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CANADA’S BIOTECHNOLOGY STRATEGY: STRUGGLES ON THE KNOWLEDGE COMMONS

Wilhelm C. Peekhaus

CANADA'S BIOTECHNOLOGY STRATEGY: STRUGGLES ON THE KNOWLEDGE COMMONS

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Wilhelm C. Peekhaus

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CERTIFICATE OF EXAMINATION

Supervisor	Examiners
Dr. Nick Dyer-Witheford	Dr. Elisabeth Abergel
Supervisory Committee	Dr. Ajit Pyati
Dr. Samuel E. Trosow	Dr. Samuel E. Trosow
Dr. Jeffrey Nisker	Dr. Tony Weis

The thesis by

Wilhelm C. Peekhaus

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Abstract: This research critically analyses a number of the social, economic, environmental, and informational questions that attach to biotechnology in the context of Canada's Biotechnology Strategy. A neo-Marxist biopolitical framework that draws on a number of theoretical elements from autonomist Marxism informs the conceptual scheme. Much like Marx's methodological orientation based on the perspective of the working class rooted in its own historical activity, contemporary efforts at understanding and situating the current conjuncture of capitalist social relations can be advanced through research into the genealogy of social and political opposition movements. By apprehending these emerging subjectivities we might begin developing a new social vision of our own era. It is precisely those struggles mobilised around biotechnology issues in Canada that this research seeks to elaborate. Drawing on documentary analysis and interviews, the research seeks to determine the role the Canadian Biotechnology Strategy has played in commodifying biotechnology and biotechnological information as part of the social factory, and to interrogate the counter struggles that have emerged to resist the enclosure of the biological and the knowledge commons, with emphasis on the information and knowledge issues encompassed by such struggles. A basic presupposition of this research is that the commodification of biotechnology, as a branch of science that has assumed a central role in production as a source of new knowledge, offers an exemplary case study of both the mobilisation of the social factory in contemporary society and the scope of counter struggles that, themselves, include a variety of information and knowledge issues.

Keywords: Canadian Biotechnology Strategy, Biotechnology, Autonomist Marxism, Primitive Accumulation, Knowledge Commons, Resistance, Intellectual Property

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Abbreviations Used

BACC:	Biotechnology Assistant Deputy Minister Coordinating Committee of the Government of Canada
BMCC:	Biotechnology Ministerial Co-ordinating Committee
CAUT:	Canadian Association of University Teachers
CBAC:	Canadian Biotechnology Advisory Committee
CBAN:	Canadian Biotechnology Action Network
CBD:	United Nations Convention on Biological Diversity
CBI:	Council for Biotechnology Information
CBS:	Canadian Biotechnology Strategy
CFIA:	Canadian Food Inspection Agency
CGIAR:	Consultative Group on International Agricultural Research
CIDA:	Canadian International Development Agency
CIHR:	Canadian Institutes of Health Research
CRSB:	Canadian Regulatory System for Biotechnology
DNA:	Deoxyribonucleic Acid
EST:	Express Sequence Tag
ETC:	Action Group on Erosion, Technology and Concentration (formerly RAFI – Rural Advancement Foundation International)
GATT:	General Agreement on Tariffs and Trade
GURT:	Genetic Use Restriction Technology
HGP:	Human Genome Project
HUGO:	Human Genome Organization
IPM:	Intellectual Property Mobilization Program
ISAAA:	International Service for the Acquisition of Agri-Biotech Applications
mRNA:	Messenger Ribonucleic Acid
NFU:	National Farmers Union
NIH:	National Institutes of Health (American)
NRC:	The National Research Council Canada
NSERC:	Natural Sciences and Engineering Research Council
PBR:	Plant Breeders' Rights
PCR:	Polymerase Chain Reaction
R&D:	Research and Development
rBGH:	Recombinant Bovine Growth Hormone
rBST:	Recombinant Bovine Somatotropin
RNA:	Ribonucleic Acid
S&T:	Science and Technology
SBSTTA:	Subsidiary Body on Scientific, Technological and Technical Advice to the United Nations Convention on Biological Diversity
SNP:	Single Nucleotide Polymorphism
SSHRC:	Social Sciences and Humanities Research Council
TRIPs:	Trade Related Aspects of Intellectual Property Agreement
UPOV:	International Union for the Protection of New Varieties of Plants
WTO:	World Trade Organization

Chapter 1. Introduction

1.1 Overview of the Proposed Research

> Biotechnology presents an exceptional economic opportunity for Canada in the 21st century. This enabling technology can strengthen Canada's competitiveness and open up export markets by creating value-added industries in the health, pharmaceuticals, agriculture and natural resources sectors. It holds the key to a productive, prosperous economy that creates sophisticated jobs for today's young knowledge workers and the youth of tomorrow (Government of Canada, 2004, p. 42).

Canada, like a growing number of countries around the globe, has embarked on a path of government-sanctioned commodification of biotechnology. In fact, the following oft-asserted statement about biotechnology is becoming clichéd: "Biotechnology is positioned to have as significant an effect on Canada over the next 15 years as the Internet has had over the past 15 years. Canada must be poised to take advantage of its socio-economic potential" (Government of Canada, 2005). As a number of commentators point out, national states are increasingly compelled to actively promote new science and technological sectors to underwrite national competitiveness in a globalised trade environment characterised by capital mobility and free trade (Industry Canada, 2005).[1] As indicated by the introductory quotation, impetus for growth in biotechnology[2] also derives from the predicted economic benefits to be reaped as this industry sector expands.

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[1] Since as early as 1988 commentators have pointed out that almost every developed country and a number of developing countries are positioning leadership in biotechnology as a national economic goal. See, for example, Busch, L., Lacy, W. B., Burkhardt, J., & Lacy, L. R. (1991). *Plants, power, and profit: Social, economic, and ethical consequences of the new biotechnologies*. Cambridge, MA: Basil Blackwell.

[2] Following Martin Kenney (1998), this work considers the business of biotechnology as an amalgam of the science of molecular biology and the engineering methods used in biochemical engineering and other technologies that together produce biological products that are readily commodifiable. See, Kenney, M. (1998). Biotechnology and the creation of a new economic space. In A. Thackray (Ed.), *Private science: Biotechnology and the rise of molecular sciences* (pp. 131-143). Philadelphia: University of Pennsylvania Press.

> In the early 1980s when prophesies of genetic engineering were articulated and employed to win resources, the seers foretold a world in which wealth would relate to the ability to manipulate the new science. After numerous reports extolled its importance and power, every major industrial power invested heavily (Industry Canada, 2005).

Although not all the early and exuberant profit expectations promised by optimistic market observers have yet materialised,[3] commercial firms, nonetheless, have significantly expanded their biotechnology research agendas and, according to many observers, they will continue to exercise a dominant role in this economic sector (Government of Canada, 2005). Some of the leading trends in biotechnology include: substantial increases in the creation of biotech start-ups; expanded merger and acquisition activity between smaller biotech firms and established pharmaceutical and agro-chemical companies; and a growing number of partnerships between commercial firms and academic institutions engaged in basic and applied research. In respect of corporate academic linkages, Krimsky (1991, 2003) asserts that a new ethos among scientific researchers in academia has transformed the conception of knowledge dissemination to include transfer to the industrial system. This is an ethos fully supported by the Canadian federal government, as demonstrated by its assertion that "[t]o fully capture the social and economic benefits of federal investments in basic research and information technology, there must be opportunities to translate new discoveries into biotechnology products and services through commercialization" (Government of Canada, 2005). It is more

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[3] In 2002 Stephen Leahy, an environmental journalist, wrote that "[f]ederal and provincial governments have long had a love affair with genetics, pumping billions into the biotech biz since the early 1980s.... So, 20 years later and how many breakthrough products has biotech produced?... The industry consistently overhypes the benefits and downplays the risks of a revolutionary new technology" (Leahy, 2002, p. 41). See, Leahy, S. (2002). Biotech hope and hype: The genetics revolution has failed to deliver. *Maclean's, 115(39),* 40-43. Devlin Kuyek (2002, p. 6) offers an even more scathing commentary: "Ottawa bureaucrats have such blind faith...that they have eagerly poured billions of dollars into a money-losing industry like biotechnology, which is terrible at producing anything worthwhile but very good at selling itself as 'cutting edge.'" See, for example, Kuyek, D. (2002). *The real board of directors: The construction of biotechnology policy in Canada, 1980-2002.* Sorrento, BC: The Ram's Horn.

concretely supported through the allocation of federal funds to finance biotechnology commercialisation projects, such as: the Industrial Research Assistance Program that has invested $60 million between 1998 and 2006; Technology Partnerships Canada, which provided $293 million between 2001 and 2006; the Canadian Institutes of Health Research that disbursed $13.8 million between 2001 and 2006; the Scientific Research and Experimental Development Tax Incentive Program, which has furnished $212 million in tax credits and refunds between 2003 and 2006;[4] and, the Business Development Bank of Canada, which has committed $154 million to life science projects, with plans to increase that amount to $191 million over the fiscal 2006-2010 planning period (Government of Canada, 2005).

Nonetheless, the corporate appropriation of biotechnology has met with resistance. Opposition to the commodification of genetic research traditionally stems from distrust of the motivations behind commercial ventures, concerns about sacrificing the objectivity of scientific research, painful memories of the recent historical experience of the eugenic movements associated with applied genetic research, and the complicated array of social, legal, and ethical issues that attach to genetic research (Government of Canada, 2005).

It is against such a backdrop that this research project seeks to provide a critical analysis of Canada's federal Biotechnology Strategy, a policy with considerable ramifications for the developmental trajectory of biotechnology in this country, and

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[4] Not surprisingly, a 2005 report by the Conference Board of Canada appeals to the Government of Canada to review the program and make it more attractive to international capital. Citing flat Research & Development investment by the business community over the last decade, the report draws the conclusion that expanding this tax incentive program will spur corporate R&D spending. See, for example, Munn-Venn, T., & Mitchell, P. (2005). *Biotechnology in Canada: A technology platform for growth.* Ottawa: The Conference Board of Canada.

which has received over $394 million in federal funding between 1999 and 2006 (van Beuzekom & Arundel, 2006). As Schiller (2007, p. 12) admonishes, it is vital to recognise that "...capitalism, in its essence a dynamic form of social organisation forever dependent on identifying and exploiting new areas of social labor, has moved from agriculture to manufacturing and beyond over the course of its history." The intent of the research is to demonstrate that the Canadian Biotechnology Strategy (CBS), beyond having implications for biotechnological production, directly impacts the manner in which the dominant actors involved in this economic sector develop, manipulate, and disseminate biological information. A substantial part of this research project is devoted to an attempt to theoretically situate the knowledge aspects of biotechnology, including the increasing commodification of biotechnological artefacts and their embodied information. "Since the production process is oriented around the transformation of use values, the use value of knowledge is also subject to transformation. As a result, the production of knowledge involves its transformation into new ways of relating to the material world" (Government of Canada, 1996). This increased importance of information as a resource possessive of exchange value and as an input into a variety of production processes across economic sectors has significantly intensified the enclosure of information and knowledge commons. We employ the term knowledge commons to refer to a specific institutional form and its inherent social practices that structure the way resources, be they material or immaterial, are accessed, used, and managed by a group of people beyond the logic of the capitalist market. The commons thus involves the production of meanings and values through active engagement between subjects who struggle to maintain or regain social control over social wealth through opposition to capitalist and state practices of enclosure (we elaborate this concept more fully in section 5.1). An emphasis on the information and knowledge aspects of biotechnology provides clear indication of the scope of the 'social factory', one of the theoretical constructs employed to facilitate our analysis. Mario Tronti, one of the leading Italian theorists who helped develop *operaismo* (workerism), which would later evolve into *autonomia* (autonomist Marxism), originally developed the concept of the 'social factory' in recognition of capital's drive to engulf all economically viable facets of society. He interpreted such manoeuvres by capital as a response to working class struggles that had spread beyond the factory to the wider community – into the social factory. Tronti extrapolated further from the industrial conflicts in the factory that posed such peril for capital's strategy of control and domination, arguing that within the broader context of the social factory there exists the very real potential for workers' revolts against their position as worker to spill over into the cultural sphere or community in a manner that destabilises the production of labour power. Although the contemporary social factory has reached a level that demands a conceptual reconfiguration of the classical Marxist concept of the 'working class', this dissertation adopts Tronti's position (and others in the autonomist Marxist spirit) that capital's drive to commodify expanding realms of social existence ignite multiple biopolitical revolts by what we term the insurgencies of 'universal labour'.

This research contends that any analysis of contemporary capitalist society must proceed from the underlying assumption that inherent to that society is the antagonistic relationship between class subjects and that attempts at domination provoke resistance aimed at emancipation. "Even though common use of the term might suggest the opposite – that resistance is a response or reaction – *resistance is primary with respect to power* (Industry Canada, 1998, p. 1).[5] Much like Marx's methodological orientation based on the perspective of the working class rooted in its own historical activity, contemporary efforts at understanding and situating the current conjuncture of capitalist social relations can be advanced through research into the genealogy of social and political opposition movements. By apprehending these emerging subjectivities we might begin developing a new social vision of our own era. Following Cleaver, this research seeks to interrogate the "nature of the totality/globality that capital has sought to impose, the diversity of self-activity which has resisted that totality and the evolution of each in terms of the other" (Munn-Venn & Mitchell, 2005, pp. iii-iv). It is precisely those struggles mobilised around biotechnology issues in Canada that we seek to elaborate. Specifically, we examine and analyse emerging counter struggles in Canada that are attempting to re-appropriate or foreclose the products and processes developed by biotechnological capital, placing particular emphasis on the implications this has for both the biological and the knowledge commons. An underlying assumption of this research is that the commodification of biotechnology, as a branch of science that has assumed a central role in production as a source of new knowledge, offers an exemplary case study of both the mobilisation of the social factory in contemporary society and the scope of counter struggles that, themselves, include a range of information and knowledge issues. As Best and Kellner (2004, p. 199) point out:

[5] This perspective, which is characteristic of autonomist Marxism, derives from Marx's own work that emphasises the primary position of labour. As pointed out in the Preface to *Capital*, Marx opens the book with a presentation of capital, in particular the commodity form, before discussing labour because this is the way we encounter and experience capitalist society, thus making it a logical starting point. However, Marx also makes it clear that this exposition differs from his research method, which begins with labour, always recognising its primacy.

> Biotechnology is thus a critical flashpoint for democratic theory and practice. It underscores the need for more widespread knowledge of important scientific issues, participatory debate, consensus, and regulation concerning new developments in the biosciences, which have such high economic, political, and social consequences.

1.2 Scope of the Present Research

This research project seeks to critically analyse the federal government's biotechnology strategy within a neo-Marxist biopolitical framework (as elaborated more fully in chapters three and four) that draws on and synthesises a number of theoretical elements from the autonomist Marxist tradition. In particular, we assess the degree to which the CBS might be understood in terms of a government policy that facilitates the commodification of science, reflecting a broader pattern of what Marx termed the 'real subsumption' of society by capital. Marx foresaw that scientific innovation would become business: "Invention then becomes a business, and the application of science to direct production itself becomes a prospect which determines and solicits it" (Canadian Biotechnology Advisory Committee, 2005b, p. ix). In a later passage in Volume III of *Capital*, Marx establishes the link between the work that yields scientific innovation and universal labour, a concept that we will elaborate in chapter three. Braverman (1974) develops this theme in his own work when contrasting the Industrial Revolution of the nineteenth century to the scientific-technical developments of the twentieth century: "science as generalized social property incidental to production and science as capitalist property at the very center of production" (Government of Canada, 2004). Scientific research and advancement must be understood in terms of the social and political processes that constitute its context of development. That is, science and technology are social and cultural practices constituted within and by the dominant power structures and values of the societies in which they take place (Canadian Food Inspection Agency, 1993, ¶ 5). "Science does not simply reveal truth and unmask reality; it invents it – or constructs – it too" (Canadian Food Inspection Agency, 1993, ¶ 3). In this respect this research abides Robins and Webster's admonition, remaining cognisant of the political dimension of biotechnology and the way in which it mediates the capital-labour relation:

> In our view any strategy in response to the new technologies of the 1980s depends upon an adequate conceptualisation of technology and a historical appreciation of the role it has played in the growth of capitalism. This is all the more important in the light of the crass pronouncements in microelectronics technology by futurists, managers and media pundits. It is essential to theorise technology in its political dimension, as it mediates the relation between labour and capital (Treasury Board of Canada Secretariat, 2006, ¶ 8-9).

In fact, contemporary biotechnology might be considered to present a microcosm of the dominant characteristics of contemporary capitalist social relations: high capital intensity as reflected in the relatively small number of firms and total number of workers involved in this sector; extensive control and command over the labour force; the involvement of both the state and capital in research and funding; the international focus of the large biotechnology firms; and intense use of information and communication technologies.[6]

Building on Marx's subsumption thesis, Mario Tronti and Raniero Panzieri developed the notion of the 'social factory', a concept that has been applied and elaborated by a number of autonomist Marxist theorists, including Harry Cleaver, Nick Dyer-Witheford, and Antonio Negri. Briefly stated, the 'social factory' thesis asserts that social relations in advanced capitalism come to mirror the relations of production to such an extent that society becomes an extension of the factory, or, put another way, that the

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[6] This discussion is based on the treatment of the nuclear industry offered by members of the Midnight Notes Collective. See, for example, p.m. (1992). Strange victories. In Midnight Notes Collective (Ed.), *Midnight oil: Work, energy, war, 1973-1992* (pp. 193-214). Jamaica Plains, MA: Autonomedia.

logic of the factory comes to dominant social life beyond the gates of the factory. The result is a situation in which capitalist relations of production increasingly subordinate social relations. Employing this as well as the concepts of biopower, biopolitical production, universal labour, primitive accumulation, commons, and enclosures (as elaborated more fully in chapters three and four), we analyse the extent to which the CBS mobilises biotechnology as a key site for appropriation by capital within the trajectory of the social factory. Our theoretical construct is designed to permit an analysis that focuses on confrontations in a variety of areas beyond the immediate point of production, with a particular emphasis on the informational aspects of biotechnology. That is, we apply a Marxist methodological framework that takes as its starting point those instances of struggle by both waged and unwaged workers against the capitalist logic[7] of the social factory. To facilitate this research we engaged in empirical investigation designed to elucidate the struggles that seek to counteract the forms of biopower being exercised as part of capital's appropriation of biotechnology.

This project is guided by the following four research questions:

1. What prescriptive role has the Canadian Biotechnology Strategy played in commodifying biotechnology and biotechnological information as part of the social factory?
2. What counter struggles have emerged in Canada to resist the enclosure of the biological and the knowledge commons?
3. What are the information and knowledge issues encompassed by such struggles?
4. How can a neo-Marxist biopolitical framework illuminate the issues inherent in biotechnology and the oppositional movements it engenders, as determined in response to research questions one through three?

[7] By 'logic' we mean the consistencies and regularities characteristic of capitalist social relations as a whole beyond the actions of individual capitalists. They are the regularities of the class struggle that revolve around the content and form of social life. This use of the term derives from Cleaver. See, in particular, Cleaver, H. (1996). Theses on secular crisis in capitalism: The insurpassability of class antagonisms. In C. Polychroniou & H. R. Targ (Eds.), *Marxism today: Essays on capitalism, socialism, and strategies for social change* (pp. 87-98). Westport, CT: Praeger.

Following a discussion of the methodology employed to conduct this research, the remainder of the current chapter proceeds to provide an overview of biotechnology as an industrial sector in this country and the main elements of the CBS. The subsequent chapter offers a review of the previous critical literature devoted to the social implications of biotechnology. Having established the academic context within which to situate the present work, chapters three and four present the theoretical model we propose to apply to the present critical analysis of Canada's Biotechnology Strategy and the groups organising against particular aspects of biotechnology. Chapter three elucidates the macro level of our proposed analytical framework, including an elaboration of the concepts of the 'social factory', 'biopower', 'biopolitics', 'universal labour', and 'species-being'. Chapter four goes on to offer a meso level of analysis that contemplates 'enclosures' and 'commons' as entry points for the analysis of resistance and struggle against biotechnology in Canada. This chapter similarly engages in a discussion of the relevance of our proposed neo-Marxist biopolitical framework to the analysis of biotechnology and the knowledge commons. Chapters five through seven offer analyses of the documentary evidence in respect of the corporate capture of biotechnology and the knowledge commons. The specific topics treated in these three chapters reflect the issues raised by the interview informants. Chapter five contemplates the major ways that capital has appropriated control over seeds and agriculture, contending that such control represents the alienation of life itself. Chapter six investigates and elaborates the ways through which capital makes use of the intellectual property regime to facilitate its command over biotechnology. The following chapter considers the various means through which capital and the state are actively constructing a discourse and a regulatory system around biotechnology that facilitates capitalist control of this science and its attendant technological applications. Chapter eight illuminates the evidence gathered from the interviews conducted with key informants mobilising against biotechnology in Canada. It is here that we lay out in some detail how these opposition groups are responding to the corporate and state control issues raised in the previous three chapters. We wrap up this chapter with a discussion of some of the ways in which the capitalist control of biotechnology is impinging on academic freedom in institutions of higher education. By way of conclusion, chapter nine offers an overview of the major empirical findings that emerge from this research project.

1.3 Significance of the Present Research

> In the last twenty years, biotechnology has become an increasingly important engine for economic growth and social development. It is now widely held that the transformative power of biotechnology will change forever the way we do things and interact with each other and the natural world, and that it will concomitantly change the culture of societies (n.a., 2006).

Rejecting the underlying teleological tone of the above contention, we suggest that our current research can contribute to the continuing academic and policy debates surrounding the role of biotechnology as a critical site within the present conjuncture of capitalist development. By employing a number of key autonomist Marxist theoretical constructs to assay the place of biotechnology within the social factory, this research seeks to yield an analysis capable of reflecting and accounting for the informational aspects of biotechnology. As one prominent molecular biologist has argued, "...the decisive, energizing perception of biotechnology since the Second World War, the key to its strength and vigour, has been one that treats organisms as information-processing machines....biology has become a kind of flatland in which the only activity is the processing and transmission of genetic information" (as cited in McNally & Wheale, 1998, p. 305). Perhaps more explicitly, another author has asserted that "[b]iotechnology is an information-intensive technology and will very easily fit into a restructured economy based on information. Indeed, biotechnology will provide one of the new economy's crucial underpinnings" (Canadian Biotechnology Advisory Committee, 2006b). This research project is dedicated to offering an account of biotechnology that goes beyond its production functions to consider and theoretically situate its informational aspects, including the way that the increasing commodification of biotechnological information finds its logical nexus in the trajectory of contemporary capitalist social relations. This research aspires to go beyond many other past and current investigations of biotechnology by interrogating the various forms of struggles that have emerged in defiance of the progressive enclosure of biotechnology within the social factory. An emphasis on the information and knowledge issues embodied in these conflicts, aside from potentially being indicative of the scope of the social factory, holds the promise of cementing an important bridge between Library and Information Studies, with its concern over information flows and the information cycle, and political economic and public policy disciplines. We contend that the multiple information issues that inhere in biotechnology, ranging from intellectual property concerns in respect of genetic information to the contested nature of regulatory and public biotech discourses, render Library and Information Studies a wholly apposite discipline within which to situate a critical analysis of this technoscience that goes beyond the current LIS engagement with bioinformatics.[8]

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[8] Bioinformatics encompasses information retrieval, communication, and data management issues as they

1.4 Type of Study and Methodology

This research is an exploratory study of the CBS that also contains elements of description and explanation. Given the relative youth of the biotechnology industry as a viable sector for economic exploitation and growth, an exploratory study seems most appropriate. As Singleton *et al.* (1993, p. 91, emphasis in original) have asserted, "[*e*]*xploratory* studies are undertaken when relatively little is known about something, perhaps because of its 'deviant' character or newness."

As Babbie (1992) points out, all research methods possess their own inherent strengths and weaknesses, which can cause research findings to reflect, at least partly, the method of inquiry. One means of addressing this problem is methodological triangulation, which requires that a researcher bring several different methods to bear upon the topic of interest (Industry Canada, 1998). In order to introduce a suitable degree of methodological rigour into this study we engaged in both documentary analysis and interviewing. We rely on documentary analysis for all chapters except eight, which is based on research interviews and that also includes a detailed account of how these were gathered. The documentary analysis focuses on the CBS and aside from the actual documents that articulate this government policy, position briefs, publications, and other relevant documents produced by the Canadian Biotechnology Advisory Committee (CBAC) and the Biotechnology Assistant Deputy Minister Coordinating Committee (BACC) of the Government of Canada are similarly examined. We also gathered data from a variety of additional sources, including relevant trade and academic publications

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pertain to biotechnological information. For a brief historical discussion of bioinformatics in the United States that similarly considers the apparent collapse of the metaphorical relationship between genetic material and genetic information, see Lievrouw, L. A. (2004). Biotechnology, intellectual property, and the prospects for scientific communication. In S. Braman (Ed.), *Biotechnology and communication: The meta-technologies of information* (pp. 145-172). Mahwah, NJ: Lawrence Erlbaum Associates.

and Statistics Canada, in order to compile a schematic overview of biotechnology as a Canadian industrial sector. In an effort to assess the level and nature of resistance to the capitalist expropriation of biotechnology in Canada, we conducted interviews with the main individuals and organisations leading these contemporary resistance movements. Given the oppositional nature of such struggles to various areas of biotechnology in Canada, which is one of the driving themes of this research, it was unlikely that documentary analysis alone would have revealed the true scope of the informational issues involved in these struggles. Moreover, it could be the case that a lack of resources circumscribes the documentary material that resistance movements can make available. By conducting interviews we ensured that important evidence was not omitted from the study.

One of the main benefits of using available data is that they avoid the problem of reactive measurement that can occur when subjects alter their behaviour because they are aware that they are being observed (Munn-Venn & Mitchell, 2005). The documentary analysis element of this project is an example of an unobtrusive measure that avoids reaction. Another advantage of using available data is their economy. As Singleton *et al.* (1993, p. 366) assert, "[i]nsofar as research using available data bypasses the stage of data collection, it can economize greatly on cost, time, and personnel." A third advantage of using existing information is that it increases the credibility of research results by helping to counteract possible charges of researcher bias. Since part of the analysis was based upon documents that are part of the public record, it will be relatively easy to defend against potential challenges of bias (Kuyek, 2002, p. 41).

Our methodology represents a synthetic approach that reflects a combination of two strains of Marxist thought – both a classical political economic analysis of capital and the state, and an autonomist bottom-up approach that commences with struggle. While we certainly privilege struggle, as demonstrated by our choice of interview informants (elaborated more fully in chapter eight), our study began with a documentary analysis designed to sketch the broad contours of the biotechnology industry and biotechnological development in this country. Having established this macro context, we proceeded to conduct interviews with fourteen key informants involved in the opposition organising around biotechnology in an attempt to comprehend the logic of the capitalist development of biotechnology in this country through an interrogation of the autonomous self-activity of the people and groups mobilising against it. We then analysed these struggles, which themselves were approached as interruptions in the circuit of capital, in terms of their development, content, direction, and means of circulation within the social factory. Finally, the analysis moved upward to relate all these aspects of struggle to the broader capitalist initiative in terms of general social planning, investment, and technological innovation, as established through our documentary analysis.

1.4.1 Validity and Reliability

A significant concern when using existing data for a research study revolves around the quality of the data (Government of Canada, 2004). This is less of a concern for the documentary analysis part of this research project since this element of the research relied on primary sources, most of which are part of the government's public record and thus presumably accurate. With regard to the interviews, only the researcher conducted these, thus eliminating the concern that different interviewers might not follow properly the interview schedule. During the interview process the researcher endeavoured to minimise actions that could potentially affect the subject's response. The interviewer used an audio recording device during the interviews in order to facilitate later transcription, unless an interviewee requested otherwise (this occurred in only one case). By recording the interview, the researcher was not distracted by having to take extensive notes, and was, therefore, better positioned to focus on responses in order to obtain the most information possible from the subject.

