technology poses little or no risk, based on reductionist scientific criteria. They promote the benefits of the technology, including enormous commercial potential and claim that it provides a new viable industry for Australia. These views have been made very clear in their so-called public education campaigns, seen by critics as 'propoganda', discussed in Chapter 6.

Overall, the majority of proponents did not support the voluntary system for the release of GMOs. A minority were in favour of the existing voluntary system, including the Pastoralists and Graziers Association of WA who stated that the proposed new system would "… enfold science and production in a straight-jacket" and "… immobilise Australian agriculture". All were in favour of a product-based approach as in the US rather than a process-based system. They believed that assessment should be carried out by 'experts" and limited to scientific risk, based on sound scientific principles.

Proponents had long resisted calls for legislation, but had moved to support statutory regulation following pressure from green interests and the public, and prompted further by the failure of the voluntary system by allowing numerous breaches to occur. For example, in 1984 senior researchers from the University of Adelaide commenced a project to produce transgenic pigs and mice without seeking prior approval from the Adelaide University Biohazards Committee (see Hindmarsh, 1994). These breaches placed pressure on industry and the Government to rectify the situation. The primary concern for proponents, however, was to have a clear pathway to commercialise. Thus, they wanted regulations to be minimal, flexible and nationally consistent, to "… allow this desired GMO-assisted agricultural revolution to proceed in a timely fashion" (ABA, 1999). They wanted the legislation to facilitate the efficient transition of GM products onto the market. Therefore, it would need to

[3] See Appendix 1 for the summary analysis of discussion paper submissions

be nationally consistent, to minimise delays in applications and commercialisation, and also consistent with international standards so that Australia could compete with other nations.

Proponents also wanted to ensure that they would not be liable for damages from unintentional or intentional release of GMOs, and it could therefore be argued that their renewed push for legislation was to help secure this outcome. Human health and the environment, based on 'sound' scientific principles, were secondary concerns, and they believed that ethical and social issues should not be a part of the assessment process.

In addition, proponents recognised the need for legislation to allay public concerns. However, they maintained that legislation should be minimal and based as much as possible on the existing structures at the time such as GMAC and institutional biohazards committees (IBCs) as well as existing legislation. A national authority was proposed with industry and scientific experts (essentially a committee modelled on GMAC) and only token community representation and public consultation. They wanted to see a range of interests represented on the body of oversight, including an ethicist for example, but dominated by proponents of gene technology. Proponents recognised the need to appear to be addressing public participation in order to stay in control. However, the dual system of public participation proposed in the discussion paper was seen as too onerous, and most proposed that the public only be involved after an application had been assessed by the national authority. Only summary information should be given to the public, *after* the evaluation. In other words, they only supported token community participation to give the appearance of full public participation and involvement. As discussed in Chapter 6, the biotech network has, on the whole, succeeded in achieving this outcome.

Proponents assert that there should only be soft penalties for non-compliance, advocating "due dilligence" and "reasonable excuse". They support patenting of all GMOs and their products to ensure maximum commercial security and incentive for innovation. They want to see intellectual property protected and commercial information kept from the public under 'commercial-in-confidence' provisions. Not surprisingly, the views of environmentalists diverged considerably from those of biotechnology proponents.

7.3.2 The Environmental Critique

Many environmentalists – including Green NGOs, Consumer groups, the US Green Party, university scientists, organic associations, individuals and at least one general practitioner – expressed in written submissions that the risks of gene technology is moderate to high, based on ecological, social, and economic criteria. They believe that precaution is warranted. Many are concerned about the risk to organic agriculture and the threat to sustainable farming systems. The benefits are seen as limited or non-existent and they state that the 'miracle crops' promised have not yet materialised.

The main concern of critics is to protect the environment and human health, as well as to ensure a long-term sustainable future for agriculture in Australia. The Genetic Manipulation Advisory Committee has done little to allay their concerns, and so they do not favour a voluntary regulatory system for either contained work or general releases. They believed that gaps in the existing system include a lack of broader criteria such as social, ethical and ecological issues; a lack of coordination between agencies; a lack of legal standing for third parties; and an inability to deal with planned releases. They want legislation to be transparent and address these broader concerns, with ESD as the main criteria for assessment. In contrast to proponents, they want the legislation to be process- and product-based, rather than purely product-based.

Environmentalists wanted the new system to be a one-stop-shop to avoid overlap between agencies and to provide greater accessibility to the public. They wanted an independent gene technology regulatory committee with broad membership, rather than an individual, to provide holistic oversight. They also wanted the GTCCC to have equal standing with the GTTAC. They believe that the public should be involved at all stages including the proposal, research and development, monitoring, and risk assessment stages, and that they should also have rights of appeal. They felt that the existing system of assessments by experts was insufficient, and that instead there should be assessment by a balance of interests. It was proposed that there be widespread advertising of proposals, extensive consultation, and community discussion and debate.

Environmentalists also wanted to see the onus of proof placed with the applicant to demonstrate safety and utility as well as social and environmental good. There should also be strict liability in the case of harm to the public or the environment, and adequate insurance cover should be obtained before an application was approved. Monitoring and EIA should be mandatory and done independently, with the results available to the public. Australia should be committed to the principles of ESD and risk assessment done on a case-by-case basis, based on the precautionary principle, and involve the community.

Many environmentalists are anxious about the ethics of increasing commercialisation and have mistrust for the scientific enterprise, as outlined in Chapters 3 and 6. Many consider spending by the Federal government on regulation through the GTR and promotion through Biotechnology Australia as a subsidy for business to develop the technology to their benefit (Organic Federation of Australia, 1999). The critics believe that there should be no patenting of any GMOs as this would lead to increased corporate monopoly on food production and distribution.

Others are concerned that consumers have not been asked whether they want GMOs, but rather, how to regulate them. They believe it should be assessed impartially whether GMOs are in the national interest. Several critics believed that Australia should remain GE free, at least for a period of five years, although some feel Australia should be a GMO-free nation. A 'clean and green' export image is seen as a real advantage. One critic stated that a complete 're-think' of gene technology is necessary. The Conservation Council of SA stated in its submission that it is an "... invasive process into the very heart of a dynamic, interdependent and self-supporting system of life" (Conservation Council of SA, 1999).

Further meetings with 'stakeholders' were held in late 1999. Interestingly, each 'stakeholder' was 'categorised' by the CSCG and placed in a particular session accordingly. Thus, 'environmentalists' and 'industry', for example, were kept apart and placed in different sessions. The reason for this, according to the CSCG, was to avoid conflict between parties with differing views and to gain all views accurately without conflict so that all could be represented fairly, and all could feel able to speak freely. While this seems reasonable, some level of debate with a forum where all could come together and get a better understanding of opposing views may have proven helpful. It is possible that DISR could take on this role as part of its public awareness program. Segregation of this kind also assumes that an actor is either 'for' or 'against' the technology and does not allow for a 'middle ground' or range of views.

The similarities between the views reflected in the submissions to the 1992 inquiry into GE (see Hindmarsh and Hulsman, 1994) and this discussion paper are undeniable and reflect that despite the intensification of debate, proponents have been reluctant to change any of their views. The views of environmentalists have also changed very little, suggesting that the problems raised in the 1992 inquiry have still not been resolved. Despite this, the Draft GT Bill 2000 emerged on 16 December 1999.

7.4 The Draft Gene Technology Bill

Following the release of the Draft Bill, public forums were held by the IOGTR in all capital cities and three regional centres. The draft was seen by opponents of biotechnology as a blueprint for industry to fast-track the technology and give them legal protection from litigation (AGEN, 1999). The Australian GeneEthics Network stated that "… the proposal for 'a clear regulatory path for industry, investors and researchers' while ignoring democratic processes is unacceptable" (AGEN, 1999). It further stated that the scope of the draft regulation was too narrow, and that,

> The proposed system should include mechanisms for a broad evaluation of the Biotech industry, GMOs and their products, so that precaution can be exercised on social, economic, ethical and other important grounds, as well as safety and the environment … Scientific risk assessment was appropriate for laboratory work but a broader, more precautionary view is needed for proposals to establish new industries. Many public interest questions must be answered before genetically engineered organisms are released (AGEN, 1999).

The Australian GeneEthics Network subsequently proposed that there should be a five-year freeze on GMO releases and any more GE foods in the meantime. At the time, there were 15 proposals for large-scale field trials of GE crops and Monsanto had applied to commercialise Roundup Ready herbicide-tolerant cotton.

It has been claimed by some, such as GeneEthics Director, Bob Phelps, and Greens senator Bob Brown that the push for federal legislation of gene technology has been brought into being by the power of multinationals over the Government. The Australian GeneEthics

Network (1999) stated that "… we are unimpressed that industry and science are only now supporting regulation because they want to speed GMOs into the market place". Murphy (2000) argued that the debate surrounding the Bill had been a reductionist one and that the Bill was "… a direct consequence of powerful industry groups seeking to be permitted world-wide to further the cause of gene manipulation. That is the primary ethic. The ethical issues are couched in terms of ultimate benefits." The policy principles listed in the discussion paper produced for stakeholder consultations in 1998 appear to support these claims (Commonwealth of Australia, 1998a: 3). The document states that, "… in essence, the principles focus on best regulatory practices, including keeping the regulatory burden to a minimum, a rigorous scientific risk assessment process, taking ethical and social issues into account in the final decision-making and minimising costs." Policy principle 14 states:

> The decision-making process shall also take into account *relevant* social, economic and ethical issues and pertinent concerns of individual jurisdictions. For transparency, social, economic and ethical considerations shall be separated from safety issues based on scientific risk assessment (Commonwealth of Australia, 1998a: emphasis added).

In February 2000, AGEN reiterated their anxiety over the Bill in a press release,

> The present system of gene technology regulation is confusing, open to misuse, irrational and unenforceable … But the Office of the Gene Technology Regulator (OGTR) model would formalise the existing system rather than replacing it with more robust, rational and user-friendly laws … The Gene Technology Bill 2000 does not fundamentally reform this system (AGEN, 2000a).

Thus, as expressed in their submissions, critics such as AGEN were pushing for the OGTR to be a 'one-stop-shop', to avoid the minor 'gap filling' role of the government's draft. AGEN proposed that the OGTR be a "… single gateway through which all applications for any genetically engineered organisms or its products would have to pass" (AGEN, 2000b). Many others such as the National Farmers Federation (NFF), the Organic Federation of Australia (OFA), Consumer Food Network (CFN), the Australian Conservation Foundation (ACF), and the Environment Defenders Office (EDO), supported this approach. The GeneEthics Network also stated that the scientific committee, ethics committee and community consultative committee should all consider "… biodiversity, environment, ecology, the precautionary principle, sustainability, intergenerational equity, social and cultural issues, ethical values and norms, philosophical questions, economic impacts, human rights, the right to know and choose, and public safety." (AGEN, 2000b).

By way of contrast, industry was supportive of this early draft. Avcare, for example, stated that it "... proposes a policy framework that would provide a clear market path..." (Avcare, 2000a). Avcare lobbied for amendments to issues of commercial-in-confidence, liability, national public interest, and recognition of intellectual property rights, most of which were included in the draft legislation which was introduced into Federal Parliament on 22 June 2000. It is interesting to note that there was no mention of the precautionary principle in the original draft of the Bill.

On the 28 June 2000, the Senate referred the GT Bill to the Senate Community Affairs Reference Committee who undertook an inquiry into the legislation. Alan Griffin, Parliamentary Secretary to the Shadow Minister for Health, stated in a media release on 27 June 2000, that "Labor will ensure that the Howard Government's Gene Technology Bill will receive the close scrutiny it deserves by referring it to a Senate Reference committee for further inquiry" (Griffin, 2000c)[4]. The Senate inquiry held public hearings in Canberra, Adelaide, Hobart and Melbourne and received over 100 submissions. In November 2000, the Committee released a report of its findings entitled *A Cautionary Tale: Fish Don't Lay Tomatoes*. Submissions to the Senate Inquiry reflected similar positions to submissions to the Government Discussion paper a year earlier and also reflected the positions of the 1992 inquiry. However, importantly, the precautionary principle emerged and was advocated for inclusion by green actors – an important issue which will be revisited in the following chapter. In addition, the principle was heatedly debated in parliament.

7.5 Debate over the Precautionary Principle in Parliament

The Senate Inquiry highlighted the increasing calls for precaution from green interests and stimulated heated debate in parliament. While the Convention on Biological Diversity allows for the possibility for a legally binding Biosafety protocol to be negotiated – to assess and minimise risks associated with transboundary transfer, handling and use of GMOs – it appears

[4] see Appendix 2 for the specific terms of reference

that countries such as Australia, the US and Japan prefer the principle of familiarity to the precautionary principle. Meyer (1999) states that these two principles exhibit opposite effects on scientific methodology and risk assessment. He comments that "... the Principle of Familiarity opens the way for superficial evaluations based on citing arbitrary references while the Precautionary Principle is an incentive for developing and applying sound methodology in experimental risk assessment" (Meyer, 1999: 1).

The Federal Government appears to share the views expressed by multinational companies in their submissions to the Senate Inquiry. The Government asserts that the precautionary principle needs to be treated with a great deal of caution, as is evident in the statements of liberal MPs:

> The precautionary principle seeks to legitimise unfounded and irrational decision making processes (Washer, 2000).

> When you go further into the Bill ... sound science is introduced into the process and the precautionary principle, the stalking horse so often of those who are opposed to scientific progress, is kept happily distant from this (Thomson, 2000).

> The precautionary principle is inappropriate for application to research ... Its application would stymie research and development (Tambling, 2000).

Several Federal Opposition senators shared the views of the Government, that it is an old technology that is just more precise, and called for a cautious but not precautionary approach and argued that relative risks must be kept in perspective. They believed that the legislation should allow for the benefits of gene technology to be expressed. The majority of the Opposition senators (13 individuals) held the middle ground, acknowledging that the concerns of the public and environmental groups were legitimate and had precedents in, for example, the introduction of exotic species into the Australian environment. A few of the Opposition, however, expressed strongly dissenting views to the Bill, questioning why it had been rushed through at that time before the problems had been identified and before crucial amendments had been put in place. They argued that it fell well short of community needs, reflecting the 'reductionist' debate that has occurred. Murphy (2000) asserted that the draft legislation was an attempt by the government to promote the industry, following in the footsteps of the United States where markets driven by multinational corporations have an overriding influence.

The Greens and the Democrats supported the Opposition's move to include the precautionary principle in the Act, as it was in the Environment Protection and Biodiversity Conservation Act. The Democrats wanted to go further by having the precautionary principle in the licensing provisions of the Bill. The other significant amendments put forward by the ALP included: the Bill establish a statutory authority of three persons rather than being a statutory office-holder of one person; field trial locations be made public; a right of third party appeals to the AAT; and that there be greater lay representation on the GTTAC. In addition the ALP agreed to support environmentalists' calls to give greater power to community interests by giving the community consultative group the power to review and comment on individual applications.

The majority of the proposed amendments, however, were not passed – only cosmetic changes were made, with very few of the recommendations of the Senate Report being incorporated (Organic Federation of Australia, 2000). The major debate on the precautionary principle and the Bill did not occur until 8 December 2000, and the ALP formally submitted its amendment at 12:59 am, omitting its initial call for the principle to be extended to include threats to human health. The Government and the ALP agreed on the "cost-effective" formulation of the precautionary principle at this time, which was vehemently opposed by the minor parties (Democrats, Greens and One Nation). Throughout the parliamentary debate, the Democrats accused the Government and ALP of striking a 'deal' in relation to the Bill, which is supported by the ALP's substantial 'about-face' on the issue of a stronger formulation of the precautionary principle. The Democrats were also critical of the timing of the debate in the early hours of the last sitting day of parliament in 2000. Despite this, the amendment was passed and agreed upon at this time. On 21 December 2000 the GT Act was enacted.

The then president of the Organic Federation of Australia, Scott Kinnear (2000), commented

> Protection of public health and safety and the environment have been put at risk and economic impacts from GMOs have been ignored completely in the Bill … The Bill is fundamentally going to affect every farmer and every consumer and people should be

very upset by this deal which is sure to make the Trans National Corporations happy (OFA, 2000b).

Further undermining public confidence in the regulatory system was a series of breaches of the GMAC guidelines.

7.6 Breaches of the Voluntary Guidelines

From their submissions it is obvious that many consumer groups and concerned individuals believe that any potential benefits of biotechnology are being perverted by biotechnology companies in their pursuit of profit alone. This is supported by the breaches of the GMAC guidelines, such as the open dumping of GM canola plants by Aventis Cropscience in Mount Gambier, South Australia, in March 2000. Experimental GM canola plants, not approved for release in Australia, were dumped in an open commercial tip. The trials were supposed to be conducted under strict guidelines. Many people are concerned that such incidents could cause cross-pollination with common weed species, producing weeds that would be herbicide tolerant, and therefore extremely difficult to eradicate, as discussed Chapter 1. In 1995 and 1996, French and British research showed that *Hirschfeldia incana,* or hoary mustard, readily crossed with GM canola. This common weed was found within 15 metres of the trial plants (Strong, 2000a), despite the fact that GMAC guidelines state that there must be a 50 metre buffer zone to prevent possible crossing. Environmental groups and organic farmers were outraged by this incident. Doug Shears, CEO of the Berri fruit juice company stated, "It [the breach] makes a mockery of the supposed controls. Australia stands to gain a premium on agricultural exports if we can guarantee they are GM free" (Strong, 2000a). Reportedly, in the same month a travelling salesman was offering a new canola seed that dramatically increased yields and tolerance to a common herbicide, suspected to be a GM variety, despite the fact that GM canola had not been approved for release (Strong, 2000a and b).

In response, Ian Gilfillan (2000) of the Australian Democrats declared, "... we have been taken for a ride by these companies, not only Aventis but also Monsanto". Moreover, a mixing of 69 tonnes of GM cotton seed with conventional seed occurred in Queensland in July 2000. There was also the failure to clean up canola field trial sites in Tasmania by both Monsanto and Aventis in early 2001 (Brown, 2001; Wooldridge, 2001).