1.4.2 Units of Analysis and Variables

Singleton *et al.* (1993) make it clear that part of the research design stage also requires a researcher to determine the units of analysis and variables to be observed. However, they also note that "not all problems can be foreseen, especially in exploratory research, and many of the decisions at the design stage will be arbitrary and subject to change" (Industry Canada, 1998, p. 3).

1.4.2.1 Units of Analysis

"Units of analysis, then, are those units or things we examine in order to create summary descriptions of all such units and to explain differences among them" (Industry Canada, 1998, p. 2). Since this research is interested in explicating and accounting for the increasing commodification of biotechnology in Canada, it took its cue from Marx, whose dialectical materialist methodology considers scientific and technological innovation to reflect social processes that are influenced heavily by the institutional and economic environments in which they occur. That is, his dialectical method captures the mutual interaction effects between technology and the economy. Thus, for Marx the focus is less on a particular individual and more on the collective social forces, including how their development is conditioned by institutional and economic factors (Government of Canada, 2004, p. 3). Certainly there are relevant stakeholders who serve as points of reference for the interviews conducted, but individuals are not the primary unit of analysis for this research. This research is instead interested in elucidating and analysing the broader social forces that shape the development and implementation of biotechnology in this country.

1.4.2.2 Variables

As Singleton *et al.* (1993) argue, exploratory research designs are usually characterised by "no clearly delineated independent and dependent variables and, therefore, no categories within which to classify what one sees" (Government of Canada, 2004). Neither the documentary analysis portion nor the interviews of the research manipulated variables and thus independent and dependent variables cannot be determined.

1.4.3 Ethical Issues

Since human subjects were involved in the research, there were ethical considerations related to informed consent, anonymity, and confidentiality that had to be considered. We applied for and received ethics approval from the Faculty of Information and Media Studies Ethics Committee prior to contacting any research participants (see Appendix V for a copy of the ethics approval). All interviewees were provided information letters describing the purpose of the study, as approved by the Ethics Committee, and asked to sign consent forms prior to the start of the interview (see Appendix VI for copies of the information letter and consent form). The signed forms are kept on file by the researcher for the term and under the conditions specified by the Research Ethics Committee. Interviewees were informed of their right to refuse to answer any question they wished. Interviewees were also made aware of the researcher's intention to employ an audio taping device, which, at the request of the interviewee, could be shut off at any time during the interview. Interview subjects also had the opportunity to stipulate that any, or all, of their responses remain anonymous when reported in the research findings. Copies of the transcribed interviews were sent to all interview participants for review, at which time individuals were provided the opportunity to request revisions.

The remainder of this chapter is dedicated to setting the stage for our analysis by providing the reader with some of the requisite background in respect of biotechnology in this country. We commence with an economic overview of the Canadian biotechnology sector and conclude with an outline of the major elements of the CBS.

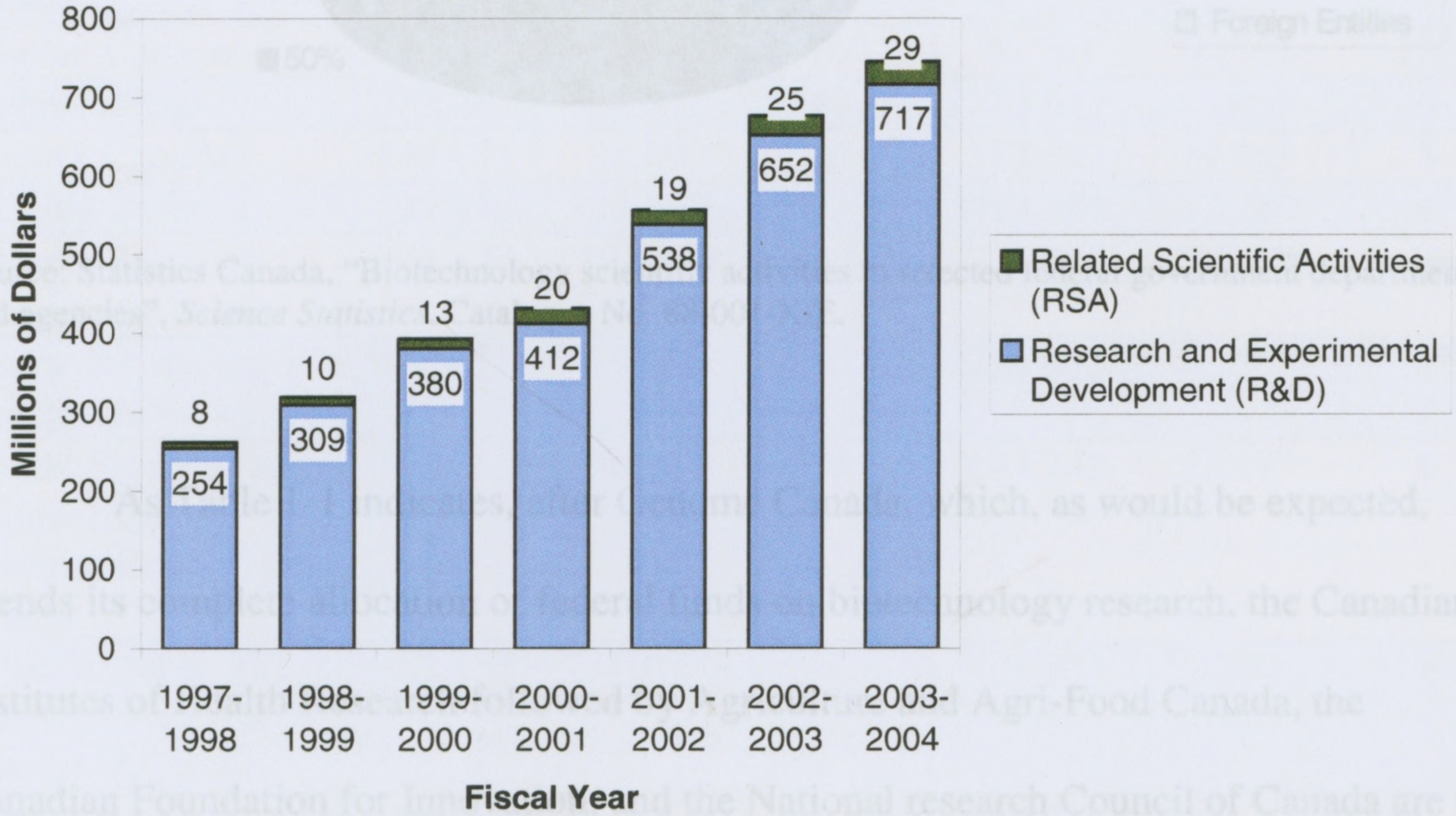
1.5 The Canadian Biotechnology Sector

This section of the chapter is offered to provide the reader with a sense of the scale of biotechnology as an economic sector in this country. The information and figures supplied here rely on data obtained by Statistics Canada, which collects such information on a bi-annual basis. The latest available figures (as of May 2008) are from 2005, although the data released are not complete and so some of the discussion offered in this section extends only until 2003.

1.5.1 Federal Government Expenditures on Biotechnology

The Canadian federal government increased its science and technology (S&T) expenditures on biotechnology by 10% between 2002-2003 and 2003-2004 from $678 million to $746 million (Figure 1-1). This amount represents 8% of the total S&T 2003-2004 budget.

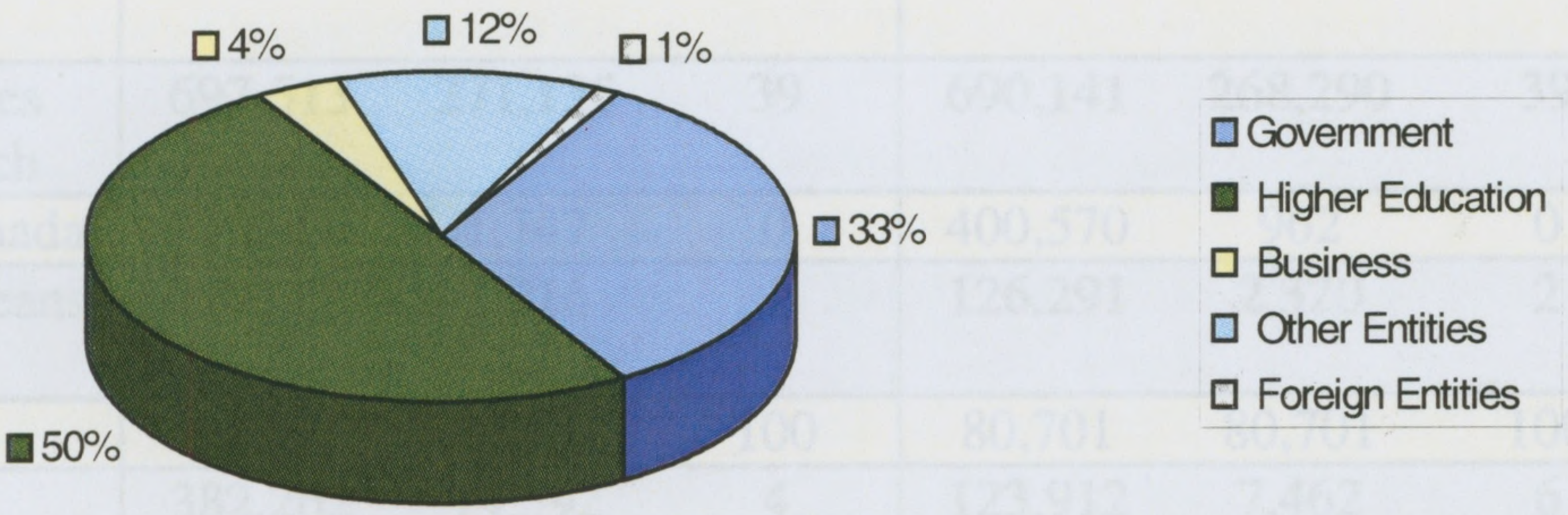
Figure 1-1 Federal Government Science & Technology Expenditures on Biotechnology, 1997-2004



Source: Statistics Canada, "Biotechnology scientific activities in selected federal government departments and agencies", *Science Statistics*, Catalogue No. 88-001-XIE.

Universities and other institutions of higher learning continue to receive the majority (50%) of the government's spending on biotechnology, although the category 'other entities' saw a substantial jump in its percentage of funding, increasing from 1% in 1997-1998 to 12% of total government funding in 2003-2004 (Figure 1-2). Unfortunately, the federal document from which these statistics are derived fails to elaborate what organisations are included in this category. An assumption is that this is a residual category that also encompasses non-governmental organisations.

Figure 1-2 Federal S&T Expenditures According to Recipient Type 2003-2004



Source: Statistics Canada, "Biotechnology scientific activities in selected federal government departments and agencies", *Science Statistics*, Catalogue No. 88-001-XIE.

As Table 1-1 indicates, after Genome Canada, which, as would be expected, spends its complete allocation of federal funds on biotechnology research, the Canadian Institutes of Health Research followed by Agriculture and Agri-Food Canada, the Canadian Foundation for Innovation, and the National research Council of Canada are the federal organisations that devote the largest portions of their S&T research funds to biotechnology research.

Table 1-1 Total Expenditures and Biotechnology Expenditures by Federal Department/Agency for Fiscal Year 2003-2004

	Science and Technology			Research and Development		
	Total Expend. (000s)	**Biotech. Expend. (000s)**	**Biotech. Share (%)**	**Total Expend. (000s)**	**Biotech. Expend. (000s)**	**Biotech. Share (%)**
Department/Agency						
Agriculture and Agri-Food Canada	322,767	63,936	20	235,508	63,936	27
Canadian Foundation for Innovation	383,427	78,261	20	383,427	78,261	20
Canadian Institutes of Health Research	697,513	271,135	39	690,141	268,290	39
Environment Canada	798,920	1,747	0	400,570	962	0
Fisheries and Oceans Canada	327,274	2,916	1	126,291	2,320	2
Genome Canada	80,701	80,701	100	80,701	80,701	100
Health Canada	382,262	14,592	4	123,912	7,462	6
Industry Canada	445,071	25,690	6	383,312	19,365	5
National Defence	439,126	13,850	3	314,890	13,780	4
National Research Council of Canada	804,142	121,389	15	728,808	118,819	16
Natural Resources Canada	492,832	8,537	2	274,275	7,238	3
Natural Sciences and Engineering Research Council of Canada	762,065	59,204	8	673,242	52,277	8
Social Sciences and Humanities Research Council of Canada	463,152	4,076	1	407,953	3,562	1
Other	2,589,218	--	--	866,224	--	--
Government of Canada	**8,988,470**	**746,034**	**8**	**5,689,254**	**716,973**	**13**

Source: Statistics Canada, "Biotechnology scientific activities in selected federal government departments and agencies", *Science Statistics*, Catalogue No. 88-001-XIE.

1.5.2 Biotechnology Firms in Canada

According to the Government of Canada this country has the second largest number of biotechnology firms in the world. As of 2005 there were 532 innovative[9] biotechnology-based companies in Canada, which in 2003 generated the third highest level of revenue in the world behind the United States and United Kingdom (Canadian Biotechnology Advisory Committee, 2006b, p. 24).[10] The number of companies has increased by 89% between 1997 and 2005, though growth has slowed to 9% between 2003 and 2005 from 31% between 2001 and 2003 (Figure 1-3). Small firms account for 75% of all biotechnology companies, followed by medium-sized firms (16%) and large companies (10%).[11] The majority of biotechnology companies concentrate on human health[12], followed by agriculture[13] and food processing[14], and the environment[15].[16] Quebec, Ontario, and British Columbia are the three leading provinces in terms of

[9] Statistics Canada classifies a firm as innovative if it meets one of the following three criteria: it has one or more biotechnology product or process on the market; it is developing a process or product that requires the use of biotechnology; or, it views biotechnology as central to its business activities or strategies (Government of Canada, 2005).

[10] There is some discrepancy between the comparisons between Canada and other countries made by the Government of Canada and the OECD. According to statistics compiled by the latter organisation, Canada ranks 6th in terms of both greatest number of biotechnology firms and biotechnology sales (van Beuzekom & Arundel, 2006). Part of this disparity seems to stem from methodological differences in computing the statistics. Moreover, the OECD report cautions about some of the figures and extrapolations it includes given varying response rates from some of the countries included in the report.

[11] Statistics Canada classifies firms according to size based on the number of people employed by a company. Small firms have fewer than 50 employees, medium-sized firms have 50 to 149, and large firms have a staff of over 150 (Government of Canada, 2005).

[12] For purposes of statistical compilation, 'human health' includes diagnostics (e.g. biosensors, immunodiagnostics, gene probes), therapeutics (e.g. vaccines, immune stimulants, biopharmaceuticals), and drug delivery.

[13] Agricultural biotechnology includes plant biotechnology, animal biotechnology, and non-food agriculture (e.g. fuels, lubricants, commodity and fine chemical feedstocks, cosmetics).

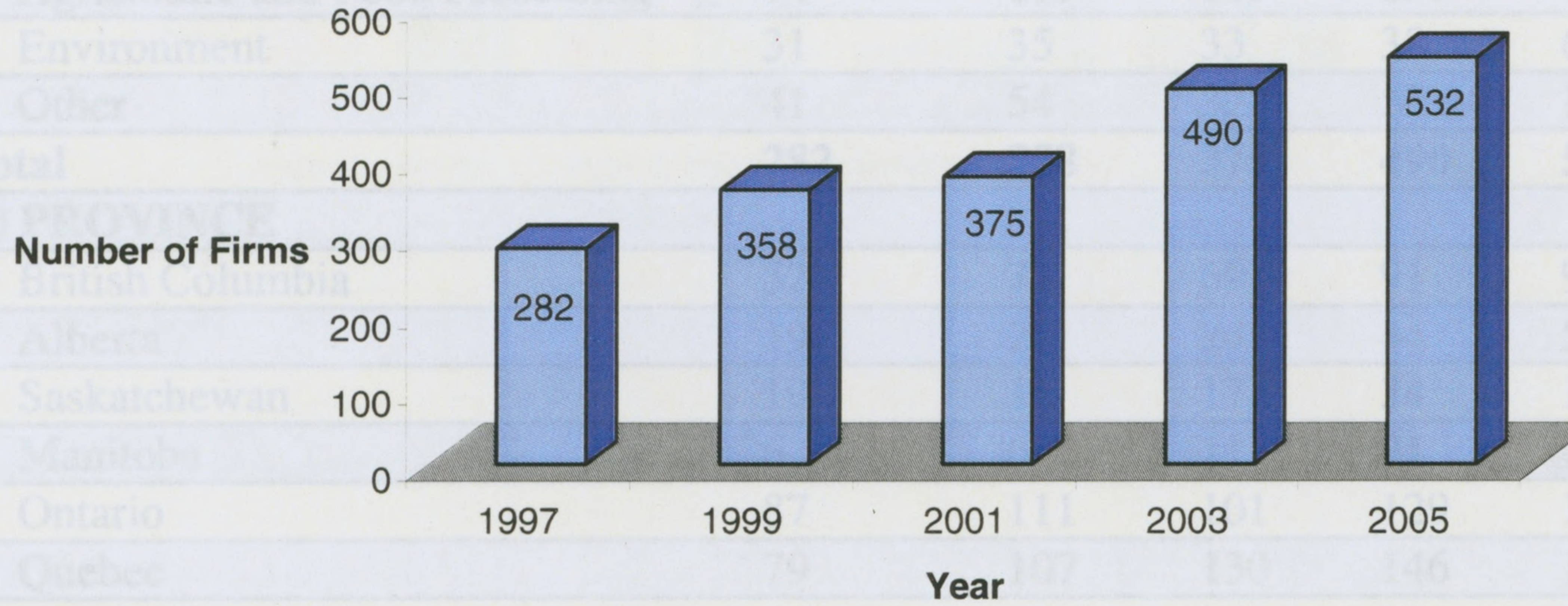
[14] Food processing includes bioprocessing (e.g. using enzymes and bacteria cultures) and functional foods/nutraceuticals (e.g. probiotics, unsaturated fatty acids).

[15] Environment includes air (e.g. bioremediation, diagnostics, phytoremediation, biofiltration), water (e.g. biofiltration, diagnostics, bioremediation, phytoremediation), and soil (e.g. biofiltration, diagnostics, bioremediation, phytoremediation).

[16] The Canadian Life Sciences Database, maintained by BIOTECanada, is a comprehensive database that contains information about the companies and institutes involved in biotechnology in this country, including company description and categorization. This database can be found at the following URL: http://www.biotech.ca/content.php?TAG=clsdb

number of firms. Table 1-2 outlines the number of biotechnology companies in Canada according to size, sector, and province. Figures 1-4 through 1-6 present the same information in a different visual format for ease of comprehension.

Figure 1-3 Biotechnology Firms in Canada



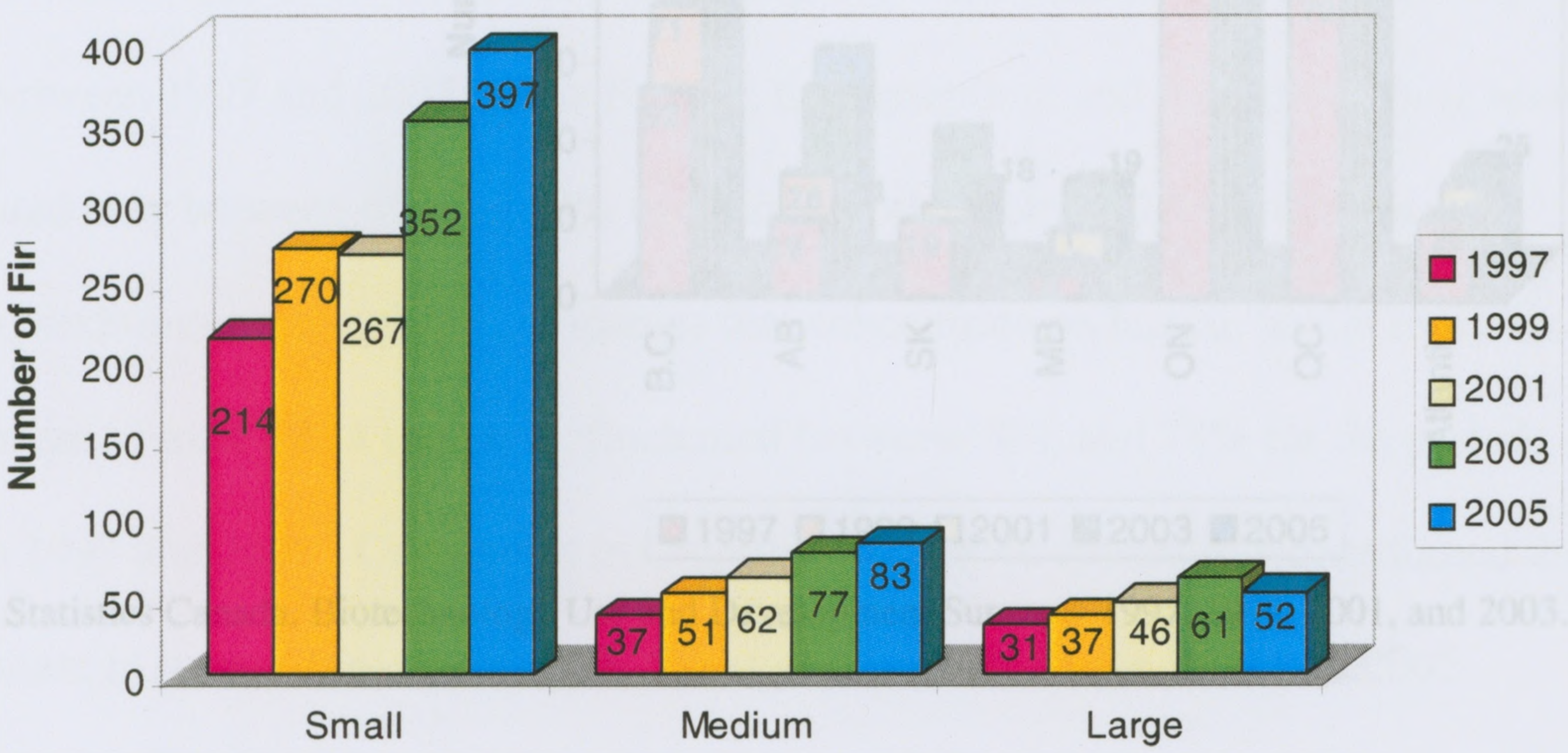
Sources: Statistics Canada, Biotechnology Use and Development Survey – 1997, 1999, 2001, 2003, 2005.

Table 1-2 Canadian Biotechnology Firms According to Size, Sector, and Province, 1997-2003

	Number of Firms				
	1997	**1999**	**2001**	**2003**	**2005**
A) SIZE					
Small	214	270	267	352	397
Medium	37	51	62	77	83
Large	31	37	46	61	52
Total	**282**	**358**	**375**	**490**	**532**
B) SECTOR					
Human Health	136	150	197	262	310
Agriculture and Food Processing	74	119	113	137	146
Environment	31	35	33	38	60
Other	41	54	32	52	16
Total	**282**	**358**	**375**	**490**	**532**
C) PROVINCE					
British Columbia	52	71	69	91	94
Alberta	19	28	24	44	51
Saskatchewan	19	16	17	34	18
Manitoba	6	6	11	21	19
Ontario	87	111	101	129	144
Quebec	79	107	130	146	181
Atlantic	20	19	23	25	25
Total	**282**	**358**	**375**	**490**	**532**

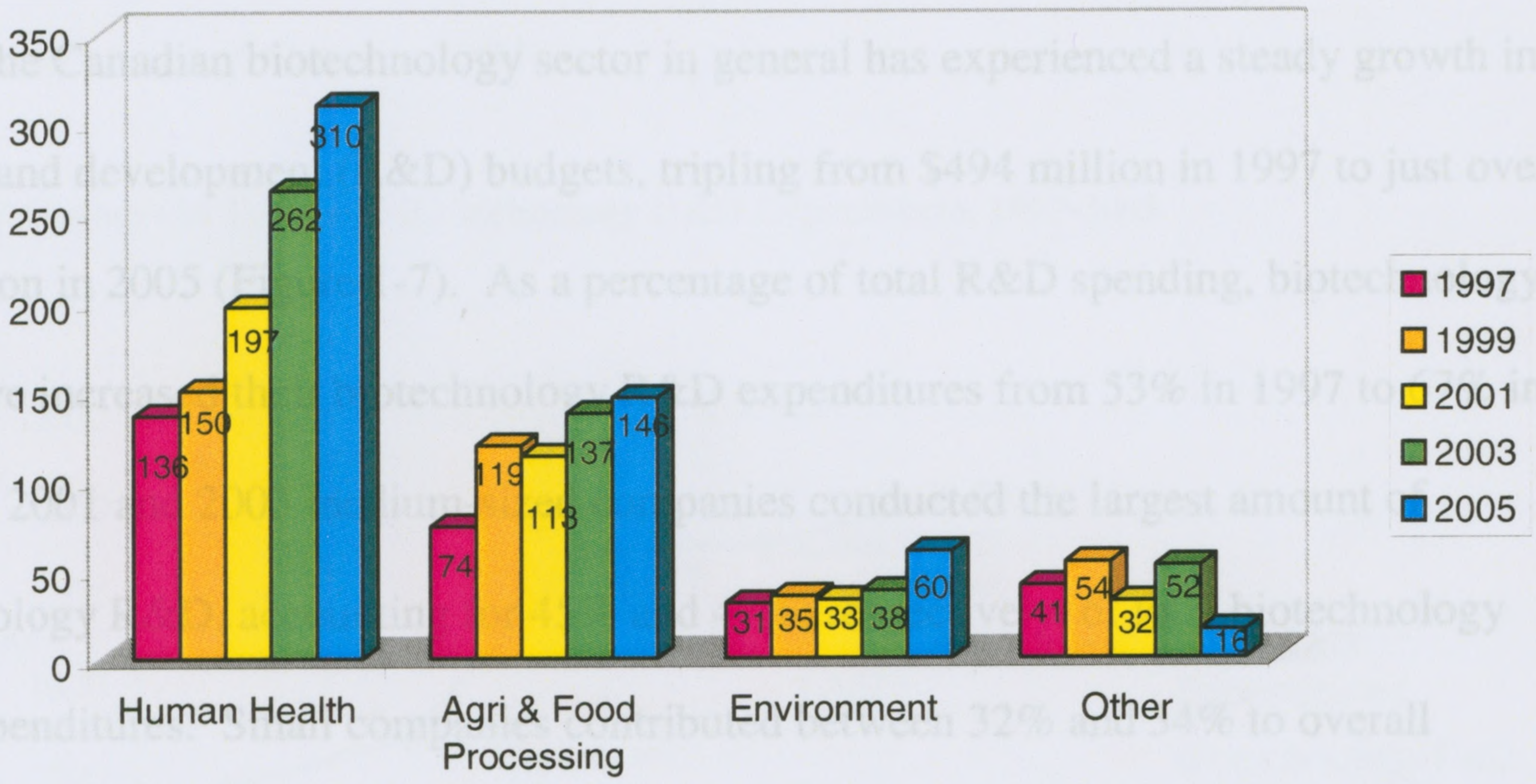
Sources: Statistics Canada, Biotechnology Use and Development Survey – 1997, 1999, 2001, 2003, 2005.