The IOGTR conducted audits of Aventis Cropscience and Monsanto, but neither it nor GMAC had any legislative basis to access documents or information necessary to the carrying out of the audit, and so had to rely on the co-operation of the companies involved to provide such information. The investigation reports into Aventis and Monsato's trial sites also remain confidential because they may contain information provided to the IOGTR in confidence (IOGTR, 2001a and b). In its reports, the IOGTR stated that, in its monitoring strategy implemented in 2000, it had carried out random inspections of 20 per cent of the current field trials involving GMOs in a calendar year (IOGTR, 2001a and b). The IOGTR monitored all past trial sites in Tasmania between 20 and 23 February 2001, and subsequently found that 18 of the 49 Aventis sites visited did not comply with GMAC guidelines regarding the destruction of volunteer plants before flowering occurred. The IOGTR monitored five sites used for trialing GM canola, three of which were found with over 1000 canola volunteers[5] at various stages of growth, including flowering and seed pod development (IOGTR, 2001a). Over the period between 22 February and 16 March, GMAC assessed the risks of flowering volunteers at the trial sites and concluded that there was negligible risk of gene flow into the environment (IOGTR, 2001a). However, on 6 March 2001, the IOGTR contacted ANZFA to confirm that honey derived from GM crops was not considered GM food (IOGTR, 2001a). This came about as Aventis, with GMAC's knowledge, introduced beehives to the trial sites during canola flowering times in order to facilitate pollination (IOGTR, 2001a). Monsanto was also found to have breached the GMAC guidelines, with three of the eight sites visited having volunteer canola present – over 1000 at one of the sites (IOGTR, 2001b).

In response to these breaches the IOGTR asked GMAC,

> … to consider how the continued lack of demonstrated capacity to manage trials in accordance with GMAC recommendations impacts on GMAC's assessments of risk associated with applications for trials involving GM canola which are currently under consideration by GMAC (IOGTR, 2001b).

These events have, for some, undermined an already shaky confidence in biotechnology and are cited as reasons for the need for legislative control and the precautionary principle (AGEN, 2000c). The GeneEthics Network at this time urged members of its network to call the Federal Health Minister, Michael Wooldridge to remove all GE crops from the

[5] The tough seeds of canola allow the regrowth of volunteer plants for more than three years after the initial trial site is harvested (Stephens, 2001).

environment now; to freeze all GE release proposals for five years; to hold an inquiry into GE; and to publish all GE crop locations (AGEN, 2000b).

In relation to the breaches, the Opposition stated,

> … the IOGTR had the opportunity to use this situation to prove to Australians that concerns relating to the introduction of new technology would be addressed through a rigorous and transparent regulator, but the way in which this issue has been handled has the potential to seriously undermine public confidence (Griffin, 2000b).

The House of Representatives Inquiry into Primary Producer Access to Gene Technology also stated that it was,

> … worried by the manner in which the IOGTR has investigated the alleged breaches, in particular its tardiness in completing the investigation … It is essential that the OGTR act much more efficiently and effectively than the IOGTR has been able to if it is to reassure the Australian people that their interests are being strenuously protected (Griffin, 2000b).

However, Senator Vanstone (2001) stated that, contrary to claims by Senator Brown that the IOGTR's detection of non-compliance with GMAC's guidelines were an indication of the inability of the IOGTR to control crop experimentation, that the detection was in fact evidence that the IOGTR's monitoring program was working. Vanstone further stated that remedial action had been taken and that the risks at the sites are considered negligible. However, the Minister for Primary Industries, Water and Environment, David Llewellyn argued that the IOGTR had proved to be "toothless" and "inadequate" (Llewellyn, 2001). Despite this perceived inadequacy, the OGTR – based on a framework similar to the IOGTR – was sanctioned under the final GT Act 2000.

7.7 The Final Gene Technology Act 2000

The Senate Community Affairs Reference Committee, dominated by senators from the ALP and Democrats, recommended in their report *A Cautionary Tale: Fish Don't Lay Tomatoes* that the precautionary principle be specifically included in the Act, in the same form as that used in the Environment Protection and Biodiversity Conservation Act 1999. However, a weak version of the precautionary principle was finally included in Section 4 ('Regulatory Framework to Achieve Objects') of the Act. The clause now reads:

> (aa) that where there are threats of serious or irreversible environmental damage, a lack of full scientific certainty should not be used as a reason for postponing *cost-effective* measures to prevent environmental degradation; ... (emphasis added).

This formulation of the principle is the same used in the United Nations Framework Convention on Climate Change (the "UN Convention") and the Rio Declaration on Environment and Development, a point repeatedly used by the Government to justify the adoption of this formulation. It is a considerably weaker formulation than that contained in the EPBC Act, with the significant difference being that the former restricts the application of the principle to "cost-effective" measures. Human health is no longer mentioned, as it was in the draft Bill, and it does not allow for broader social, economic, or ethical considerations to be taken into account.

The Federal Government subsequently tried to develop a regulatory model based on co-operative federalism that has further slowed and complicated the process, particularly as some states (for example Tasmania and Western Australia) have voiced concerns about participating at all. Despite this, a Government press release subsequently portrayed: "... this is legislation with teeth" which adopts a "cautious" approach to regulation (Wooldridge, 2000). In support was the IOGTR's acting regulator Liz Cain: "What the Australian people wanted was a regulatory system that was strong, that was effective, that was open, that was transparent, and that's what we've delivered" (ABC, 2001).

Green interests however, disagreed. An initial problem they identified was that when lawyers refer to sections of an Act, the objects of the Act are often referred to for the 'feel' or 'spirit' of the Act. Because of the interpretive nature of this process, and because the PP was not an integral part of the legislation, it calls into question whether the PP will actually guide decision-makers (Hindmarsh and Risely, 2001). The inclusion of "cost-effective measures" means that measures aimed at protecting the environment can be avoided if it is considered not to be "cost-effective". This formulation clearly reflects the political leanings of the Federal Government, that there must be a balance between commercial and environmental interests, and that environmental interests can not be given priority at the expense of commercial interests. It also appears that the two major parties struck a deal on this issue, as the Government was only prepared to accept the formulation that was consistent with the Rio Declaration which excluded threats to human health.

Thus, by embracing a cautionary approach, the GT Act lent itself to a minimalist regulatory regime that primarily facilitated a 'business as usual' approach, a model long constructed by biotechnology interests in Australia (see Hindmarsh, 2001). Thus, in many ways the Gene Technology Act 2000 can be seen as the legislative entrenchment of GMAC, although the legislation does go further in some areas (Adelaide University Law School, 2000). The approach is lightweight overarching legislation with the weight of the system being contained in the regulations. Kerr (2000) has accused the government of failing to apply even the most basic of ESD principles. The legislation only regulates certain *dealings* with GMOs and the Regulator has the power to exempt certain GMO dealings, neither of which is consistent with the principles of ESD, which places the emphasis on precaution and shifts the onus of proof to the applicant. The main role of the PP in the legislation therefore appears to be one of appeasing certain interests rather than questioning modern science as being too reductionist to adequately address uncertainty and risk.

The effect of the inclusion of the cost-effective formulation of the precautionary principle in the Act will depend ultimately on how the Regulator interprets available information when making a decision under Section 56(1)[6] of the Act. It is also difficult to predict at this time how the appeals process will unfold. The scope for appeal of the GTR's decisions is arguably substantial, since applicants for a licence may believe that an appeal is justified if the Regulator takes measures that are perceived as not "cost-effective" (a term which is itself unclear and open to interpretation). They may also believe that an appeal is warranted if the

[6] This section states:

(1) The Regulator must not issue the license unless the Regulator is satisfied that any risks posed by the dealings proposed to be authorized by the license are able to be managed in such a way as to protect:
    (a) the health and safety of people; and
    (b) the environment

GTR's decision is believed to go beyond the precautionary approach specifically required by the Act. On the other side of the debate, opponents of applications may launch an appeal if they believe there is any evidence of "serious or irreversible environmental damage" (again terminology that is open to interpretation) and the Regulator has not applied what they see as all cost-effective measures to avoid such risk.

Another contention of critics was that both the Government and the Opposition voted down Democrat amendments that would ban members of the regulatory committees having links with commercial interests relating to biotechnology. Thus, although the minor parties such as the Greens and Democrats stood up to the major parties in the Senate, it had little effect on the final outcomes.

In the final Act, the regulator is an individual not a statutory authority, and the recent appointment of a biotech proponent as the new Gene Technology Regulator has done little to appease environmentalists' concerns. Another favourable outcome for biotechnology interests was where the technical advisory committee was empowered as a prime site of decision-making, while the GTCCC and GTEC will only provide advice at the request of the regulator. The Federal Government believes that allowing the GTCCC and GTEC to advise on all applications would compromise the scientific integrity of the regulator's decision making and also distract the Gene Technology Technical Advisory Committee (GTTAC) from its role of providing strategic policy advice (Eggleston, 2000). The GTTAC is comprised of biotechnology interests that have long directed the shape of regulation since the early negotiations in the 1970s when the first oversight committee was constructed by the Australian Academy of Science (see Hindmarsh, 2001).

Independent Peter Andren and consumer groups have, therefore, questioned the real value of either the GTCCC or the GTEC given their inability to advise on policy guidelines, and therefore having no binding authority. Critics have expressed their frustration that the ALP sought public acceptance of GE rather than strong effective laws (Phelps, pers. com. 2000). As a result, many exempt dealings will not be disclosed; public participation will remain limited; and the system will continue to rely on proponent-generated data (Phelps, pers. com., 2000). This is a continuation of earlier agenda setting in Australia, indicating that the problems for public participation raised a decade earlier still have not been resolved. For example, Hindmarsh and Hulsman (1994) in their analysis of the 1992 inquiry, found that the

HRSC's suggested provisions for public participation were flawed, based on the principles of the highly criticised EIA process, and that their treatment of the public overall was only token. They further revealed that this tokenism was reflected in the recommendation that the Government should ensure that the CSIRO was given specific funding for a public information (or as they saw it, "propaganda") campaign since the CSIRO is a strong proponent of genetic engineering. As can be seen from the above discussion, this token participation has continued in the latest round of regulatory negotiations.

Further criticism came from Alan Griffin (Griffin, 2001). The ALP condemned the Howard government for launching the Office of the Gene Technology Regulator (OGTR) before appointing a regulator to run the office. In addition, the Intergovernmental Agreement between States and the Commonwealth had still not been signed, and so there had not been a Ministerial meeting to decide on the policy principles that would direct the activities of the OGTR. Guidelines outlining the risk assessment issues for applications had also not been released.

Such evidence reveals that the PP in this policy context is a weak or light green version, some would argue in a role of cooptation (Hindmarsh and Risely, 2001). Significantly, O'Riordan and Jordan (1995: 197) assert that light green versions are applied to the most toxic and human life threatening substances or activities; advocate cost-benefit analysis; and emphasise 'sound science'. In this context, the PP offers a legitimising purpose to high-risk activities by providing an appearance of green morality while marginalising the strong PP which would fundamentally challenge those activities (Hindmarsh and Risely, 2001).

7.8 Analysis and Findings

Because the relationships that form the basis of an actor-network help to explain why some will be successful and others will fail, it is important to identify the various relationships between different actors, both human and non-human, involved in any case study (Martin, 2000: 721) – in this case Australia's gene technology policy. The analysis incorporating power relations theory and translation analysis from actor-network theory reveals that there are essentially two main actor-networks in the biotechnology controversy in Australia – the biotechnology network ('biotech-network') of the proponents and the 'green-network' of environmentalists. Broadly speaking, the biotech-network consists of TNCs, federal and state governments (except Tasmania), farmers and farmers' federations, major sections of the scientific community (including the CSIRO, CRCs and university scientists). The green-network consists of environmental and public interest NGOs, concerned members of the public, organic groups, organic farmers and some religious groups. The biotech-network was better mobilised in translating its interests, and so greater attention will be given to this actor-network, to gain a better understanding of why and how this was the case.

7.8.1 Problematisation Strategies

As discussed in Chapter 5, in this first stage of translation, the initial outline of an actor-network is formed. In the context of the biotech-network, the main initiating entity for flexible legislation was the IOGTR, with pressure from industry groups who were pushing for a more certain environment for the commercialisation of GE products and to encourage further investment from industry. The government's policy principles played the pivotal role as an obligatory passage point for the biotech-network. The radical libertarian discourse, asserting that environmental problems can be resolved with better management, is evident in these policy principles which read clearly as a business management strategy. The principles represent an elite 'business-as-usual' top-down approach, aimed at ensuring the unhindered growth of the industry. The benefits of the technology and inevitability of its growth are underlying assumptions, again illustrating the mobilisation of bias that has occurred since the beginning of the regulatory process.

By positioning these policy principles as an obligatory passage point, restrictive regulation was presented as an obstacle to the realisation of the interests of the actors within the biotech-network, and therefore that flexible regulation was what was needed for a more certain research, development, and commercialisation environment. The biotech-network therefore needed to define the identities and interests of other actors in such a way that they shared this objective of flexible, certain legislation to be implemented as a matter of urgency. To achieve this, they needed to demonstrate that environmentalists' calls for precaution were unnecessary and unacceptable. We will now turn to look at the way in which the biotech-network defined the identities and interests of these actors.

Problematisation of Agriculture/the Environment

The identity constructed for agriculture/environment differed dramatically between the biotech-network and the green-network. In the biotech-network, biotechnology was framed as in the best interests of agriculture and the environment generally. Agriculture was defined as in need of improvement and protection from the technology. It was heralded as the solution to yield problems, and to environmental stresses such as salinity, drought and so on. If biotechnology was not taken up, the nation's agriculture would be threatened by less productivity and therefore less food resources, and a degraded environment. Therefore, flexible and not restrictive legislation was needed to provide a favourable environment for biotechnology research and development in order to provide the technological fix to the world's environmental and agricultural problems. Thus, opposition from environmentalists was framed as a threat to agriculture, the environment, and ultimately sustainability.

Problematisation of Federal and State Governments

The role of both federal and state governments in the biotech-network was defined as needing to manage the conflict between capital accumulation and public concern. The biotech-network needed to convince the state that responsible management of agriculture, the environment, and the economy involved further research, development, and commercialisation of biotechnology, and that a flexible regulatory regime was needed to achieve this goal.

A number of policy statements identified the voluntary regulation of biotechnology as a problem in need of fixing. The need for a statutory regime was seen as an urgent priority for the environment and for industry. The state's identity was such that flexible legislation was seen as central to its goal of resolving conflict between successful commercialisation of biotechnology and capital accumulation, and the environmental concerns of the public.

Problematisation of Farmers and Farmers' Federations

The biotech-network also sought the support of farmers and farmers' federations when forming its actor-network. The biotech-network used the concerns that many farmers had about increasing insect pest and weed problems, resistance problems, and problems of trying to increase crop yields and profitability. Promises of crops able to withstand, for example, drought conditions were also used to gain support from farmers for the continued development of the technology. The interests of the farmers were portrayed as being in line with the objectives of the biotech-network. Therefore, the farmers' goals of increasing productivity and profit were defined as depending on the success of the biotech industry.

Problematisation of Trans-National Corporations

In order to achieve their goal of improving public perceptions of biotechnology, as well as to obtain a minimal flexible regulatory system to fast-track their products on to the market, it was in the companies' interests to pursue statutory regulations under the terms of reference framed by Federal Government bureaucrats. By supporting such legislation, and seeing it implemented, it would also help to avoid any form of moratorium which environmentalists wanted to see enforced.

Problematisation of The Scientific Community (including universities, CSIRO, CRCs)

The final major actor that the biotech-network needed to recruit into their actor-network was the broader scientific community. The biotech-network needed to frame the problem for the scientific community in terms of the need for flexible legislation to make research and development easier and more certain, and reduce the chances of liability. Restrictive legislation that environmentalists were rallying for would be detrimental to research, employment, funding opportunities and so on. Again, flexible regulation would also give the public the impression that something was being done to assure safety. This approach would mean that a moratorium, that would also impact upon research and development, would be much less likely to be applied. To further try and gain the support of ecologists and environmental scientists, who have often spoken out about the risks and problems of biotechnology, the biotech-network also promoted the environmental benefits of biotechnology – applications such as bioremediation, species preservation, and reduced use of chemical herbicides, to name just a few.

Therefore, the major aim of the biotech-network's problematisation strategies was to build an actor-network that would allow them to succeed in their goal of obtaining legislation that was flexible and conducive to industry objectives – namely increased research, development, and commercialisation of biotechnology. In order to achieve this, the biotech-network had to cultivate alliances with a range of different actors, the viability of which was tested in the next phase of translation.

7.8.2 Interessement Strategies

As outlined in Chapter 5, the second stage of translation entails interessement which involves the consolidation of identities in the actor-network. In other words, it is the reinforcement of the identities of actors that were first established in the problematisation process.

The interessement of agriculture and the environment occurred through evidence of pest and weed problems, problems with excessive weather conditions such as drought, resistance to pesticides and so forth. Therefore the success of this stage in the development of the biotech-network depended on the network's ability to produce evidence to support their representation of agriculture as threatened by excessive legislation that would serve to restrict the technology that could 'fix' these problems. Thus, the interessement of agriculture and the environment occurred through various studies undertaken by the biotechnology companies themselves, claiming the success of GE crops in increasing yields, reducing pests and the need for chemical pesticides, for example. They therefore used these studies to establish the identity of agriculture and the environment in such a way that supported their claim that environmentalists had not provided conclusive evidence that biotechnology posed a risk to the environment and that strict regulation was needed. Thus, the biotech-network further developed their argument that biotechnology was essential for agriculture and the environment, as well as the economy and that flexible regulation was required. While the studies were refuted by environmentalists, who also criticised the in-house nature of such studies, successful interessement occurred.

Successful interessement of TNCs also occurred through the promise of a certain and timely path to market and increased profits, as well as increased public acceptance of the technology. TNCs became involved in the network as it was in their interests to go along with the government's policy principles in order to achieve the companies' own goals.

In a similar way, interessement of the scientific community occurred through the prospect of a clearer and more certain research and development pathway, and the prospect of less paperwork. The reduction in liability was also an important issue for the scientific community. The prospect of increased opportunities for research and development, collaborative opportunities, and increased funding opportunities also formed a major part of the interessement of the scientific community.

Another key tactic in the interessement of the broader scientific community involved undermining the evidence from environmentalists about the risks and problems of GE. Their claims were portrayed as 'emotional', 'irrational', and 'unscientific'. The biotech-network consistently claimed that there was no evidence of harm to human health or the environment of any planned releases of GMOs. For the biotech-network to be successful it had to produce enough evidence to suggest that GE did not pose a risk to human health or the environment and restrictive regulations were therefore not required. It achieved this not through extensive scientific studies, but rather through a reverse onus of proof, that is, that there is no evidence of harm and therefore it must be safe (despite the fact that rigorous testing has not yet occurred, and that research is carried out by TNCs). So, rather than being a potential risk, GE was promoted as the answer to environmental and agricultural problems, and even to the social problem of third world hunger.