Figure 1-4 Biotechnology Firms by Size, 1997-2005



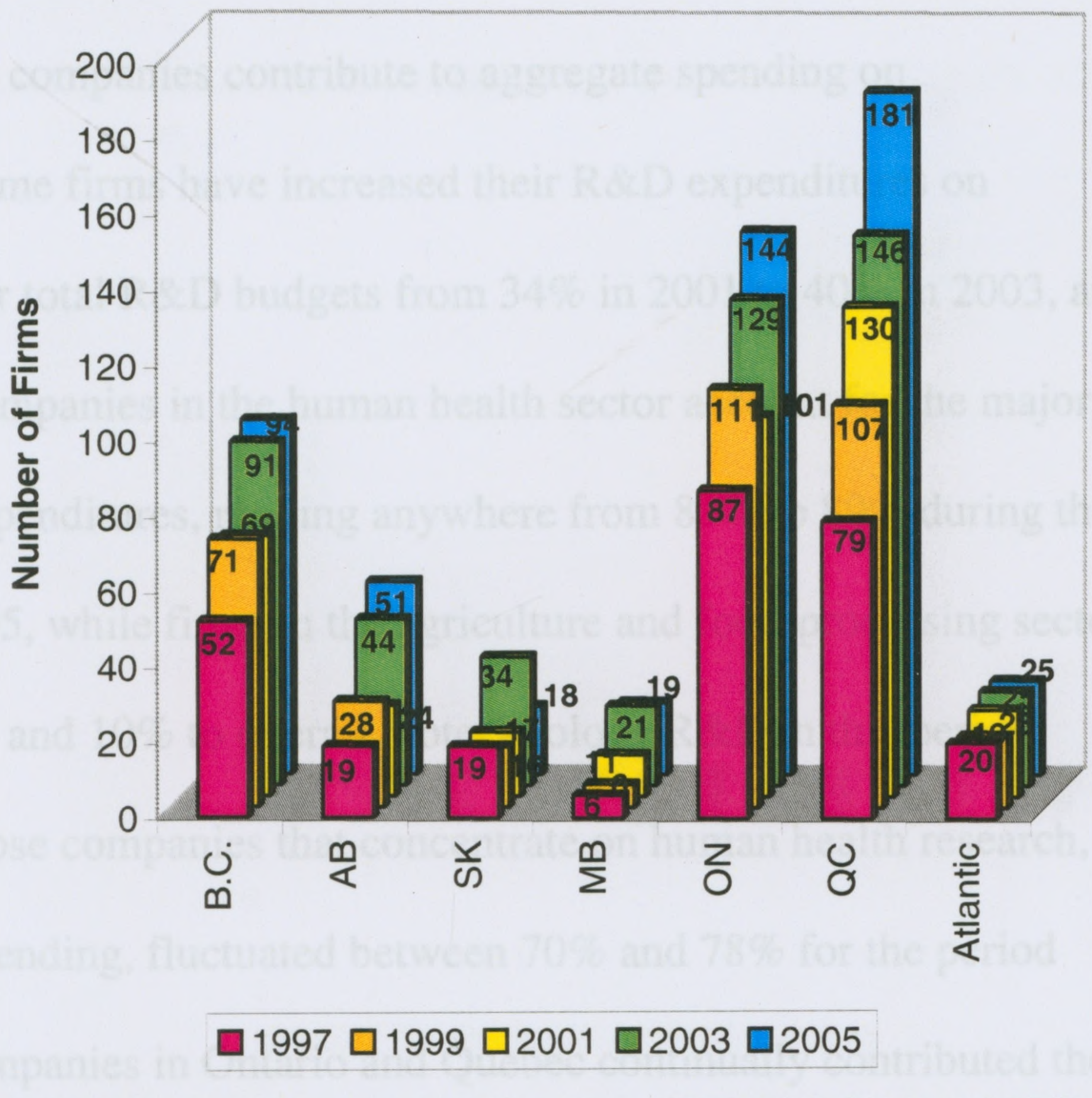
Sources: Statistics Canada, Biotechnology Use and Development Survey – 1997, 1999, 2001, 2003, 2005.

Figure 1-5 Biotechnology Firms by Sector, 1997-2005



Sources: Statistics Canada, Biotechnology Use and Development Survey – 1997, 1999, 2001, 2003, 2005.

Figure 1-6 Biotechnology Firms by Province, 1997-2003



Sources: Statistics Canada, Biotechnology Use and Development Survey – 1997, 1999, 2001, and 2003.

1.5.3 R&D Spending by Canadian Biotechnology Companies

The Canadian biotechnology sector in general has experienced a steady growth in research and development (R&D) budgets, tripling from $494 million in 1997 to just over $1.7 billion in 2005 (Figure 1-7). As a percentage of total R&D spending, biotechnology firms have increased their biotechnology R&D expenditures from 53% in 1997 to 67% in 2005. In 2001 and 2003 medium-sized companies conducted the largest amount of biotechnology R&D, accounting for 45% and 47%, respectively, of total biotechnology R&D expenditures. Small companies contributed between 32% and 34% to overall biotechnology R&D expenditures from 2001 and 2005. While large firms accounted for 59% of all biotechnology R&D expenditures in 1999, their share fell to 23% in 2001 and 20% in 2003, but then increased in 2005 to 37%. However, despite this absolute decline in the amount of money large companies contribute to aggregate spending on biotechnology R&D, these same firms have increased their R&D expenditures on biotechnology relative to their total R&D budgets from 34% in 2001 to 40% in 2003, and 47% in 2005 (Table 1-3). Companies in the human health sector account for the majority of all biotechnology R&D expenditures, ranging anywhere from 83% to 89% during the period between 1997 and 2005, while firms in the agriculture and food-processing sector contributed only between 6% and 10% to overall biotechnology R&D in this period. R&D expenditures among those companies that concentrate on human health research, as a percentage of total R&D spending, fluctuated between 70% and 78% for the period between 1999 and 2005. Companies in Ontario and Quebec continually contributed the largest share to overall biotechnology R&D expenditures between 1997 and 2005 (Government of Canada, 2004). In 2004 Ernst & Young reported that public biotechnology firms increased their R&D spending by 22% each year between 1998 and 2003 (Government of Canada, 2004).

Figure 1-7 Changes in Total and Biotechnology R&D Expenditure, 1997-2005

Sources: Statistics Canada, Biotechnology Use and Development Survey – 1997, 1999, 2001, 2003, 2005.

Table 1-3 Changes in Biotechnology R&D Expenditures by Firm Size, Sector, and Province, 1997-2005

	Biotechnology R&D Expenditures (Millions of Dollars)					Biotechnology R&D Expenditures a % of Total R&D Expenditures (%)				
	1997	**1999**	**2001**	**2003**	**2005**	**1997**	**1999**	**2001**	**2003**	**2005**
A) SIZE										
Small	193	256	433	495	577	63	87	67	65	95
Medium	124	106	601	699	492	73	58	87	87	88
Large	177	465	303	293	635	40	63	34	40	47
Total	**494**	**827**	**1,337**	**1,487**	**1,704**	**53**	**68**	**60**	**65**	**67**
B) SECTOR										
Human Health	409	703	1,177	1,316	1,488	56	77	78	70	77
Agriculture & Food Processing	53	73	107	89	166	57	59	34	36	83
Environment	10	..	16	37[E]	38	24	..	5	..	12
Other	22	..	37	46[E]	12[E]	39	..	41	..	..
C) PROVINCE										
BC	77	131	420	370	285	88	83	73	92	12
Alberta	20	81	118	88	103	71	79	99	26	41
Saskatchewan	19	28	10	23	14	54	65	24	70	88
Manitoba	12	20	31	56[E]	84	86	65	94	90	90
Ontario	220	223	395	453	649	60	53	69	58	69
Quebec	132	337	349	490	559	34	75	39	74	62
Atlantic	14	6	14	7	10	100	100	93	70	91
Total	**494**	**827**	**1,337**	**1,487**	**1,704**	**53**	**68**	**60**	**65**	**67**

Sources: Statistics Canada, Biotechnology Use and Development Survey – 1997, 1999, 2001, 2003, 2005.

1.5.4 Biotechnology Products and Processes

A network of over 100 research institutes and teaching hospitals, including sixteen Canadian universities, performs research with a heavy emphasis on products and applications that exhibit commercial potential. According to Industry Canada, as of 2005 there were over 540 products in the biopharmaceutical product pipeline (Canadian Biotechnology Advisory Committee, 2006b, p. 3). In 2003 biotechnology firms reported 17,065 biotechnology products or processes at all stages of development and on the market[17] (see Table 1-4). The human health sector experienced growth of over 300% in the total number of products between 1999 and 2003, while the second largest sector, agriculture, suffered a 13% decline during the same period. Of the total 17,065 products, 4,960 were in the R&D stage and over two-thirds (11,046) were on the market. Between 1999 and 2003 the number of products at the R&D stage declined from 8,690 to 4,960. Conversely, the same time period witnessed a 67% increase in the number of products on the market, growing from 6,597 to 11,046 (Canadian Biotechnology Advisory Committee, 2006b, p. 5). The number of products on the market in 2003 more than doubled (from 652 to 1,573) for the agricultural biotechnology sector compared to 2001. The result has been a corresponding 92% increase in agricultural biotechnology revenues between 2001 and 2003 (Munn-Venn & Mitchell, 2005).

Table 1-4 Number of Biotechnology Products/Processes by Stage of Development, 1999 to 2003

	1999	2001	2003
Research and Development	8,690	5,964	4,960
Pre-clinical trials/Confined field trials	628	732	806
Regulatory phase/Unconfined release	1,659	1,663	254
Approved/On market/In production	6,597	9,661[E]	11,046[E]
Total Products/Processes	**17,574**	**18,020[E]**	**17,065**

Note: The 1997 survey question about biotechnology products and processes contained a different wording than subsequent surveys.
Sources: Statistics Canada, Biotechnology Use and Development Survey – 1999, 2001, and 2003.

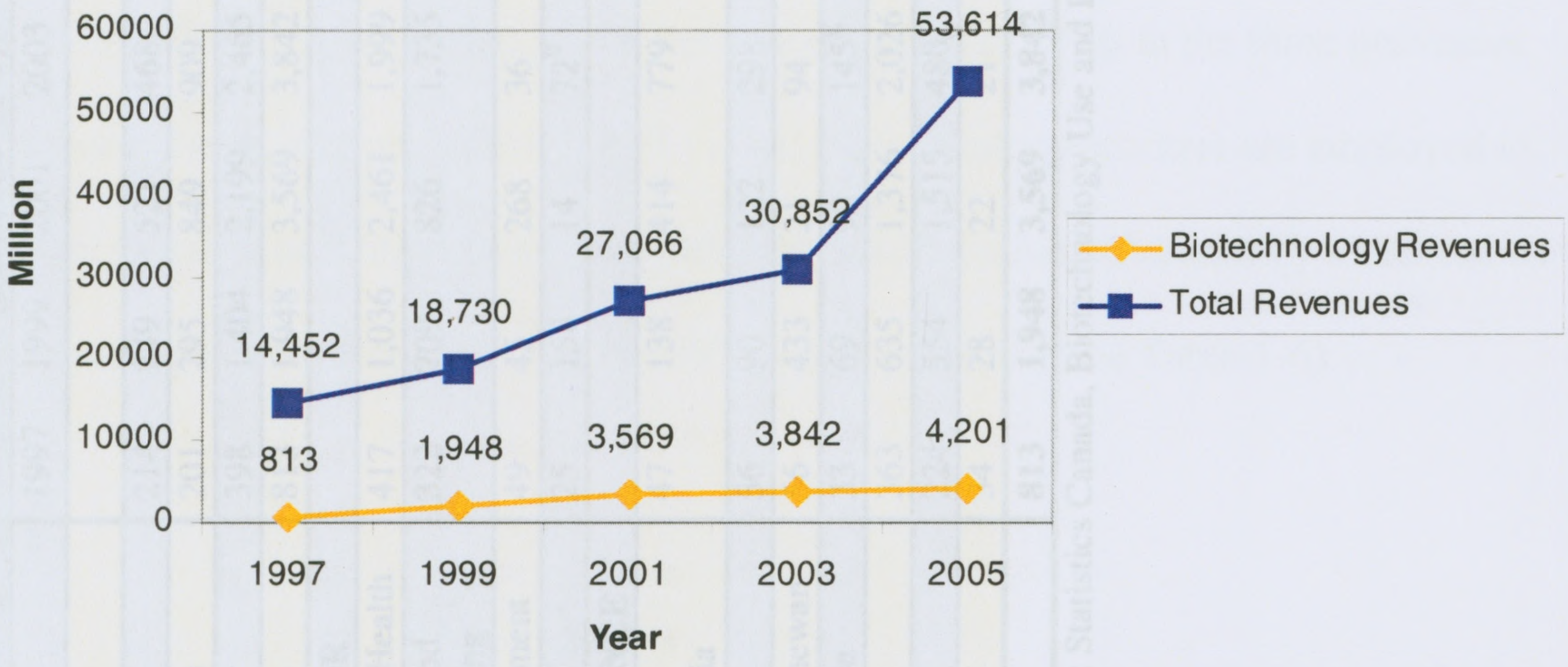
1.5.5 Revenues of Canadian Biotechnology Companies

Between 1997 and 2005 Canadian biotechnology companies almost quadrupled their total revenues. In this same period, the revenues these firms derived from specific biotechnology-related activities increased more than fivefold from $813 million to $4.2

[17] The survey instrument included the following stages of development: 1) Research and development; 2) Pre-clinical trials/Confined field trials; 3) Regulatory phase/Unconfined release assessment; 4) Approved/On market/In production (Government of Canada, 2005).

billion, though overall this represents only 8% of total revenues generated by firms involved in the biotechnology sector (see Figure 1-8). Large firms account for the majority of revenue: of the $4.2 billion generated in 2005, 67% came from large firms, 23% from medium-sized firms, and 10% from small firms. In terms of proportion of total revenue derived from biotechnology activities for 2005, this represents 6% for large firms but over half of all revenues generated by small and medium-sized firms come from biotechnology. The human health sector produces over half of all biotechnology revenue, followed by the agriculture and food-processing sector, which contributes the second highest level of revenue. Companies situated in Ontario generate the majority of revenue, although Quebec and British Columbia are also important hubs for biotechnology. In 2005 these three provinces together accounted for nearly 91% of total biotechnology revenues (see Table 1-5) (Government of Canada, 2005).

Figure 1-8 Changes in Total and Biotechnology Revenues, 1997-2005



Sources: Statistics Canada, Biotechnology Use and Development Survey – 1997, 1999, 2001, and 2003.

Table 1-5 Changes in Firm Biotechnology and Total Revenues by Size, Sector, and Province, 1997-2005

	Biotechnology Revenues (Millions of $)					Total Revenue (Millions of $)					Biotechnology Revenue as a % of Total Revenue (%)				
	1997	1999	2001	2003	2005	1997	1999	2001	2003	2005	1997	1999	2001	2003	2005
SIZE															
Small	214	249	521	468	403	1,756	590	1,169	2,624	716	12	42	45	18	
Medium	201	295	849	909	969	685	849	1,504	1,499	1,932	29	35	56	61	50
Large	398	1,404	2,199	2,465	2,829	12,011	17,291	24,392	26,729	50,966	3	8	9	9	6
Total	813	1,948	3,569	3,842	4,201	14,452	18,730	27,065	30,852	53,614	6	10	13	12	8
SECTOR															
Human Health	417	1,036	2,461	1,999	2,967	3,397	3,185	5,074	5,972	7,562	12	33	49	33	39
Agri/Food Processing	322	709	826	1,735	1,082	9,792	7,153	12,998	6,653	..	3	10	6	26	..
Environment	49	45	268	36	132	1,090	287	8,900	11,756[E]	..	4	16	3	0	..
Other	25	158	14	72[E]	19[E]	173	8,105	94	6,472[E]	50[E]	14	2	15	1	38
PROVINCE															
British Columbia	47	138	414	779	586	118	1,880	7,118	4,337	..	39	7	6	18	..
Alberta	56	90	122	298	137	248	392	132	1,275	27,747[E]	22	23	92	23	0.5
Saskatchewan	56	433	21	94	53	5,644	..	F	3,891	..	1	na	na	2	..
Manitoba	33	69	99	145[E]	164	1,908	123	759	390[E]	..	2	56	13	37	..
Ontario	363	635	1,376	2,026	2,769	2,665	8,121	3,485	11,032[E]	6,726	14	8	39	18	41
Quebec	224	554	1,515	480	459	3,805	3,960	10,511	9,708[E]	7,774[E]	6	14	14	5	6
Atlantic	34	28	22	21	33	61	..	F	220[E]	59	55	na	na	10	56
Total	**813**	**1,948**	**3,569**	**3,842**	**4,201**	**14,452**	**18,730**	**27,065**	**30,852**	**53,614**	**6%**	**10%**	**13%**	**12%**	**8%**

Sources: Statistics Canada, Biotechnology Use and Development Survey – 1997, 1999, 2001, 2003, and 2005.

1.5.6 Human Resources in the Biotechnology Sector

Employment in the biotechnology sector has fluctuated quite significantly between 1997 and 2003. For example, between 1997 and 1999 it decreased by 14% but then rebounded by 54% between 1999 and 2001, and then fell minimally between 2001 and 2003. For the overall period between 1997 and 2003 the number of biotechnology-related jobs has grown by 32%. Firms engaged in some type of biotechnology work employed 11,863 people in 2003, a figure that represents 16% of these companies' total labour force. As might be expected given some of the above statistics, the largest number of workers is employed in the human health sector, followed by the agriculture and food-processing sector. In both these sectors more workers are becoming directly involved with biotechnology-related activities. In the human health sector the percentage of total workers tasked with specifically biotechnology jobs rose from 42% in 1999 to 54% in 2001 and 58% in 2003. The agriculture and food-processing sector saw increases from 6% in 1999 to 10% in 2001 and 14% in 2003. Perhaps surprisingly, the number of workers directly involved with biotechnology jobs in the environmental sector, as a percentage of firms' total labour force, declined from 8% in 1999 to 3% in 2001 and to a mere 1% in 2003. As expected, given the concentration of firms in the three provinces mentioned above, a large majority (80%) of all biotechnology workers are employed in Quebec, Ontario, or British Columbia, although Manitoba has substantially increased its biotechnology workforce from 209 in 1997 to 1,213 in 2003 (see Table 1-6).

Table 1-6 Personnel Changes in Biotechnology Firms, 1997-2005

	Number of Employees with Biotechnology-Related Tasks					**Total Number of Employees**					**Biotechnology Employees as a % of Total Workforce (%)**				
	1997	1999	2001	2003	2005	1997	1999	2001	2003	2005	1997	1999	2001	2003	2005
SIZE															
Small	2,895	2,902	3,144	3,619	4,460	3,470	4,907	3,910	5,184	5,809	83	59	80	70	77
Medium	2,299	1,323	3,230	3,746	3,613	3,514	4,673	5,268	6,416	6,160	65	28	61	58	59
Large	3,825	3,470	5,523	4,498	5,360	23,936	53,033	53,065	63,848	74,920	16	7	10	7	7
Total	9,019	7,695	11,897	11,863	13,433	30,920	62,613	62,242	75,448	86,889	29	12	19	16	15
SECTOR															
Human Health	6,280	5,433	8,675	9,255	10,865	11,383	12,945	16,145	16,069	26,158	55	42	54	58	42
Agri/Food Processing	1,542	1,323	2,264	1,832	1,755	16,436	24,037	22,332	12,684	13,758	9	6	10	14	13
Environ.	291	323	709	246	719	2,074	4,187	22,689[E]	31,630[E]	46,668	14	8	3	1	1
Other	906	616	249	531[E]	94	1,027	21,514	1,076[E]	15,065[E]	306	88	3	23	4	31
Total	9,019	7,695	11,897	11,863	13,433	30,920	62,613	62,242	75,448	86,889	29	12	19	16	15
PROV.															
BC	1,042	1,191	1,746	2,173	1,942	1,376	7,558	15,049[E]	10,042	11,137[E]	76	16	12	22	17
AB	789	574	494	727	944	1,539	X	719	1,899	32,323	51	na	69	38	3
SK	351	289	262	337	167	7,904	4,769	5,272[E]	5,423	654	4	6	5	6	26
MB	209	357[E]	936[E]	1,213[E]	491	1,616	635	1,469	1,429[E]	5,215	13	56	64	85	9
ON	3,416	2,547	3,346	3,508	5,203	8,079	14,568	7,141	25,716	14,252	42	17	47	14	37
QC	2,722	2,557	4,710	3,700	4,554	9,672	31,060	31,054	30,094	22,935	28	8	15	12	20
Atlantic	490	181	402[E]	206	132	733	X	1,539[E]	845[E]	374	67	na	26	24	35
Total	**9,019**	**7,695**	**11,897**	**11,863**	**13,433**	**30,920**	**62,613**	**62,242**	**75,448**	**86,889**	**29%**	**12%**	**19%**	**16%**	**15%**

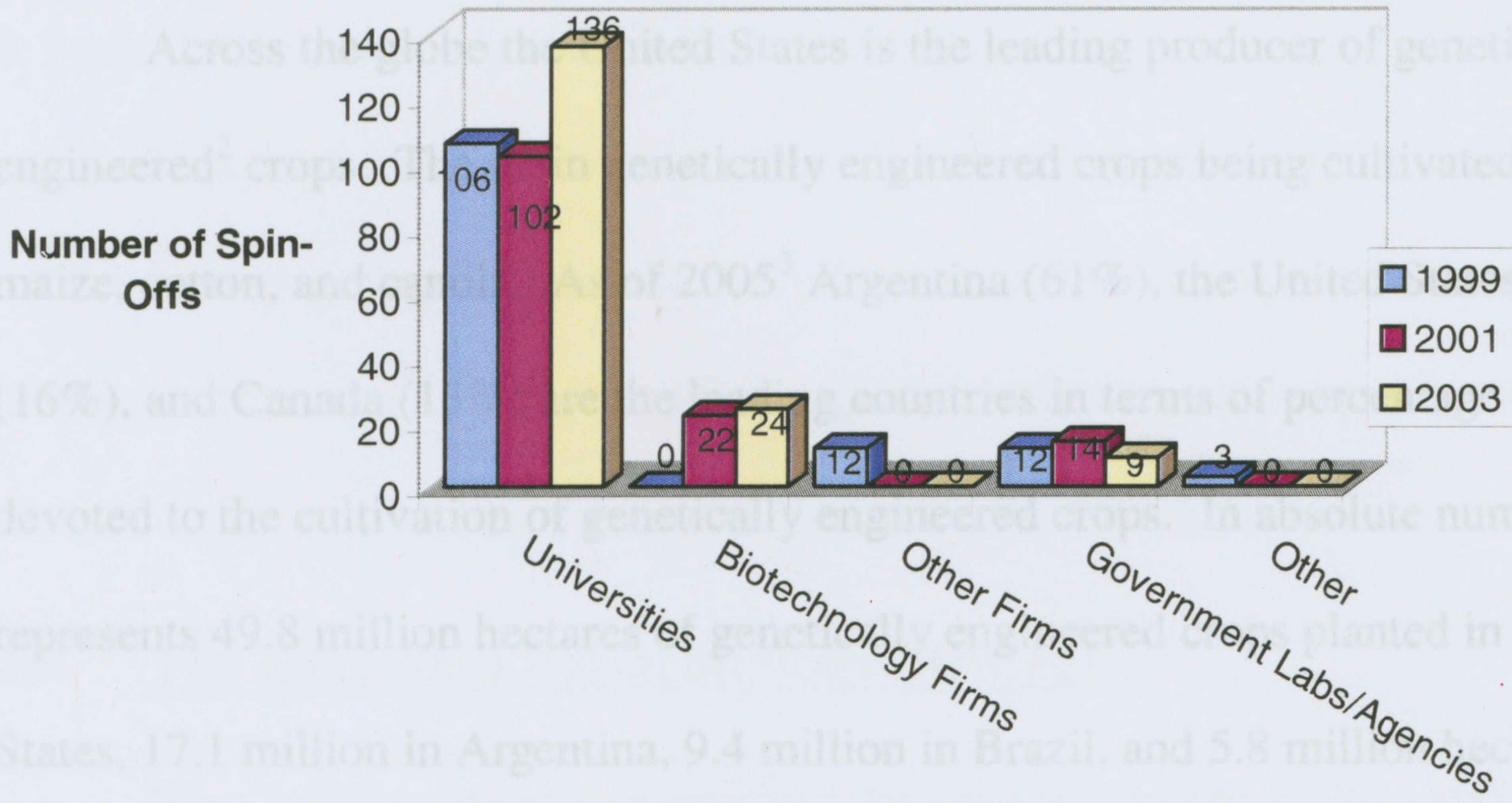
Sources: Statistics Canada, Biotechnology Use and Development Survey – 1997, 1999, 2001, 2003, and 2005.

1.5.7 Canadian Biotechnology Spin-off Firms

Almost one-third of Canadian biotechnology companies were spun-off from other entities, mainly from universities.[1] Figure 1-9 outlines the 2003 distribution of spin-off companies according to the source from which they were spun off. Most spin-off companies are small, with only 20% of all spin-off firms categorised as either medium or large. In fact, 43% of all small biotechnology companies are spin-offs, whereas only 27% of all medium-sized and 6% of all large companies were created as spin-off firms. Given some of the characteristics of the biotechnology sector discussed above, it should not be surprising that the human health sector has the largest number of spin-off companies, followed distantly by the agriculture and food-processing sector. Similarly, Quebec, Ontario, and British Columbia are home to the largest number of spin-offs (see Table 1-7), although Alberta ranks with British Columbia in having the highest proportion of spin-off companies as a percentage of total biotechnology firms (BSDE Working Party, 2006).

[1] Statistics Canada defines a spin-off as "a new firm created to transfer and commercialize inventions and technology developed in universities, firms or laboratories" (Government of Canada, 2005, p. 61).

Figure 1-9 Number of Biotechnology Spin-Offs by Source of Spin-Off, 1999-2003



Note: Data are not included for 1997 as the survey instrument did not ask this question that year.
Sources: Statistics Canada, *Biotechnology Use and Development Survey* – 1999, 2001, and 2003.

Table 1-7 Number of Biotechnology Spin-Off Firms by Size, Sector, and Province, 1999-2003

	1999	2001	2003
A) SIZE			
Small	112	117	151
Medium	6	18	21
Large	5	6	3[E]
Total	**123**	**141**	**175**
B) SECTOR			
Human Health	75	98	123
Agriculture & Food Processing	28	26	29
Environment	X	7	5[E]
Other	X	9	19[E]
C) PROVINCE			
British Columbia	31	33	38
Alberta	..	16	22
Saskatchewan	..	6	8
Manitoba	..	4	6
Ontario	30	28	40
Quebec	33	48	54
Atlantic	..	5	8

Note: Data are not included for 1997, as the survey instrument did not ask this question that year.
Sources: Statistics Canada, *Biotechnology Use and Development Survey* – 1999, 2001, and 2003.