7.8.3 Enrolment and Mobilisation of Actors in the Biotech-Network

Following the successful interessement of the actors in the biotech-network, enrolment in the GE controversy involved the formulation of management strategies in the form of policy documents. The aim was to transform the broad goals of the biotech-network into more detailed accounts. The Federal Government's *National Biotechnology Strategy*, firmly embracing the earlier policy principles, stated its aims: to capitalise on the existing advantages of biotechnology; aim for sustainable growth for established and new industry sectors; strengthen coordination among Commonwealth Government activities and partnerships with State Governments; build on industry commitment and active participation; and develop a catalytic role for government.

Through the policy processes associated with the IOGTR, the various documents including the discussion papers, the draft GT bill, and the National Biotechnology Strategy, played key roles in consolidating the roles and responsibilities of the various actors in the biotech-network. The different groups within the network all took ownership of moves for flexible regulation for the continued development of biotechnology.

The final GT Act 2000 illustrates the way in which the earlier policy principles and also the terms of reference for the inquiries (to be discussed in more detail in the next chapter), remained obligatory passage points for the biotech-network. It succeeded in arguing that a moratorium on GE releases was not warranted, that restrictive regulation would be detrimental to Australia's competitive future in a global market, and consequently that the strong precautionary principle should not be embodied in the legislation. The IOGTR wielded sufficient legitimacy to achieve the aim of rejecting environmentalists' goals for a moratorium on planned releases, rights of states to remain GE-free, and the inclusion of the strong precautionary principle in the legislation and to be the guiding principle for all decision-making in the context of planned releases and commercialisation. To reiterate, the use of the weak precautionary principle in the final Act was in the spirit of cooptation, not genuine regulatory reform.

As stated at the beginning of this chapter, a useful approach to conceptualise the above translation process in more detail is through closure of controversy and this will be discussed further in the concluding analysis in Chapter 9. We now turn in Chapter 8 to look in more detail at the role that public inquiries have played in the Australian GE policy process – do they represent a genuine attempt at reformed decision-making practices to incorporate greater public participation and the principle of precaution, or are they a political tool to allay public concerns and absorb protest?

8

The Role of Inquiries in Australia's Gene Technology Policy Terrain

This chapter continues to outline the translation strategies of actors in the biotechnology policy terrain – that have resulted in a cautionary, rather than precautionary, regulatory approach. The chapter focuses particularly on the role of public inquiries in this process. Again the primary issue is one of unequal power relations. The biotech-network seeks to retain control over the regulatory agenda so that research, development, and commercialisation can continue unhindered by the green-network that seeks an alternative precautionary ethic for biotechnology and its regulation. First, the background to the Australian public inquiries into GE is presented, followed by a discussion of the inquiry process itself. A translation analysis of these processes also undertaken in order to gain insights into the role and effectiveness of this 'discursive design' (see Dryzek, 1990). Again, a useful way to conceptualise the translation processes involved is through closure of controversy, outlined in Chapter 5, and this will be discussed in the concluding chapter of the thesis.

8.1 Background to the Australian Inquiries into Genetic Engineering

Public inquiries have become an essential part of the political system and therefore of policy making in Australia, and indeed in many countries of the world (Prasser, 1985). As Prasser (1985) attests, following the course of an inquiry can tell us a great deal about the complexities of the policy making processes. In addition to the inquiry processes there is the inquiry report itself. This document can also tell us a lot about policy by looking at how controversial its recommendations are, what reception it receives, and how strongly its chairman seeks to advocate the report's recommendations (Prasser, 1985). While these reports may be discarded, however, the inquiry process can have a lasting impact on the policy agenda (Prasser, 1985). Also, as Prasser (1985: 7) points out, future public debate tends to be heavily influenced by the parameters set by inquiries. Thus, inquiries are both relevant and important to the policy process and deserve some detailed attention.

It was in the context of the state and industry's strong desire that "Australian expertise in genetic manipulation be harnessed to the benefit of Australian farmers and generate a financial return to Australians" (HRSC, 2000) that the House of Representatives Standing Committee on Primary Industries and Regional Services' inquiry into primary producer access to gene technology originated[1]. The then Minister for Agriculture, Fisheries and Forestry, Mark Vaile, referred the inquiry to the Committee on March 30, 1999. The Committee advertised the inquiry and calls for submissions in national newspapers, and public hearings were held in Melbourne, Perth and Canberra. The Committee's final report *Work in Progress: Proceed with Caution* was released in June 2000, just as the draft legislation for gene technology was introduced into Federal Parliament on June 22, 2000.

As discussed in Chapter 7, one week later, the Senate referred the GT Bill to the Senate Community Affairs Reference Committee who undertook a much hastier inquiry into the legislation[2]. The Committee which was dominated by non-government members released its findings in the report entitled *A Cautionary Tale: Fish Don't Lay Tomatoes.*

Concurrently, the Tasmanian Government issued a policy statement, on 20 July 2000, outlining its intention to impose a moratorium on the growing of GM plants, except under contained conditions, using the *Plant Quarantine Act 1997* (Department of Primary Industries, Water and Environment, DPIWE, 2000). This moratorium would stay in place until a final policy position on GMOs was reached. This decision did not receive support from all quarters, however. The Federal Minister for Agriculture, Fisheries and Forestry, Warren Truss, stated in a media release that:

> I am pleased that at least one Federal Labor Member has had the guts to speak out against the anti-Tasmanian stance being taken by the Bacon Government … I share Mr Lyon's concerns that the Bacon Government is condemning Tasmanian farmers to yesterday's technology and missing the opportunity to attract new investment and development (Truss, 2000).

[1] See Appendix 3 for the full terms of reference for the HRSC inquiry.
[2] Whereas the HRSC inquiry's deliberations took fifteen months, the Senate inquiry was conducted over a four month period.

The Tasmanian Government however, while supportive of the principles underlying the federal regulatory regime, has always stated that its co-operation would be subject to the Commonwealth legislation containing an opt-out clause to allow jurisdictions to remain GE free if they so desired. The government states,

> … the issues surrounding adoption of GMOs is unclear and with such a degree of uncertainty that the Tasmanian Government is unwilling to have GMOs present in our agricultural systems until the issues are resolved. Tasmania's position agrees with that of the dissenting report of Mr Peter Andren MP to the Primary Producer Access to Gene Technology Inquiry, that there is not enough information to "conclusively say that the benefits of gene technology to agriculture in Australia will outweigh the potential detriments in the long term" (Tasmanian Government, 2000b).

While the Federal Government has maintained that an opt-out clause would have the potential to breach sections 92 or 99 of the Constitution and certain World Trade Agreements, advice from the Tasmanian Solicitor General is that it should not (Tasmanian Government, 2000b). Indeed, the State Government argues that, "… it is a necessary precautionary measure to ensure our agricultural industries and our environment are not compromised by the continuation of GM crops being grown in the state" (DPIWE, 2000). The Tasmanian Government stated that in the absence of an opt-out clause, it would not sign the Inter-Governmental Agreement (IGA) (Tasmanian Government, 2000b). It argued its sovereign right to decide its own appropriate level of protection and it was concerned that the Federal legislation would leave the decisions with a national regulator, and one flawed decision could have disastrous consequences for Tasmanian agriculture and ecology (Tasmanian Government, 2000b).

Given its precautionary stance, on the 6 September 2000, the Tasmanian Government stated its intention to investigate the economic, environmental, safety, social and ethical issues associated with GM crops and GM food production in the state, and the risks and benefits of either accepting or rejecting the technology (DPIWE, 2000). The Joint Select Committee on Gene Technology sought submissions to the inquiry through advertisements in regional newspapers and through a press release from the Minister or Primary Industries, Water and Environment. The Committee received 163 public submissions.

Since this time, the role of GM crops in Tasmanian agriculture has come under increasing scrutiny (Parliament of Tasmania, 2001) and in April 2001, one of Tasmania's largest exporters of horticultural products, Webster Limited, came to its own conclusion and called for a GE-free state (Bailey, 2001). This was due to the demand from Europe and Asia for non-GM products. They believed that staying GE-free would help the company's "clean, green" image, especially in niche markets.

8.2 The Inquiry Process

8.2.1 Terms of Reference

By means of the terms of reference for each of the inquiries, the state structured the processes of opinion formation through submissions, which were received in the social context outlined above (see Ashforth, 1990). A precedent for this approach occurred a decade earlier in the first HRSC inquiry into GE. In this inquiry, the terms of reference included an *a priori* acceptance of the benefits of GE, thereby placing the views of those opposed to the technology outside the terms of reference of the inquiry (Hindmarsh, 1994).

All of the inquiries were framed by the earlier formation of 'policy principles' used to enclose the public consultation process and discussion paper regarding gene technology regulation, which acted to restrict debate. To recap from the previous chapter, the first policy principle listed in the Discussion Paper was,

> To realise the benefits of gene technology for the Australian community, industry and the environment, while ensuring human safety and environment protection, through regulation that is timely, science-based, consistent with Australia's international obligations and takes account of ethical and socioeconomic concerns (Commonwealth of Australia, 1998a).

Thus, the policy principles reflect the requirements of the state to foster innovation and international competitiveness through a streamlined and cost-effective regulatory system; separate issues based on scientific risk assessment from social, economic and ethical issues; and to gain pubic acceptance by portraying gene technology as a 'common good' (see

Ashforth, 1990). As a result of the policy principles, and the resulting terms of reference, the inquiry reports in turn reflected these political requirements of the state. Tasmania was a slightly different case however, with the government recognising the opportunity to capitalise on remaining GE-Free[3].

Reflecting the State's agenda, the terms of reference for the HRSC inquiry were limited and framed to give "... particular emphasis on the capacity of small and medium sized enterprises to access the benefits of gene technology" and include looking at opportunities "... to educate the community of the benefits of gene technology" (HRSC, 2000: iv). These terms of reference make it clear that the benefits of GE were assumed to be certain, and acted to marginalise alternative views. Given that these underlying assumptions helped to predetermine the committee process, findings and outcomes, the inquiry cannot be considered to be an instrument of objective fact finding, but rather as a political instrument of agenda management to control public opinion and relations with key interest groups (see Stone, 1993).

The Senate Inquiry had similar limited terms of reference. One of the main tasks was to assess "... a) whether measures in the Bill to achieve its object 'to protect health and safety of people and to protect the environment' are adequate" and "... b) whether the proposed regulatory arrangements and public reporting provisions will provide sufficient consumer confidence in the regulation of the development and adoption of new gene technologies" (SCARC, 2000b). The remaining terms of reference involved the adequacy of specific areas of the proposed legislation, including the OGTR, other proposed bodies, liability and insurance, the validity and practicability of a state opt-out clause, and breaches of the voluntary guidelines.

Thus, from the beginning of the regulatory development process, the Federal Government has framed gene technology as *a priori* beneficial, and in some instances essential, for Australia. As a result, the only issue is seen as how to regulate the technology effectively to gain public confidence so that such development can continue unhindered. So, continuing on from the earlier 'negotiations', and consistent with the findings of the HRSC inquiry to continue the development of GE, the Senate Inquiry was framed in terms of the adequacy of the proposed regulations, not whether the technology was wanted or needed, or would provide any real

[3] See Appendix 4 for the terms of reference for the Tasmanian inquiry.

benefits to the community. Submissions were invited to comment on "... any or all of the above terms of reference" (SCARC, 2000b). Alternative issues were again marginalised, as any issues falling outside of the question of the regulations were not considered to part of the terms of reference of the inquiry, and therefore irrelevant to the proceedings.

The situation was similar for the Tasmanian Inquiry, although the terms of reference did include "... environmental risks and effects" and "... social and ethical issues surrounding the use of genetically-modified organisms in Tasmanian primary industries" (Parliament of Tasmania, 2001: 21). However, the first two terms of reference were to investigate:

- The economic costs and benefits for Tasmanian and individual industry sectors in relation to genetic modification in primary industries.
- Market opportunities and associated strategies for Tasmania as a producer of genetically-modified and non-genetically modified products.

Interestingly then, the Tasmanian Inquiry did address the issue of whether or not GM was wanted or not, unlike the other inquiries, however this was framed only in economic terms, that is, whether GM or GM-free would be better for Tasmania's trade opportunities. Thus, many of the submissions from both critics and proponents discussed the pros and cons of the technology in economic and trade terms for Tasmania, in an effort to legitimise their submissions to the Tasmanian government.

Thus, the overall effect of the limited terms of reference for the inquiries and submissions not only assumed support for GE (which was clearly not the case from the submissions), but effectively silenced many of the views of environmentalists, by ignoring the central issue of power and failing to question worldviews. Thus, the outcome of the inquiries was to act as obligatory passage points for genetic engineering interests, and disempower environmentalists and those opposed to GE.

Environmentalists voiced their concerns over the limited terms of reference and their inability to express their views in the manner that they would have liked, instead being restricted by the 'rules' set out by the inquiries. In its submission to the senate inquiry, GE-Free Tasmania expressed the difficulties in addressing their arguments in terms of their own worldviews, stating that the underlying assumptions of the legislation "... ensured that members of the public have a limited capacity to make submissions on the potential regional economic or moral effects of the release of GMOs and GM products" (GE-Free Tasmania, 2000: 27). They expressed that GE offends the moral beliefs of a significant proportion of society, and that the Bill only allows these to be considered where they would pose a significant risk to human health or the environment. However, many of the moral risks associated with GE are only indirectly related to the potential threat to human health or the environment, with many concerned with the very *process* of the technology (GE-Free Tasmania, 2000). For example, David De Havelland stated in his submission to the Senate inquiry that many believe that genetic engineering "... violates natural reproductive boundaries set in place by God. Others find the patenting of life forms blasphemous" (DeHavelland, 2000: 5). Canberra Consumers Inc (2000: 13) also expressed that there was a strong consensus among their members that genetic engineers see themselves as creators, and so they are seen as interfering with the natural law. Also, in oral evidence to the HRSC inquiry, Bill Hankin expressed:

> ... we have a very human-centred perspective on this whole thing – what I continue to call 'genetic engineering'. Many people with whom I have contact and have talked to are concerned about the ethical, moral aspects of this whole technology. Some people have said, 'Look, it is not appropriate for humanity to be doing this.' I agree with them ... Just because we can do it does not mean we should (Hankin, 2000: 169).

Thus, despite the limited terms of reference, some questioned whether the public wants GE at all. For example, the Consumers' Association of SA asked "who wants this food?" and concluded that it is "only the multinationals ..." Likewise, an individual campaigner expressed concern in her submission to the Senate Inquiry that GMOs were already being released into the environment without the public ever being asked if they wanted GMOs (Stafford, 2000: 1).

Along with the terms of reference, the adversarial framework of the public hearings also acted to disempower opponents, as Taplin (1992) also found in the case of the Terania Creek Inquiry in NSW in the late 1970s. Taplin (1992) found that only straightforward scientific evidence was considered 'sound' and acceptable by decision-makers in power. The uncertainties inherent in ecology mean that it is treated as 'unscientific' and therefore not credible for decision-making. Wynne (1982) has also recognised the increased use of 'scientific' evidence to support a case in inquiries. This is partly because of increasing opposition and also because of increasingly elaborate attempts to defend applications. Such an approach is time and resource intensive and puts opponents at a disadvantage as they do not have the same level of resources as the proponents. Thus, even if the green-network does manage to mount counter-expertise, the greater credibility of the proponents' "lavishly funded" arguments tend to win out in the end (Wynne, 1982: 64). As Wynne (1982) argues, the elaborate pursuit of facts can be seen to conceal more important social judgements, in this case that GE is a social and economic good.

The inquiry processes were therefore compromised and did not adequately represent alternative views. They acted to restrict further the ability of some environmentalists to express their opposition to gene technology in terms of their own worldviews, further compromising the 'objective' representation of all views. In the words of Brian Wynne (1982: 55) "earlier decisions constrain later ones". Thus, the earlier decisions made about the policy principles for GE constrained later decisions on the terms of reference for the inquiries. This served to depoliticise the issue by narrowing the scope of the discussion to the elucidation of rational 'facts' and interpretations (see OECD, 1979). The findings from the Australian inquiries are consistent with the findings of Rogers-Hayden and Hindmarsh (2001) regarding the RCGM in NZ. They also found that despite strong opposition, the RCGM recommended the continued development of GE in NZ. They further found, as was also the case in Australia, that modernist ideals predisposed those in control of the proceedings to favour the technology.

8.3 Analysis of the Text

8.3.1 Submissions

Submissions to all three inquiries reflected long held positions found in consultation processes to the Government Discussion paper a year earlier and to the much earlier 1992 inquiry into genetic engineering convened by the House of Representatives Standing Committee on Industry, Science and Technology (see Hindmarsh and Hulsman, 1994). Typically, submissions demonstrated a polarisation of views. A large proportion of submissions to the HRSC inquiry (approximately 68 per cent) were in favour of the further development and promotion of gene technology in Australia. On the other hand, an overwhelming number of submissions to the Senate and Tasmanian inquiries were critical of the technology (approximately 62 per cent for the Senate Inquiry and 92 per cent for the Tasmanian Inquiry). We now turn to investigate these views.

The Proponents' Views

Proponents argue that traditional breeding and selection is "clumsy" and that GE provides simple solutions to plant breeding and environmental problems. They claim that GE has enormous potential benefits and believe that continuing research and application of GM technology around the world is inevitable and that this should be recognised when formulating any policy regarding GE (Frankcombe, 2000: 1).

The economic benefits of GE are promoted and in the case of Tasmania, it is claimed that the state will lose considerable competitive advantage if it continues to remain GE-free. As such, Heazlewood Seeds recommended in their submission to the Tasmanian Inquiry: "That the Tasmanian Government immediately lift the ban on genetically modified organisms in Tasmania" and "That the DPIWE actively assist the seed industry in Tasmania to increase the multiplication of GM crops for export" (Heazlewood Seeds, 2000: 4). Proponents believe that while human health and the environment are important, there is a need to support a viable commercial industry, into which the CSIRO puts $50 million annually towards gene technology research. Thus, it is argued that GE is of critical importance to Australia's economic future.

Financial benefits are not the only ones put forward, however. The ABA declares that GE is a "public good" with benefits that will accrue to the whole community. Improved environmental outcomes including a decrease in pests, chemical sprays, weeds and waste, increased yields, improved sewerage and water treatment, soil remediation, and household and industrial waste composting (McCall, 2000: 3) are all examples of the potential advantages of the technology promoted by proponents. They therefore claim GE will maintain sustainable, globally competitive agriculture in Australia.