1.5.8 A Brief Comparison Among OECD Members

Across the globe the United States is the leading producer of genetically engineered[2] crops. The main genetically engineered crops being cultivated are soybeans, maize, cotton, and canola. As of 2005[3] Argentina (61%), the United States (29%), Brazil (16%), and Canada (13%) are the leading countries in terms of percentage of arable land devoted to the cultivation of genetically engineered crops. In absolute numbers this represents 49.8 million hectares of genetically engineered crops planted in the United States, 17.1 million in Argentina, 9.4 million in Brazil, and 5.8 million hectares in Canada.[4] These numbers represent an increase in the number of hectares planted with genetically engineered crops between 2002 and 2005 of 27% for Argentina, 28% in the United States, 169% in Brazil, and 53% in Canada. Between 2002 and 2004 inclusive, 4,970 traits were field tested in the United States, Canada, the European Union, and Australia. 3,506 trait field trials were conducted in the United States (71%), followed by 1,147 in Canada (23%), 240 in the European Union (5%), and 77 in Australia (2%). These field tests examined the following five major categories of genetic traits: herbicide tolerance; pest resistance to viruses, bacteria, insects, nematodes, and fungi; product improvements such as type of oils, starches, sugars, or cellulose produced by the plant; agronomic enhancement such as yield performance or salt and cold tolerance; and

[2] This work consciously employs the term 'genetically engineered' in direct opposition to the industry preferred appellation 'genetically modified', which is meant to convey a sense of naturalness and line of continuity between conventional (natural) agricultural and breeding practices and modern biotechnology.
[3] As of writing, these are the latest available OECD statistics.
[4] According to a report issued by the International Service for the Acquisition of Agri-Biotech Applications (ISAAA), an agricultural biotechnology promoter, these numbers increased in 2006 to 54.6 million hectares of land sown with genetically engineered seeds in the United States, 18 million hectares in Argentina, 11.5 million in Brazil, and 6.1 million in Canada. Perhaps more importantly, in terms of foreshadowing things to come, India (3.8 million hectares) and China (3.5 million hectares) have greatly expanded the amount of land now devoted to genetically engineered cotton cultivation. Across the globe in 2006 some 102 million hectares in 22 countries are planted with genetically engineered crops. See, James, C. (2006). *Global status of commercialized biotech/GM crops: 2006* (ISAAA Brief No. 35). Ithaca, NY: The International Service for the Acquisition of Agri-Biotech Applications.

technical traits, such as marker genes and genetic containment (Busch, Lacy, Burkhardt, & Lacy, 1991; Gaskell, Bauer, & Durant, 1998).

This brief economic outline of the Canadian biotechnology sector sets the context for the following discussion of the federal government's attempts to harness the vitality of this sector as a motor for scientific innovation and economic expansion.

1.6 The Canadian Biotechnology Strategy

The Canadian federal government has long considered science and technology as integral to Canada's economic development and prosperity. In its 1996 *Science and technology for the new century: A federal strategy*, the federal government articulated its goals of expanding the number of partnerships between governments, academia, and businesses, which it views as central to ensuring job creation, economic growth, and the advancement of knowledge. One significant element of the science and technology strategy includes federal government support for private sector R&D through tax relief, development of industry-led consortia involved in pre-competitive research, and assistance targeted to specific firms engaged in high-risk commercialisation. The strategy also contemplates the intellectual property regime, asserting that it must better serve the goal of increasing private sector commercialisation of federally supported research (Government of Canada, 2004, p. 16). This emphasis on innovation and economic growth is also a focal point of Canadian biotechnology policy: "Biotechnology is one of the world's fastest-growing technologies. It offers significant economic benefits, particularly in exports and job creation..." (National Human Genome Research Institute, 2003). A Conference Board of Canada report admonishes Canadian governments "to recognise biotechnology as the next economic growth platform for Canada – the successor to the information and communications technologies that have underpinned our economic growth in recent years" (Grace, 1997; King, 1997).

In defining biotechnology, the Canadian government adopts the OECD definition: "the application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services" (Grace, 1997).[5] This definition, with its explicit mention of science, technology, and knowledge, aligns quite closely with the goals of this research project. The federal government, through Industry Canada, promotes scientific development in this country by funding the Canadian Foundation for Innovation, the Canada Research Chairs Program, Networks of Centres of Excellence, and Genome Canada. The latter organisation was established by Industry Canada in order to position Canada as an international leader in genomic and proteomic research.[6] A growing portion of the budget of the Canadian Foundation for Innovation is dedicated to basic biological research. As of June 2003, the federal government had invested $220.5 million to create 201 Canada Research Chairs focused on biotechnology. Similarly, the Business Development Bank of Canada, which is wholly owned by the federal

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[5] Subsection 3(1) of the *Canadian Environmental Protection Act* (1999, c. 33) defines biotechnology in a more circumscribed manner as "the application of science and engineering in the direct or indirect use of living organisms or parts or products of living organisms in their natural or modified forms."

[6] Genome Canada is the primary funding and information resource for genomics and proteomics in Canada. It is responsible for developing and implementing a national genomics and proteomics research strategy to ensure that Canada becomes a world leader in this type of research. Genome Canada has established six Genome Centres across the country (Atlantic, Quebec, Ontario, Prairies, Alberta and British Columbia) and has received funding in the amount of $700 million from the Government of Canada. Together with its six Genome Centres and other partners, Genome Canada invests in and manages large-scale research projects in key selected areas such as agriculture, environment, fisheries, forestry, health and new technology development. Genome Canada also supports research projects aimed at studying and analyzing the ethical, environmental, economic, legal and social issues related to genomics research (Genome Canada, n.d.). One might question whether this organisation is able to promote Canadian leadership in genomics and proteomics research in a manner that does not conflict with these latter duties.

government, announced in 2002 that it would provide $200 million in venture capital to the biotechnology sector over five years (Best & Kellner, 2004; Kimbrell, 1997; Thacker, 2005).[7]

Assuming that biotechnology will continue to play an increasingly significant role in the economic growth of industrialised nations, the Government of Canada first adopted a National Biotechnology Strategy in 1983,[8] which was subsequently refocused and transformed into the Federal Regulatory Framework for Biotechnology in 1993. The stated goal of the Federal Regulatory Framework for Biotechnology is to "minimize environmental risks while foster [sic] competitiveness through timely introduction of biotechnology products to the marketplace" (Best & Kellner, 2004, pp. 201-202). This regulatory framework for biotechnology has been developed to:

1. maintain Canada's high standards for the protection of the health of workers, the general public and the environment;
2. use existing legislation and regulatory institutions to clarify responsibilities and avoid duplication;
3. continue to develop clear guidelines for evaluating products of biotechnology which are in harmony with national priorities and international standards;
4. provide for a sound scientific database on which to assess risk and evaluate products;
5. ensure both the development and enforcement of Canadian biotechnology regulations are open and include consultation; and,

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[7] Science and technology (S&T) policy in Canada, like all other developed countries, has long been of central importance to federal policymaking. The focus on exploiting biotechnology for commercial purposes contained in the CBS, in fact, finds its precursor in Canada's broader S&T policy, which emphasises the link between S&T research and economic growth and the perceived corresponding need to foster partnerships between business, academic institutions, and government (Industry Canada, 1996a).

[8] The present work concentrates on an analysis of the 1998 Canadian Biotechnology Strategy. For an historical overview of federal policy, see, Abergel, E., & Barrett, K. (2002). Putting the cart before the horse: A review of biotechnology policy in Canada. *Journal of Canadian Studies, 37*(3), 135-161. Devlin Kuyek (2002) offers a detailed and critical historical account of the development of biotechnology in Canada from 1980 until 2002. His work outlines how the originally publicly-funded research and development in biotechnology was successively appropriated by private corporations beginning with the Conservative Mulroney government and continuing under the Liberal Chrétien government. Kuyek also examines the increasing infiltration of the federal policymaking phalanx by biotech industry insiders. See, Kuyek, D. (2002). *The real board of directors: The construction of biotechnology policy in Canada, 1980-2002*. Sorrento, BC: The Ram's Horn.

6. contribute to the prosperity and well-being of Canadians by *fostering a favourable climate for investment, development and adoption of sustainable Canadian biotechnology products and processes* (Government of Canada, 2004).

In 2000 Treasury Board Ministers approved the Canadian Regulatory System for Biotechnology (CRSB) in order

> to enhance Canada's regulatory capacity and to ensure that Canadians have an efficient, credible and well-respected biotechnology regulatory system that safeguards health and the environment as a priority and, thereby, permits safe and effective products to enter the market. The strategic objectives of the CRSB are to meet technical capacity and human resource needs; improve public awareness of and confidence in the regulatory system; increase the efficiency, effectiveness and timeliness of the regulatory system; and generate knowledge to support the regulatory system (Gaskell et al., 1998).

The most contentious element of this regulatory framework, as will be discussed in greater detail below, is that regulatory review is triggered by the novelty of the product rather than the specific process by which it is created (despite the claim made by the fourth principle of the regulatory framework outlined above). That is, Canada's regulatory system is tasked only with reviewing and examining the presence of a particular novel trait in a product and not the means by which that novelty is introduced into the product or organism. The rationale offered for why Canada has failed to enact legislation specific to biotechnology and genetic engineering is that the *Canadian Environmental Protection Act*[9] apparently functions as a safety net to catch all those products that might not be covered by other legislative devices.

Other countries that have developed national biotechnology strategies include: Japan, New Zealand, Australia, the European Union, and Russia, which in 2006 inaugurated a national biotechnology program that has received 150 billion roubles (US$ 5.25 billion) in funding until 2015 (Busch et al., 1991; Kloppenburg, 2004). According

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[9] *Supra* note 5.

to a European Commission document from 1991, "[b]iotechnology is a key technology for the future competitive development of the Community and it will determine the extent to which a large number of industrial activities located within the Community will be leaders in the development of innovatory products and processes" (Rifkin, 1998). Although the United States does not have a national strategy many states have incorporated biotechnology programmes into their economic agendas. Similarly, a number of other countries around the world have begun focussing special attention on biotechnology, including: India, Singapore, Malaysia, South Korea, Chile, and Cuba (Best & Kellner, 2004).

The 1983 National Biotechnology Strategy focused exclusively on developing Canadian research capacity. This strategy, which fell under the jurisdiction of Industry Canada (a departmental placement that itself is quite telling of the economic emphasis accorded biotechnology), articulated the following four objectives:

1. To strategically focus biotechnology research and development on areas of importance to Canada;
2. To ensure a sufficient supply of well-trained personnel to work in the Canadian biotechnology sector;
3. To encourage cross-disciplinary and cross-sectoral research and communication of research results;
4. To develop an investment environment that would attract corporate investment in Canadian biotechnology (Critical Art Ensemble, 2002, p. 43).

The increasing importance of biotechnology to Canada's overall science and technology framework was made evident by the 1997 Speech from the Throne in which biotechnology was singled out as a 'key sector'. This emphasis on biotechnology was later re-iterated in the 2004 Speech from the Throne, in which biotechnology, along with information and communication technologies and advanced manufacturing, was identified as the one of the platforms paramount to Canadian economic prosperity

(Loeppky, 2005, pp. 93-94). It was also the 1997 Throne Speech that outlined the creation of a team of seven ministers, led by then Industry Minister John Manley, to oversee the renewal of Canadian biotechnology policy. As a result the Canadian Biotechnology Strategy Task Force was struck in that same year to review and further develop the 1983 National Biotechnology Strategy, which had lagged in responding to the extreme pace of development in biotechnology that was occurring at the time. Early in 1998 this Task Force engaged in consultations with provincial officials, industry, non-governmental organisations, scientists, academics, and other relevant stakeholders about what should be the vision, goals, and principles of a renewed national biotechnology strategy, as well as its potential impacts on the biotechnology industry and R&D. The Task Force also solicited input from Canadians about how their interests could best be reflected in the policy development process, although the entire process has been criticised as being "a contrived public consultation process" (Yoxen, 1983, p. 187). According to the federal government over 5,000 individuals and organisations participated in the deliberations that led to the latest iteration of federal biotechnology policy, the Canadian Biotechnology Strategy (CBS), which was published in 1998 to address a broader range of issues in respect of biotechnology (Young, 1985; Yoxen, 1983). However, another publication issued by Industry Canada admits that the figure of 5,000 includes "web site "hits"" (Kloppenburg, 1988a, p. 279, emphasis in original). Although neither a definition of what was considered a website hit, nor an exact number of such hits is provided, inflating public consultation numbers through such means lends legitimacy to Kuyek's above assessment of the process. Despite the expanded range of issues consolidated under the new and expanded Canadian biotechnology policy, federal documents make it explicitly clear that commercial imperatives drive the CBS:

> Biotechnology is a powerful "enabling technology" with applications in many industrial sectors and holding much promise for the future. It has great potential to add to industrial efficiency, output and jobs, enhance the productivity and competitiveness of Canada's important natural resource sectors, safeguard the environment and enhance our quality of life through improved pharmaceuticals, diagnostic medicine and food production (Cozzens & Woodhouse, 1995, p. 553).

The CBS is conceptualised by the federal government as a "blueprint to enhance the quality of life of Canadians in terms of health, safety, the environment and social and economic development by positioning Canada as a responsible world leader in biotechnology" (Magnan, 2006).[10] The CBS draws on the expertise of a number of federal departments and agencies that are involved in regulatory activities, R&D, technology transfer, and investment and trade related to biotechnological products and services. According to the federal government the CBS represents a policy framework that incorporates social, ethical, health, economic, environmental, and regulatory issues into decisions about how biotechnology should be developed in this country (Krimsky, 1991, p. 17). The CBS is based on the following nine pillars:

1. Ensure that Canadians have access to, confidence in and benefit from safe and effective biotechnology-based products and services;
2. Ensure an effective scientific base and make strategic investments in R&D to support biotechnology innovation, the regulatory framework and economic development;
3. Position Canada as an ethically and socially responsible world leader in the development, commercialization, sale and use of biotechnology products and services;
4. Be sensitive to the need for developing countries to build indigenous capacity to assess and manage the risks of biotechnology;

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[10] Dr. E. Ann Clark, Associate Professor of Plant Agriculture at the University of Guelph, contends that contrary to the public relations spin of 'responsible world leader', Canada has actually joined forces with the United States in efforts to bully the rest of the world into accepting genetically engineered products. See, for example, Clark, E. A. (2005). *Whose interests are served by agricultural biotechnology?* Paper presented at the Prince Edward Island Standing Committee on Agriculture, Forestry, and the Environment, Charlottetown, PEI.

5. Improve public awareness and understanding of biotechnology through open, transparent communications and dialogue;
6. Solicit broadly-based advice to the government on biotechnology;
7. Promote awareness of, and maintain excellence in, Canada's regulatory system, based on the Federal Regulatory Framework for Biotechnology (1993), to ensure the country's continued high standards for protecting health, safety and the environment;
8. Support the development of a Canadian biotechnology human resources strategy to ensure an adequate supply of highly qualified personnel.
9. Work with the provinces, territories, business, academia, and consumer and other interest groups to develop and implement action plans addressing stewardship issues (for example, health, safety, environment, and social and ethical matters), sectoral opportunities and horizontal challenges (for instance, R&D, regulations, human resources, investment, innovation, technology transfer and market access) (Grace, 1997, p. 125; Seabrook, 1993).

During the 1998 consultations conducted by the Task Force developing the CBS, a number of Canadians indicated a need for an independent advisory body that would operate at arm's length from government to advise on crucial policy matters. Thus was created the Canadian Biotechnology Advisory Committee (CBAC).[11] The CBAC, which

[11] The CBAC issues advisory memoranda to the federal and provincial governments of Canada in order to apprise policymakers of issues related to biotechnology that will require immediate or medium term attention, as well as the effects of government policy on biotechnological developments in Canada (Canadian Biotechnology Advisory Committee, 2004). The CBAC consists of a Chair and 12 to 20 members who possess a range of expertise. Membership is ostensibly based on individual attributes of a particular member and not on the basis of representing a particular interest, though this claim is widely contested by observers critical of biotechnology in this country. The nomination process is public but a Biotechnology Deputy Ministers Selection Panel reviews nominations according to specific criteria such as expertise, knowledge, and experience. This selection panel issues recommendations about appointments, with final decisions reserved for the ministerial members of the Biotechnology Ministerial Co-ordinating Committee (BMCC). The Chair and committee members are usually appointed for a three-year term, although extensions are permissible at the discretion of the BMCC Ministers. The CBAC receives direction from and provides advice to the BMCC, which itself is supported by the Biotechnology Assistant Deputy Minister Coordinating Committee (BACC). From an operational perspective, the BACC is the management committee of the CBS. BACC has a permanent representative from each department that receives CBS funding and that possesses significant biotechnology expertise and experience (Agriculture and Agri-Food Canada, Environment Canada, International Trade Canada, the Department of Fisheries and Oceans, Health Canada, Industry Canada, Natural Resources Canada and the Department of Justice), as well as one member from the National Research Council, one member from the Canadian Food Inspection Agency, and one member representing the tri-councils (the Canadian Institutes of Health Research, the Social Sciences and Humanities Research Council of Canada and the Natural Sciences and Engineering Research Council). BACC is responsible for setting priorities and providing horizontal coordination of CBS initiatives. In executing its functions of managing the operations of the CBS, the CBAC is supported by a secretariat, which, aside from providing secretariat services to the CBAC, is tasked with coordinating horizontal decision-making across all the departments and agencies associated with the CBS (Canadian Biotechnology Advisory Committee, 2006b).

was disbanded during the course of this research on May 17, 2007,[12] was comprised of volunteer members from the areas of science, business, nutrition, law, philosophy, ethics, and environmental and public advocacy. The scope of the policy advice provided by the CBAC ranged from ethical to social, regulatory, economic, scientific, environmental, and health issues associated with biotechnology (Krimsky, 1991). As will be discussed below, the opposing nature of some of these roles resulted in conflicts of interest, leading some commentators to assert that the CBS and CBAC are biased in favour of the biotechnology industry. According to Devlin Kuyek (2002, p. 4), Canadian "biotechnology policy has been the private domain of a small number of corporate executives, the offices of the Prime Minister and the Privy Council, a selection of senior government bureaucrats…university presidents and board members of governmental/industry promotion and granting agencies." In the broader context of the neoliberal policy agenda that dominates in a majority of countries, including Canada, Kuyek (2002) postulates that the trajectory of biotechnology policy in this country will support ongoing efforts to privatise our health care system, undermine the effectiveness of the food safety system, and ultimately serve the financial interests of a select group of multinational corporations.

The CBAC originally identified five special research projects: regulation of genetically engineered food; intellectual property concerns related to biotechnology; issues around novel uses of biotechnology, such as stem cells; how to integrate ethical

[12] According to the CBAC website, the Harper Government's new Science and Technology Strategy announced the government's intention to "create a new Science, Technology and Innovation Council as part of a broader effort to consolidate external advisory committees to strengthen the role of independent expert advisors. The new council will provide the government with policy advice on issues referred to it by the government and will release regular state-of-the-nation reports that track Canada's S&T performance and progress against international benchmarks of success." See http://cbac-cccb.ca/epic/site/cbac-cccb.nsf/en/Home.

and social issues into biotechnology policy; and, consequences for privacy that emerge around biotechnology (Krimsky, 1991, p. 6). In a 2006b report the CBAC (p. 3) recommends that the Government of Canada update the CBS (the CBAC first called upon the federal government to renew and revise the CBS in December 2004) in a manner that "integrates the economic, environmental, ethical, legal, regulatory, scientific and social considerations pertaining to biotechnology and its implications for Canadian society and its long-term interests." Failure to do so will apparently hinder "Canada's ability to access, apply and harness the power of biotechnology to best serve the public's social and economic interests" (Rifkin, 1984, p. 11). The report urges Canadian governments to create "a supportive business environment for biotechnology firms by addressing the factors that influence innovative capacity; namely: university systems, university-industry technology transfers, intellectual property laws, the pool of scientists and engineers, and availability of venture capital funding" (Parry, 2004). A Conference Board of Canada report on biotechnology in Canada voices similar concerns, albeit in a more critical manner. According to the Conference Board Canada's investment strategies, aside from being only modest in size, lack sufficient focus, publicly-funded research is too slow to be commercialised (note the lack of any debate over whether such research should be commercialised), there is an apparent lack of sufficient venture capital to facilitate corporate growth and research commercialisation, Canada faces a skilled labour shortage, and overall Canada is struggling to compete globally in the biotechnology sector (Heller, 2001, p. 411). According to the Conference Board report Canada needs "to build a culture of commerce, a focus on customers and an emphasis on global markets, all of which are so necessary to Canada's future success" (Merton, 1970, 1973).

Although the CBAC document articulates the importance of social and ethical dimensions in informing biotechnology policy development, the overall tone of the report leaves the reader with the unmistakeable conclusion that commercialisation of this science and its resulting technological applications is the driving motivation. Even in respect of environmental concerns (encompassed by pillar nine of the CBS) the CBAC, following recommendations made by the Expert Working Party on biotechnology and sustainable development that it established, urges the federal government to develop environmental initiatives in a manner that would employ biotechnological innovations for economic development (Merton, 1973). The environmental catastrophe wrought on the earth over the previous two centuries under the dominance of capitalist social relations, and the corresponding corporate hindrance of concerted and effective efforts to respond to this situation seriously undermine the proposition that capitalist-inspired economic development and environmentalism can coexist in any equal manner. As this research seeks to elucidate, a number of these issues have come to serve as focal points around which oppositional movements are mobilising. But before delving into the resistance against appropriation of biotechnology in this country, the following chapter first provides a review and exposition of the major literature devoted to various aspects of this technoscience.

Chapter 2. Literature Review

This chapter reviews the previous literature conducted around the social implications of biotechnology, with particular emphasis on those works that attempt to develop a critical perspective on this technoscience. Our review of this growing body of critical academic literature, within which we attempt to position the present work, commences with a summary examination of the historical emergence of a discourse around biotechnology and society. We then proceed to a discussion of some of the dominant critiques launched against the thesis about the apparent neutrality of science and technology, which lays the groundwork for consideration of the place of biotechnology in the academy and the increasing corporate/academic linkages being established today. Attention then shifts to a focus on the informational aspects of biotechnology in an attempt to tease out the dual material/immaterial nature of biological resources in a way that sets the stage for our own analysis of the information issues implicated in this science and its attendant technological applications. Following a brief review of the major international agreements in respect of biotechnology, we proceed to outline the major implications of the increasing commodification of biotechnology. We conclude the chapter with a brief discussion of the impacts of patents on biotechnological research and development, including some of the implications patenting has for the dissemination of biological information.

2.1 Biotechnology and Society

Although genetics research had an earlier start, it was not until the late 1980s that it began in earnest around the world.[1] In general, a number of potential benefits are attributed to biotechnology, including the development of: new diagnostic tools and therapeutic procedures to combat disease, new crop varieties to eliminate world hunger,[2] and new technologies that might help reverse environmental degradation[3] (Polanyi,

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[1] Daniel Charles traces the corporate development of biotechnology in the United States. While his work considers both the apparent benefits and disadvantages of biotechnology, including some treatment of resistance to biotechnology, his book strikes an equivocal tone with respect to the implications of this new technology and its corporate capture. See, Charles, D. (2001). *Lords of the harvest: Biotech, big money, and the future of food.* Cambridge, MA: Perseus.

[2] George W. Bush, in a speech at an international biotechnology conference in 2003, invoked the rhetoric of feeding the world in his vitriolic attack on European governments that banned the import of genetically engineered crops: "Acting on unfounded, unscientific fears, many European governments have blocked the import of all new biotech crops...because of these artificial obstacles, many African nations avoid investing in biotechnology, worrying that their products will be shut out of important European markets....For the sake of a continent threatened by famine, I urge the European governments to end their opposition to biotechnology". See, Harper, T. (2003, June 24). Bush links EU ban to famine in Africa; Cites resistance to biotech crops; Calls on Europe to accept imports. *Toronto Star,* pp. A10. The Critical Art Ensemble (2002, p. 63), in its book *The molecular invasion*, is extremely critical of such corporate rhetoric, contending instead that "[t]he world could be fed before biotechnological means were available. For more than half a century, starvation has been little more than a military tactic to bring rogue nations into line or eliminate excess populations, and will probably remain so long after new, more efficient means of food production are in global use." Indeed, as Indian economist Amartya Sen has demonstrated (and for which he won a Nobel Prize), hunger is not primarily due to scarcity of food but rather to the lack of money the poor have to buy available food. As a number of other commentators point out, the paradox of hunger in an era of high growth in food production and general overproduction (relative to markets and income distribution) is the result of a capitalist system driven by the quest for profits rather than the goal of achieving and sustaining human well-being. See, for example, Magdoff, F., Foster, J. B., & Buttel, F. H. (Eds.). (2000). *Hungry for profit: The agribusiness threat to farmers, food, and the environment.* New York: Monthly Review Press. On April 15, 2008 the International Assessment of Agricultural Science and Technology for Development (IAASTD) released its 2,500-page report on agriculture and food sustainability. 400 scientists and other participants from a variety of national governments, NGOs, and corporations took four years to research and write the report, which adopts a critical perspective toward agricultural biotechnology. Indeed, because the IAASTD refused to endorse genetically engineered crops as a mechanism to combat world hunger, a number of biotechnology companies, notably Monsanto and Syngenta, ended their participation in late 2007. According to the report, "[a]ssessment of the technology [biotechnology] lags behind its development, information is anecdotal and contradictory, and uncertainty about possible benefits and damages is unavoidable" (as cited in Vidal, 2008, ¶ 10).

[3] An apologist version of unrestrained capitalist growth known as the 'environmental Kuznets curve hypothesis' posits that the initial stages of environmental destruction that accompany industrialisation can be addressed in a post-industrial society where increased affluence permits people to respond to issues beyond basic survival concerns and to develop more efficient production measures, all of which results in increased environmental protection. The underlying assumption of this thesis is that environmental degradation is simply an evil that society must endure if it wants to prosper and that eventually things will improve to a level that otherwise would not be attainable without the preceding and necessary economic

1962). According to the Government of Canada biotechnology helps "develop better diagnoses and treatments of human, animal and crop diseases, breed new crops that are more stress tolerant, nutritious and higher yielding, and reduce the need for pesticides and fertilizers in food production" (Kloppenburg, 1988a; Moser, 1995).

The Human Genome Project,[4] which is perhaps the most well-known genomics project in the world, was initiated in 1988 by a special committee of the U.S. National Academy of Sciences to develop detailed genetic and physical maps of the human genome and to place the resulting genome information into the public domain in order to facilitate scientific and medical research.[5] It should be noted that Celera Genomics, a

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growth. See, for example, McCarthy, J. (2004). Privatizing conditions of production: Trade agreements as neoliberal environmental governance. *Geoforum, 35*(327-341). The passage of a significant amount of environmental legislation in much of the developed world in the 1970s notwithstanding, given all the hyperbole one encounters regarding the apparent post-industrial, post-modern era in which we now find ourselves, one is left wondering when the real environmental remediation will begin. As McCarthy (2004) credibly argues in his article, the contemporary international trade environment adopts an instrumental approach to the environment that seeks to privatise and commodify nature. Rather than implement environmental protection measures, the global neoliberal juggernaut seeks to jettison any impediments to capitalist accumulation, thus ultimately legitimating environmental despoliation (McCarthy, 2004).

4 There is certainly no shortage of literature that treats the Human Genome Project. For a comprehensive overview of the Human Genome Project that clearly presents the marriage between information technology and biology that helped make biotechnology possible, see Cook-Deegan, R. M. (1994). *The gene wars: Science, politics, and the human genome.* New York: W.W. Norton & Co. For a somewhat dated but nonetheless useful collection of essays about the social implications of the project, see Kevles, D. J., & Hood, L. (Eds.). (1992). *The code of codes: Scientific and social issues in the Human Genome Project.* Cambridge, MA: Harvard University Press. For two representative articles found in the legal literature, see Boyle, J. (2003). Enclosing the genome: What squabbles over genetic patents could teach us. In F. S. Kieff & J. M. Olin (Eds.), *Perspectives on properties of the Human Genome Project* (pp. 98-124). Amsterdam: Elsevier.; and, Eisenberg, R. S. (1992). Patent rights in the human genome project. In G. J. Annas & S. Elias (Eds.), *Gene mapping: Using law and ethics as guides* (pp. 226-245). New York: Oxford University Press. An updated study of the Human Genome Project from a Marxist perspective is offered by Rodney Loeppky in his book, *Encoding capital: The political economy of the Human Genome Project.* For an edited collection that considers a range of philosophical and ethical issues that attend the Human Genome Project, including such things as the link between genetic research and eugenics, genetic reductionism, and the anthropology of the project, see Sloan, P. R. (Ed.). (2000). *Controlling our destinies: Historical, philosophical, ethical, and technological perspectives on the Human Genome Project.* Notre Dame, Indiana: University of Notre Dame Press.