Further down the chain, claims are also made that GE foods are more nutritious, and the example of rice cultivars capable of synthesising vitamin A is often cited (Johnston, 2000: 2).

Some, such as the Institute of Public Affairs (a think tank) state that extreme and unnecessary caution may create harm by depriving consumers of cheaper and more nutritious food, which is even more of a concern in the Third World. Likewise, Professor Peter Gresshoff (2000) states that it is irresponsible not to use GE as it has the potential to feed the increasing population. Proponents also claim that an overwhelming majority of scientists are in favour of the technology in a further attempt to legitimate the technology (Institute of Public Affairs, 2000).

Proponents claim that the risks posed by GE are not intrinsically greater than other known risks for similar organisms. Gene drift is declared to be a natural phenomenon and if it needs to be managed this can be done by conventional techniques (Serve-Ag, 2000a). Thus, the belief is that GE crops should not be treated any differently from conventional crops, supporting the notion of "substantial equivalence[4]". They also argue that GE is a "precise" technology so the risks are therefore very low.

Given this, they want regulation that is not too restrictive and that will foster development of the technology. Some believe that the GT Bill is considerable 'overkill' since, according to the Institute of Public Affairs, GE poses no risk to humans and is likely to improve environmental outcomes. Likewise, the Australian Biotechnology Association and Professor Peter Gresshoff claim that it cannot be argued that GE has any intrinsic risk to health or the environment (ABA, 2000; Gresshoff, 2000). Proponents are also concerned to keep the costs of regulation to a minimum and therefore do not want post-release inspection, compliance and audit requirements to be made too prescriptive.

They want a clear roadmap for industry that builds on the successful operation of GMAC, to build consumer confidence and certainty for investors. Thus, they commend the objective of the Bill, that has the PP omitted, as a means of managing the commercial release of GE in Australia. Although some, such as Florigene were in favour of the earlier objective that focussed on the support for the sustainable application of GM rather than focussing on health and safety. Florigene (2000) also went further, calling for the Ministerial council to encourage

[4] According to the principle of 'substantial equivalence', if the final GM product is grossly similar to its non-GM counterpart then it does not need to be treated any differently to the non-GM product in terms of testing and regulation.

and promote the beneficial applications of GE and that the council should be 'appropriately' weighted in favour of science, technology, health and agriculture portfolios.

The multinational companies involved expressed the belief that society accepts that risk and reward is a 'two-edged sword' (Florigene, 2000). They therefore do not support a moratorium or an opt-out clause, seeing such an approach as "... a tool for short-term political point-scoring" (Serve-Ag, 2000a) that could disadvantage world trade and cause uncertainty and confusion. Similar claims were made about the PP. Using this justification they call for a unified regulatory regime that is consistent with world trade agreements.

They believe that a rigorous science-based risk assessment and management approach is necessary for good policy and decision making. The majority believe that the GT Bill ensures such an approach, free from political influence, with broader issues, such as ethics, addressed separately to the GTR's decision-making. (Avcare, 2000; IOGTR, 2000). As stated by the IOGTR, it is a "streamlined, certain pathway for industry" (IOGTR, 2000).

Proponents believe that the GTEC and GTCCC should have advisory roles only, with the GTEC given responsibility for aiding decision-making. They are concerned that these groups have a high risk of being "hijacked" by "vociferous ideological opponents of the technology" (Serve-Ag, 2000a). They are also concerned that such interests will impact on "consumer confidence" which they recognise as very important for future commercial development of the technology. They believe that "... public concern has evolved as a result of extremist groups whose arguments lack scientific credibility, fuelled by a media that feeds on sensation" (Valley Seeds, 2000). Thus, proponents want the public to be seen as actively involved in the process, but only in the limited sense above, in order to counter public opposition. They also support information being made available to the public by them, or by supporters of the technology such as Biotechnology Australia and Agrifood Awareness, to promote the technology and gain consumer confidence. However, their lack of support for third party appeals "in the public interest" does not engender such confidence in the eyes of critics and the public generally.

In direct contrast to environmentalists, proponents are concerned that the economic and trade benefits of the nation are treated as less important than meeting the demands of the organic product lobby (Grains Research and Development Corporation, ACT, 2000). They believe that the organic industry is promoting distrust of GE and that NGOs have a disproportionate influence on the GM debate (Florigene, 2000). They believe the debate has been characterised by unsubstantiated claims and an unwillingness to consider "real" and "reputable" data (Florigene, 2000).

Thus, another major concern was to educate the public about the legitimacy of this approach and the benefits of GE. The Australian Biotechnology Association stated in its submission to the HRSC inquiry that "A better informed community ... [is] less likely to be influenced by scaremongers" (ABA, 2000: 8). Also, Agrifood Awareness stated that "Until the public trusts ANZFA, GMAC and IOGTR ... there always will be this distrust of the technology" (Agrifood Awareness, 2000: 189). The Committee stated its belief in the report that the reason for greater acceptance of GMOs in the US than in Australia may be associated with a greater knowledge of regulation in that country (HRSC, 2000: 47).

The Environmental Critique

The general support for the regulations by biotechnology proponents has made critics very sceptical about their real rigor. Environmentalists assert the adage that 'we don't know what we don't know' and there will always be some consequences that we will not anticipate (Nieman, 2000). They are concerned that damage caused by GE may be irreversible, and we still know little about the possible long-term effects. Examples of past unanticipated consequences were given such as Thalidomide, DDT, Asbestos, Agent Organge, PCBs, and 'Mad Cow' disease. Even if studies are done, it may take decades to know the major effects of GE. they are concerned by the lack of long-term environmental and health research into the effects of GMOs, and most research that is undertaken is funded heavily by the biotechnology industry. Issues such as horizontal gene transfer, increased allergenicity, anti-biotic resistance, viral resistance, increased toxic pesticide use, threats to biodiversity from increased monocultures, effects on non-target organisms, are oft-listed concerns. They also claim that the benefits that have been promised by the proponent organisations have so far not materialised. They point to the fact that it is the same corporations that promise to reduce the need for agrochemicals now were the proponents of the Green Revolution a few decades ago, and that this technology poses the "second onslaught" for Third World countries (Bio-Dynamics Tasmania, 2000: 6).

Many environmentalists expressed their concerns about the profit-driven nature of GE and multinational control of the food supply, along with the political agenda for GE. In her submission to the senate inquiry, Margaret Waspe argued:

> As a society, we are now used to giving priority to short-term personal profit or larger commercial interests. This, combined with an almost unquestioning belief in new technology bringing 'progress', 'growth', 'benefit', has already brought many problems to earth. As scientific understanding of life unfolds, it does not mean we automatically have the right to immediately apply aspects of it to commercial advantage, which then almost inevitably distorts objectivity. In respect of commercially driven genetic manipulation, this has never been more the case (Waspe, 2000: 5).

The concern is that farmers will become more reliant on multinational corporations for their seed stock and "… become beholden to the whims of the corporations for their ultimate survival in the marketplace" (Wilson, 2000: 1). As a result, small scale farmers are being squeezed from their properties, and there is increasing evidence that small farms are far more efficient (Stevenson, 2000: 2). They also believe that the argument that GM technology will be necessary to feed the third world is spurious, as there is already enough food according to the OECD to feed the Earth's population 1.5 times. Shortages are related to inequities in global food distribution and the unsustainable consumption patterns of the first world. They believe that the application of GM crops is likely to exacerbate this problem through exploitation and corporate monopolies on seed stocks.

Environmentalists believe that GMOs are only dealing with economics and benefit only these few large companies who have a monopoly on seed supplies. Priority is given to short-term profit and commercial interests. The risks and benefits of the technology are unevenly distributed, with unfair costs and risks upon certain sectors of society which jeopardises democratic principles. Genetic engineering therefore exacerbates inequalities between the First and Third world as well as existing ecological and socio-economic problems, and prevents a shift to sustainable agriculture. There is also the concern that corporate confidentiality is placed above public health and environmental risk. They believe that commercial interests should come second to the PP. There is also the problem of commercially funded research which distorts objectivity and excludes independent scientific research, "giving the fox the key to the hen-house" (National Genetic Awareness Alliance, 2000).

Green actors do not want to see good regulation subsumed by consideration of trade implications and it is their belief that biosafety should take precedence over trade and financial agreements. They also want to see a ban placed on the patenting of genetic material that many feel is "morally repugnant" (Van Essen, 2000: 1) because it threatens food security and sanctions bio-piracy.

Environmentalists promote alternatives such as organics and agro-ecological and biodynamic farming to achieve sustainability. This would empower small farms to combat poverty and hunger. Many believe that agro-ecological approaches hold great promise for sustainable agriculture and that GE and organics are not compatible. In fact, they are concerned about the threat that GM releases pose to the organic industry in Australia. In the case of Tasmania, critics want to see the state capitalise on being GE-free.

They want to see regulation and legislation that supports ESD, the PP and intergenerational equity, and they believe that the regulator's decisions should be based on these principles. They are also concerned about the level of public participation, stating that the public has never been asked if they want the technology and call for public debate. Many complained about the level of secrecy surrounding GE and misinformation, and want the public to have access to all information involving GE.

Despite the limited terms of reference, ethical issues were raised by a large number of the submissions to the inquiries. This is consistent with the outcomes of the First Australian Consensus Conference held in Canberra in March 1999, where ethical issues associated with GE were given a high priority. The conference concluded that there are many moral and ethical issues raised by gene technology such as: should life become a commercial property through patenting?; should we create transgenic organisms, particularly those containing human and animal DNA?; who advocates for nature?; and, how do we ensure that our decision-making processes respect the diverse cultural, moral and religious beliefs within our multicultural society? The lay panel concluded that "It would be presumptuous of us to answer these issues or to assume that we have identified all of them, however we believe that ethical considerations must assume a prominent role in decision making about gene technology" (Lay Panel, 1999).

However, despite this, none of the inquiries into GE in Australia have had ethics in the scope of their terms of reference, except in the sense of the ethics committee in the GT Bill. Nevertheless, critics made their views on ethics heard in their submissions. Many of the moral concerns are directed towards the process, involving immoral meddling with nature. In their submission to the Tasmanian inquiry, GE-Free Tasmania expressed their concern that the GT Bill had limited scope for moral issues to be adequately addressed. The structure of the Bill is based on the underlying assumption that the risks associated with GE can be identified and managed. The National Council of Women Australia combined the notion of the PP and ethics, stating their belief that the PP should be considered in all dealings with GMOs, including ethical issues.

Heritage Seed Curators Australia and one concerned individual also stated in their submissions to the Senate inquiry that the moral and ethical dimensions are very important but are often ignored. Two other submitters expressed similar concerns and wanted the IOGTR to address ethics. Others asserted their beliefs that issues relating to ethics should be incorporated in the Bill. The Australian Centre for Environmental Law, and two concerned individuals, wanted ethical values and norms to be included in matters that the GTR has to take into account. The Australian GeneEthics Network also expressed that certain dealings with GMOs should be prohibited by the GTEC on ethical grounds (AGEN, 2000c). Likewise, one member of the public stated that the GT Bill should provide scope and design for moral and ethical issues to be accounted for in decision-making, and that the opt-out clause should be broadened to allow for the prevention of release of GMOs if it "... offends the ethical beliefs of the local community" (Macintosh, 2000). GE-Free Tasmania stated:

> It would be undemocratic, offensive and highly insensitive to permit the release of GMOs and GM products in communities where the greater majority of the population morally object to the process, irrespective of the measure that may be taken to lower the risks to human health and the environment (GE-Free Tasmania, 2000: 49).

Many ethical and moral issues were raised in submissions to all three inquiries, and ethical questions were raised such as "Do people in general ... actually want GE organisms, and especially in the food chain?" and: "Do we, in our ignorance, have the right to contaminate the environment with GE plants for the rest of time?" (Smith, E, 2000: 3). The onus of proof of safety and ethics should be with the proponent, and there should be legal protection for whistleblowers. In addition, biotechnology TNCs should be liable for the damage they may cause through the application of the technology.

The majority of environmentalists wanted the OGTR to be a statutory body, not an individual. They want the OGTR to commission advice from independent scientists, and disclosure of committee members' interests should be mandatory. They want the regulator to take economic, social, cultural and ethical issues into account and believe there should be the right of third party appeals to decisions by the regulator.

They believe that the ethics and community committees should have equal standing to the scientific and technical committee. In other words, the ethics and community committees should have greater powers to advise the Ministerial Council, not just upon the request of the regulator. The GTEC and GTCCC should therefore have a more proactive role. Membership on all of the committees should be broadly representative, independent and multi-disciplinary.

Many believe that GE is driven by outmoded genetic determinist science. There is the almost unquestioning belief that technology brings 'progress', 'growth' and 'benefit' and this is evident by the assumptions reflected in the regulations that the problems of gene technology can be resolved solely by scientific risk management. However, the risks of GE are not just scientific and technical, but also environmental, social, ethical, and economic and they want holistic regulation that adequately takes these broader issues into account.

Many biotech critics call for a moratorium. They believe the rights of those who do not wish to eat or grow GE food or crops should be protected, as GE crops and organic crops are incompatible. Others called for a Royal Commission into gene technology, like that undertaken in NZ, which indicates that such a commission is seen to be more independent and balanced than inquiries undertaken by governments. However, findings from Rodgers-Hayden and Hindmarsh (2001) indicate that a Royal Commission may well yield similar results.

A Shift in Focus: Debate over Precaution

Reflecting the rising popularity of the strong PP argument since the early 1990s, the precautionary principle emerged in the later Australian inquiries – in contrast to the first Australian inquiry into GE in 1992 – as a strongly held imperative for inclusion by the majority of critics to gene technology.

A typical example of the precautionary principle was provided by the Australian GeneEthics Network, which selected their definition from the Intergovernmental Agreement on the Environment:

> Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by: (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and (ii) an assessment of the risk-weighted consequences of various options. Under the principle the 'onus of proof' regarding impacts has shifted to those that might cause change (AGEN, 2000c).

Approximately 37 per cent of submissions to the Senate inquiry – primarily those of the public, and including all of the eight environmental groups who made submissions – advocated that the precautionary principle be included in the Act as the central foundation of the regulatory framework; incorporated into the objects of the Act; and form the basis for the Gene Technology Regulator's (GTR) decisions. Many went further to argue that a lack of scientific certainty should be justification for the GTR's decision to disallow an application, regardless of the projected benefits. Commercial interests were declared second to precaution – the precautionary principle should outweigh every other consideration. They asserted the belief that this is essential due to the uncertainties surrounding the release of GMOs, particularly with regard to long-term risks including those associated with antibiotic resistant marker genes, threats to biodiversity, and food safety. Similarly, 24 per cent of submissions to the Tasmanian Inquiry made specific mention of the precautionary principle, and an overwhelming 76 per cent called for Tasmania to be a GE-free state.

The above concerns tie in directly with the notions of ESD, in the sense that precaution is seen as necessary to achieve ESD because of the problems associated with uncertainty. As stated by the Australian Centre for Environmental Law (ACEL) "The precautionary principle finds its basis in the principles of economically [sic] sustainable development which should also be taken into account by the Regulator in deciding whether to issue a licence" (ACEL, 2000: 5). The GeneEthics Network therefore considered the Bill to be inadequate because of its failure to refer to ecological sustainability. In their submission they recommended:

> The Objects of the GT Bill 2000 should also be amended to include the principle of ecological sustainability, to ensure GEOs do not contribute to the long term destabilisation and decline of our food and fibre production systems, the natural environment and biological diversity (AGEN, 2000c).

Many others including the National Council of Women, the National Genetic Awareness Alliance of Australia (NGAA), Australian Centre for Environmental Law, and concerned individuals, directly expressed their support of sustainable development principles. Leila Huebner went further stating that there is a need for a "paradigm shift in consciousness" to achieve ESD. An example of how the notion of ESD can be used by both sides of the debate however is illustrated by the Australian Cotton Co-Op Research Centre, who stated in their submission to the Senate Inquiry that "We believe gene technology has the potential to provide substantial gains in environmental sustainability of agriculture production and to advance prospects for improved human nutrition, health and quality of life" (Australian Cotton CRC, 2000).

Highlighting their strong position on precaution, half of the environmental groups who submitted to the Senate Inquiry called for a minimum five-year ban on the environmental release of GMOs. The National Genetic Awareness Alliance (NGAA) was one of these groups, and included in its submission a copy of the *Open Letter From World Scientists to All Governments Concerning Genetically Modified Organisms (GMOs),* released by the UK Institute of Science in Society. This letter has 327 signatories, scientists from around the world who are concerned about the hazards of GMOs. The scientists cite examples of the risks of gene technology such as increased chemical usage, horizontal gene transfer, increased unemployment and Third World debt, disruption to evolutionary processes, and production of novel pathogens. They call for a moratorium on the environmental release of GMOs in accordance with the precautionary principle, and believe that national biosafety regulation should take precedence over trade agreements. They are opposed to GM crops that they believe will prevent the shift to sustainable agriculture, with farmers at the mercy of multinational companies, unable to keep and reuse their seeds. The scientists state that small farms are believed to be more productive, efficient and economically viable than large farms and small farmers are better stewards of the environment, safeguarding the sustainability of world agriculture. Agro-ecological approaches are seen to hold more promise for sustainable agriculture, incorporating local farm knowledge and techniques. The scientists further assert that these approaches are more likely to combat poverty and hunger than GM farming.

Several submissions by individuals to the Senate inquiry into the GT Bill 2000 also expressed concern that GM farming is unsustainable and will pose enormous problems for future generations. The promise of increased yields and therefore better treatment of the environment through GM is believed by them to be untrue. They argue that cash crops destroy soil fertility while monocultures lead to decreased biodiversity, and therefore an increased susceptibility to pests and disease. Many extreme critics also support a ban on GMOs, while others, such as dissenting Independent Peter Andren and Bob Brown of the Australian Greens, recommend a five-year moratorium on the development of GMOs to allow time for independent research on the effects of the technology to be carried out. They assert that GMOs only deal with economics and members of the public were never asked whether or not they wanted it.

Similarly, a large number of submissions to the Tasmanian Inquiry called for the continuation or extension of the existing moratorium, and many called for an outright ban on GMOs so that Tasmania could promote itself as "GE-Free" and "clean and green". Another aspect of precaution, held by all of these groups, was that an opt-out clause for states and local governments was essential. This would enable states and local governments to declare GM-free zones. Thus, another imperative of precaution was to include within its scope, broader ethical, moral, socio-economic and environmental issues, and also greater public participation and information (Rogers-Hayden *et al.,* 2002).

Several submissions to both the senate inquiry and the Tasmanian inquiry summarised the connection between precaution and an alternative to GE, organic agriculture, or agro-ecological approaches (for example the National Genetic Awareness Alliance; Bio-Dynamics

Tasmania; and three individuals). By way of contrast, the Australian Biotechnology Association (ABA) argued that confusion about interpretations of the PP may lead to its own uncertainties in the operation of the legislation. They claim that the wording of the PP in the Biosafety protocol is "… almost grammatical nonsense and extremely difficult to understand" (ABA, 2000: 246). On the other hand, one public interest group stated in their submission to the Tasmanian inquiry that "The *precautionary principle* should be applied to help minimise conflict within the community, along with long term communication to the public" (Tasmanian Women in Agriculture, 2000: 6).

However proponents again expressed their cynicism of such views:

> While it is natural for our species to fear the "unknown" and while I accept that "zero risk" technology is unattainable, I believe it is essential that we as a society of thinking and rational individuals venture on the side of reason rather than superstition and hear-say (Gresshoff, 2000: 1-2).

Thus, GM proponents (including Florigene, 2000 and Dupont, 2000) reject the precautionary principle, claiming that "… indiscriminate use of the precautionary principle will stifle technological advancement in this area" and "… significantly reduce the global competitiveness of Australia's agricultural exports …" (Florigene, 2000). The corporations believe that "… it is neither appropriate nor practical for the location of commercial plantings of GM crops or raising of GM animals to be notified to the Regulator" (Florigene, 2000). They also believe that "… society appreciates that risk and reward is a two edged sword and that an appropriate balance must be sought to sustain continuous and responsible application of the benefits which will undoubtedly emerge from further scientific and technological innovation" (Florigene, 2000). While Dupont (2000) states that it supports a *science based* precautionary *approach* for risk assessment, the company states that, "… the Bill should not adhere to a zero risk assessment and the multiple opportunities for public consultation provide comprehensive precautionary legislation". Serve-Ag, in their submission to the Tasmanian inquiry, also expressed that "Australia has developed a world leading, robust, well structured, consultative *science based* regulatory system" (Serve-Ag, 2000b: 19, emphasis added).

These views are consistent with the American situation, which was pointed out in one submission to the Tasmanian inquiry (Brown, W, 2000) in which an excerpt from *Seeds of*

Opportunity: An Assessment of the Benefits, Safety and Oversight of Plant Genomics and Agricultural Biotechnology was included. In part, this document states:

> Set against the political nature of the precautionary principle is the scientific consensus that risk assessment should focus on probable, not hypothetical, risks. Historically, the United States has not endorsed the precautionary principle as a basis for regulatory decisions. Doing so would completely undermine the science-based regulatory structure that has relied on a cautious approach in the scientifically-objective assessment of risk, which has served the Nation well for decades ... Adoption of the precautionary principle by FAO and WHO could have a devastating effect in U.S. trade and scientific interests (Smith, 2000: 69; cited in Brown, W, 2001: 6).

The IOGTR expressed similar views:

> ... rather than explicitly referencing the Precautionary Principle and potentially creating uncertainty about its interpretation, all jurisdictions [Commonwealth and States] agreed it was better to provide clear directions to the Gene Technology Regulator about how to apply precaution in considering each application. Debate on the adequacy of the legislation should therefore focus on the adequacy of the risk assessment and management process in the legislation rather than be misdirected into argument about the interpretation of the precautionary principle (IOGTR, 2000: 74; see also Avcare, 2000).

Further emphasis on 'sound science', based on modernist principles was given by Serve-Ag in their submission to the Senate inquiry. They submitted a quote from Justice Michael Kirby in the forward to the 1989 Boyer Lectures:

> The primary rule for good policy, law and ethics ... is, as he (Prof Charlesworth) constantly emphasises, a sound understanding of the scientific data. Good law and good ethics must be grounded in good data. Let others indulge in preconceptions, prejudice, emotion and dogma ... experts need to approach the difficult problems dealt with here with an affirmation of the scientist's first obligation: to get the data right.

> Out of that approach, the answers to ethical questions and to the design of legal policy may not readily come. But when they come, the answers are more likely to be sound and lasting if they are based on good science (cited in Serve-Ag, 2000a: 10).

Serve-Ag went further to state (in relation to the GTTAC):

> As the Committee is a scientific and technical body, it must not be permitted to be used for political purposes by any person or organisation, using so called "junk science" and misinformation, in an attempt to influence the Committee (Serve-Ag, 2000a: 3).

The company expressed similar views in its submission to the Tasmanian Inquiry:

> It is essential that all stakeholders be prepared to present their respective argument based on good science and sound logic. All stakeholders must also be willing to reject any argument not soundly based, or based on ideology or prejudice alone … and not be distracted by ideology, ill formed argument or irrational emotion (Serve-Ag, 2000b: 19).

The South Australian Government in their submission to the Senate inquiry also expressed that what was needed was a rigorous scientific risk assessment and management approach. Similarly, in the HRSC inquiry, a science-based case-by-case approach received support from the AFGC, the NFF, representatives of the cotton industry, and the Veterinary Manufacturers and Distributors Association (see HRSC, 2000: 131).

Not all proponents believe, however, that a sole focus on science is the answer. Brendan Gogarty of the Centre of Law and Genetics stated in his submission to the Tasmanian inquiry:

> The industry has attempted to dispel such concerns [non-scientific] by relying on economic and scientific arguments. Indeed there has been almost a derisory response to ethical responses. It must be strongly suggested that this attitude is self destructive and is in fact causing a great deal of harm to further industry growth. Beliefs not

> founded in scientific evidence are unlikely to be dispelled by scientific evidence to the contrary (Gogarty, 2000: 19).

Critics also call the science-based approach into question, for quite different reasons, contesting the nature and role of modern science through the advocacy of the strong PP.

The Contestation of Science

Thus, within their submissions, several environmental groups and some concerned individuals expressed their concerns about the limitations of western science, consistent with the issues discussed in some detail in Chapters 3 and 4. The GeneEthics Network (Perth) included in their submission to the Senate inquiry a quote from Dr Mae-Wan Ho:

> … the genetic determinist mentality that misinforms both practitioners and the public takes hold of people's consciousness, making them act unquestioningly to shape the world to the detriment of human beings and all its other inhabitants (Ho, 1998; cited in AGEN Perth, 2000).

They also expressed concern about the narrow focus of GE policy and legislation. GE-Free Tasmania argued in its submission to the Senate Inquiry:

> This proposed legislation seems to be based on the assumption that all risks associated with gene technology can be identified, assessed and managed. The reality is that the current state of firm scientific knowledge on the safety of GE is extremely limited. In light of the nature of GE and the uncertainty regarding its safety, if the role of this legislation to protect human health and the environment is to be successful, a precautionary approach is paramount (GE-Free Tasmania 2000: 7).

Similar views were expressed in submissions to the Tasmanian Inquiry. For example,

> Gene biotechnology has been labeled 'Old Genetics'. Old Genetics assumes that genes behave in predictable, linear, unidirectional ways, passed on unchanging from

> generation to generation. Genes do not in fact behave themselves like that even in their original organism … That appears not to matter to those adopting this reasoning (Public Health Association of Australia, 2000: 5).

In addition, the Australian GeneEthics Network argued in their submission to the Senate Inquiry (2000c: 1): "The GT Bill 2000 … assumes gene technology's problems and uncertainties can be resolved solely by science, risk assessment and risk management. This will not satisfy us or win the public's confidence." And again, the Australian Centre for Environmental Law stressed:

> The precautionary principle has particular application to GMOs. Not only could direct damage be serious, but ongoing and expensive because of irreversibility. Once released freely to the environment, a living organism, or a novel gene that has transferred to an unintended host, cannot be 'recalled' (Australian Centre for Environmental Law, 2000: 4).

Thus, gene technology was labelled by critics as a "… misguided use of science to fix a problem which science cannot fix" (Abbott, 2000: 1). The Organic Gardeners and Farming Society of Tasmania also asserted that GE is based on science that "… while technically very clever, is based on proven, flawed, principles" with the aim "… to attempt to dominate nature" (Organic Gardening and Farming Society of Tasmania Inc, 2000: 1). Likewise, in their submission to the Tasmanian Inquiry, the Organic Federation of Australia (2000c: 5) stated that "… genetic engineering perpetuates the paradigm that we can control and manage nature". Green actors rejected this paradigm and called for a more holistic approach due to the high uncertainties surrounding the environmental release of GMOs. Bio-Dynamics Tasmania (2000: 1), for example, called for a holistic approach based on "spiritual scientific knowledge".

Thus, concerns were also raised about scientific interpretation. They claimed that 'expert' knowledge was only one part of a larger knowledge base. As such, the limitations of reductionist scientific approaches for addressing complex environmental issues was raised, as was the scope for subjectivity in the data gathering and evaluation stages of environmental decision-making processes. To claim that science can be objective is nonsense to environmentalists. GE-Free Tasmania (2000: 14) highlighted that an acceptable level of risk was further distorted when the decision about it solely relied on expertise that was involved in the development and commercialisation of biotechnology. Likewise, the Consumers' Association of SA stated in their submission to the Senate Inquiry:

> 'Sound science' which is so often quoted as being the only criteria to be taken into account in determining risk, is not static, but changes as new knowledge comes to hand. What is considered 'sound science' today may change in the future due to new knowledge and understanding ... Science may be subjectively viewed and skewed towards a particular policy of the day (Consumers' Association of SA, 2000: 8).

Others, such as the Organic Federation of Australia (OFA) argued (in relation to the Community Consultative Group):

> ... to limit this group to providing advice on policy only does not do justice to concerns in the community about the way regulation is made, and the desire for the community to move beyond the simplistic notion that decisions must be based on science and logic (OFA, 2000a: 19).

The Department of Agriculture, Fisheries and Forestry Australia (2000: 15) in their submission to the HRSC inquiry also pointed out that the technology should not be considered on a purely scientific level, and identified important ethical, social, economic and environmental concerns. The Australian United Fresh Fruit and Vegetable Association (2000: 3) also stated in their submission to this inquiry that "It is not a scientific debate – it is an emotional one in which the consumer has genuine concerns".

Overall, the precautionary principle was seen by green actors as an avenue through which to address the perceived inadequacies of modern science. Some submissions extended this critique, suggesting a reform of science was needed for the realisation of precaution, as well as to contest biotechnology proponents that the precautionary principle had no place within modern science. For example, one submitter reiterated the arguments of the World Scientists Statement (2000) that "The technology is driven by an outmoded, genetic determinist science ... whereas scientific findings accumulated over the past twenty years have invalidated every assumption of genetic determinsim" (Waspe, 2000: 3). Also, Leila Huebner, an individual GE campaigner, argued to the Senate inquiry that the PP was "... not anti-science, but gives a 'reason to assume' that there could be or are problems that cannot be specifically defined in any certainty in any time frame ..." (Huebner, 2000: 3). Similarly, another individual stated in his submission to the Tasmanian inquiry that "Science can include the precautionary principle, depending on how it is otherwise used, free of accusations of being politically inspired" (Brown, W, 2001: 5). Leila Huebner further stressed that "... this proposal is not so much a perceived stepping aside in the scientific model role, but effectively a 'new science', where recognition of uncertainty tackles environmental complexities in a preventative precautionary concept "(Huebner, 2000).

Thus the answer, according to these commentators, is not to move away from science but rather to embrace a reformed science. However, despite all the critiques and arguments for the strong precautionary principle, the effect of the inquiry was to marginalise it.

8.3.2 The HRSC Inquiry Report

The HRSC Report reads as a wish list for the proponents of rDNA technology. Representatives of the food industry told a national science and industry forum in 1999 that "the horse has already bolted" (Hudson, 1999: 8; cited in HRSC, 2000) and that "... it is not a matter of whether there will be this technology, rather when" (Hooke, 1999: 2; cited in HRSC, 2000). The HRSC appears to share these views. It states that "The third revolution [after mechanisation and industrialisation], which promises further gains in productivity, as well as greater environmental sustainability, is based on biotechnology" (HRSC, 2000: 1). It goes on to say that "... varieties can be 'custom designed' to suit particular primary producer, consumer or environmental requirements, and contribute to increased agricultural productivity and sustainability". And further that "Notwithstanding the recent lack of consumer confidence in GM food and consequent reduction in plantings, it has been expected that GM crops will eventually be very widely grown" because there is "... a strong desire that Australian expertise in genetic manipulation be harnessed to benefit Australian farmers and generate a financial return tò Australians" (HRSC, 2000: 2-3). The Committee also stated that "Access to biotechnology in agriculture is therefore seen as vital to Australia's success as a nation" (HRSC, 2000: 12). It also sees GE as essential to maintain Australia's international competitiveness and so deserves government funding as well as a larger role for the private sector.

The report further takes up the proponents' argument that "… biotechnology can be seen as extending earlier methods of plant and animal breeding which date back many thousands of years" and "… obtains results more rapidly, is more precise, and gives access to a broader genetic base than traditional breeding techniques" (HRSC, 2000: 7). It reports that the majority of submissions to the inquiry listed the benefits, including those for farmers, the economy, the environment, the consumer and world food supplies (HRSC, 2000: 10). The Committee itself expressed its opinion that "… applying gene technology to agriculture can benefit farmers, consumers and the Australian environment and economy" (HRSC, 2000: 27).

While the Committee recognised, as pointed out by the CSIRO in their submission to the inquiry that "… there are still many unanswered questions about ecological impacts", the reason seen for addressing these was "to assuage possible community concerns", which was seen as essential for the successful commercialisation of GE (CSIRO; cited in HRSC, 2000: 17). Further, submissions that pointed to the need for more time to observe what the long-term health and environmental impacts will be, and invoke the precautionary principle, were described as "more alarmist view(s)" (HRSC, 2000: 24). Thus, the committee "… does not believe that there is a case for a complete moratorium on all GMOs" (HRSC, 2000: 27).

Ethical concerns in the report were highly summarised and also trivialised by the chosen discourse. For example it states "Disquiet about the use of gene technology in agriculture reflects in part people's reaction to the new and unexpected and their coming to terms with its implications …" (HRSC, 2000: 26). This insinuates the inevitability about people having to 'come to terms with' the technology, rather than acknowledging that there are alternatives. Ethical concerns raised were countered by alternate views, such as those of Richard Dworkin who asked what is wrong with 'playing God' if it enabled us to resist natural catastrophes, and also those of Nuffield Council on Bioethics that suggested it would be unethical not to develop GMOs if they would help to alleviate world hunger (HRSC, 2000: 26). The report also added that "… from a scientific point of view, the outcomes of genetic manipulation may seem no stranger than naturally occurring phenomena" (HRSC, 2000: 26).

While Heritage Seed Curators Australia claimed that "… the moral and ethical aspects of developing and using this technology have not been examined at all" (HSCA, 2000a) and stressed the importance of this, the report effectively dismissed this concern, stating that the GT Bill would address this with the establishment of an ethics committee.

The report did recognise the need for community participation and education, but for different reasons than environmental groups. There was concern that consumer reaction would impact on the acceptance of GM products and that:

> It is important, with the current level of concern about the safety of GMOs that government is *seen to be* actively pursuing the public interest by supporting research into, and assessment and management of, the benefits and risks associated with their use (HRSC, 2000: 29, emphasis added).

The Committee supports the role of Biotechnology Australia in providing information to the public, even when acknowledging that "BA carries out this task as part of its role of ensuring that, consistent with safeguarding human health and ensuring environmental protection, Australia captures the benefits of biotechnology ..." (HRSC, 2000: 40). However, the committee did concede that "... the framework within which BA operates, does not provide it with the necessary independence to *be seen to be* providing unbiased information" (HRSC, 2000: 46, emphasis added), and therefore recommended that BA become a statutory authority. The government did not support this recommendation, however. The Committee also recognised the need to present different points of view as it would be "... likely to reduce the sceptics' impression that they are being told only one side of the story" (HRSC, 2000: 47).

The report also stated that fact sheets are published by a number of government and industry bodies including CSIRO, ANZFA, the Therapeutic Goods Administration, and a number of biotechnology companies, and recognised the importance of the internet for this information provision function. Thus, a consequent recommendation of the committee was to review the design of government agency internet sites to ensure they are user friendly and up to date. The report also stated that CSIRO and BA have established telephone hotlines to answer public inquiries regarding gene technology. The Committee stated that "... it is entirely appropriate for community education to be shared by a number of different government and industry parties" (HRSC, 2000: 45). There was no mention of community or non-profit organisations to share in this function. All of the processes discussed above are resource-intensive and therefore non-profit organisations can not compete with these government and industry groups in providing information. It is difficult to imagine then, how balanced information will get to the public. Thus, there is no mention of meaningful public participation, but rather token participation to change public perceptions and gain their acceptance.

The report has a strong emphasis on public trust and acceptance, and makes several references to "appearances". It states that it believes that it is appropriate for the IOGTR to be in the health portfolio, as it is "... vitally important in establishing public trust in the regulatory system that the regulator is *seen to be* free of commercial pressures" (HRSC, 2000: 129, emphasis added). The committee also stated that a more timely and transparent approach needs to be taken in relation to breaches to "reassure the Australian people" (HRSC, 2000: 29). Also, in relation to regulation, the committee states that "the importance of getting it right" is "critical to public acceptance" (HRSC, 2000: 29). Again, on the following page of the report, the committee states that the regulatory system "must provide confidence in the community ..." (HRSC, 2000: 30). To further gain public confidence, a "practical regime of labelling" (HRSC, 2000: 144) is supported, however it is not clear what they mean by "practical". In the context of the report, it would appear that they wish for the public to feel that they have a choice in what they eat, but without significantly restricting the industry through high costs.

The report acknowledges that until recently, the regulatory pathway to commercial release of GMOs in Australia was unclear and "represented a deterrent to commercialisation" (HRSC, 2000: 73). The Victorian government also commented that "Until an effective regulatory system is in place, gene technology owners will not be able to invest with any certainty in the infrastructure needed to commercialise GM varieties" (Victorian government, 2000: 3) and patents were also seen as necessary by the Committee as an incentive for innovation and for investors to recover their costs. This strengthens the claim that effective legislation is supported by industry to streamline commercialisation.