[5] Gene mapping actually traces its roots to studies in the 1910s that examined the common fruit fly, *Drosophila*, although large-scale mapping would not be technically possible until the advent of powerful computer technologies in the 1980s. See, for example, Nelkin, D., & Lindee, M. S. (2004). *The DNA mystique: The gene as a cultural icon* (2nd ed.). Ann Arbor: University of Michigan Press. Basic biological processes, such as fermentation and the use of yeast, however, have been exploited for millennia. For some of the origins of biotechnology, see Bud, R. (1993). *The uses of life: A history of biotechnology.* New York:

private corporation, was quick to enter the race to map the human genome in direct competition with the international, publicly funded Human Genome Project. As might be expected, Celera ventured into the mapping race in order to develop proprietary databases that it could then lease to genetic researchers. According to Thacker (2005), subscription fees for access to Celera's genome database range from $5 million to $15 million for corporate subscribers. Academic researchers can obtain access for a significantly lower amount of around $8,000. Conversely, the main goals of the Human Genome Project, which were later adopted through a detailed series of five-year plans jointly written by the U.S. National Institutes of Health and the U.S. Department of Energy,[6] were based on open access to information, decentralised, international operations, and joint publication. Despite the significant American involvement, the Human Genome Project was indeed a global research project with teams in 20 different countries, including Canada through Genome Canada. On April 14, 2003 the U.S. National Human Genome Research Institute, the U.S. Department of Energy, and their partners in the International Human Genome Sequencing Consortium announced the successful completion of the Human Genome Project, although there are still small gaps (about one percent of the gene-containing portion of the human genome) that remain unrecoverable given the limits of current sequencing technology. Nonetheless, the gene-containing portion of the genome is considered to be nearly complete in every functional way for the purposes of scientific

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Cambridge University Press., and Finn, R. K. (1989). Some origins of biotechology. *Swiss Review for Biotechnology, 7*, 15-17.

[6] For an outline of the stages of the Human Genome Project, see Gibson, G., & Muse, S. (2002). *A primer of genome science*. Sunderland, MA: Sinauer.; and, Freeland Judson, H. (1992). A history of the science and technology behind gene mapping and sequencing. In D. J. Kevles & L. Hood (Eds.), *The code of codes: Scientific and social issues in the Human Genome Project* (pp. 37-80). Cambridge, MA: Harvard University Press.

research. It should also be pointed out that the International Human Genome Sequencing Consortium has made this information freely and publicly available (Noble, 1984, p. xiii).

According to proponents, genomics, a branch of biotechnology that examines the complete set of genes and their interactions for an organism, holds a number of promises, including the identification of disease genes, the development of preventive measures or new treatments for disease, and direct economic payoffs. As researchers discover more links between particular diseases and genetic mutations, genetic tests can be developed to examine individuals who indicate symptoms or who have a family medical history of a certain disease. The expanded molecular understanding of diseases facilitated by genomics research might also aid in developing prophylactic measures such as improved vaccines. For example, interferon, which was originally discovered in 1957, is a naturally occurring protein in the body that helps cells ward off viral attack by stimulating the immune system. However, the body produces such an extraordinarily small amount of this chemical that it required 90,000 blood donations to derive one-tenth of a gram of interferon, making a single dose worth about $50,000. Genetic engineering changed all this. By the mid-1980s Swiss researchers had developed a procedure using cloned bacterial cells to mass-produce large quantities of interferon, bringing the dosage price down to about one dollar. Moreover, given the extreme economy of this genetically engineered chemical it is now being used in a wider array of treatment contexts, ranging from fighting viral infection in transplant patients to other viral diseases and as an anti-caner drug (Loeppky, 2005; Wynne, 1995). Similarly, producing human vaccines with bacteria through recombinant DNA[7] (deoxyribonucleic acid) procedures not only reduces

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[7] Scientists first began deciphering what is popularly referred to as the 'genetic code' in 1953 when it was determined that deoxyribonucleic acid (DNA) permits cells to synthesise proteins. Gene mapping actually

costs, thus theoretically making them available to a wider range of the population, but they are purported to be safer than vaccines manufactured using animal organs (e.g. the pancreas of cattle or swine were previously used to produce insulin for the treatment of diabetes) (Burke, Mooers, & Shields, 2000, p. 12). Another increasingly important area of biotechnology is 'pharming' (pharmaceutical farming), which involves the genetic manipulation of animals to induce their bodies to produce proteins and medicines with human therapeutic value in their milk. For example, in January 1988 Genzyme Transgenics spliced human genes and bovine cells to create transgenic cattle capable of producing milk that contains human proteins such as the blood-clotting factor required by haemophiliacs. The original two transgenic creatures created were subsequently cloned for production purposes (Lyon, 1988).[8]

> Strolling through the Brave New Barnyard, one can find incredible beings that appear normal, but are genetic satyrs and chimera. Cows generate lactoferin, a human protein useful for treating infections. Goats manufacture antithrombin III, a human protein that can prevent blood clotting, and serum albumin, which regulates the transfer of fluids in the body. Sheep produce alpha antitrypsin, a drug used to treat cystic fibrosis. Pigs secrete phytase, a bacterial protein that enables them to emit less of the pollutant phosphorous in their manure; and

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traces its roots to studies in the 1910s that examined the common fruit fly, *Drosophila*, although large-scale mapping would not be technically possible until the advent of powerful computer technologies in the 1980s. See, for example, Nelkin, D., & Lindee, M. S. (2004). *The DNA mystique: The gene as a cultural icon* (2nd ed.). Ann Arbor: University of Michigan Press. Basic biological processes, such as fermentation and the use of yeast, however, have been exploited for millennia. For some of the origins of biotechnology, see Bud, R. (1993). *The uses of life: A history of biotechnology.* New York: Cambridge University Press., and Finn, R. K. (1989). Some origins of biotechology. *Swiss Review for Biotechnology, 7*, 15-17. Messenger ribonucleic acid was subsequently discovered in 1960. By 1967 scientists succeeded in isolating an enzyme (DNA ligase) that facilitates the joining of DNA chains. In 1970 restriction enzymes (endonuclease) that cut DNA strands at specific sites were isolated. Within three years these newly discovered enzymes were being used to introduce foreign DNA into bacteria by cutting and splicing gene fragments. Herbert Boyer, from the University of California at San Francisco, and Stanley Cohen, from Stanford University, invented the first DNA recombinant technique in 1973. They succeeded in splicing genetic material from a frog into bacterial DNA so that the produced bacterial cell lines contained these same genetic attributes of the frog. This process is known as 'recombinant DNA' since the genetic information contained within the DNA is recombined *in vitro*.

[8] For a more detailed exposition of the quest within the biotechnology industry to develop mammalian bioreactors, see Kimbrell, A. (1997). *The human body shop: The cloning, engineering, and marketing of life* (2nd ed.). Washington, D.C.: Regnery Publishing.

> chickens make lysozyme, an antibiotic, in their eggs to keep their own infections down (Feenberg, 1995, p. 4; 1999, 2002).

These very brief examples only touch the surface of the range of health products and applications that researchers believe are yet to be developed through genetic engineering.[9]

Biotechnological advances in the agricultural sector have been heralded by proponents of this new technology as providing the means to increase crop yields, as well as nutritional content, while simultaneously reducing the required levels of chemical pesticides applied to protect crops.[10] In this regard the federal government developed the Canadian Crop Genome Initiative, a major project led by Agriculture and Agri-Food Canada, the federal department responsible for agricultural matters, including food products developed using biotechnology. This project is tasked with developing corn, soybeans, canola, and wheat varieties that are resistant to disease and insect attack, cold and drought, and which yield improved crops in terms of both quantity and quality (Marcuse, 1964). The first confined field trials were conducted in 1988 for herbicide resistant canola. Since then, genetically engineered canola, corn, and soybeans have been

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[9] The Genome Canada Website provides a significant amount of information about the potential benefits that genetics and proteomics hold for human health and the environment, including a list of all the research projects currently being funded through this federal organisation (http://www.genomecanada.ca/index.asp?l=e).

[10] The field of agricultural biotechnology is also a site around which a burgeoning oppositional literature is developing. For a small sample of some of these works see the following: Cummins, R., & Lilliston, B. (2004). *Genetically engineered food: A self-defense guide for consumers* (2nd ed.). New York: Marlowe & Co; Krimsky, S. (1991). *Biotechnics & society: The rise of industrial genetics*. New York: Praeger; Krimsky, S., & Wrubel, R. P. (1996). *Agricultural biotechnology and the environment: Science, policy, and social issues*. Urbana, IL: University of Illinois Press; Manning, R. (2000). *Food's frontier: The next green revolution.* New York: North Point Press; Nestle, M. (2003). *Safe food: Bacteria, biotechnology, and bioterrorism*. Berkeley, CA: University of California Press; Raeburn, P. (1995). *The last harvest: The genetic gamble that threatens to destroy American agriculture*. New York: Simon & Schuster; Shiva, V. (1997). *Biopiracy: The plunder of nature and knowledge*. Boston: South End Press; Smith, J. M. (2007). *Genetic roulette: The documented health risks of genetically engineered foods*. Fairfield, IA: Yes! Books.; and, Tokar, B. (Ed.). (2001). *Redesigning life?: The worldwide challenge to genetic engineering*. Montreal: McGill-Queens's University Press.

given regulatory approval for unconfined release in this country. Similarly, a number of new food products have resulted from the application of biotechnology to agriculture: 'vegetarian' cheese (early 1990s); the 'Flavr Savr' tomato (1995, though it failed to achieve wide market success); 'Roundup-Ready'[11] soybeans (1996), canola (1997), and corn (1998); and Bt maize and cotton (1996) (Feenberg, 1999, 2002). Roundup Ready sugar beet is Monsanto's latest seed development in the Roundup Ready product line, with full release in the United States scheduled for this year. Other predicted, though as yet mainly unfulfilled, benefits claimed by proponents of agricultural biotechnology include: drought tolerance, frost resistance, improved photosynthesis and nitrogen fixation, delayed ripening, improved flavour, and the metabolism of a slew of apparently advantageous biochemical products (Feenberg, 1999, 2002). Biotechnology companies have also been developing virus-resistant transgenic seeds, which are designed to protect the resulting crops from particular blights and viruses. Most of these crops contain a gene from a naturally occurring soil bacterium known as *Bacillus thuringiensis*, which produces a crystal protein that destroys the digestive tract of certain Lepidopteran insects (insects that metamorphose from a caterpillar stage) when ingested and mixed with stomach acid. Known as Bt prototoxin (crops that contain this gene are noted by the prefix 'Bt', e.g. Bt-Cotton), this naturally occurring toxin has also been used to manufacture a biopesticide solution that does not have to be activated by stomach acid and therefore can be used by organic farmers on their crops (Feenberg, 1999, 2002).[12] Synthetic chemicals and genetic engineering techniques are also being employed to speed

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[11] Roundup-Ready is the trade name Monsanto uses to market its line of glyphosate resistant seeds. Glyphosate is the active ingredient in its Roundup herbicide.

[12] Pointing to the failure of Roundup Ready to reduce pesticide use given the propensity of weeds to develop resistance to this herbicide, Kloppenburg (2004) hypothesises that Bt resistant insects are probably just a matter of time.

up the maturation process of meat animals while simultaneously reducing their required feed levels (Diamond, 1981). While one would be hard-pressed to contest the fact that biotechnology has yielded some groundbreaking discoveries in a variety of areas, it is equally true that a plethora of issues that go beyond the science, and which have wide-ranging implications for contemporary society, follow in the wake of this new technoscience. A balanced account of the development of biotechnology must challenge the assumption, either implicit or explicit, that scientific progress derives from the capacity of scientists to surmount technical barriers, public apprehension, or the obstacles placed by bureaucratic and political elites.[13] Members of the Critical Art Ensemble poignantly sum up the dangers of uncritically equating technological development in the service of capital with progress:

> Of course there is no real gain, only relative gain. Class structure replicates itself in the technology.... decades of technoculture have taught us only that the greater the intensity of technology, the greater the workload. Much the same is true of efficiency. Improved efficiency only means more profit and speed for capital, while the implied promise of individual benefit never seems to materialize. Taken together, a working definition of progress emerges that means nothing more than the expansion of capital, but presents itself as advancement of the common good (Cohen, 1995a, p. 1706).

As another researcher points out in respect of his work on the Human Genome Project:

> Whether the results of genome research will ultimately deliver the beneficial new therapeutic products promised by pharmaceutical and biotechnology capitals remains to be seen. That, after all, is a qualitative question pertaining to use value, and capital is concerned about use value only insofar as it can be translated into commodity production and new rounds of accumulation. From the perspective of capital, the primary significance of the HGP has always been, and continues to be, the potential it creates for an ever-increasing array of

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[13] A few examples of such accounts of genetic science, that, to borrow from Latour, leave the seal on the 'black box' of scientific technology unbroken, include the following: Bishop, J. E., & Waldholz, M. (1990). *Genome: The story of the most astonishing scientific adventure of our time - The attempt to map all the genes in the human body*. New York: Simon & Schuster; Lee, T. (1993). *Gene future: The promise and peril of the new biology*. New York: Plenum; and, Lyon, J., & Gorner, P. (1996). *Altered fates: Gene therapy and the retooling of human life*. New York: W.W. Norton.

commodities produced specifically for the market (Busch et al., 1991; Etzkowitz, Webster, & Healey, 1998a).

In the early 1980s when advances in computing power[14] began to enable what some have referred to as the 'biotechnology revolution' based on the science of biology,[15] molecular biologist Edward Yoxen was already contemplating the social issues raised by the burgeoning new developments in science, medicine, and technology that accompanied advances in biotechnological research.[16] In a series of case studies, Yoxen (1983) outlines the transformative capacity of biotechnology for a range of products that affect the daily life of humans, including medicine, agriculture and food production, and energy and chemicals. In general, Yoxen (1983) casts a critical eye on the corporate influence over the development of biotechnology.[17] He is also wary of the effects that economic values might exercise over academic values: "In David Noble's phrase, the ivory tower is "going plastic"; it is becoming a think tank for major corporations, which

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[14] According to Castells (2000b, p. 63), "[t]echnological convergence increasingly extends to growing interdependence between the biological and microelectronics revolutions, both materially and methodologically. Thus, decisive advances in biological research, such as the identification of human genes or segments of human DNA, can only proceed because of massive computing power." See, Castells, M. (2000). *The rise of the network society* (2nd ed. Vol. I: The Information Age: Economy, Society and Culture). Malden, MA: Blackwell Publishers. Though this contention understates some of the important advances made in the fields of biology, cybernetics, and information theory, the importance of advanced computing power to the massive growth in biotechnological research and application development remains clear. Indeed, the claim has been advanced in the scientific literature that genetic engineering is a type of information technology. See, for example, Voigt, C. A. (2008). Life from information. *Nature Methods, 5*, 27-28. Zweiger (2001, p. xi) similarly makes the claim that "[b]iology is being reborn as an information science, a progeny of the Information Age....Molecules convey information, and it is their messages that are of paramount importance." See, Zweiger, G. (2001). *Transducing the genome: Information, anarchy, and revolution in the biomedical sciences*. New York: McGraw-Hill.

[15] Best and Kellner employ the term "biocybernetic era" to capture the synthesis between genetic engineering and computers. See, for example, Best, S., & Kellner, D. (2001). *The postmodern adventure: Science, technology, and cultural studies at the third millennium*. New York: The Guilford Press. Thomas Mitchell speaks of "biocybernetic reproduction". See, Mitchell, W. J. T. (1998). *The last dinosaur book: The life and times of a cultural icon*. Chicago: University of Chicago Press.

[16] For an earlier account of the social nature of technology that treats writing as the first technology, see Fuller, R. B. (1975). *Synergetics: Explorations in the geometry of thinking*. New York: Macmillan.

[17] Cary Fowler and Pat Mooney, as discussed by Jeremy Seabrook, have also voiced concern about the effects of corporate influence on the integrity of the scientific research process. See, Seabrook, J. (1993). Biotechnology and genetic diversity. *Race & Class, 34*(3), 15-30.

have exclusive access to it, rather than remaining a general social resource" (Etzkowitz & Webster, 1998, p. 22).

Yoxen (1983) discusses the tension between the commercial aim of securing a strong return on investment on the one hand and serving the public good on the other. A key theme in his work, and one also articulated by Bob Young (1985), is the need for greater citizen participation in scientific and technological decision-making at the research and development stage, when change is much easier to effect than is the case once a technology or scientific development has been deployed (Haber, 1996, p. 442). "*We must not allow our options to be foreclosed by ceding to capital the exclusive power to determine how biotechnology is developed and deployed*" (Caulfield & Feasby, 1998; Washburn, 2005). Other writers emphasise the predominance of the business-industry relationship as the dominant power relationship driving the politics of science, arguing that "because science is socio-politically constructed and constructing, knowledgeable societies need far more sophisticated processes for steering science democratically (Rosenbloom & Spencer, 1996, pp. 70-71). André Magnan (2006), in his case study of the CBAC, makes a similar point about the need to democratise the science and technology policy adopted in this country in respect of biotechnology. He discusses a number of democratic approaches that challenge a technocratic approach to policy development, including 'discursive policy process'[18], 'participatory policy analysis'[19],

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[18] On this point, see also, von Schomberg, R. (1998). Democratising the policy process for the environmental release of genetically engineered organisms. In P. Wheale & R. von Schomberg & P. Glasner (Eds.), *The social management of genetic engineering* (pp. 237-248). Aldershot, GB: Ashgate.
[19] On this point, see also, Mayer, I., & Geurts, J. (1998). Consensus conferences as participatory policy analysis: A methodological contribution to the social management of technology. In P. Wheale & R. von Schomberg & P. Glasner (Eds.), *The social management of genetic engineering* (pp. 279-301). Aldershot, GB: Ashgate.

and 'deliberative technology policy'[20] (Freeland Judson, 1994; Sigurdson, 1993). As Best and Kellner (2004, p. 220) put it, "[a] schizoid modern science that rigidly splits facts from values must give way to a postmodern metascience that grounds the production of knowledge in a social context of dialogue and communication with citizens." Ultimately, however, Yoxen (1983) strikes a sceptical tone with regard to the chances for success of any concerted efforts to transform the corporate-led priorities of the biotechnology research agenda at its early developmental stages into support for goals designed to foster a broader public good. In part, Yoxen's early pessimism was prescient; the last two decades have witnessed an escalating commercialisation of biotechnology, but as this research sets out to examine, attempts are being made to insert a more democratic voice into the way biotechnology is developed and incorporated into our everyday lives.

Sheldon Krimsky (1991), in his book *Biotechnics and society: The rise of industrial genetics*, sets out to examine the social discourse surrounding biotechnology. His work considers the early regulatory approaches taken in the United States toward new biotechnologies, including which actors were involved in the policy development process and to what degree the expectations that attached to early product development cycles have been satisfied.[21] In Krimsky's own words, his work seeks to begin

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[20] On this point, see also, von Schomberg, R. (Ed.). (1999). *Democratising technology: Theory and practice of a deliberative technology policy*. Hengelo, NL: International Centre for Human and Public Affairs.
[21] In his book *Encoding capital: The political economy of the Human Genome Project*, Rodney Loeppky (2005, p. 4) is critical of Krimsky for adopting "an uncomfortably pure image of scientific research, a somewhat benign view of capital, and an optimistic view of the state (which he [Krimsky] feels can regulate any potential problems), weakening its utility as comprehensive social criticism." This critique seems to rest on a somewhat uncritical reading of Krimsky's work, which explicitly rejects technological determinism and bemoans the fact that "too many of our [American] agencies of government conceive of their role as promoting innovation and development rather than assessment and selectivity" (Krimsky, 1991, p. 229). One is left wondering whether some of Loeppky's cavilling comments stem from a perceived need to demonstrate a gap in the critical literature within which to situate his own work.

> the task of chronicling the nascent stages of its [biotechnology] development. We do not yet know whether the revolution in applied genetics will establish higher standards for civilization as a whole, will respect diverse forms of life and habitats, will liberate us from disease or enslave us to a genetic determinism, whether its achievements will be shared equitably, or whether its significance will be mixed with a favorable outcome to narrow interest groups (Etzkowitz et al., 1998a; Etzkowitz, Webster, & Healey, 1998b).

Some seventeen years on, the current research seeks to pick up on some of these considerations and sketch a picture of how they are being worked out. In the opening chapter to his book, Krimsky (1991) introduces the interesting metaphor of the cell as a factory and basis of a new mode of production.[22] While living organisms have been manipulated for human use for millennia, it was not until the 1970s that scientists were able to harness the internal biochemical processes of cells for production purposes. Cells can now be employed to synthesise proteins that were not part of their original function, a development reflected in the prominent models and symbols utilised in molecular biology that represent the cell as a complex machine. As one observer has noted, "[g]enetic engineering is also turning plants and animals into "bioreactors" – living factories for making drugs, industrial chemicals, fuels, plastics, medical products, and other materials" (Powell & Owen-Smith, 1998, p. 263). According to Krimsky (1991), such conceptualisations reflect not only attempts by scientists to render the science comprehensible to an audience unfamiliar with the traditional biochemistry vernacular, but also the explicit belief within the scientific community that the cell has been subordinated to human control. Perhaps most interesting from the perspective of the

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[22] Though not explicit, the extension of the factory metaphor to the cellular level seems to follow on Descartes' metaphor of the world as a machine, which the latter outlined in Part V of his *Discourse on Method* as a means for contemplating organisms and conceptualising the broader universe: "I have hitherto described this earth and generally the whole visible world, as if it were merely a machine in which there was nothing at all to consider except the shapes and motions of its parts" (*Principles of Philosophy*, IV) (as cited in Lewontin, 2000a, pp. 3-4). See, Lewontin, R. (2000a). *The triple helix: Gene, organism, and environment.* Cambridge, MA: Harvard University Press.

current research, the contemporary mechanistic conception of cellular production differs from the traditional mechanistic views of seventeenth and eighteenth century physicists; it is one based on cybernetic materialism in which genes and DNA are considered bits of information or carriers of the code necessary to produce particular proteins. These molecular chemical factories, which are the basic units of life responsible for the development of plants, animals, and humans, are implicated in intricate processes of information transfer and feedback (Dasgupta & David, 1987, 1994).

As a place of production, the 'machinery' of the cell factory can be harnessed in any one of a variety of arrays to produce a particular protein, chemical substance, or even pharmaceutical. According to Jeremy Rifkin (1998), agricultural, pharmaceutical, and chemical companies intend to clone animals on an industrial scale to use them as chemical factories that will produce a range of drugs and medicines. As in the traditional factory where tools and dies can be interchanged to manufacture a different industrial product, the 'machinery' of cells might be appropriated to produce different substances by transplanting the gene responsible for synthesising the required protein and its regulating sequences. Similarly, just as the production line can be sped up to increase output, so too can cellular production. The economic viability of the biological synthesis of commercially useful products demands swift rates of biosynthesis. "Industrial scientists study how to amplify or enhance the cell's products by introducing multiple copies of a gene or by controlling environmental factors. As a "factory" the cell must be brought to peak efficiency" (Rosenberg, 1982; Rosenberg & Nelson, 1994). "Our ultimate goal is to rival the growth curve of the Industrial Age by producing living matter at a tempo far exceeding nature's own time frame and then converting that living material into an economic cornucopia" (Nestle, 2003, 2007). The products of the biotechnology industry, which differ from those traditionally associated with the industrial economy, might be considered hybrids that fuse organic and technical properties (Krimsky, 1991; Krimsky, Ennis, & Weissman, 1991). Yet similar to industrial manufacture, the biotechnology industry also requires raw material inputs, albeit in the form of plant, animal, and human genetic materials rather than the iron ore, timber, and fibre requirements of the former. Biotechnology renders biological life processes such as genes, bacteria, viruses, and other organisms into raw material inputs for production purposes.

> Exchanging the factory shop floor, with its heavy machinery and army of (organized) labourers, for the sterile laboratory, with its delicate instruments and handful of experts (often unorganized but well paid) research directors, postdoctoral fellows and technicians, the biotechnology lab is truly a postmodern factory (Krimsky, 1991, p. 78).

2.2 Critiquing the Autonomous/Neutral Nature of Science and Technology Thesis

Robert Merton, in his discussion of the sociology of science, places emphasis on a perceived shared ethos among members of the scientific community that is instrumental in exerting a dominant influence on scientific development (Krimsky, 2003, p. 7). According to Merton, four basic norms interact to form the ethos of science and thus accordingly regulate scientists' behaviour: *universalism*, which demands that contributions to scientific knowledge be evaluated impersonally in an objective manner; *organised scepticism*, which requires scientists to probe the veracity of the work of other scientists, including those upon whom they base their own work; *communality*, such that empirical knowledge is considered a resource owned in common; and, *disinterestedness*, requiring that scientists engage with science for the sake of science rather than pecuniary gain (Hubbard & Wald, 1993; Washburn, 2005). Merton's work thus provided a basis for a normative conception of science that long clung to the idea of an objectivity of its own practice that insulated it from social practice.[23] Michael Polanyi develops a similar argument with his notion of the 'Republic of Science' that he conceives as being independent and self-governing, and therefore necessarily autonomous of the "popular will" of public debate (Kenney, 1986, p. 240). Such accounts, which posit an endogenous determination of scientific progress, have also been referred to as 'internalist' perspectives of science (Powell & Owen-Smith, 1998, p. 259). An internalist approach, however, not only closes off science to public scrutiny and intervention, it also runs the risk of overlooking crucial social factors and derailing into a technologically determinist account. As David Noble makes clear:

> technology does not necessitate. It merely consists of an evolving range of possibilities from which people choose. A social history of technology that explores beneath the appearance of necessity to illuminate these possibilities which technology embodies, reveals as well the contours of the society that realises or denies them (Eisenberg, 1987; Etzkowitz & Webster, 1998).

In fact, the aftermath of World War II and finally the Vietnam War laid to rest the image of an objective and disengaged scientific apparatus that had served to remove any epistemological rationale for public fear of or intervention into the domain of science.

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[23] It is also noteworthy in the context of this research project that Mertonians tend to conceive of scientists as a privileged segment of the workforce whose work transcends such issues as profit and control, while Marxist perspectives conventionally consider scientists as part of the working class and thus antagonistic toward capital and the managers who represent capital's interests. Some selected examples of the former include the following: Glaser, B. G. (1964). *Organisational scientists: Their professional careers.* New York: Bobbs-Merrill; Kornhauser, W. (1962). *Scientists in industry: Conflict and accommodation.* Berkeley: University of California Press; and, Raelin, J. A. (1986). *The clash of cultures: Managers and professionals.* Boston: Harvard Business School Press. Examples of the latter include: Braverman, H. (1974). *Labor and monopoly capital: The degradation of work in the twentieth century.* New York: Monthly Review Press; Derber, C. (Ed.). (1982). *Professionals as workers: Mental labor in advanced capitalism.* Boston: G.K. Hall; and, Noble, D. F. (1977). *America by design: Science, technology and the rise of corporate capitalism.* New York: Knopf.