The report acknowledged the strong emphasis in submissions on a "precautionary approach" in assessing risks, but warned that the "precautionary principle" can be misused (HRSC, 2000: 132). The committee stated that it supports the "thrust" of the Biosafety Protocol, but was concerned that it lacked clarity regarding the rules of international trade and has the potential for misuse – both factors that could deter trade (HRSC, 2000: 149). Thus the report, rather than accepting the PP, proposed that a "cautious approach" should be continued in approving the use of GMOs (HRSC, 2000: 153). It also supported the US approach of "product" rather than "process" regulation, stating that it is inappropriate to impose unique requirements on crops based solely on their method of production (HRSC, 2000: 157).

Thus, the overall thrust of the report was to recommend the continued development of GE, with minimal, flexible regulations. Continued Government support through funding, grants and start-up programs was seen as necessary in stimulating further developments, and it was further recommended that "… research institutions that receive Commonwealth funding … acknowledge and reward their researchers for innovative output that leads to commercial success …" (HRSC, 2000: 111). The report offered little to small producers, other than making the recommendation that "Biotechnology Australia, in conjunction with other agencies, develop and deliver educational programs and materials targeted at small producers and breeders" (HRSC, 2000: 94), covering IP issues and practical aspects of GMO use.

The HRSC inquiry served in the production of a discursive framework for state power (see Ashforth, 1990), allowing the state to sit above society as the "embodiment of the common good" (Ashforth, 1990), and express the political requirements of the state in 'commonsense' terms.

Responses to the HRSC Inquiry Report

The Federal Government responded favourably to the HRSC report, supporting its recommendation for the continued use of gene technology in Australia, consistent with the Government's vision for biotechnology. Stronger links between biotechnology researchers and industry was welcomed. The Government further supported the report's calls for Biotechnology Australia to be responsible for monitoring the efficiency and effectiveness of public education materials. It further supported, in principle, the Report's recommendation to reward research institutions for innovations that lead to commercial success, adopting a favourable environment for research commercialisation. Thus, overall, the Government supported the Report that read as a public relations document for industry, providing a favourable environment for research and commercialisation of the technology and recognising the importance of 'winning over' the public to its potential benefits through education initiatives which are essentially public relations campaigns.

Peter Andren, MP, released a dissenting report calling for a five year moratorium on the development of GMOs in Australia "… to enable adequate independent research to be carried out on health and environment impacts and consumer demand" (Andren, 2001). The Government responded negatively to this report, claiming that such a moratorium would have negative consequences for Australia and that field research was necessary to gain the appropriate data on the consequences of planned releases.

The later Senate Inquiry Report addressed some of the environmental concerns raised by the HRSC Inquiry, reading as a slightly more balanced document.

8.3.3 The Senate Inquiry Report

Some of the views expressed in the final report were critical of certain aspects of the Government's proposed regulatory regime. They criticised the IOGTR's handling of breaches of the voluntary guidelines and were sceptical about reassurances of the safety of GMOs:

> Assurances that there is 'no evidence' of harm may in fact mean no research has been done, and that worries the community. While there may be genetic exchange between species occurring in nature, genes from fish do not get into tomatoes under normal circumstances (SCARC, 2000a: xii).

They were also critical about the dismissal by proponents of community concerns:

> Protagonists of gene technology who described opponents as 'a noisy minority' or 'extremists' did not reflect the breadth of concern in the community or the weight of serious and scientific opposition. And they did little to persuade people to their point of view with such derogatory language (SCARC, 2000a: xi).

This may reflect the largely non-government membership of the committee. Despite these criticisms, however, the recommendations in the Senate Inquiry report supported Ashforth's assertion that inquiry recommendations are usually restricted to those which are likely to be implemented, as inquiry committees view their success in terms of whether recommendations are implemented or not. For example, the report states:

> The Committee believes that the Gene Technology Ethics Committee should have a broader role than that envisaged in the Bill and that the moral and ethical dimensions

> in relation to gene technology should be considered in relation to license applications (SCARC, 2000b: 136).

However, despite this view, the final recommendation was weak:

> The Committee RECOMMENDS that the Bill be amended to provide that the Regulator *may, if he or she deems it necessary*, refer individual licence applications to the Gene Technology Ethics Committee for advice (SCARC, 2000a: 136, emphasis added).

These views largely reflect those of the Committee chairperson, Senator Rosemary Crowley, and not those of Government senators on the Committee. Ultimately, in any inquiry there is a lot of negotiation and compromise, and inevitably, the objective nature of the inquiry suffers. As asserted by Ashforth (1990), although there may be strong views expressed, recommendations remain restricted to those likely to succeed. Also, unambiguous recommendations and findings can give the assurance that "wisdom" and "objective scrutiny" has prevailed over the process (OECD, 1979).

Thus, despite the restrictive nature of the terms of reference for the inquiry and submissions, the final report did include some nominal discussion of ethics and the precautionary principle in its findings. However, this coverage was still superficial, with a summary of ethical concerns that covered just over one page, effectively compressing the critics' responses, compromising the diversity of opinions based on ecological worldviews. The report also provided a conduit for the IOGTR to discount ethical views. Concerns raised over multi-national control in the report were largely dismissed, stating that these problems would be solved by the legislation:

> The legislation has … been drafted so as not to impose unfair burdens on small industry nor entrench overly restrictive practices between companies and for example, contract farmers … If individual companies do … engage in unfair or restrictive trade practices, this will be a matter for consideration by the Australian Competition and Consumer Commission – the independent statutory watchdog administering the *Trade Practices Act 1974* … (IOGTR, 2000; cited in SCARC, 2000: 57).

The IOGTR further discounted ethical views in the report, converting normative arguments into a rational one by stating that the GTEC will deal with the ethical issues. However, while critics supported the formation of the GTEC (although they stated their desire for it to have greater powers), so too did proponents, but for very different reasons. For example, Heritage Seed Curators Australia stated:

> We believe that the moral and ethical dimensions to gene technology are extremely important, however, this aspect goes largely ignored in the general debate on GE. We trust that the creation of this committee will bring this aspect of GE more to the fore in future (HSCA, 2000b: 14-15).

The CSIRO also welcomed the establishment of the GTEC, "... but attaches urgency to its formation and productive output, particularly the provision of ethical codes with a strong focus on the practical means by which their tenets are to be applied" (CSIRO, 2000: 5).

Therefore, critics wanted general discussion and deliberation over ethical issues involved in the development of GE, and indeed whether certain developments should proceed at all. On the other hand, proponents wanted ethics institutionalised in the form of codes, as a way to gain public confidence through token consideration of ethics, in a modernist framework whereby it can be 'rationally' decided on how "their [ethical codes] tenets are to be applied".

The report was also framed by the operational worldview of rational science and technology, avoiding any discussion or questioning of worldviews, including its own which was undoubtedly seen to be appropriate and above questioning. This modernist worldview was further expressed in the separation of science and technology from ethics. Even one proponent of GE, Rick Roush, expressed problems with this approach:

> ... if you really want ethics to infuse the whole debate, why not thoroughly integrate the so-called ethics committee, or the ethicists that are involved, in both the technical committee and the community committee. Why have a separate entity? If anything it reinforces the public view that ethics is over here and scientists are over here and the twain never meet (Roush, 2000: 101).

The report lists 'core elements' underlying the PP, including: proaction; cost-effectiveness of action; providing ecological margins of error; intrinsic value of non-human entities; a shift in the onus of proof to those who oppose change; concern with future generations; and paying for ecological debts through strict liability regimes (SCARC, 2000: 35). This implies that green actors support 'cost-effective' actions, involving the proportionality of costs. However, most environmentalists feel so strongly about ecological imperatives, that they see economic costs as secondary. This is indicated by the definition chosen by the Australian GeneEthics Network above, and calls by other environmentalists to have the definition in the EPBC Act used:

> The *precautionary principle* is that lack of full scientific certainty should not be used as a reason for postponing a measure to prevent degradation of the environment where there are threats of serious or irreversible environmental damage (EPBC Act, 1999, section 391).

This was also the definition that the Senate Inquiry proposed be used in any reference to the PP, to avoid the confusion that the IOGTR reported had been a problem in negotiations between the Commonwealth, States and Territories:

> In recognition that an explicit reference to the precautionary principle may create potential uncertainty about its interpretation, all jurisdictions agreed that the risk assessment and risk management approach contained in the Bill embodied an appropriate precautionary approach without being directly stated (IOGTR, 2000: 74).

However, despite calling for the definition used in the EPBC Act, the Senate Report also stated that "The weight of evidence supported a great deal of caution" (SCARC, 2000: xii) and that:

> The Committee considers that the precautionary *approach* would be underpinned in the Bill if the precautionary *principle* appeared as one of the objects in the same form as it appears in the EPBC Act. The Committee does not support the precautionary principle being made a specific test in the licensing provisions (SCARC, 2000: 45, emphasis added).

This statement shows the confusion between the notions of the precautionary approach and the precautionary principle. It also highlights, as discussed in the previous chapter, that having the PP in the objects of the Act, rather than the body of the Act, means that the PP may not be effectively implemented, and rather lead to a precautionary 'approach' at best.

The terms of reference assumed support of GE, despite the large number of submissions that were critical of the technology, and thereby avoided the central issue of power between the contesting worldviews involved in the process. This effectively disempowered environmentalists, silencing their interests, and further empowered genetic engineering interests.

The report also acted as a promotional tool for the industry, stating that Australia is at the forefront of regulation of GE by the inclusion of a community and ethics committee:

> … the establishment of a statutory community consultative group advising on matters of policy is itself fairly unique in both the Australian regulatory environment and internationally… most of the existing Australian schemes for regulation of GM products do not have statutory established community committees … internationally most countries have not established a community consultative group under legislation and where community groups are utilised they provide advice on policy rather than on individual applications (IOGTR, 2000; cited in SCARC, 2000: 132 - 133).

> … the involvement of an independent ethics advisory committee in the regulation of gene technology places Australia ahead of similar regulatory schemes overseas. For example, no statutory ethics committee is involved in providing policy guidance in the United States, New Zealand, Japan or Canada (IOGTR, 2000; cited in SCARC, 2000: 135).

Responses to the Senate Inquiry Report

Green actors believed that the Senate Inquiry Report recommendations were the minimum changes required for an effective regulatory system. In a press release dated 1 November

2000, Senator Bob Brown stated his belief that the Senate Inquiry Report did not go far enough. He sought a five-year freeze on all GMO releases into the environment and opt-out provisions for state and local governments. Likewise, Scott Kinnear of the Organic Federation of Australia stated:

> If they were really serious about the Precautionary Principle, they would have recommended a one to five year moratorium on the consumption and production of GMOs in the food chain. Without this, Australians will continue to be subjected to one of the largest uncontrolled experiments the world has ever witnessed (cited in ABC, 2000b: 2).

Environmentalists argued that despite the incompleteness of the Inquiry recommendations, even the existing ones were not incorporated sufficiently in the final Act which was passed in December 2000, and which came into force on 21 June 2001. Liz Cain, the acting regulator, stated on ABC's Lateline program that: "What the Australian people wanted was a regulatory system that was strong, that was effective, that was open, that was transparent, and that's what we've delivered" (ABC, 2001). Critics did not agree. Senator Brown emphasised that the report's recommendations were not sufficient for the degree of uncertainty that surrounds the environmental release of GMOs. Brown believed that a moratorium was needed if the Bill's objective to protect health and safety of people and to protect the environment was to be achieved. The Greens formed part of a national network of GE-Free groups, who actively called for states' and local governments' rights to 'opt out' of the Bill. On 1 November 2000, this network dropped a 20 metre banner in Canberra, which declared "Federal ALP must support states' rights to choose GE-free".

The Government denounced the Senate Report, claiming that the proposed changes to the Bill would add considerable cost to the regulatory system and also complicate it. Senator Knowles stated that the title of the report was "flippant" and "disgraceful" and that "… it simply fans the unfounded fears of many in the community; fears that have been promoted by some lunatic fringe that does not want to address this issue properly" (Knowles, 2000). Knowles further stated that "We have an interest and a desire to ensure that the Australian scientists who contribute so much to the health, wellbeing and prosperity of this country are able to continue to make this contribution. Today is science day" (Knowles, 2000).

Government senators issued a dissenting report which defended the Bill in its current form. They were "entirely opposed" to the OGTR becoming a statutory authority on the grounds that it was "economically unviable" (Government Senators, 2000: 182). They also argued that precluding an individual from holding office was "problematical" because the field is limited and so "... as long as an individual declares his or her interests, an application must be assessed on a merit only basis" (Government Senators, 2000: 182).

The Minority Report also argued that "An increased role for either or both of these Committees [Commmunity Consultative Group or Ethics Committee] would be entirely detrimental to the science-based decision making process. It would also be contrary to every other country's risk assessment policy and furthermore creates absolute uncertainty in the process" and result in "unacceptable delays" and "increased costs" (Government Senators, 2000: 184).

Thus, the recommendations of the Senate Report prompted a major lobbying campaign by industry and governments supporting GM agriculture. In the end, members of the Labor Party who had supported amendments to the Bill, made significant concessions in negotiations with the government in order to ensure the passage of the legislation. They eventually supported an amendment that would allow for state governments to opt-out but only on 'market' grounds. Local or state governments would not be able to declare GE-free zones on health, environmental, or ethical grounds. Thus, although the Senate Report was critical of many aspects of the proposed GT Bill, perhaps largely due to the committee membership of which the majority were non-Government, the recommendations still reflected the terms of reference set by the Government, preceded by the earlier Policy Principles. Not only that, the recommendations of the Report were largely ignored by the Government, due to concessions eventually made by the Labor members. Part of the function of the Inquiry then could be argued to be political point scoring between the two major parties, in an attempt to reproduce state power in this 'hot' issue. In other words, the inquiry was "... part of the political game of retaining and seeking power" (Prasser, 1985: 2). The Tasmanian Inquiry Report presented a different outcome again.

8.3.4 The Tasmanian Inquiry Report

The Tasmanian Government released its Report on Gene Technology in June 2001. One of the findings of the report was that zero tolerance in any production system is very difficult to achieve, and so the introduction of GM crops into regions where there is organic production will be problematic (Parliament of Tasmania, 2001). The findings of the report are largely based on the effects of GM on the Tasmanian market. While ethical and environmental issues are acknowledged, this is only in terms of market reaction. The report also claims that "Despite some concerns raised before the Committee, there was no scientific evidence of any known human health or safety concerns with appropriately regulated and approved GM food products." (Parliament of Tasmania, 2001: 15). Despite this, the Committee recommended an open-ended continuation of the moratorium. Critics were supportive of this result and have long argued that there have not been sufficient tests of such risks undertaken to show one way or the other (Carmen, 2000).

Responses to the Tasmanian Inquiry Report

In contrast to the Senate Inquiry Report which was largely discounted by the Federal Government, all fifteen recommendations of the Joint Select Committee were supported by the Tasmanian Government and incorporated into the State's Gene Technology Policy. This included "GM-free protected areas" to "… preserve the identity of our non-GM produce for market purposes". However, the policy then allowed for some areas not to be GM-free and did not ban further food crop trials in the field, and has given the green light for non-food crop trials (such as poppies). Thus, while the policy is encouraging and reflects the concerns of the majority of Tasmanians, it has stopped short of declaring Tasmania GE-free which is what green actors wanted to see. It is also only a temporary victory in that the Committee reported that there had been no evidence of harm from GE, implicating that it was a safe technology. Thus, the motivation for the moratorium appears to be purely on economic and trade grounds. If it is decided some time in the future that the GE-free option is not proving as financially viable as first thought, it could open the floodgates for GE in Tasmania.

The implications of this analysis and that of Chapter 7 are now addressed in Chapter 9 which provides a summary of the major arguments, methods and findings of the research, and makes suggestions for areas of future research.

9

Conclusions

This chapter reviews the major arguments, epistemology, methods, and findings of this research. Due to the bounded nature of the research as a PhD thesis in environmental studies, several areas for future research are identified. Improving our understanding of the nature and use of power relations in the GE policy terrain could be used to assist decision-makers in empowering ecological interests and to create an eco-politically informed policy structure – incorporating the precautionary principle, including its major tenets of open public participation and transparent decision-making.

As discussed in the introductory chapter of the thesis, the genetic engineering debate that emerged due to the ethical and policy dilemmas surrounding the technology is continuing, and indeed increasing. It was this concern among members of the public, some members of academia and the scientific community that forced an Australian parliamentary inquiry into genetic engineering in 1992. Despite this process and numerous recommendations resulting from it, there has, to this day, been little resolution between critics and proponents about the adequacy of biotechnology regulations. The criticisms raised at the initial inquiry were ongoing and environmentalists continued to express their concern about ensuring a long-term sustainable future for Australia and called for special legislation to address wider concerns about gene technology, including social, ethical and ecological issues. Environmentalists argued that biotechnology regulation in Australia is not based on the principles of ESD and the precautionary principle, but rather on the assumptions of a 'rational', business-as-usual approach. It has been the working hypothesis of the thesis that a business-as-usual approach is an inappropriate model for biotechnology policy in Australia, or indeed anywhere in the world, as evidence suggests that such a model will lead to increased environmental degradation and is antithetical to ecological principles.

However, the thesis demonstrates that self-regulation based on the DSP has long been characteristic of the GE policy terrain and ideologies and methods of the DSP continue to dominate, as is the case in most modern environmental policies. From the beginning, this has received criticism from environmentalists who object to such a model being institutionalised. Much of the rhetoric of environmentalists points to the need for profound changes in worldviews and policy practices to incorporate more holistic ideals, consistent with deep green conceptions of ESD and the precautionary principle, discussed in Chapter 4. Such claims have constituted the starting point for this investigation into the nature of Australia's GE policy terrain.

In this context, the most important question is: Is Australia's gene technology policy broad enough in its scope to facilitate long-term sustainability? Additionally, were the recent regulatory negotiations a genuine attempt to reform gene technology policy in this country, to include ecological principles, or was it a means to continue to strengthen biotechnology development and absorb protest on social, ethical and ecological issues as environmentalists charge?

It was argued in Chapter 2 that, ultimately, what is meant by ESD is a question of underlying values and ethics and these need to be made explicit. In the context of the thesis, it is the ecological formulation of ESD that has been adopted – the preservation of the integrity of ecology and dynamic relationships between all Nature is at the fore. It opposes unhindered economic growth and the marginalisation of alternative views and technologies, and rather encourages diversity. It embraces ecocentric partnership ethics and incorporates ecological, social, and ethical dimensions. It recognises the importance of the strong precautionary principle in cases of uncertainty and acknowledges complexity and subjectivity (discussed in Chapters 2, and 5). Similarly, the strong precautionary principle challenges modernity and the dominant scientific method and seeks a broader science that incorporates anticipatory action, places the burden of proof on proponents of the technology, and considers alternatives (Montague, 1998; Raffensperger, 2000). It also incorporates open and meaningful public participation, as discussed in Chapter 5. In order to achieve long-term sustainability, therefore, the incorporation of the strong precautionary principle in GE policy is needed. Applied environmental ethics therefore needs to be repositioned form the periphery to a central place within regulatory processes concerning gene technology (Hindmarsh and Risely, 2001). Thus, an underlying assumption of the thesis is that ecological principles should be part of the decision-making model for biotechnology policy, and it adopts Dryzek's notion of 'ecological rationality' which attempts to incorporate environmental/ecological discourse into the policy process, providing greater flexibility by recognising the uncertainty and complexity of ecological systems, which was outlined in Chapter 4.

In order to generate meaningful findings and conclusions, it is essential to recognise the complexity of the GE policy issue. Thus, the thesis has adopted a broad theoretical and epistemological framework that is inherent to environmental studies. A translation approach provided a useful tool for analysing the biotechnology 'text' and understanding and explaining strategic processes such as how agendas are set and decisions are made, addressed in Chapters 7 and 8. Its' most useful characteristic (outlined in Chapter 5) is the recognition of the need for fluid methodologies due to different visions, realities, truths and ideals (Law, undated). By also incorporating some discourse analysis, the method has helped in understanding how the biotechnology terrain is socially constructed and how groups involved have been negotiated. The thesis has established that different models of power are relevant to GE policy and discourse as they represent the broad spectrum of politics, in line with Parson's (1995) assertion that no one theory or model is adequate to explain the policy process. It further adopts the post-positivist approach of Fischer (1989; 1993) and Hawkesworth (1988), emphasising the importance of addressing social and political values, and the role of the state.

9.1 The Role of the State in the Australian GE Policy Terrain

The importance of the structural context of GE policy should not be underestimated. This context shapes policy and imposes a certain ideology (in this case the 'rational' DSP) on the policy process. The results of the research found that the recent policy processes were a continuation of previous manoeuvres by the biotech-network that acted to strengthen biotechnology development. This is due to unequal power relations between actors – corporations have a privileged position and can manipulate policy terms – resulting in successful translation strategies employed by the biotech-network. The green-network on the other hand has been unable to secure the resources to achieve such success in translating their own interests.

Thus, the findings show that pluralist models of power – that hold that there are no differences in the amount of power held by all individuals, and that account for only 'visible' decisions and actions – are clearly flawed. This is substantiated by the fact that, as Wynne (1982) recognised, even if the green-network does manage to mount counter-expertise to the biotech-network, the greater credibility of the proponents' arguments, due to their extensive resources, tend to win out in the end. Given this context, the state has conflicting roles in the GE policy terrain – supporting industry on the one hand, and appeasing public discontent on the other. Pressures are imposed on the state from outside by powerful individuals and coalitions, such as the biotech industry that is readily mobilised and heavily resourced.

These findings support Lindblom's (1977) work which points to the power of corporations in Western industrialised countries and their ability to block change induced by the state – the state is often persuaded that its role is to provide business with what it requires to be profitable, and so the state shows constant concern over business performance. The market can therefore constitute a significant constraining element on government policy. Lindblom outlines how big business often exercises its influence over the policy process through "persuasion, exchange, and authority" (Lindblom, 1980: 75). This is consistent with the results of the research which demonstrated that the state received pressure from industry groups who were pushing for a more certain regulatory environment for commercialisation of GE products and to encourage further investment from industry. This was evident in the State/industry funded public 'education' campaign, labelled by critics as 'propaganda'. It is just one example of how the huge resources of industry helped to translate their interests, promoting the industry and influencing public opinion. This included discrediting the views, methods and findings of opponents of the technology (as was the case for example with Arpad Putzai, discussed in Chapter 6), which commonly result in self-censorship. Thus, advanced capitalism can form a significant obstacle to the realisation of environmental policy goals that do not conform with business goals (Crowley, 1992). This is consistent with Dryzek's (1995) assertion that contemporary liberal democratic states are structured to respond to powerful forces of capitalism.

Structural constraints placed on the state by the power of capital are, therefore, significant. These constraints explain the political force of corporations and therefore, "... thought and action are conditioned to serve the interests of capitalism through ideological hegemony" (Cox *et al.,* 1985: 66). This hegemony perceives the dominant capitalist worldview prevail "... by distorting beliefs, values, common sense assumptions and popular culture" (Cox, *et al.,* 1985: 67). Thus, the market model based on 'rational' decision-making involving rational scientific methods (such as cost-benefit analysis) has dominated the policy field. In the GE policy terrain, decisions continue to be made according to this model – that GE can be implemented, managed and controlled and provide a 'public good'. This was clearly evident in the negotiations surrounding the regulation of gene technology in Australia, which also illustrated the importance of the role of the state and its associated institutions that set the policy agenda. The negotiations promoted a sense that there was a consensus position on environmental issues – under the banner of sustainability. This is consistent with McEachern's (1993) findings in relation to negotiations over the *National Conservation Strategy for Australia* and the *Ecologically Sustainable Development Reports*, discussed in Chapter 2 of the thesis. In the same way, the policy process surrounding GE regulation in Australia adopted the form that it did due to an already existing consensus among state and business interests on the over-riding importance of biotechnology/economic development (as discussed in Chapter 7). In both instances, the public forums that were held were a strategy to absorb the potentially destabilising influence of environmentalist and public interest groups and to promote economic growth and development.

Further evidence of this can be seen in the Government's policy principles for GE regulation. Incorporating Clegg's (1989) notion of the circuits of power, it can be seen that these policy principles played the pivotal role as an obligatory passage point for the biotech- network. The radical libertarian discourse, asserting that environmental problems can be resolved with better management (Doyle, 1999), is evident in these policy principles which read clearly as a business management strategy. The principles represented an elite, business-as-usual, top-down approach aimed at ensuring the unhindered growth of the industry. They reflected the requirements of the state outlined by Ashforth (1990), to foster innovation and international competitiveness through a streamlined and cost-effective regulatory system; separate issues based on scientific risk assessment from social, economic and ethical issues; and to gain public acceptance by portraying gene technology as a 'common good'. The benefits and inevitability of the technology were underlying assumptions, showing the mobilisation of bias that has occurred since the beginning of the GE regulatory process.

The terms of reference also served to silence many of the views held by environmental actors by ignoring the central issue of power and failing to question worldviews. By positioning the policy principles as an obligatory passage point, precautionary regulation was presented as an obstacle to the realisation of the interests of the actors within the biotech-network. Flexible regulation that would provide a more certain path to market for biotechnology products was presented as the best policy option by the state and industry. Given this socio-political context, it appears that changes made to the regulatory system were largely imposed to assist

Australia's biotechnology development, and allay public concerns so that commercialisation can run smoothly.

The research therefore indicates that the restrictive framework of the liberal democratic state is not equipped to deal with the complexities and uncertainties of biotechnology, and broader environmental problems. At present, the shaping of policy in favour of an eco-political ethic is restricted by this structural context which, as it stands, it is ill-equipped to deal with ecological principles and prevents true policy reform, and alternatives are undermined by the unconscious acceptance of the dominant ideology (Milliband, 1969; Poulantzas, 1973). Capitalist ideology based on a business-as-usual model is therefore inhibiting the shift from the DSP to an eco-political ethic. This has lead to conservative approaches to dealing with the problems of biotechnology, rather than more radical eco-political approaches.

The translation processes discussed serve to illustrate how corporations have helped to facilitate this conservative approach by dictating policy terms. The distinction between corporations and the state, between public and private, is becoming blurred in this era of corporatism, as discussed in Chapter 6. Thus, in contradiction to pluralist accounts, power is multi-directional and dispersed throughout society (see Doyle, 1995). This notion of business power being disproportionate in society is difficult to argue when the majority of decision-makers still act in accordance with the pluralist model. Having said this, it is also important not to overestimate business/corporate power either. As Adam Simpson found in a case study of Shoalwater Bay, their power, despite its extensiveness, can also be quite vulnerable (cited in Doyle, 1995).

Recognising this vulnerability, the alternative conceptions of power offered by Parsons and Foucault (discussed in Chapter 5), that purport productive and enabling forms of power (which are often ignored by all but theorists) deserve greater attention. These alternatives reject the concept of power as zero-sum, instead conceptualising it as strategic and interactive. It is important for these forms to be recognised in practice as well as theory – power in the policy context needs to be more openly discussed. Of great importance is Foucault's argument about the connection between modes of power and resistance – resistance itself being another facet of power. More work needs to be done on the way in which this alternative form of enabling power can be applied to the GE conflict and policy making (and to environmental conflicts and policy making generally).

A useful approach to conceptualise the translation processes discussed in Chapters 7 and 8 is through the concept of closure of controversy outlined in Chapter 5. For ease of discussion, the following will be divided into closure of controversy in the government domain and public domain respectively.

9.2 Closure of Controversy in the Government Domain

As identified by Hindmarsh (1994), in the context of earlier regulatory negotiations in the 1980s and early 1990s, the formation of the RDMC (the predecessor of GMAC) which incorporated self-regulation within existing forms of authority, was vitally important for the biotechnology industry to attain and retain power as it provided a conduit for the commercialisation of biotechnology. This history has been repeated in the recent policy processes with the formation of the GTTAC, essentially a reformulation of GMAC within the episodic circuit of power. This reformulation of another essentially self-regulating body under the umbrella of the OGTR continues to provide a conduit for the commercialisation of biotechnology. This is obvious by the ongoing participation of TNCs in the biotech-network. Thus, mirroring the earlier policy processes analysed by Hindmarsh (1994), the parameters for current regulation have taken on the values of commercialisation and capital accumulation, as well as reductionism, and, to a large extent, expert objectivity. Thus, the new legislation is not proper reform, but rather a formalising of existing structures of domination. Despite an ongoing campaign by the green-network, it was unable to secure the resources to achieve real reform in the form of a 'one-stop-shop' which would have provided a more holistic regulatory regime. Nor was it successful in securing a statutory authority rather than a single regulator. The efforts of the green-network were further undermined when the Government attempted to fast-track biotech development by watering down GM food labelling laws, through the first face of power, force.

The change in institutional location from DAS to DIST (later DISR) and then to the Department of Health and Aged Care, was essentially a reversal of moves in 1996 when the RDMC was transformed into GMAC and removed from the Department of Industry, Technology and Commerce (DITAC) and relocated in the Department of Administrative Services (DAS) which was seen as a 'safe' location where protest could be absorbed and issues, such as regulation, organised off the agenda (Hindmarsh, 1994). The placement of GMAC and the IOGTR in the Department of Health served to shift the focus from the controversial area of agricultural applications, to a focus on the benefits it could provide for human health – an area that was known to be less controversial in the public domain. The Government claimed that this move was to separate the regulation of GE from its promotion, in order to achieve public acceptance, however, responsibility for public education and the promotion of the technology remained within the same department (DISR) presenting a clear conflict of interest.

The positional power of the IOGTR enabled it to fix a narrow regulatory agenda and was the central authority for the problematisation of the GT regulation issue, as well as its final 'solution' in the form of the GT Act 2000. The IOGTR (and later the OGTR) was empowered as the regulatory site of translation for biotechnology research and development, and the site of legitimisation of its safety. The IOGTR's policy processes were based on the assumptions that biotechnology was a fait accompli in Australia, despite calls from the green-network that the issue of whether or not the technology should proceed should be debated in the public domain. Such public debate was organised off the agenda. Actors in the biotech-network were enrolled to biotechnology as not only acceptable and inevitable, but essential.

Closure of controversy through the redefinition of issues was another form of translation process that demonstrated the strength of the biotech-network's political campaign (not scientific debate as it would like the public to perceive it) that was occurring on a global scale, as discussed in Chapter 6. The issue was framed as one of a technology that could provide the means to feed growing populations, increase agricultural yields and profitability, overcome unfavourable environmental conditions through applications such as drought and salt-tolerant plants, and improve the human condition through applications such as functional foods. At the same time, the booming technology would lead to increased wealth and jobs. Any dissent was therefore declared as a threat to job security, agriculture, the environment, and ultimately sustainability. The discourse of sustainability, therefore, has been co-opted by the biotech-network, using it to promote GE as the answer to environmental and social problems. In this way, environmentalists were defined as a group of 'hysterical' radicals, and the broader ethical, moral, philosophical, and social issues, were effectively marginalised. The focus was on technological fixes for the symptoms of environmental, agricultural and social problems rather than on the broad range of issues behind their causes.

An essential outcome of this translation was to gain a clear regulatory path to commercialisation with minimum restrictions. Through this process, the proponents hoped to gain public confidence, with any risks then framed as justifiable for such 'noble' causes. The ultimate outcome was the acceptance and implementation of a cautionary, rather than a precautionary, regulatory scheme within the episodic circuit of power, with the strong precautionary principle excluded from the legislation.

Breaches of the regulatory guidelines during the regulatory negotiation process could have acted to swing the balance of power from the biotech-network to the green-network. However, the green-network did not acquire the resources to achieve a moratorium on planned releases, but it did achieve a small victory in having the breaches investigated in the Senate Inquiry process.

Thus, to summarise, the manoeuvres of the biotech-network strengthened their position by continuing to determine the parameters of the regulation of GMOs in Australia which it has done from the beginning. The obligatory passage point to control of the agenda was constructed through the reconfiguration of GMAC into the GTTAC. In this way, regulatory structures of domination have been produced and reproduced in the first circuit of agency power, reflecting a direct continuation of the trends found in the earlier regulatory processes.

9.3 Closure of Controversy in the Public Domain

The biotech-network strove to close the controversy in the public domain by 'sound argument'. The focus was on winning over the public to the benefits of GE, not providing unbiased factual information. Thus, a concerted effort of 'disinformation' was mounted by government departments and agencies that supported biotechnology (discussed in Chapter 6). The issues were framed in terms of needing flexible regulation of a technology that was necessary to solve the nation's (and the world's) environmental, agricultural and social problems. As already stated, other issues such as the ethical, social and economic causes of these problems, and also the question of whether the technology should proceed, and therefore need legislation at all, were deliberately avoided so as to organise them off the policy agenda.

The biotech-network sought to absorb protest through a number of strategies. They remained in control of the agenda through written reports such as the government's discussion papers; the reformulation of GMAC as GTTAC, thereby retaining power in existing structures of domination (as discussed above); limiting the powers of the GTEC and GTCCC; blocking the development and implementation of unbiased education initiatives including those of NGOs; and cooptation of green interests into the membership of GTEC and GTCCC. Given that biotech industry actors have a long history of blocking public participation and their strong objection to such participation throughout the policy process, inclusion of actors such as Bob Phelps (director of the GeneEthics Network) on the community consultative committee, for example, suggests that it was another absorption of protest manoeuvre.

The biotech-network was also in control of the agenda throughout the public consultation process, inviting in the initial stages only 'selected stakeholders' to participate. The discussions were based on the form that the legislation should take, and not on questions relating to whether or not the technology should proceed or whether there were viable alternatives. The policy principles restricted debate and acted as an obligatory passage point for the translation of biotech-network interests. Thus, the IOGTR continued the relatively closed processes of its predecessor, GMAC.

The final GT Act 2000 demonstrates the way in which the earlier policy principles and also the terms of reference for the public inquiries into GE continued to act as obligatory passage points for the biotech-network. They succeeded in translating their views that a moratorium on GE releases was not warranted, that precautionary regulation would be detrimental to Australia's competitive future in a global market, and consequently that the strong precautionary principle should not be embodied in the legislation.

Inclusion of a weak version of the precautionary principle in Section 4 of the Act, despite overwhelming calls by environmentalists and the public for inclusion of the strong precautionary principle (discussed in Chapters 7 and 8), therefore, reflects the successful translation by the biotech-network that the precautionary principle is not a legitimate tool for rational decision-making and that it threatens to restrict GE progress. By embracing a cautionary approach, the GT Act lent itself to a minimalist regulatory regime that primarily facilitated a 'business as usual' approach which, as stated throughout the thesis, is not an appropriate model for decision-making. Thus, in many ways the GT Act 2000 can be seen as the legislative entrenchment of GMAC, although this is overly simplified. The result is lightweight overarching legislation with the weight of the system contained in the regulations. The legislation only regulates certain dealings with GMOs and the Regulator has the power to exempt certain GMO dealings, neither of which is consistent with the principles of ESD which places the emphasis on precaution and shifts the onus of proof to the applicant. The main role of the weak precautionary principle in the legislation therefore appeared to be one of appeasing certain interests rather than questioning modern science as being too reductionist to adequately address uncertainty and risk. Such evidence reveals that the precautionary principle in this policy context is a weak or light green version in a role of cooptation (Hindmarsh and Risely, 2001). Significantly, as O'Riordan and Jordan (1995: 197) assert, light green versions are applied to the most environmentally destructive activities. In this context then, the precautionary principle offers a legitimising purpose to high risk activities by providing the appearance of a green ethic while marginalising the strong precautionary principle which would fundamentally challenge those activities.

Hindmarsh (1994) found that, in the earlier policy processes focussed around the 1992 inquiry, biotechnology critics had been unable to attain power in the socially insulated policy process because they lacked the key resources to do so. He concluded that the main reason for this was a lack of strong bureaucratic power, the relative lack of a strong inter-organisational policy network, and an uninformed public to recruit from, as well as a lack of money and personnel (Hindmarsh, 1994: 401). Within the context of the recent policy processes, the same problems remain – despite the acknowledgement of these problems by actors of the green-network, they have not been able to resolve them. However, the increased role of public inquiries in the policy process has given them a voice. We now turn to look in more detail at the closure of controversy in the public domain through the inquiry process.