Balanced contemporary assessments of science recognise the socially derived interests inherent in science, demonstrating that scientists too are susceptible to externally developed subjectivity and hierarchy (Best & Kellner, 2001).[24]

Critical of those who attribute an autonomous nature to technology, Krimsky (1991) seeks to demonstrate the specious nature of teleological claims that equate science and technology with progress. As Krimsky (1991) makes clear, in order to appreciate the opportunities for shaping the trajectory of technological development, one must devote considerable attention to the social and economic conditions that prevail during a technology's early developmental stages. The sociologist David Lyon advances similar arguments about the importance of refuting notions of technological neutrality. A more fruitful line of investigation employs a complementary analysis that considers the impact social effects exercise on the trajectory of technological development, and, conversely, the effects that technology has on shaping society. As Lyon (1988) demonstrates, a multitude of forces, including military, economic, and political ones, are brought to bear on the processes of technological development. Against a backdrop of neoliberalism that "extends the class power of large capital and erodes the collective capacity of labour and the popular sector" (Rosenberg & Nelson, 1994), contemporary governments respond to this constellation of forces through agendas of deregulation and the abandonment of once

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[24] See also, Berg, M. (1998). The politics of technology: On bringing social theory into technological design. *Science, Technology, & Human Values, 23*, 456-490.; and, Mulkay, M. (1976). The mediating role of the scientific elite. *Social Studies of Science, 6*, 445-470. Failure to interrogate the broader social context in any depth, according to Langdon Winner (1993, p. 369), leaves accounts of scientific development susceptible to a narrow view in which the social and political context that emerges appears as the balanced outcome of a set of 'pushes and pulls' within an otherwise pluralistic and conservative framework. Instead, Winner posits the importance of considering the effects of elitism. He criticises social constructivism for overlooking "the problem of elitism, the ways in which even a broad, multicentered spectrum of technical possibilities is skewed in ways that favor some social interests while excluding others" (Winner, 1993, p. 370). See, Winner, L. (1993). Upon opening the black box and finding it empty: Social constructivism and the philosophy of technology. *Science, Technology, & Human Values, 18*, 362-378.

'public' goods and services to the logic of the marketplace in an effort to stimulate national competition and economic growth (Florida & Kenney, 1993, p. 639).

John McMurtry (2002, p. 97) is similarly explicit in his assessment of the lack of neutrality in science and technology: "Scientific technology is not, in fact, 'neutral' in its meanings or value, but is a vast global system of moving parts that materially reproduces the transnational corporate order as a totalising mechanism to serve an absolutist value-set of turning money into more money for investors." This position is echoed by Jack Kloppenburg (2004, p. 4), who writes that "[t]he existing social formation conditions the manner in which a new technology is deployed, even as it may be changing under the influence of that deployment." By conceptualising technological development in this recursive manner, opportunities arise to alter or even resist a particular path that might otherwise appear beyond control.

As Andrew Feenberg (1995, 1999, 2002) points out, notions of technological neutrality, necessity, or rationality serve as ideologies to choke off debate and opportunities for active citizen participation in the institutions of industrial society: "unless democracy can be extended beyond its traditional bounds into the technically mediated domains of social life, its use-value will continue to decline, participation will whither, and the institutions we identify with a free society will gradually disappear"(Florida & Cohen, 1999; Yoxen, 1981).[25] This is not an altogether new observation; Marcuse (1964) elaborated this theme in his discussion of the infiltration of

[25] Feenberg's (1995) position, as he admits, finds its genesis in the work of Marx, who maintains that the disenfranchisement and alienation of individuals will continue until they can actively participate in industrial decision-making, thus extending democracy from solely the political realm to the domain of work. Democratising technology and the workplace requires, beyond formal legal rights, rights of initiative and participation that derive from the experience and needs of people opposed to a particular technological hegemony driven by the dual goals of profit and power. See, for example, Feenberg, A. (1995). Subversive rationalization: Technology, power, and democracy. In A. Feenberg & A. Hannay (Eds.), *Technology and the politics of knowledge* (pp. 3-22). Bloomington, IN: Indiana University Press.

technological rationality into the social realm, which works to the oppressive detriment of humanity. Political questions are rendered as technical issues to which only experts might respond, thus replacing political rationality with technological rationality, in a manner that serves to denude critical opposition of its legitimacy (Blumenthal, Gluck, Seashore Louis, Stoto, & Wise, 1986). Feenberg (1999, 2002) advocates an approach to technological development and implementation that conceptualises technology as *one* element among an array of dimensions that constitute human existence. He develops a critical approach to technology that, rejecting its neutrality, admits the constituting influence of the values and interests of the dominant social system and its ruling classes in the design of new technologies. Technological design might thus be construed to be an ontological decision to which attach substantial political, social, and economic implications (Blumenthal, Causino, Campbell, & Seashore Louis, 1996). Feenberg (1999, 2002) develops the term 'technical codes' to refer to the imbrication of ideology (a discursive expression of class interest) and technique through the rules and artefacts of technology in a manner that indiscernibly facilitates the power interests of the dominant hegemons. That is, while technological progress can deliver advances of general social utility, the specific manifestation of technological development is mediated by the social power dominant at the historical conjuncture in which such advances are achieved in service of that particular power constellation; or as Foucault contends, truth and power are connected at their origins rather than contingently in the moment of application. It is through these 'technical codes' that a dominant ideology can be entrenched in a particular technology, which amounts to an embedding and reinforcement of unequal power relations in the developmental trajectory of technological design. As a result, technological development contains an inherent bias toward the *status quo* of a given social and ideological constellation (Bekelman, Li, & Gross, 2003). Kevin Robins and Frank Webster (1999, p. 4, emphasis added) are even more emphatic in their assertion that

> technologies always articulate particular social values and priorities. Indeed, we may see technologies as articulating the social relations of the societies on which they are mobilised – and, of course, that must mean articulating the *power* relations….We need to be concerned with the way in which technologies mediate capitalist social relations.

However, unlike some other writers, but very much complementary to the analytical framework adopted in this work, Feenberg (1999, 2002) conceives emancipatory potential in progressive technology such that attempts at defining its limits must not always overreach into either instrumental or substantive approaches that foreclose future liberating potentialities. On this account, technological development is an ambivalent and socially contested process in which different alternatives compete, though certainly not always from an equal position of power. Nonetheless, as a dependent variable, technology is always susceptible to being reshaped in service of the interests associated with a new hegemony (Blumenthal, Campbell, Causino, & Seashore Louis, 1996).

While Best and Kellner (2001) recognise that significant technological advancements often become shorthand for particular historical periods, they stress that analysis of technological development in contemporary society cannot be reduced to one quintessential technology. Rather, technological advancement has been progressing in an oftentimes-complementary manner among multimedia, computers, the Internet, biotechnology, and recently nanotechnology. The imbrication of these various technologies, in turn, has implications for the developmental trajectory of technoscience, technocapitalism (the term they use to represent the new syntheses and modes of capital, science, and technology – it signals the expanded importance of technology but within a social and economic context characterised by capitalist relations of production), and technoculture (culture defined more by science and technology than by religion, social norms, ethics, or the humanities). The difference between theirs and the present analysis lies in the emphasis they place upon an examination of the co-evolution of science, technology, and markets, all of which are considered to be responsible for provoking a global reorganisation of capital (they employ chaos and complexity theory, quantum mechanics, and ecology to help explain the interrelationships between science, technology, and society). Our analysis instead specifically considers the autonomous actions of social agents in compelling capital to respond and reorganise. Best and Kellner (2001) certainly consider the agency of social actors when they unpack science and technology but ultimately their analytical lens focuses less accent on autonomous social agency.

As Diamond (1981, p. 32, emphasis in original) contends, "[i]n its most basic aspects, the concepts with which scientists organize data and formulate theories, science is inherently political." Science is inherently political because the concepts and theories about nature that it develops are firmly rooted in the social and political ethos prevailing at the time of their development. This should not be construed as an appeal to relativism, but rather as an admonition to bear in mind that politics do impact the way science is practiced in a particular historical epoch (Bekelman et al., 2003, p. 463).[26] This

[26] In a similar vein, Herbert Marcuse contends that "[t]echnology, as a mode of production, as the totality of instruments, devices, and contrivances which characterise the machine age, is thus at the same time a mode of organizing and perpetuating (or changing) social relationships, a manifestation of prevalent thought and behavior patterns, an instrument for control and domination" (as cited in Noble, 1977, p. xxii). See, Noble, D. F. (1977). *America by design: Science, technology, and the rise of corporate capitalism.* New York: Knopf. While this research agrees with the general premise of Marcuse's argumentation, the current project goes beyond Marcuse and others of the Frankfurt School to discern the liberatory potentials in new

perspective begs some pertinent questions in respect of biotechnological development in this country: does biotechnology in Canada contribute to capitalist accumulation? Does it presuppose and reinforce dominant social relations? If so, does the critical analysis offered by this research help to open these social relations to scrutiny? In any event, the tensions outlined in this section of the chapter in respect of the nature of science and technological development are partly reflected in the tensions arising from the increasing linkages being established between industry and academia.

2.3 Biotechnology and the Academy

Loeppky (2005) makes the general point that prior to 1980 and the capitalist infiltration of science in the United States, the field of molecular biology was infused with a strong normative grounding that facilitated the academic process, including autonomy, creativity, and insulation from political and economic pressure. This general ethos resulted in expectations that "a scientist is supposed to respect the collaborative nature of the process: credit is to be shared appropriately; the findings of others – even from competing labs – are to be cited; students are to be treated generously; materials and data are to be shared freely" (Blumenthal, Causino et al., 1996, p. 372). Today, however, the university landscape is increasingly characterised by pressure on faculty to commercialise research and develop partnerships with commercial companies; a development Elzinga terms an epistemic drift through which the utility of science is

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technologies that can be appropriated by movements organised against capitalist control of science and technology.

measured according to market criteria (Dyer-Witheford, 1999).[27] American commentators assert that university policy and regional economic development initiatives have helped "create the conditions to produce a self-sustaining chain reaction of high technology firms...linking universities to firm formation through private and state venture capital" (Federici & Caffentzis, 2007).[28]

One author has reported that "[a]mong the Fortune 500 companies, $10 million invested internally resulted in 13.1 patents; the same amount invested in university alliances resulted in 22.6 patents" (Schiller, 2007, p. xiv). Despite the benefit to industry from access to the university research infrastructure, there are concerns within industry about loss of control over research, including the potential for premature dissemination of research results, and a loss of intellectual property rights.[29] Conversely, universities are also plagued by a number of concerns related to funding alliances with corporate partners, including: restrictions on internal collaboration within the university; loss of academic freedom; loss of objectivity; emphasis on applied research at the expense of basic research; student exploitation; pressure on faculty to concentrate disproportionately

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[27] Les Levidow (2002) offers a compelling analysis of the way that neoliberal strategies have been employed to commodify and marketise tertiary education. See, Levidow, L. (2002). Marketizing higher education: Neoliberal strategies and counter-strategies. *The Commoner, January*(3), 1-21. David Noble similarly analyses how information and communication technologies have contributed to the increasing commodification of both research and teaching in institutions of higher education. See, for example, Noble, D. F. (2002). *Digital diploma mills.* New York: Monthly Review Press.

[28] Etzkowitz and Webster tend to be more sanguine than other authors reviewed in this section about the increasingly tighter linkages between industry and academia, voicing the hope that such relationships will infuse both sides with some of the values inherent in the other. However, their work remains wholly unconvincing about the positive values industry might instil in university culture. See, for example, Etzkowitz, H., & Webster, A. (1995). Science as intellectual property. In S. Jasanoff & G. Mankle & J. Peterson & T. Pinch (Eds.), *Handbook of science and technology studies* (pp. 480-505). Thousand Oaks, CA: Sage.; and, Etzkowitz, H., & Webster, A. (1998). Entrepreneurial science: The second academic revolution. In H. Etzkowitz & A. Webster & P. Healey (Eds.), *Capitalizing knowledge: New intersections of industry and academia* (pp. 21-46). Albany: State University of New York Press.

[29] For articles that deal with industry-academic linkages from the corporate perspective, see Blumenthal, D., Gluck, M., Seashore Louis, K., & Wise, D. (1986). Industrial support of university research in biotechnology. *Science, 231*, 242-246; and, Murray, M. (1986). Professors minding their own business: Survey of university biotechnology researchers with industry ties. *Science News, 129*, 374.

on commercial activities instead of other duties such as teaching; and, abuse of the researcher/physician-patient relationship in the case of clinical trials (Ciccotti, Cini, & de Maria, 1976, p. 41). Nonetheless, some authors have gone so far as to assert there is a "diminishing role for corporate laboratories as the wellspring of innovation," suggesting that the "seeds of new technological advance will probably sprout more often in university or government laboratories" (Perelman, 1998). As the literature presented in this section attests, this trend already appears well established.

Etzkowitz and Webster (1998) speak of a 'second academic revolution', characterised by the drive to translate the research developed in institutions of higher education into products and new business ventures for the benefit of the private sector.[30] They assert that we can expect a growth in the amount of long-term collaboration between industry and universities, particularly with regard to fundamental, discovery-oriented research programs. This contention, which has been voiced by others, thus assumes a shift of research agendas from industrial laboratories to campus labs. This changing situation is progressively impinging on the traditional normative considerations that guide research agendas (as discussed more fully in section 2.2). Similarly, scientific knowledge, which has normally been considered an input necessary to expand the field, is, under mounting commercial pressure, being evaluated increasingly as a research

[30] The first academic revolution involved a change in emphasis among universities from being bastions of cultural preservation to becoming institutions concerned with expanding the frontiers of knowledge. See, Etzkowitz, H., & Webster, A. (1998). Entrepreneurial science: The second academic revolution. In H. Etzkowitz & A. Webster & P. Healey (Eds.), *Capitalizing knowledge: New intersections of industry and academia* (pp. 21-46). Albany: State University of New York Press. Ultimately, these authors argue that "the genie of capitalizable knowledge, whose potential was recognised as early as the seventeenth century, has emerged in the late twentieth century from the "ivory tower" created by the proponents of an ideology of pure research in the late nineteenth century. Moreover, the expansion of academic research has irrevocably changed the function of the university, since potentially commercializable knowledge is created as a byproduct of normal research activities even without new subventions directed toward that purpose" (Etzkowitz et al., 1998a, p. 16). See, Etzkowitz, H., Webster, A., & Healey, P. (1998). Introduction. In H. Etzkowitz & A. Webster & P. Healey (Eds.), *Capitalizing knowledge: New intersections of industry and academia* (pp. 1-20). Albany: State University of New York Press.

outcome that can drive industrial utility (Schiller, 2007, p. 26). Certainly scientific ideas have long been translated into industrial applications as evidenced by the historical importance of the chemical and electrical industries to the Industrial Revolution.[31] What does appear both quantitatively and qualitatively novel is the intensification of this process in terms of the reduced temporal period between discovery and application, the strategic importance of the knowledge developed in academic institutions to industry, and the expanded push by governments to encourage (coerce?) universities into becoming incubators for economic growth and development through partnerships with business (Heller, 2001, p. 413). "In short, the labor market for life scientists has been greatly expanded, and the cross-traffic between universities and industry is now so extensive that it is fair to consider biotech firms and universities as part of a common technological community" (Thacker, 2005, p. xii). A few commentators have developed economic arguments in support of the separation between academic and industry research, asserting that the difference in motivation driving these two realms of scientific study would lead to negative social welfare implications if they were co-mingled. That is, optimal resource allocation and social welfare follow from a strict division between academic and industry science (Thacker, 2005, p. 47, emphasis removed). Other economists counter that it is becoming increasingly difficult to clearly delineate between science and technology or basic versus applied research (Bowker, 2000). While Etzkowitz and Webster (1998) discuss the conflicts of interest that emerge from the blurring of boundaries between the corporate world and academia, or what they see as the decreasing gap between

[31] Hindmarsh and Lawrence (2004) point to an even earlier historical period, discussing Francis Bacon's ideas of science as technology. See, Hindmarsh, R., & Lawrence, G. (2004). Recoding nature: Deciphering the script. In R. Hindmarsh & G. Lawrence (Eds.), *Recoding nature: Critical perspectives on genetic engineering* (pp. 23-40). Sydney: University of New South Wales Press.

technology and science, they tend to downplay the dangers, resigning themselves to the fact that it is apparently too late to change the contemporary situation. In contradistinction, Marion Nestle problematises the funding alliances between industry and educators, researchers, and professional societies, maintaining that this type of co-operation raises, at a minimum, concerns about conflict of interest that must be addressed to ensure the integrity of biotechnology and food health research (Braman, 2004b, pp. 35-36).

Sheldon Krimsky, who writes from an American perspective, is similarly critical of the increased commodification of biotechnology in academia, asserting that the corporate ethos will lead to conflicts of interest within the university, skew research, and indoctrinate a new generation of academic researchers motivated predominantly by private rather than public interest (Powers, 1997, p. 366). "The triad of government, industry, and academia constitutes a mutually reinforcing system of self-interest that brings to a close an important period of independence for basic research in the biomedical sciences" (Keller, 2000, p. 87).[32] "The consequences are that secrecy has replaced openness; privatisation of knowledge has replaced communitarian values; and commodification of discovery has replaced the idea that university-generated knowledge is a free good, *a part of the social commons*" (Bullard, 1988, p. 220). Similar concerns have been articulated by a number of other writers (Yoxen, 1981, p. 102).

Martin Kenney (1986), in his book *Biotechnology: The university-industrial complex*, also voices concerns about the shift away from the notion of science as public

[32] In another empirical study, Krimsky and colleagues provide direct evidence of the widespread links between American biologists and corporate entities. See, Krimsky, S., Ennis, J. G., & Weissman, R. (1991). Academic-corporate ties in biotechnology: A quantitative study. *Science, Technology, & Human Values, 16*, 275-287.

knowledge that accompanies the intrusion of capitalist imperatives into the social relations of production. He outlines the ways in which the academic science of biotechnology has been transformed into a technology and scientists into a labour force. Similar themes about new divisions of labour emerging in academic institutions as a result of the increased role of universities in industrial innovation are developed in the monograph edited by Etzkowitz, Webster, and Healey (1998), *Capitalizing knowledge: New intersections of industry and academia*. Kenney's work, which focuses on biotechnological research, analyses the relationships between universities as institutions and business, paying particular attention to the growth in start-up companies that are increasingly funded by venture capital and managed by both businesspeople and active members of the professoriate.[33] Jack Kloppenburg advances comparable ideas in his book *First the seed: The political economy of plant biotechnology, 1492-2000*. It is Kenney's (1986) assertion that the growth in biotechnology, as an economic sector, was completely dependent upon university research and thus on university scientists and researchers. His analysis includes the role of the state in funding the initial basic research that helped biotechnology metamorphose into an applied science with practical applications, as well as the role played by the state in legitimating the transformation of the natural world into private assets through the intellectual property system.[34] More so

[33] Similar to his concerns with Krimsky's work, Loeppky (2005) takes Kenney to task for an apparent failure to clearly outline the means by which science and technology establish themselves as important social factors, including the way this emergence is connected to broader social relations.

[34] A prime example of this situation occurred in the United States in 1974 when Stanford University was granted permission by the American National Institute of Health to file a patent on Stanley Cohen's and Herbert Boyer's recombinant DNA work. This decision facilitated the trend toward the privatisation of university research, which stripped the public of any rights to or claims over publicly-funded research (Kenney, 1998). In fact, Kenney (1998) goes on to argue that such developments helped give rise to the American biotechnology industry. See, Kenney, M. (1998). Biotechnology and the creation of a new economic space. In A. Thackray (Ed.), *Private science: Biotechnology and the rise of molecular sciences*

than some of the other scholars investigating the increasing close relationships between the corporate sector and academia, Kenney (1986) pays particular attention to the role of information in this process and in the wider capitalist environment. "Biotechnology has been the cutting edge of new institutional arrangements that are evolving to facilitate the flow of information from the university to industry.... If the next upswing in the world economy is to be based on information, then building new channels of information flow is crucial" (de Landa, 1991).[35]

Edward Yoxen (1981) examines the way biotechnology is being appropriated by capital as a system of control in an attempt to reproduce and sustain its hegemony. His analysis of the infiltration of universities by capital, similar to Martin Kenney's work, serves to demonstrate how capital's exploitation of biotechnology is emanating, in large part, from institutions of higher learning.[36] It is Yoxen's (1981) belief that the history of molecular biology is a social history that reflects a complex process comprised of both conceptual and institutional factors. Yoxen (1981) demonstrates how the increasing commodification of biotechnology, coupled with capital's infiltration of universities, is

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(pp. 131-143). Philadelphia: University of Pennsylvania Press. See also, Drahos, P., & Braithwaite, J. (2002). *Information feudalism: Who owns the knowledge economy?* London: Earthscan.

[35] Kenney references the work of Joseph Schumpeter and Ernest Mandel in his discussion of 'long economic waves' that help account for upswings in scientific and technological development. See, for example, Mandel, E. (1975). *Late capitalism* (J. De Bres, Trans.). London, GB: NLB.; and, Schumpeter, J. A. (1939). *Business cycle: A theoretical, historical, and statistical analysis of the capitalist process.* New York: McGraw-Hill. Mandel's notion of 'late capitalism' remains unconvincing when one considers the capacity of capital to respond to and re-organise in the face of crises – as discussed in chapter three. This weakness is particularly obvious in the contemporary context of capital's re-organisation in the form of globalised financial and techno-capitalist social relations.

[36] Florida and Cohen (1999) assert that the close collaboration between industry and academia has largely come about through the explicit actions of universities, a thesis that refutes those who claim universities have been subject to corporate manipulation. However, these two authors overlook some of the important structural factors, such as significantly reduced government funding that followed from the neoliberal agenda pursued by most Western governments, that provide a convincing explanation of why universities actively sought out industry collaboration and funding. See, for example, Florida, R., & Cohen, W. M. (1999). Engine or infrastructure? The university role in economic development. In L. M. Branscomb & F. Kodama & R. Florida (Eds.), *Industrializing knowledge: University-industry linkages in Japan and the United States* (pp. 589-610). Cambridge, MA: MIT Press. Ultimately, the cause might be less important than the consequences, which are spelled out in this section of the chapter.

leading to heightened emphasis on applied research at the expense of basic research.[37] Though today, more than a quarter of a century later, the basic/applied dichotomy may no longer be relevant to biotechnological research. "Biotechnology has...largely collapsed the distinction between basic and applied science: Fundamental new discoveries, such as gene therapy or the identification of a fat gene, have immediate scientific and medical importance as well as enormous commercial relevance" (Boyle, 1996, p. 4, emphasis in original). Innovation today is considered to depend on a scientific infrastructure characterised by close linkages between basic and applied research (Rifkin, 1998, pp. 13-14). Other authors date the implosion of the Manichean distinction between basic and applied science even earlier to the Cold War, when corporate and state-funded militarisation was a catalyst for deriving from 'pure' science practical applications, which themselves, in turn, spawned new grounds for scientific research (Kloppenburg, 1988a). That is, in an iterative fashion basic research often yields applied work and vice versa. Extrapolating further, not only does university research fuel technical innovation by industry, but technical applications developed by industry also contribute to advancing levels of fundamental understanding (Doyle, 1985; Mooney, 1983). Etzkowitz and Webster (1998) therefore speak of a 'layered' rather than a 'substitution' strategy in which scientists maintain their basic research programs but add applied projects to them in a recurrent process that moves between the two research types while always remaining cognisant of the implications each has for the other. Florida and Kenney (1993, p. 640) contend, "[t]he new model of capitalism involves the blurring of the lines between

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[37] See also, Feller, I. (1986). Universities as engines of economic development: They think they can. *Research Policy, 19*, 335-348. Tension between these two types of research was evident prior to the burgeoning of biotechnology, when, at the turn of the twentieth century, engineering and chemistry faculties were split between those faculty members who wanted to pursue applied research funded by industry and those who favoured projects dedicated to advancing basic research.

production and innovation. The distinctions between the factory floor and the R&D laboratory are neither hard nor fast." That having been said, these authors reject appeals to 'post-capitalism' as an explanation for information-based production:

> While we would agree...that knowledge is increasingly important as a source of value, we do not believe that the increasing role played by knowledge, intelligence and innovation in the economy represents a shift to a new, post-capitalist form of economic and social organisation. In our view, capitalism has evolved in a dynamic way to harness and integrate knowledge and intellectual labour as sources of value within the boundaries of capitalist progress (Castells, 1989, pp. 12-13).

As will be made clearer in the following chapter, this epistemological position resonates closely with the theoretical framework adopted by this research.

These new social processes are also serving to erode the traditional autonomy of academic researchers, a situation leading Yoxen (1981) to suggest that the notion of 'directed autonomy' may be a more suitable way of conceptualising contemporary academic research agendas, which are subject to the power exercised by institutional, political, and economic forces. Such forces are increasingly brought to bear on decisions about what research will be funded and what degree of managerial control will remain with which actors (Levidow & Tait, 1995).[38] In a similar vein, Loeppky (2005, p. 147) contends that social relations between scientists are being reprioritised and "increasingly organized around the economic and quantifiable value derivable from their work."

At least one early American study indicates that both industrially affiliated and non-affiliated scientists (70% and 78%, respectively) believe that industrial support for research risks shifting too much emphasis to applied research away from basic research,

[38] Yoxen's review of the history of molecular biology does indicate that there was a substantial amount of reluctance among scientists to conceive of their work as one of the structural components driving industrialisation and economic growth, but that once this transpired structural change within the institutions of science was quick to follow. See, Yoxen, E. (1981). Life as a productive force: Capitalising the science and technology of molecular biology. In L. Levidow & B. Young (Eds.), *Science, technology and the labour process: Marxist studies* (Vol. I, pp. 66-122). Atlantic Highlands, NJ: Humanities Press.

and creates pressures for faculty to devote too much time to commercial activities (68% and 82%, respectively) (Guattari, 1992). Blumenthal and his colleagues determined in a 1996 follow-up study that the extent of industry-university collaboration not only increased in the intervening years, but also was characterised by a heightened emphasis on applied research projects. This later survey also provided evidence that American corporations funding academic research increasingly require universities to maintain the confidentiality of information for periods longer than necessary to acquire patent rights (Beurton, 2000; Falk, 2000; McAfee, 2003). Another study found similar evidence that industry linkages tend to result in deferral of publication and other information withholding practices, although industry sponsorship alone was not sufficient; instead such practices occurred when the investigators were also involved in marketing the research results (McAfee, 2003, p. 212). As Kenney (1986, p. 124) points out, "[p]ublication of research results becomes somewhat trivial when the patent filing precedes publication." Perhaps more importantly, the companion study that considered the participation of faculty in corporate relationships determined that twice as many scientists without industrial affiliation nonetheless feel that commercial pressures shape their work (up from 7% in 1986 to 14% in 1996), which appears to be a significant change (King, 1997; McAfee, 2003, p. 204).[39] Similarly, a 2003 empirical study suggests that

> the financial ties that intertwine industry, investigators, and academic institutions can influence the research process. Strong and consistent evidence shows that

[39] At least one commentator has argued that studies like those conducted by Blumenthal *et al.* and Krimsky likely underestimate the extent to which non-industry affiliated faculty remain unaffected by corporate pressure on research projects in institutions of higher education. See, for example, Etzkowitz, H. (1999). Bridging the gap: The evolution of industry-university links in the United States. In L. M. Branscomb & F. Kodama & R. Florida (Eds.), *Industrializing knowledge: University-industry linkages in Japan and the United States* (pp. 203-233). Cambridge, MA: MIT Press.

> industry-sponsored research tends to draw pro-industry conclusions. By combining data from articles examining 1140 studies, we found that industry-sponsored studies were significantly more likely to reach conclusions that were favourable to the sponsor than were nonindustry studies (Oyama, 2000).

Overall Blumenthal and his colleagues posit that reliance on industry financial support by academic institutions "may not generally be conducive to maintaining the level of excellence of fundamental academic research in those fields" (Parry, 2004).

Nick Dyer-Witheford (1999) also discusses the infiltration of the academy by business and its attendant subservience of education to the demands of job-markets and basic research to applied research. However, as might be expected from an autonomist Marxist, he glimpses in this era of corporate-university partnerships the potential for professors and students to cement stronger bonds between themselves as well as with other waged and unwaged workers. As the distance between the 'ivory tower' and the 'real' world progressively shrinks, the position of members of academia, both instructor and pupil, comes to more closely resemble that of the rest of the labour force. From this arises the potential for the university community to connect with movements outside its gates, as well as to function as a nodal point within a broader circulation of struggles (Braman, 2004a).

The general theme that tends to run throughout much of the literature on industry-academia linkages is that universities have emerged as fundamental components in an underlying innovation infrastructure that is imperative to the expansion of contemporary capitalist social relations; a situation that has led some observers to speak of the "edu-factory" (Lewontin, 1982, p. 163, emphasis in original). Again, part of this research is devoted to an investigation of some of the implications of corporate infiltration of academic biotechnology research agendas in this country. Similarly, and following on the potential for optimism perceived by Dyer-Witheford (1999), the examination and analysis of resistance movements are designed to provide some evidence as to whether members of the academy are descending from the tower to become actively engaged in struggles against the various strategies of enclosure designed to capture knowledge within the circuits of capitalist accumulation.

2.4 Informational Aspects of Biotechnology

According to one prominent information theory scholar:

> We are living through a transition into an informationalized capitalism. As a consequence of policies adopted beginning around the 1970s, a long-standing process of commodification – the growth of wage labor to produce commodities and of market mechanisms to distribute them – has gripped the global information and communications sector. At the same time, communications and information have come to infuse the more encompassing process of capitalist development (McAfee, 2003).

Given this general process of expanded commodification, Schiller (2007) emphasises the integral role that the information commodity has played in the expansion of capitalist development. Schiller (2007) is critical of the hypothesis made by information-society theorists that information is intrinsically different from other resources, and instead draws a distinction between information as a resource and information as a commodity. The assumption explicit in the post-industrialist thesis that the value of information springs from its inherent attributes as a resource is discounted by Schiller (2007), who maintains instead that the value of information derives from its commodification, which occurs through the application of wage labour and the market as the mechanism for production and exchange. Similar arguments are advanced by Samuel Trosow (2003), who provides a critical analysis of contemporary copyright from the perspective of Marx's labour theory of value. The wage relation has been extended into progressively more fields of social labour and market exchange has been applied to a growing range of commodities, including information. Other theorists develop similar arguments about the value of information to capital accumulation:

> Without examining in detail the capitalist mode of production of information as a commodity it seems clear that some aspects of the submission of labour to capital in this sphere recall those which occur in the general process of the capitalist production of material goods: the division of labour, with the relative fragmentation and repetitiveness of work, the hierarchisation of function, the alienation of the products of labour from the worker, the way in which capital confronts the worker as if it was a foreign power – in a phrase, the submission of the labour process to the valorisation of capital (Beurton, Falk, & Rheinberger, 2000; Bourgaize, Jewell, & Buiser, 2000; Fox Keller, 2000; Hubbard & Wald, 1993; Rose, 1997).

Schiller (2007), against those political economists who deny the productivity of the information sector, most notably Baran and Sweezy, emphasises the integral role that the information commodity has played in the expansion of capitalist development. One of the themes of Schiller's (2007) book, *How to think about information*, is that the import of information to contemporary capitalist social relations extends beyond any one economic sector to constitute a general political economic phenomenon. Along similar lines, another author asserts that the increasing importance of information to capitalist society will actually exacerbate rather than ameliorate class divisions (Lewontin, 2000a). According to Perelman (1998, p. 33), "so long as we permit the existing class structure to remain in place, we will never be able to enjoy the promise of an information age."

Schiller (2007, p. 25) situates biotechnology firmly within the domain of information capitalism, in which information assumes a prominent role as a factor of production across all economic sectors: "As commodity relations are imposed on previously overlooked spheres of production, new forms of genetic and biochemical information acquire an unanticipated equivalence with other, more familiar genres." Schiller (2007) employs a Marxist analysis in his work that leaves room for contemplating resistance to the capitalist commodification of biotechnology:

> In and around these emergent sites of private accumulation, not only has capital sought to rework culture to further self-interested objectives, but others, opposed on varying grounds to specific biotechnology applications, have tried to make the issues amenable to political rather than purely proprietary determinations (Lewontin, 2000a, p. 38).

It must, however, be noted that Schiller (2007) does not offer any empirical evidence of emerging counter struggles focussed on biotechnology that would support the above assertion. In part this might be explained by the fact that the emphasis of his book is on the communication sector, for which he does offer evidence of points of resistance. Part of the purpose of this proposed research is to respond to such gaps by outlining and analysing contemporary resistance struggles that seek to liberate aspects of biotechnology from the confines of capitalist controlled information.

Chaia Heller (2001) also locates biotechnology firmly within the ambit of what she refers to as 'informational capitalism'. "As an expression of what may be called "the advanced capitalization of nature," biotechnology represents the attempt of informational capital to profit from and transcend the limits of a biological nature that has been greatly compromised by industrial capitalist production" (Lewontin, 2000a, p. 100). Viewing biotechnology as an information issue highlights another entry point to critique the commodification of biotechnology and commodification more generally. Against this backdrop of general commodification processes at play in broader society, this research examines and situates the economic importance attributed to biotechnology and biotechnological information in Canada from a perspective that privileges resistance to capitalist enclosures of these material and immaterial resources.

In a similar vein, Thacker (2005) offers a political economic account that attempts to analyse the impact of broader globalisation processes on the development of biotechnological knowledge and practice (he focuses predominantly on biomedical and genetic research). His book, *The global genome*, seeks to address how ontological questions in respect of biotechnology are insinuated in broader social, economic, and cultural questions. Avoiding an unsophisticated determinist line of argument, Thacker (2005) contends that the contemporary globalising context helped facilitate biotechnology and the creation and development of a biotechnology industry. The bulk of his work is devoted to an investigation of the interstices between biology and informatics, including the way advances in the latter have facilitated innovation in the former. He is therefore also interested in interrogating the often-contradictory dichotomy found in biotechnology between the natural and the artificial, the biological and the technological. Thacker (2005) examines the way genetic materials are rendered into digital forms that capture the informational content of the embodied artefacts, and which, in turn, are manipulated and recombined to produce novel biological materiality. He conceptualises these activities as existing in a spiral relationship to one another that consists of encoding (production), recoding (circulation), and decoding (consumption). As Thacker (2005, xi) puts it, we can conceive of "three kinds of DNA: "wet" DNA in a test tube, "dry" DNA from a computer database, and valuable DNA as part of a patent." Thacker (2005) contends that the interplay between these three activities or types of DNA demonstrates the way that biotechnology mediates between the biological and the informational. A basic claim made in the book is that "in their very existence, these unique entities – genome databases, DNA synthesizers, regenerative tissues – are ontologically redefining the notion of biological "life itself"" (Parry, 2004).

Drawing on Foucault's concept of 'biopolitics' and Marx's notion of 'species-being', Thacker (2005) develops the argument that the biotechnology industry relies on an appropriation of the productive activity of species-being at the molecular, genetic, and informational levels in a way that transforms human biological life activity (labour power) into a type of nonhuman production. Biology is not merely science, but also a productive technology that relies on the labour power of cells, enzymes, and DNA. Put another way, biotechnological production relies on the body itself as a factory in which human labour is superseded by production at the molecular, enzymatic, and genetic level, which, in a nod to the 'immaterial labour' thesis of Hardt and Negri, Thacker refers to as biomaterial labour. According to Thacker (2005, p. 95), this 'biomaterial labour' is based on a redefinition of "the nonhuman labor power of cells, enzymes, and genes…as both material (that is, as living labor) and as informatic (that is, as a biotechnology)." Biomaterial labour thus integrates the technological with the biological or, to employ Marx's terms, living with dead labour. "In the biotech industry, we see the continual transformation of biological value and medical value into economic value, a continual refashioning of the species-being as at once biological and economic, as a form of "biomaterial labor"" (Parry, 2004). Thacker (2005) maintains that value derivation, and hence profitability, for a number of the so-called life-science companies will depend increasingly upon manipulation of the information derived from biological resources and rendered into digital format. The underlying assumption is that biological material – tissue, cells, chromosomes, genes, molecules, etc. – lends itself to easy transformation into data, which provides further impetus for the propagation of the myth of genetic reductionism in service of broader capitalist commodification imperatives. But what differentiates biotechnology from other industries is that this same information can be further recombined to produce novel instantiations of biological materiality in the form of cell cultures, human tissue, or genetically engineered plasmids, for example. The informational aspects of biotechnology thus continue to be qualified by biological materiality (as cited in Parry, 2004, pp. 195-196).

Discussing the notion of information as power, Braman (2004b, p. 35) postulates that, specific to biotechnology, "[t]he terms "genetic" or "informational" can be used to describe this form of power as it appears at the genesis, the informational origins, of the materials, social structures, and symbols that are the stuff of power in its other forms." She goes on to add:

> Genetic power is a particularly important form of power today because it is that which takes the greatest advantage of the distinct characteristics of this stage of the information society, the harmonization of systems – of nationally based information and communication systems with each other, and of information and communication systems with other types of social systems. In such an environment, information flows have structural effects as powerful as those traditionally associated with the law. As a result, the ability to shape those flows is the most important form of power of all (Parry, 2004).

Madison Powers has also touched on the social implications of control over information, in this case genetic information:

> The ability to control access to genetic information itself must be seen as an important social resource, and its distribution can profoundly affect the distribution of much of what else matters to the well-being and autonomy of individuals. For genetic information policies can shape how much access individuals have to other valuable social goods, including the ability to make other personal decisions about a range of significant life options….An informed and effective genetic information policy simply cannot be formulated in isolation from an awareness of its distributive implications (Thacker, 2005, p. 187).

In her discussion of the progress made in molecular and reproductive biology, the science historian Evelyn Fox Keller contends "the informational content of DNA remains essential – without it, development (life itself) cannot proceed" (Thacker, 2005, p. 189).[40] The extinction of species has thus been characterised as "an irreversible loss of information" (Parry, 2004). According to Edward Yoxen (1981, p. 69) "[t]he molecular biological schema purports to describe all organisms as self-assembling, self-maintaining, self-reproducing information-processing machines." Molecular biology represents an "advance towards biology as the science of information" (as cited in Parry, 2004, p. 75). Others liken DNA to a software programme capable of abstract symbol manipulation (Kloppenburg, 1988a, p. 155). Boyle asserts that:

> We have already reached the point where genetic information is thought of primarily *as* information. We look at the informational message – the sequence of As, Bs, Cs, and Ts – not the biological medium. The human genome project is simply a large-scale exercise in cryptography. Like archaeologists with the Rosetta Stone, we have broken the cipher, and can now deal with DNA as a *language to be spoken, not an object to be contemplated* (Thacker, 2005, p. xv).

Rifkin (1998) similarly argues that genetic information makes up the biotech economy. Genes, which constitute the resource base of this scientific and industrial sector, are, at the same time, ultimately comprised of information – DNA provides the necessary code, or set of information, to synthesise the proteins required to create and maintain life. From a commercial perspective, "interest now focuses increasingly on the thousands of chemical strands of genetic information that comprise the blueprints for living things" (Rossiter, 2006, p. 24). Almost two decades ago Kloppenburg left room

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[40] It bears pointing out that this should not be construed as evidence of Fox Keller's support for genetic reductionism. As she makes clear throughout her work, a great many contemporary molecular biologists have moved beyond earlier conceptualisations through which it was believed that 'simply' decoding the information contained in DNA sequences would reveal the 'programme' responsible for generating a particular organism. In her own words, "…it seems evident that the primacy of the gene as the core explanatory concept of biological structure and function is more a feature of the twentieth century than it will be of the twenty-first" (Fox Keller, 2000, p. 9).

for the possibility that biotechnological material would increasingly derive its value from its informational content rather than its material form (Burrows, 2001; Kloppenburg, 2004; Parry, 2004). In that same period other writers postulated that, given the ability of emerging technology to transform fundamental genetic and biochemical properties, the tradition of valuing biotechnological materials as material resources alone would have to accommodate a new assessment that also reflected their informational resource aspects (Panitch, 1994). Manuel Castells argues that because biotechnology

> benefited from the enhanced capacity to store and analyse information, genetic engineering extended the technological revolution to the realm of living matter. This laid the foundations for biotechnology, itself an informational technology with its scientific basis in the ability to decode and reprogram the information embodied in living organisms....What genetic engineering does is to decipher and, eventually, program the code of the living matter, dramatically expanding the realm of controllable information processing" (Critical Art Ensemble, 2002, pp. 8-9).

Other observers discuss the computer metaphor in discourses on biotechnology, through which life is represented as being reducible to a genetic code that can be read, edited, and copied (Parry, 2004).[41] As science and economic productivity move to this level of

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[41] The notion of DNA as code goes back to Watson and Crick's early work on the structure of DNA, as well as the claim by Matthai, Nirenberg and colleagues to have "cracked the genetic code". See, for example, Crick, F. (1962a). The genetic code. *Scientific American, 207*, 66-75.; Crick, F. (1962b). Towards the genetic code. *Discovery, 23*(3), 8-16.; Crick, F. (1963). The recent excitement in the coding problem. *Progress in Nucleic Acids Research, 1*, 163-217.; and, Matthai, H., Jones, O. W., Martin, R. G., & Nirenberg, M. (1962). Characteristics and composition of RNA coding unit. *Proceedings of the National Academy of Sciences, 48*, 1580-1588. See also, Nirenberg, M. (1963). The genetic code II. *Scientific American, 208*, 80-94. For a detailed history of the intersections between molecular biology and cybernetics and information theory, including the rise to prominence of the information metaphor in biology, see Kay, L. E. (2000). *Who wrote the book of life? A history of the genetic code*. Stanford, CA: Stanford University Press. Indeed, Kay (2000, p. 328) characterises her work as a study of the "...epistemic rupture from purely material and energetic to an informational view of nature and society." At least one writer is critical of the trope of the 'genetic code', claiming that its attendant conception of easily adding, deleting, or otherwise manipulating genetic material belies the empirical evidence and experience of most molecular scientists, who are unable to transfer genetic material between organisms with any exacting degree of precision. See, McAfee, K. (2003). Neoliberalism on the molecular scale. Economic and genetic reductionism in biotechnology battles. *Geoforum, 34*, 203-219. Moreover, living organisms are sometimes adept, in ways still not well understood by science, at adjusting to additions or deletions of genetic material by substituting alternate pathways for those altered in some way, thus

research and production, the import of information to contemporary science and economic activity comes into stark relief. As Yoxen (1981) points out, the conceptual re-definition of nature as information, communication, and control supports and reinforces its increasing commercial exploitation, a process that has been facilitated by the application of chemistry and biology as the instruments to link the interpretation of organic processes with their technological and commercial exploitation (General Agreement on Tariffs and Trade, 1994, sec. A1C, 13).

Biotechnology, as should be evident from the discussion thus far, is another realm, among an already expanded range of areas, of social existence that is falling prey to the imperatives of capitalist commodification in the contemporary 'social factory'. The mobilisation of private property norms and market-based mechanisms to subvert biotechnology into the service of capitalist accumulation has, in no insignificant measure, been facilitated by the dominant, though increasingly challenged, genetic reductionist paradigm, which relies on representations of 'genes' and 'genetic codes'. Genetic reductionism, which is based on the proposition that genes are discrete constructs, assumes that one or more specific genes cause a particular trait. At their most basic level, genes are considered to be functional packets of information that not only can be mapped to determine their characteristics with exacting precision, but that also can be readily enumerated, transplanted from one organism to another through genetic engineering, or otherwise manipulated by adding to or subtracting from them in a manner that affects whether they express themselves or not.

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preventing the organic change the genetic engineering was designed to induce. See, for example, Fox Keller, E. (2000). *The century of the gene*. Cambridge, MA: Harvard University Press.

Yet as various observers note, genetic reductionist representations are misaligned with both the theory and practice of the researchers and farmers who engage with genetically engineered life forms (Shiva, 2001b). Instead, such representations of genes as discrete and stable objects that possess knowable and predictable properties offer a theoretical justification for transforming genes and their attendant information into alienable commodities that, through a stringent intellectual property protection system, can be owned and traded in the neoliberal marketplace. Genetic reductionism "helps to rationalize the privatization of science, the treatment of genetic information, organisms, bio-techniques, and research findings as proprietary commodities, and the valuation [sic] genetic resources in terms of the prices they can fetch in international markets" (May & Sell, 2006). "[E]conomic and genetic reductionism share the same fatal flaw: abstraction from the spatial and temporal specificity of nature and from the environmental and social contexts in which nature coevolves" (May & Sell, 2006, p. 163). Put simply, the genetic reductionist paradigm dovetails quite readily with the economic reductionism inherent in neoliberalism, helping to sustain capital's encroachment into nature and physical existence.

Other authors are more critical of the form/matter dualist tradition from the computational model that has infiltrated evolution theory, contending that it is inaccurate to conceptualise DNA as the message and the remainder of the cell as the receiver (Fowler, 1995; King & Stabinsky, 1999). According to Oyama (2000), the informational aspects of genetics encompass more than just DNA and include the chemistry of the cell and its neighbouring environment, as well as the interactions between these various forms of matter within this sophisticated chemical environment.[42] There are difficulties with the corporeal informational dichotomy in those instances when an artefact retains properties of both. For example, the engineered material that is produced during DNA sequencing remains a form of matter while simultaneously functioning as a source of information that, with the aid of advanced computing technology, can be 'decoded' and 'translated' into text (Kloppenburg, 2004). At an even more basic level, the genetic information embedded in the physical material of DNA is often conflated with the DNA itself. By way of analogy, this is similar to mistaking a book for the information contained within it (de la Perrière & Seuret, 2000).

As scholars critical of genetic reductionism[43] point out, our expanding understanding of molecular science seriously questions the validity of the notion that genes are discrete organic objects involved in the seemingly linear chain of causality that is heredity. "Organisms within their individual lifetimes and in the course of their evolution as a species do not *adapt* to environments; they *construct* them. They are not simply *objects* of the laws of nature, altering themselves to bend to the inevitable, but active *subjects* transforming nature according to its laws" (de la Perrière & Seuret, 2000). The belief that one gene codes for one protein is nonsense given that the human body produces some 200,000 proteins using only between 30,000 and 40,000 genes. The reductionist view that an analysis of the parts will yield a complete understanding of the

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[42] This has negative implications for information theory and its inherent linear model based on source, receiver, encoder, and decoder. If information is found beyond DNA within the entire cell and in the interactions between the cell and its environment, then it is incorrect to conceptualise DNA as the message and the remainder of the cell as the receiver that produces particular proteins based on the code/information contained in the DNA.

[43] For trenchant works that consider the multiple social implications of genetic reductionism, see, in particular, Beurton, P. J., Falk, R., & Rheinberger, H.-J. (Eds.). (2000). *The concept of the gene in development and evolution: Historical and epistemological perspectives*. Cambridge: Cambridge University Press.; and, Rose, S. (1997). *Lifelines: Biology beyond determinism*. Oxford: Oxford University Press.

whole must give way to a dialectical method that adopts an opposite approach. That is, the various genetic elements of an organism can only be comprehended through examination of the whole organism as it develops and evolves through interaction with its environment, including the ways in which such organic development and evolution affects the environment (May & Sell, 2006). Genes, in fact, are context dependent. Their expression, or lack thereof, follows on the basis of a complex set of interactions between various areas within the genome, between the information contained in DNA and ribonucleic acid[44] (RNA) as well as information from other cellular molecules, between cells and other physiological systems, including the entire organism itself, and between organisms and their broader environment, which also includes social co-determinants. Molecular scientists are coming to recognise that cells possess capacities for self-regulation and self-repair, and that gene expression is influenced by a web of feedback mechanisms between genes, proteins, other cellular elements, and the organism itself. The emergent properties inherent in organisms indicate a high level of complexity that cannot be deduced in a linear manner from their component parts (May & Sell, 2006, p. 217). Moreover, organisms with identical genomes, whether the result of nature or engineering, are susceptible to different developmental and behavioural trajectories when environed by different conditions. Evidence for this position has been offered by plant researchers who have determined that the growth of cloned plants varies when diverse

[44] Ribonucleic acid is defined as any of a class of single-stranded molecules transcribed from DNA in the cell nucleus or in the mitochondrion or chloroplast, containing along the strand a linear sequence of nucleotide bases that is complementary to the DNA strand from which it is transcribed. The composition of the RNA molecule is identical with that of DNA except for the substitution of the sugar ribose for deoxyribose and the substitution of the nucleotide base uracil for thymine. (RNA. (n.d.). Dictionary.com Unabridged (v 1.1). Retrieved April 03, 2007 from Dictionary.com website: http://dictionary.reference.com/browse/RNA).

fluctuations (e.g. in temperature, elevation, etc.) are introduced into their immediate environment (McAfee, 2003).

In recent work, Richard Lewontin introduces the view of genetics as a 'triple helix' comprised of genes, organism, and environment. Arguing against the reductionist paradigm that reduces genes to their informational content, he maintains "the organism does not compute itself from the information in its genes nor even from the information in the genes and the sequence of environments" (McNally & Wheale, 1998; Moser, 1995). The weakness of such a deterministic model is its proclivity to overlook the chance properties of random processes such as 'developmental noise'. Instead, Lewontin (2000) advocates a perspective that admits the interrelationships between organism and environment: "Taken together, the relation of genes, organisms, and environments are reciprocal relations in which all three elements are both causes and effects" (Brecher & Costello, 1994). Nonetheless, the research into such molecular/environmental interactions tends to remain underdeveloped since the resulting findings do not usually yield forms of knowledge or technology that are easily commodified.

The United Nations Convention on Biological Diversity (CBD)[45] distinguishes between 'genetic materials' and 'genetic resources', indicating that the drafters of the convention envisioned the potential for a separation of genetic resources from the actual 'container' of a particular biological material.[46] Bronwyn Parry (2004), a cultural and

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[45] The United Nations Convention on Biological Diversity was adopted by 170 countries at the Earth Summit in Rio de Janeiro in 1992.

[46] Article 2 of the Convention on Biological Diversity defines genetic material as "any material of plant, animal, microbial or other origin containing functional units of heredity". Genetic resources are defined to include "any genetic material of actual or potential value". A number of observers have voiced criticism of the CBD, arguing that it was drafted in a manner to ensure access and use of biological diversity for economic development within a neoliberal framework. See, for example, Burrows, B. (2001). Patents, ethics and spin. In B. Tokar (Ed.), *Redesigning life?: The worldwide challenge to genetic engineering* (pp. 238-251). Montreal: McGill-Queens's University Press.; Kloppenburg, J. R., Jr. (2004). *First the seed: The*

economic geographer, considers the term 'genetic resource' to include both genetic material and the resulting genetic and biochemical information that it might yield. Biotechnology and its accompanying information technologies, as alluded to previously, now render it possible to not only derive genetic and biochemical information from organic material, but to use such information independently of the original biological sample. Increasingly it is precisely the derived biotechnological information rather than the material form that is of interest to researchers. Thus, similar to other economic sectors that rely heavily on information, there is significant pressure in the biotechnology field to ensure that biotechnological information is readily accessible in a form amenable to subsequent digital manipulation.

Parry (2004, p. 7) has devoted considerable research into the effects that changes in the way biotechnological materials and information are embodied and presented have had on the development of "new resource economies in bio-information". Her study, which concentrates on the American biotechnology industry, demonstrates that the increased emphasis on the informational aspects of biotechnological material not only allies with broader structural transformations of the economy, but offers those actors involved in the collection of biotechnological material, and the subsequent derivation of its intrinsic information, the ability to capture economic advantage from such assets without having to relinquish ultimate control (Shiva, 1993, p. 82). Similar to Mosco's (1988, 1996) discussions in the field of communications, Parry (2004) demonstrates how metered access to biotechnological information along the lines of a pay-per-view or rental

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political economy of plant biotechnology (2nd ed.). Madison: The University of Wisconsin Press.; and, Seini, M. (2004). Commodification and access: Biotechnology and Australia's indigenous flora. In R. Hindmarsh & G. Lawrence (Eds.), *Recoding nature: Critical perspectives on genetic engineering* (pp. 192-205). Sydney: University of New South Wales Press.

model is generating new and continuous revenue streams for the owners of such information – information that functions as a critical resource required for the further development of biotechnological products and processes. The nascent trade in genetic and biochemical information has been made possible by the advanced gene sequencing technologies developed in the 1990s that allow biological information to be disembodied from its organic, corporeal form and rendered in digital format that can be accessed, viewed, and transferred from one location to another with relative ease (Shiva, 2000, pp. 116-117). Bill Neirman, a former research director at the American Type Culture Collection, has outlined how this trade in biological information operates:

> We work locally here with Human Genome Sciences and The Institute for Genomic Research. One is a for-profit, one is a nonprofit [sic], and the whole thing was set up by Smith Kline Beecham pharmaceutical company. They [SKB] are basically looking at establishing sequences of human genes, and they're setting up this huge database of these kinds of gene sequences. And so what they are doing is licensing people to search it for things – to pay money to look. And as part of the agreement, you can look, you can find things, you can commercialize it, but Smith Kline has first right of negotiation with you on commercial arrangements. So the details of the profit sharing are not established up front, just that you agree to negotiate first with Smith Kline (Best & Kellner, 2001).

Other major pharmaceutical manufacturers have made similar arrangements. For example, in February 2000 Incyte (an American drug discovery and development company based in Wilmington, Delaware) signed agreements with a number of drug manufacturers, including Pfizer, Eli Lilly, and AstraZeneca, which would provide these companies with access to its database of genetic information and data management services. Citing a US$18 billion life-sciences research budget among American academic institutions, the company also announced that it would seek to expand its revenue stream by renting these research institutes access to its genetic information databases (McMichael, 2000). Those who assert and maintain control over the growing number of genetic databases are positioned to become "biocommerce brokers" and such databases themselves sources of "biopolitical management" (as cited in Dorsey, 2001, p. 275). "In biotechnology, the bioinformatics of database access is inextricably connected, [sic] to software and subscription models of research, which is where bioinformatics intersects with biocapitalism, or genetic bodies are integrated into an advanced capitalist framework" (Dorsey, 2001).

Parry (2004) also considers the role that the emerging global regulatory regime has had on the growing commodification of biological derivatives, including the terms that govern their trade and use. She ultimately concludes that the increased prominence of biotechnological information over its corporeal embodiment means that large quantities of biological material no longer need to be collected *in situ*, thus frustrating international agreements that seek to channel remuneration to those regions and countries from whence the biotechnological material comes (Dorsey, 2001, p. 277). John Barton, who writes about international intellectual property issues and genetic resources, has opined that

> the export (e.g. over the Internet) of a gene sequence from a nation is now the operational equivalent of the export of the organism containing the gene sequence....As biotechnologists are increasingly likely to look to global genomic databases rather than to the underlying organisms from which the information is derived...genetic resource issues may soon be outflanked by genomic information issues (Seabrook, 1993).

The following section takes up a discussion of the major international regulatory mechanisms in respect of biotechnology.

2.5 International Regulation of Biotechnology

The technological advances in biotechnology being developed in the late 1970s onwards contributed to a growing demand for genetic and biochemical resources, which, in turn, created a robust trade in such materials – a trade that traces its lineage back to the "Columbian exchange" that emerged from Columbus' landing on the American continents and which opened the way for global flows of genetic materials and information (de la Perrière & Seuret, 2000; Hobbelink, 1995; Parry, 2004; Seabrook, 1993). As one commentator notes, "[b]iotechnology, it seems, takes place on a global level, be it in terms of exchanging biological information, controlling epidemics, deterring biological attacks, or standardizing intellectual property laws" (Bud, 1993). By the late 1980s and early 1990s attempts were underway to enact global regulatory mechanisms that guide the collection and use of these resources. The first regulatory instrument ratified was the United Nations Convention on Biological Diversity (CBD)[47] in 1992, followed by the General Agreement on Tariffs and Trade's (GATT)[48] Trade Related Aspects of Intellectual Property Agreement (TRIPs) in 1994, which one commentator insists ushered in the "informatization of social relations" (Kevles, 1998). The salient point to be recognised in respect of these agreements is that both treat genetic and biochemical materials as commodities to which property rights and intellectual

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[47] Nations are required to collect biological material in a "just and equitable manner", although 'just' and 'equitable' are not extensively defined in the Convention. One reading might suggest that profits be more evenly distributed. Another interpretation would suggest that commitments be made to redress past injustices and to ensure that contemporary collection procedures avoid the exploitation that characterised their forebears. For a deeper discussion, see Parry, B. (2004). *Trading the genome: Investigating the commodification of bio-information.* New York: Columbia University Press.