9.3.1 Closure of Controversy Through Inquiry

With the exception of the Tasmanian case, the inquiries served as obligatory passage points for proponents to secure a minimalist regulatory regime. This was despite the fact that the Senate inquiry was secured by the opposition government, Australian Democrats and the Greens and therefore could have acted instead as an obligatory passage point to secure a precautionary regulatory regime. The fact that the green-network was unable to secure this outcome suggests that the initiation of the inquiries was a further absorption of protest strategy. This is not surprising in the case of the HRSC inquiry held by the Department of Primary Industries and Regional Services, with an interest in gene technology development and innovation. Also, in the case of the HRSC inquiry, given that it covered many of the same issues as the 1992 inquiry, it needs to be asked why there was a need to conduct yet another similar inquiry. To answer this question, we must look at the power relations involved. As Wynne (1982: 56) points out, control is frequently exercised over inquiries in collaboration with powerful private industrial concerns – the "elective autocracy". It can be argued that this was the case in the HRSC inquiry, and also the Senate inquiry, with private industrial interests reflected in the values dominating State administration (see Wynne, 1982). The Government's view in the case of GE is identical to the industry's – that sections of the public opposed to GE are being 'irrational'. The HRSC inquiry therefore enabled the industry to present a coherent public case, with appropriate 'rational facts' in favour of the technology. Pressure to include questions of broader socio-economic, ethical and moral issues had to be resisted by defining the terms of reference carefully. Thus, the inquiry provided a focus for those with a stake in the technology to join forces and act cohesively to produce a strong case for GE and to improve its tarnished public image. In so doing, this would make it easier to propose legislation in their favour.

The inquiries can therefore be seen as "reckoning schemes of legitimation" (Ashforth, 1990) – conduits for the reproduction of State power via the strong links between government and industry, and also via the forms of communication organised (see also Wynne, 1982). The authority of the inquiries stemmed from their social and epistemological status as 'objective' finders of 'facts'. Ashforth (1990: 7) argues that "epistemic predilections of modernity" mean that inquiries look for a rational cause and solution to a problem. This involves the common language of 'science' and 'reason' to articulate these problems and solutions, giving the State the power to frame questions with institutionalised language. Burton and Carlen (1979) argue that inquiries represent:

> … a system of intellectual collusion whereby selected … intelligentsia transmit forms of knowledge into political practices. The effect of this process is to replenish official arguments with both established and novel modes of knowing and forms of reasoning (Burton and Carlen, 1979: 8).

Thus, Ashforth asserts that "… it is in Commissions of inquiry that we find the examples of the formation of rational and instrumental discourse *par excellence*" (Ashforth, 1990: 3). This is true of the Australian inquiries that served to replenish arguments of rational and scientific administrative discourse. Continued economic development was seen as essential, and it was argued that GE provided the only means for Australia to remain internationally competitive in Agriculture and food production, and that consequently, Agricultural GE was a 'public good'. 'Problems' were framed in terms of scientific risk which could in turn be addressed by the practical and rational tool of risk assessment and management within a minimalist, 'flexible' legislative framework.

Another purpose of the inquiries may have been to establish connections between organisations of the state and the significant elements of power in society. As Ashforth (1990: 4) argues, this is a very important function during "crises of legitimacy" for state power. In the case of the Australian inquiries, by bringing actors such as the Greens, Democrats and NGOs such as the GeneEthics Network, into the process of discussing policy, the Government could "… help to appease discontent of those with the power to threaten the stability of the state" (Ashforth, 1990: 4). Also, the establishment of the possibility of dialogue, or the appearance of dialogue, as well as the silencing of certain interests, are essential elements of power of the State (Ashforth, 1990).

Through the terms of reference, the State also structured to a large extent the process of opinion formation, restricting discourse to the technical and rational issues of GE regulation and marginalising alternative worldviews. This is clearly evident in the case of the debate over precaution (introduced in Chapters 2 and 5). As revealed in Chapters 7 and 8, there was a significant call for the strong precautionary principle from critics, despite the limiting terms of reference for the inquiries. However, as already discussed, the HRSC report dismissed the PP and while the Senate inquiry report called for its implementation, this recommendation was rejected by the Government, and a weak version adopted in the legislation. While the Tasmanian government did apply precaution by implementing a moratorium on GE in that state, this was done on economic grounds alone. Thus, the inquiries acted to marginalise the strong PP from the evaluation of GE. As Wynne (1982: 57) asserts, "… the frequency of demands for larger perspectives, and their equally frequent refusal, indicates that longer-term political control is the real issue at stake".

In addition to the limited terms of reference:

> Only ... fragments are exposed to public participation, and the government can therefore control the comprehensive vision. Participation at inquiries is usually expensive, elaborate, and exhausting, but it is also highly structured by the political centre (Wynne, 1982: 59).

Thus, public hearings and oral evidence are symbolic, portraying the State as serving the interests of society and that it is open to all views. In the process of questioning and cross-examination, however, contentious matters are transformed into discourses of reasoned argument (Ashforth, 1990) and so alternative views are again marginalised. Thus, while this process serves as a source of marginalisation for opponents, it serves many beneficial purposes for the State. For example, the articulation of policy positions by actors benefits the State by adjusting relations between it and other centres of social power, and enables them to gauge support and resistance to possible initiatives, as well as to reduce the number of representatives that must be heard for decision-making, and to secure adherence to agreed compromise (Ashforth, 1990: 15).

Therefore, in the context of the literature on the role of inquiries, the analysis of the Australian inquiries would suggest the following reasons for the inquiries being held: 1) to appease the discontent of interest groups with the power to threaten the stability of the State; 2) by association secure adjustment of conflicting interests, involving participation of interested actors as an inducement to compliance with the results; 3) to 'educate' the public or mobilise support for action which the Government did not want to take solely on its own responsibility 4) to overcome limitations of resources within the bureaucracy; and 5) to empower key interest groups, namely those of the biotech-network (industry and government involved in rDNA research) (Ashforth, 1990; OECD, 1979).

Thus, while environmentalists may seek the enhancement of opportunities for democratic participation through the increasingly popular avenue of the public inquiry (Paehlke and Torgeson, 1990; Stone, 1993), it is important for them to recognise that the decision to hold an inquiry, and the fate of its recommendations, are shaped by the political priorities of the government of the day. As Dryzek (1990) concludes, discursive designs such as inquiries are not blueprints for an alternative administration but do offer a challenge to dominant institutional forms and offer hope of an alternative. They may also serve to give them a voice to a potentially wider audience. In seeking public participation and open debate, inquiries also allow reflection upon the processes that give rise to them. At present, these processes are framed by principles of modernity, and so critical reflection allows for the consideration of alternatives towards a more reflexive modernity (see Beck, 1992). Such reflection may facilitate the broadening of the precautionary scope of Australia's GE policy.

9.4 Expanding the Precautionary Scope of GE Policy

There is much uncertainty about the social consequences of new technologies and this has continued to drive the debate about gene technology and sustainable futures (Turnbull and Hindmarsh, 2001). The green movement has, therefore, increasingly promoted the ESD concept of the precautionary principle to be applied in all areas involving uncertainty and risk. Reflecting the rising popularity of the precautionary principle since the early 1990s, it emerged in the recent Australian inquiries into GE as a strongly held imperative for inclusion in the regulations. They maintain that it is appropriate, and indeed necessary, to counteract the risks and uncertainties associated with science reduced to serving the interests of TNCs (Meyer, 1999).

As discussed in Chapter 2, the precautionary principle is not a strict formula for environmental decision making, but rather it provides guidance on how to respond to possible environmental impact in cases of scientific uncertainty. This 'institutionalisation' of the treatment of uncertainty in environmental decision making is seen by a growing number of environmental commentators as an important step in the right direction for environmental protection (Harding, 1998: 190) and therefore future sustainability. It challenges the established scientific method, although the tension between science and precaution is not inevitable. The strong precautionary principle is about broadening science to include a wider range of values and possibilities and interpreting scientific evidence in socially responsible ways (Saunders, 2000). Ways need to be sought to incorporate these precautionary and ecological values into decision-making if ESD is to be achieved.

Public participation is an important way that precaution can be achieved and a wider range of values and alternatives incorporated into the policy process. One way that ecological interests can be achieved is through public pressure, with industry shown to yield to pressure based on self interest (see Rissler and Melon, 1990). A more open regulatory system is more likely to be acceptable to the public, and industry would also benefit as a result. As Wynne (1988: 164) queries: "If experts...are concerned to maintain (or restore) legitimation, as they increasingly appear to be, are they prepared to yield some power in order to buy legitimation – or do they want to have their technological cake and eat it?" Chapters 3 and 4 of the thesis demonstrated the need for holistic, socially responsible science in GE policy, and Chapter 5 outlined the importance of public participation in this context, which raises the important issue of further research into these and related areas.

9.4.1 Implications for Future Research

Given the limitations placed on the research by its nature as a multi-disciplinary thesis covering many wide-ranging theoretical and practical spheres, there is a need for greater research into this area. A better understanding of the nature and use of power in the biotechnology policy terrain is essential to empower and inform environmentalists of the power options available to them, and those likely to be the most successful in achieving desired outcomes. Improved ways to empower the green-network, enabling it to achieve its goals is also a valuable area of investigation.

As Hay (2002: 310) asserts, "It is one thing to point out the ecological failings of liberal democracy. It is another thing entirely to devise democratic structures that can be sourced to ecological principles". A key finding of the research therefore, is that further research needs to be conducted to develop a comprehensive way for ecological ethics to be incorporated into GE policy and state structure so that long-term sustainability can be achieved. Ultimately, there needs to be a shift in the power structures of science/biotechnology to include green actors and incorporate green ethics, including the strong precautionary principle. Planned releases of GMOs are a relatively new challenge for policy, and only through application of the strong precautionary principle and subsequent analysis can it be established whether it is the key to effective policy reform. Further research into this area is therefore warranted given this promising line of research advanced in the thesis.

As discussed in 4, there is a crisis of confidence in modern decision-making systems, and for some this is seen as the result of the 'age of science', outlined in Chapter 2, where citizens relinquished their decision-making powers to the 'experts'. This crisis has been increased by what Endre (1993) terms "institutionalised environmentalism", whereby environmental concerns are placed within the hierarchical and patriarchal system of legal regulation, further alienating community participation in decision-making. This failure by government to effectively involve the public in decision-making also symbolises the government's failure to acknowledge ecological values (Messer, 1992). Ways therefore need to be found to open up the regulatory system and incorporate meaningful public participation.

The results of the thesis found that fundamental decisions had already been factored into the decision-making process by the time the public was asked to react and so permitted changes were marginal. This reinforces the need to develop pathways for access to decision-making processes at the earliest possible stages. This would allow for controversial issues to be aired during policy development rather than excluding controversial views at a later stage (Holman and Dutton, 1978). In addition, adversary processes can illuminate issues involving different values and priorities, a process which was denied in the public consultation process of the development of the draft gene technology bill when 'proponents' and 'critics' were grouped separately (discussed in Chapter 7).

Public membership on government committees can be problematic when Ministers choose the nominees and ultimately decide the final membership, as well as many problems associated with the bureaucratic system. However, such membership can provide greater access to information, which can give the public and environmentalists the opportunity to present their cases more effectively. It can also improve the capacity to assist interest groups, while also ensuring that decision-making is more informed (see also Messer, 1992). Research into the effectiveness of the new committees under the OGTR now needs to be undertaken to see whether the powers of the ethics and community committees are sufficient (which the findings of the thesis suggest they are not), and if not how meaningful public participation can occur within this context.

Consensus conferences (CCs), originally developed in Denmark where there is a strong history of action research (Rappert, 1996), have been used around the world to broaden the debate on controversial issues such as the biotechnology debate, and one such CC was held in Australia in 1999, as discussed in Chapter 6. By mixing experts with a panel of lay members, CCs encourage citizens to play a more pro-active role in the policy process. While these CCs have not demonstrated a strong, direct policy influence, and questions have been raised over how representative they are, they have nevertheless demonstrated that lay people can understand and tackle complex issues, and also demonstrated the political nature of so-called 'technical' issues. They also facilitate information dissemination to the wider public through media coverage, and may therefore stimulate public debate. However, the major criticism of CCs is that their topics are decided by politicians and 'experts', again raising the significance of agenda setting, discussed in Chapters 5 and 7, that limit democratic decision making. Modes of public participation are beyond the scope of this thesis, but future research can address the usefulness of various models such as citizen advisory panels, science courts, and informal hearings, to assess which offer the best avenues for accountability, openness, objectivity and ecological values (see also Krimsky, 1984). Ways to encourage and attract broad participation and to create new community networks are also needed. As discussed in Chapter 4, local, informal and traditional knowledge have a legitimate role to play in decision-making that is ecologically sound.

Theories of political power are again important to concepts of public participation, and public participation could benefit from further research relating it to these theories. As asserted by Wengert (1976: 38), "...no theory or procedure for participation can be adequate if it does not deal explicitly with how participatory processes relate to the formal structures of government, including the regular representative system..." It has, therefore, been recognised that participation without the redistribution of power is a frustrating process for the powerless and can actually serve to reinforce the status quo (Holman and Dutton, 1978: 1531). The results of the thesis are consistent with such claims. They have shown that ultimately meaningful public participation requires power re-distribution, and further research needs to be done on how this can be best achieved, with community participation becoming central to environmental decision-making. With power conceptualised as contextually specific and unstable, decentralised alliances and resistances are possible ways for marginalised people to act (Pinn and Horsfall, 1999: 8). Working towards more effective FOI legislation and stronger third party rights (discussed in Chapter 7) are realistic goals for environmentalists.

9.5 Concluding Remarks

Of great concern are the expanding private ownership of genetic materials, and the growing concentration of control over plant breeding and seed industries. Biotech-industrial agriculture is enabling 'life science' TNCs to extend their control over the entire food chain.

This trajectory is facilitated by the current policy structure of the liberal democratic state that relies on the principles of economic rationalism and sound science for decision-making. Corporate interests dominate the policy agenda and marginalise ecological imperatives.

I agree with other commentators who argue that GE is driven by an outmoded genetic determinist science. There is the almost unquestioning belief that technology brings progress, growth, and benefit, and this is evident by the underlying assumption that the problems of gene technology can be resolved solely by scientific risk management, which is reflected in the regulation of GE in Australia. However, the risks of GE are not just scientific and technical, but also environmental, social, ethical and economic – a point that has been fervently argued by environmentalists for decades. Thus, there is a need for policy-makers to be more socially responsible and question the worldviews and assumptions that influence decision-making. Additionally, the unequal power relations between actors in the biotechnology policy terrain need to be urgently addressed, and more flexible and genuinely transparent organisational decision-making structures put in place.

I am hopeful that this research has helped to further the cause of encouraging new ways of thinking about biotechnology policy problems in particular, and environmental policy problems in general. The inclusion of broader eco-political issues and principles, including greater public participation and information, is a vital imperative of precautionary policy – an important challenge to be met in order to move towards a sustainable future.

Appendix 1

Summary Analysis of Discussion Paper Submissions

Category	Percentage	Total	
Firm Proponents	28%		
Moderate Proponents	6%	Proponents	34%
Middle Ground	11%	Middle Ground	11%
Moderate Critics	12%	Critics	44%
Firm Critics	32%		

Appendix 2

Senate Community Affairs Reference Committee Inquiry into the GT Bill 2000:

Terms of Reference

1.1 The Gene Technology Bill 2000 and two related Bills, the Gene Technology (Consequential Amendments) Bill 2000 and the Gene Technology (Licence Charges) Bill 2000, were introduced into the House of Representatives on 22 June 2000. The Bills were debated in the House on 28, 29 and 30 August. The Bills passed the House on 30 August and were introduced into the Senate on the same day.

1.2 On 28 June, the Senate referred the provisions of the Gene Technology Bill 2000 to the Committee for inquiry and report, with particular reference to:

Objectives

(a) whether measures in the Bill to achieve its object 'to protect health and safety of people and to protect the environment' are adequate;

(b) whether the proposed regulatory arrangements and public reporting provisions will provide sufficient consumer confidence in the regulation of the development and adoption of new gene technologies;

The Office of Gene Technology Regulator

(c) structure of the Office of the Gene Technology Regulatory (OGTR) and its assessment processes compared with other proposed stakeholder models and similar overseas bodies;

(d) whether the powers and investigative capability of the OGTR are adequate to ensure compliance with conditions imposed on licences;

(e) whether the proposed cost recovery and funding measures for the OGTR are appropriate and will allow for adequate resourcing of the Office;

Other proposed bodies

(f) the role of membership of the proposed Ministerial Council;

(g) the functions and powers of the Gene Technology Community Consultative Committee and the Gene Technology Advisory Committee;

(h) procedures for review of decisions and, in particular, the rights of third-parties to seek review of decisions;

Other issues

(i) liability and insurance issues relating to deliberate and accidental contamination of non-genetically modified crops by genetically-modified crops and how those issues are being addressed in international regulatory systems;

(j) the validity and practicability of any proposed clause allowing individual States the right to opt out of the scheme and the implications of such an option in the context of Australia's international trade and related obligations; and

(k) the alleged genetically-modified canola contamination in Mount Gambier and the processes followed by the Interim Office of Gene Technology in investigating and reporting on the allegations.

Appendix 3

The House of Representatives Standing Committee on Primary Industries and Regional Services Inquiry into Primary Producer Access to Gene Technology:

Terms of Reference

The House of Representatives Standing Committee on Primary Industries and Regional Services will inquire into and report on the following areas, with particular emphasis on the capacity of small and medium sized enterprises to access the benefits of gene technology:

- The future value and importance of genetically modified varieties;
- The ability for producers to compete using traditional available varieties;
- The commercialization and marketing of agricultural and livestock production varieties;
- The cost to producers of new varieties;
- Other impediments to the utilization of new varieties by small producers;
- Assistance to small producers to develop new varieties and the protection of the rights of independent breeders, in relation to genetically modified organisms;
- The appropriateness of current variety protection rights, administrative arrangements and legislation, in relation to genetically modified organisms; and
- Opportunities to educate the community of the benefits of gene technology.

Referred by the Minister of Agriculture, Fisheries and Forestry on 30 March 1999.

Appendix 4

The Tasmanian Joint Select Committee Inquiry into Gene Technology:

Terms of Reference

Both houses of the Tasmanian Parliament on 6 September 2000 ordered that a Joint Select Committee be appointed with power to send for persons and papers, with leave to sit during any adjournment of either House exceeding 14 days, and with leave to adjourn from place to place, and with leave to report from time to time, to inquire into and report upon:

- The economic costs and benefits for Tasmanian and individual industry sectors in relation to genetic modification in primary industries.
- Market opportunities and associated strategies for Tasmania as a producer of genetically-modified and non-genetically modified products.
- Environmental risks and effects of the use of genetically-modified organisms in Tasmanian primary industries.
- Social and ethical issues surrounding the use of gene technologies with particular regard to Tasmania's primary industries.
- Assessment processes for genetically modified food.
- The application of genetic modification techniques to non-food crops and the risks and benefits of the use or avoidance of genetic modification techniques in non-food primary industries products in Tasmania.
- Assessment of proper strategies for primary industries research and development in Tasmania.

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