[48] The GATT was replaced in 1994 by the World Trade Organization (WTO). As early as 1986, during the eighth round of negotiations, the GATT agenda included the deregulation of nontariff barriers to trade such as: local content laws, foreign investment, patent rights, packaging requirements, as well as other issues that were deemed by the powerful actors within the GATT (according to Parry (2004) this included not only the G7 nations but also their most powerful transnational corporations) to be used to protect domestic industry from foreign competition.

property protection may attach. Both agreements therefore serve to legitimate the growing global commodification and trade of these materials (Gottweis, 1998). Such a result was congruous with the prominence of the neoliberal agenda in most developed countries at the time, an agenda that had also successfully infiltrated the international fora where these international treaties are negotiated. At least one observer argues forcefully that such international and regional trade agreements represent the efforts of states to define and guarantee the global and domestic rights of capital (Kenney, 1998). This contention is not meant to minimise the efforts made by a number of developing countries to secure results more favourable to their own interests and cultural values in respect of biotechnological materials. However, the bargaining power brought to bear upon these negotiations by developed nations, particularly the United States, was significant in ensuring that informational products and processes, including genetic and biochemical material, which were rapidly becoming motors for economic development in the developed world,[49] would receive global protection through an international regulatory environment.

As Parry (2004, p. 123) notes with regard to the negotiations of the Uruguay Round of GATT that lasted seven years from 1987 to 1994, "[i]t became increasingly evident during these years that developing countries would, in time, be required to recognise, adopt, and enforce a U.S.-based system of global intellectual property rights protection."[50] "In a moment of eco-piracy disguised as Lockean property rights, the labor

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[49] By 1994 the United States led global production in the life sciences. It had a higher percentage of domestic and international patents for biotechnological healthcare inventions than any other country or group of countries. See Parry, B. (2004). *Trading the genome: Investigating the commodification of bio-information.* New York: Columbia University Press.

[50] One of the most prominent and outspoken critics of American trade policy and the American-styled intellectual property protection embodied in the TRIPs Agreement is Vandana Shiva, who considers patents to be legal mechanisms that facilitate the efforts by the North to rob the South of its biodiversity and

of separating the various micro-properties of the plant overrides any holistic function and collective ownership" (Krimsky, 1991). A central theme in Bettig's (1996) book, *Copyrighting culture: The political economy of intellectual property*, is that even if innovation occurs at the periphery, which economists usually interpret as a means of ensuring competition, such innovation is often integrated back into the core. Though Bettig's focus is not on the divide between developed and developing countries, his idea, nonetheless, aptly characterises contemporary trends in biotechnology toward the widespread application of intellectual property devices. The 'enclosure' metaphor captures this corralling of biodiversity and knowledge and the corresponding erosion of the commons and community.

The GATT, and subsequently TRIPs, following judicial decisions made in American and European courts, have come to treat modified biological materials as inventions for the purpose of patent decisions, a decision that has unleashed significant controversy among developing countries about the legitimacy of the TRIPs agreement (Bud, 1993). By ratifying the agreement, over 100 signatory countries became obliged to adhere to article 27, paragraph 1 of TRIPs on Patentable Subject Matter, which reads: "Subject to the provisions of paragraphs 2 and 3, patents shall be available for any inventions, whether products or processes, in all fields of technology, provided that they are new, involve an inventive step and are capable of industrial application." Subparagraph 27.5.3 of the TRIPs agreement states:

> Members may also exclude from patentability:
> (a) diagnostic, therapeutic and surgical methods for the treatment of human or animals;

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maintain the dependence of the latter on the former. See, for example, Shiva, V., & Moser, I. (Eds.). (1995). *Biopolitics: A feminist and ecological reader on biotechnology*. London, GB: Zed Books.

> (b) plants and animals other than micro-organisms, and essentially biological processes for the production of plants or animals other than non-biological and microbiological processes. However, Members shall provide for the protection of plant varieties either by patents or by an effective *sui generis* system or by any combination thereof. The provisions of this subparagraph shall be reviewed four years after the date of entry into force of the WTO Agreement (Sunder Rajan, 2006).

At first glance it appears that plants and animals remain beyond the purview of patentability. However, the words "other than micro-organisms" and plants and animals produced by "non-biological and microbiological processes" provide the authority to patent micro-organisms and genetically engineered plants and animals (Best & Kellner, 2004, p. 198). That is, though they may be treated differently, TRIPs sets out the proviso that plant varieties be brought within the purview of some form of intellectual property regulation. This stipulation serves as the interstice between TRIPs, the CBD, and the International Union for the Protection of New Varieties of Plants (UPOV).[51] Perhaps more importantly, a permissive rather than mandatory limitation on patentability provides a backdoor through which developed countries, during the course of bilateral trade negotiations, can sneak in to exert subsequent pressure on developing countries to ratchet up domestic patent protection (Critical Art Ensemble, 2002, p. 30). Also worth noting is that the TRIPs preamble recognises intellectual property rights as private rights, completely disregarding the public element that intellectual property regimes are ostensibly designed to protect and balance against proprietary entitlements. In fact, the

[51] UPOV (the widely used French acronym for the convention) was established by the International Convention for the Protection of New Varieties of Plants. The Convention was adopted in Paris in 1961 and it was revised in 1972, 1978 and 1991. The objective of the Convention is the protection of new varieties of plants by an intellectual property right. According to the UPOV website (last consulted April 2008), as of October 18, 2007 65 countries, including Canada, have joined this union. Similar to the Berne and Paris treaties, signatory countries were permitted to choose the version of the Convention to which they wished to accede. However, unlike Berne and Paris, this option was only maintained until December 1995, after which time new members were and are required to join the more restrictive 1991 version. UPOV maintains close ties with the World Intellectual Property Organization; the Director General of WIPO is the secretary-General of UPOV and WIPO lends administrative support to UPOV.

language of TRIPs systematically privileges rights' holders over users. "For knowledge and information, this leads to the emphasis on *individualized* rights to reward for effort, alongside the practical organisation of production through alienable property" (Hubbard & Wald, 1993; Krimsky, 1991).

A number of authors discuss the UPOV and Plant Breeders' Rights (PBR) as precursors to patent protection for genetically modified organisms (Caulfield & Feasby, 1998, p. 345). Considering that PBR such as UPOV offer protection only for the whole plant and not its component parts such as genes, proteins, or DNA sequences, and that, unlike patents, they allow for the use of protected varieties in research activities, one might expect agricultural biotechnology companies to lobby beyond PBR toward patent protection for plants (Nelkin & Lindee, 2004, p. xiii). Whereas the CBD explicitly outlines the collective nature of biological resources (Article 8j), TRIPS and the UPOV Convention are ultimately positioned to circumscribe the earth's biodiversity by awarding private intellectual property rights to such resources. May and Sell (2006) contend that the CBD recognition of communal knowledge offers an implicit suggestion that individual ownership rights would inhibit dissemination and subsequent development of such communal knowledge, thus foreclosing its commodification. Nonetheless, article 16 of the CBD does permit biotechnology patenting (subject to limitations on genetically engineered organisms for environmental reasons) and nowhere in the convention is there an explicit prohibition on the commodification of biological resources. Similarly, the latest version (1991) of the UPOV Convention conveys rights on plant breeders similar to those offered by the patent system (Nelkin & Lindee, 2004, p. xxiv).[52] For example,

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[52] According to one writer, the UPOV is America's preferred system for plant variety protection and the main reason the United States rejected the CBD was pressure from biotechnology companies who believe

farmers, under the 1991 version, are only permitted to keep and use seeds if the member country has a specific provision to this effect in its national legislation. Moreover, the 1991 revisions convey significantly enhanced rights on plant breeders. If a farmer grows a crop with a protected variety of seed without having remunerated the right holder (breeder), the latter is entitled to claim ownership of the harvest and any of its resulting products. The latest iteration of the Convention also permits breeders to seek patent protection for any varieties protected by the UPOV. Such double forms of protection were expressly forbidden in previous versions (Malinowski & O'Rourke, 1996, p. 239).

International agreements such as TRIPs have been criticised for undermining the CBD and imposing First World norms and legal traditions on other countries and cultures, in service of the interests of First World elites and business interests. In fact, the multilateral nature of TRIPs that seeks to establish a universal set of global trading rules stands in stark contrast to the recognition of the sovereign rights of countries over their natural resources as embodied in the CBD (Testart, 1995, p. 310).

> The history of IPRs [intellectual property rights] suggests that there is a threshold moment when disadvantage is finally outweighed by the advantages of protecting IPRs. Few developing countries are at this point for all their commercial sectors, however, and thus for historical justice to be served [the recognition that most developed countries were 'pirate' nations during their own development stages], a return to a more varied diet of global legal protection of IPRs is required (Roy, Williams, & Dickens, 1994, p. 187).

Instead, however, the flow of biological resources from the South to the North and the resultant development of new scientific applications exacerbate the ecological

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that the intellectual property protections contained in the CBD are not sufficiently strong and that the stipulations it mandates in respect of the transfer of genetic resources could be profit eroding for American companies. That is, genetic inputs (i.e. the material found abundantly in the global South) should be freely accessible as part of humanity's common heritage but the products developed on the basis of such material (i.e. developed and manufactured in the global North) should attract property protection and an attending bundle of rights given the ostensible value added by the researchers in the employ of the large corporations that produce such products. See, McAfee, K. (2003). Neoliberalism on the molecular scale. Economic and genetic reductionism in biotechnology battles. *Geoforum, 34*, 203-219.

vulnerability and economic dependence of the South while augmenting the economic power and independence of the North.[53] Article 26 of the CBD permits countries to consider the potential social and economic impacts they might incur as a result of importing genetically engineered organisms, though it is unclear whether countries that make use of this article risk being subjected to an action by the WTO on the grounds of erecting 'unfair trade barriers' (Caulfield & Feasby, 1998; Kimbrell, 1997). Though not exactly the same situation, the loss experienced by the European Union at the WTO in 2006 for not providing regulatory approval of genetically engineered seeds certainly indicates the position of this international trade body.[54]

Such asymmetrical power relations immediately bring into focus questions about the political role of biotechnology in North-South relations and the role of biotechnology in the capitalist global economy (Caulfield & Feasby, 1998). Rather than McLuhan's 'global village', we are today witnessing what some have more appropriately termed 'global pillage' (King, 1997). One outspoken critic, Vandana Shiva, has levelled the charge that such global regulatory instruments facilitate a process of "bio-imperialism" or "bio-colonialism" (Ho, 1999; McMurtry, 2002).

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[53] There is currently some negotiation occurring at the WTO to amend intellectual property rules to require that the origin of genetic resources be disclosed in patent applications. At the 23-24 October, 2007 meeting of the WTO Council on TRIPs, 50 least-developed countries added their support to the amendment, which now appears to have achieved a majority among the 151 WTO members.

[54] This decision by the WTO was the result of a complaint launched against the European Union in 2003 by the United States, Canada, and Argentina for failing to authorise the commercial release of any new genetically engineered organism since October 1998. The complaint was based on provisions outlined in the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS), the Agreement on Technical Barriers to Trade (TBT), and the General Agreement on Tariffs and Trade (GATT) 1994. In support of its position the European Union referenced the precautionary language contained in Article 5.7 of the SPS, which permits signatories to adopt provisional measures in situations where there is insufficient scientific evidence. The European Union also made reference to the precautionary principle and risk assessment language contained in the Biosafety Protocol. For a detailed and critical legal analysis of the WTO decision, see Currie, D. E. J. (n.d.). *Genetic engineering and the WTO: An analysis of the report in the 'EC-biotech' case.* Amsterdam: Greenpeace International.

> The poorer two thirds of humanity sustains itself through livelihoods based upon biodiversity and indigenous knowledge. Today, this resource base of the poor is under threat as their plants and seeds are patented and claimed as inventions of Western scientists and Western corporations, denying the collective innovation of centuries of Third World peasants, healers and crafts people who are the true protectors and utilisers of this biodiversity....The TRIPs agreement of GATT and the WTO is not the result of democratic negotiations between the larger public and commercial interests or between industrialised countries and the Third World. It is the imposition of values and interests by Western transnational corporations on the diverse societies and cultures of the world (Gostin, 1991; Gottweis, 1995a).

While we certainly concur with such assessments of the developed world's pillage of the biodiversity found in the global South, we consider such actions to be a continuation of trends that trace their origin to the earlier period of capitalist colonial expansion. As postcolonial critics point out, colonial exploitation was dependent upon the attainment of a certain level of scientific and technological knowledge that facilitated advances in such areas as astronomy, navigation, and agriculture necessary to reach and conquer new territories and peoples. In turn, these colonies supplied both a 'laboratory' environment for Western science as well as a cornucopia of resources that fuelled the development of further Western knowledge. As is the case today, many of the scientific and technological advances achieved by colonial powers relied on the appropriation of the indigenous knowledge and cultures they had conquered (Bereano, 2005; Dyer-Witheford, 1999).[55] These international agreements serve to legitimate at a global level the interminable drive by capital to envelop increasing areas of social existence within its expansionary logic. Domestic policy development is increasingly circumscribed by these multilateral trade agreements, which render trade and investment decisions, including their social implications, immune to citizen oversight. The end effect is that property

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[55] See, for example, Harding, S. G. (1998). *Is science multicultural?: Postcolonialisms, feminisms, and epistemologies.* Bloomington: Indiana University Press.

rights, mainly those of corporations, are privileged over citizenship rights (Gottweis, 1995a, p. 137).

Biotechnology corporations, particularly those engaged in pharmaceutical development, advance the claim that biodiversity protection depends on their assistance. The argument made is that:

> Bioprospecting represents...[an effective]..."conservation tool"...[and]...the bioprospecting industry is dependent on conservation advances, it provides an effective means of bringing critical conservation concerns to the attention of industrial and governmental leaders. They represent one of the most comprehensive conservation approaches to date – providing short- and long-term benefits for both indigenous peoples and national industries (Gottweis, 1995b, p. 197).

Such magnanimous claims notwithstanding, empirical evidence demonstrates that when left to the machinations of capital, talk of conservation quickly yields to practices that threaten to extinguish entire species. For example, the complete adult population (27, 215 kilograms) of *Maytenus buchananni*, which is the basis of the oncological compound maytansine, was collected in Kenya by a team sponsored by the U.S. National Cancer Institute for testing use in its drug development programme. The promised benefits for indigenous populations have, however, been slow in materialising. In another example, *Catharanthus roseus*, also known as rosy periwinkle and originally native to Madagascar, has been refined by Eli Lilly to produce vincristine, which is used to treat paediatric leukemia, and vinblastine, which is used for Hodgkin's disease. Yet Madagascar has not received any money from Eli Lilly, either for the original bioprospecting it carried out in Madagascar's extremely stressed ecosystem or from the subsequent sales of the above two drugs; sales of which are in the hundreds of millions of dollars annually. In a further example, the University of Toledo acquired a process patent related to *Phytolacca dodecoandra*, the endod berry native to Ethiopia. Ethiopians have been using the endod berry for centuries as a detergent and fish intoxicant when researchers from the University of Toledo discovered that the berry is also useful in combating zebra mussels, which are a massive problem for the North American Great Lakes region. The university, which has continually refused to donate the profits from its patent to Ethiopian non-profit organisations, is willing only to either sell the patent for $125,000 or licence it for $50,000 and 2.5 percent royalties to the Ethiopian scientists who originally helped on the project. Overall, pharmaceuticals based on indigenous plants have returned less than 0.0001 percent of their profits to the local people who aided in the research and discovery necessary for development (Gottweis, 1995a). Despite claims of reciprocity and new knowledge for local populations, "a bag full of aspirins and other simple remedies that they [bioprospectors] might provide is far from fair exchange for information or the actual biological resources which may ultimately be responsible for eliminating a major disease like AIDS or cancer" (Hallam, 2004). Rajni Kothari, publisher of *Lokoyan* in Delhi, applies the epithet 'ecological holocaust' to this tendency among transnational agrochemical and biotechnology companies to whittle away at the genetic diversity of the world's food crops (Andrews & Nelkin, 2001, p. 26-27).

Hobbelink (1995) and Seabrook (1993) discuss the way that capitalist controlled biotechnology research is actively engaged in cloning genes from crops like sugar and its substitutes, cocoa, vanilla, and oil palms, among other products, that traditionally have been grown in developing countries. Such new developments serve to depress world market prices, thus further eroding the meagre incomes of small-scale farmers in developing countries. In some cases they displace production from traditional African countries, and, in general, they increase the power of patent owners and large plantation owners (Sunder Rajan, 2006, p. 283). Biotechnology appears poised to become yet another area incorporated into the social factory. As the next section outlines, the commodification of biotechnology is already well advanced.

2.6 The Commodification of Biotechnology

As Daniel Kevles (1998) points out, the scientific breakthrough that facilitated the commodification of biotechnology was the technique of recombinant DNA that Herbert Boyer, from the University of California at San Francisco, and Stanley Cohen, from Stanford University, invented in 1973.[56] Three years later Boyer and Robert Swanson, a venture capitalist, founded one of the first biotechnology companies, Genentech (a shorthand version of 'genetic engineering technology'), which continues to be one of the dominant biotechnology firms operating today, though the Swiss firm Roche now largely owns it (Roche Holding Limited paid US$2.1 billion for majority control in 1990). Following the hype surrounding the announcement in 1978 that Genentech had managed to clone human insulin using recombinant technology and bacteria, the biotechnology industry quickly expanded in the United States.[57] Wall Street picked up on these developments when in August 1979 Nelson Schneider, a financial analyst at E.F. Hutton[58] who specialised in the pharmaceutical sector, wrote a paper directed to

[56] Ironically, it was also in 1973 that major chinks in the capitalist armour began to appear, highlighted most prominently by the effects from the first oil crisis and the beginning American fiscal crisis.
[57] The rights to this invention were licenced to Eli Lilly and Company in 1982 when its human insulin received marketing approval from the Food and Drug Administration. For an account of the race between different companies and research labs to synthesise human insulin see: Hall, S. (1987). *Invisible frontiers: The race to synthesise a human gene*. London, GB: Sidgwick & Jackson.
[58] This once large and now defunct brokerage house was famous for its television commercials in the late 1970s and early 1980s that contained the phrase "When E.F. Hutton talks, everyone listens" and arguably even more famous for its corporate malfeasance that, among other things, included money laundering for the mafia and other illegal organisations such as those involved in the "Iran-Contra Affair".

institutional investors entitled "DNA – The Genetic Revolution". At a presentation one month later, at which Schneider was going to present his ideas about the investment opportunities he perceived in this newly emerging technology, the actual number of over 500 people in attendance dwarfed the expected 30 participants. For analysts at Hutton and other investment banking firms, biotechnology[59] appeared poised to become an enabling technology along the lines of information and communication technologies (referred to in those days as 'micro-processor technology') (Sunder Rajan, 2006, p. 12). Aside from a plethora of start-up biotechnology companies, a number of the major pharmaceutical and chemical multinationals began developing in-house research programs using recombinant DNA, signed research contracts with some of the start-ups, and even began acquiring equity stakes in a number of them.[60] It was also at this time that the industry-academia collaboration in biotechnology, as discussed above, began in earnest (Sunder Rajan, 2006, p. 17). The American model of relying on venture capital to underwrite the growth of the biotechnology industry differs from the systematic efforts initiated by European states, and to some extent Canada, to actively promote the development of this industrial sector (Kloppenburg, 1988a).[61] In fact, Martin Kenney

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[59] True to the spirit of Wall Street (though interestingly Schneider worked out of Washington, D.C. rather than New York), Schneider applied in December 1979 for a trademark on the term 'biotechnology' when used "for magazine reporting scientific and financial developments in the field of genetics" [U.S. Trademark 1180658, Provisional Registration 3 December 1979 (US Class 38)] (Bud, 1993, note 66, p. 256). See, Bud, R. (1993). *The uses of life: A history of biotechnology*. New York: Cambridge University Press.

[60] For a history of the biotechnology industry up to the late 1990s, see Robbins-Roth, C. (2000). *From alchemy to IPO: The business of biotechnology*. Cambridge, MA: Perseus.

[61] On the differences between American and British development of their biotechnology industries, see Wright, S. (1994). *Molecular politics: Developing American and British regulatory policy for genetic engineering, 1972-1982*. Chicago: University of Chicago Press. See also, Gottweis, H. (1998). The political economy of British biotechnology. In A. Thackray (Ed.), *Private science: Biotechnology and the rise of molecular sciences* (pp. 105-130). Philadelphia: University of Pennsylvania Press., in which Gottweis analyses the active role played by the British government in trying to develop a national biotechnology industry. Gottweis ultimately concludes that the government strategy was fraught with difficulties and contradictions that allowed existing transnational corporations to expand their operations

(1998) maintains that a true biotechnology industry composed of freestanding companies exists only in the United States, in part because of the availability of a mobilisable source of capital from venture capitalists. In other countries the biotechnology sector tends to be driven by multinational pharmaceutical, chemical, and food corporations, which have harnessed biotechnology as an enabling technology to augment their core business lines (Kloppenburg, 2004, p. 292). However, the empirical evidence presented in section 1.5 refutes this characterisation, at least in terms of Canada, pointing instead to a mixed industrial sector comprised of small, medium, and large businesses.

The commodification of biotechnology is unique compared to other areas of science in that its commercialisation was not driven in large part by military applications or defence spending (Smith, 2003, p. 1). In fact, one author contends that biotechnology offered an opportune substitute for the numerous and destructive technologies that had been financed and developed through the military-industrial complex[62] (ETC Group, 2007c). That having been said, one wonders whether the immense injection of capital into the coffers of large-scale defence contractors and private armies as a direct result of the 'war on terror' will have spillover effects into an expansion of biotechnological weaponry, whether defensive or offensive. One commentator recounts his experience at an October 2001 venture capitalist conference in Boston, at which attendees articulated the jubilant expectation of a boon in research contracts from the United States

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into biotechnology rather than fostering the emergence of a new and independent industrial biotechnology sector.

[62] Interestingly, it was Dwight Eisenhower himself who, in his 1960 Farewell Address, used the term 'military-industrial complex' to refer to the increasing militarisation of the economy and society that was responsible for a hugely wasteful spiralling arms race; an arms race that escalated the co-extensive developmental trajectory of science, technology, and capitalist social relations. See, Best, S., & Kellner, D. (2001). *The postmodern adventure: Science, technology, and cultural studies at the third millennium*. New York: The Guilford Press.

Department of Defence following the multiple anthrax laced letters being sent to Members of Congress at the time (Lewontin, 2000b).

Through a series of case studies that assess various biotechnological applications and products, Krimsky (1991) identifies the inability of regulatory and other scientific assessment mechanisms to accommodate social interests such as: ecological impacts, effects on human health, ethical considerations, distributive justice, social need, economic productivity, and market demand. Instead, the development of new biotechnological products is driven by market incentives to create new products and improve production methods. "Consequently, all natural reality – from microorganisms and plants to animals and human beings – is subject to genetic reconstruction in a commodified "Second Genesis"" (Ruivenkamp, 2005, p. 14). Biotechnology also offers a solution, at least a temporary one, to the finite territory problem that has plagued capital. "The molecular invasion of the body is the new frontier where untold resources and profits may be appropriated" (Goodman, Sorj, & Wilkinson, 1987, p. 47). Krimsky (1991) cites three main reasons for this situation. First, the involvement of public sector institutions in the development of the biotechnology industry has reduced the ability of American federal and state governments to develop a neutral regulatory position. Second, the expanded role of university industry partnerships, which, in part, have been promoted by government, has eroded the position of academia as an objective source of analysis in the assessment of new technologies. Finally, as the importance of biotechnology as an industrial sector has grown, so too have the social demands on new technology. The overall result is a situation in which contemporary measures designed to assess new technology have been outpaced by social expectations, thus rendering them deficient and the cause of increasing conflicts of interest (Marx, 1993, p. 527). Seabrook (1993, p. 16) expresses similar concerns:

> The danger from biotechnology is not that it is an act of hubris that threatens to modify creation, but that it will be used in a context where it can only exacerbate existing injustice. What could provide humanity with a real opportunity to relieve the suffering is likely to become yet another weapon in the armoury used to oppress the poor while, at the same time, exposing the world to unforeseeable, grievous risks.

Caulfield and Feasby (1998) argue that the commodification of the genetic industry is different from the commodification of other healthcare services not only because contemporary society has attributed a special role to genetics but also because genetic testing is fundamentally different from other forms of medical testing.

> Genetic testing and screening have the potential to reveal immutable information about individuals that has implications for, *inter alia*, reproduction decisions, insurance, employment, self-image, and family dynamics. For this reason alone, understanding the impact of growing commercial forces on the use of genetic services is essential (Critical Art Ensemble, 2002; Kloppenburg, 2004).

"In the 50 years since the famous Watson and Crick paper, genetics has become an important corporate enterprise, and much of the promotion of genes and DNA reflects this commercial nexus" (Lewontin, 2000b, pp. 97, 104).

> Cells, in the language of science, are extracted like a mineral, procured like a parcel of land, harvested like a crop, mined like a resource, patented like an invention, and banked like money.... The 1988 patenting [in the United States] of Harvard's Oncomouse – a mouse that gets breast cancer and has a price tag of $1,500 per mouse – linked commerce, cancer research, genes, and academe in a single packet of fur and tissue. The DeCode project in Iceland suggested that an entire population could be "sold" (images of slavery appeared in the protest literature) to private industry for profit.... Commercialization is now, irretrievably, a part of the DNA mystique (Expert Working Party on Human Genetic Materials Intellectual Property and the Health Sector, 2005).

A concern articulated in the literature is that the rapid commodification of genetic services will result in the marketing of new diagnostic tools whose efficacy, not to mention their ethical, legal, and social implications, have not been proved definitively.

"[Task forces] have acknowledged that commercial and academic institutions are making genetic testing capabilities easily accessible to the public too quickly and that many genetic tests are subject to misinterpretation" (Expert Working Party on Human Genetic Materials Intellectual Property and the Health Sector, 2005).

The commodification of genetic services has also led some to question whether contemporary perceptions of human normalcy will be subject to change through market pressure. "For reasons associated with the economy and the market, normality of human beings will be more and more defined according to the needs of industry and insurance contracts" (Willison & MacLeod, 2002). Commenting on the eugenic potentials inherent in biotechnology, some critics observe that "[t]here is no need for a state-inspired and state-organised and, by implication, coercive eugenics programme, if voluntary parental uptake and utilization of prenatal diagnosis, with selective abortion of foetuses found to be defective, will, for all practical purposes, achieve the same result" (Sevilla et al., 2003).[63] As members of the Critical Art Ensemble (2002, p. 54) charge, "[t]his form of positive eugenics is market-driven, and pays for itself, thereby killing two birds with one stone by achieving both profits and a better worker/citizen. The values/needs of capital are now being inscribed on the body at a molecular level." By altering the definition of normalcy, and by implication, disease, medical research companies will be able to expand their product markets. For example, Genentech has successfully marketed its recombinant growth hormone, Protropin, beyond the 20,000 individuals affected by

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[63] For an overview of some of the concerns that biotechnology could result in a new eugenics movement, see Duster, T. (1990). *Backdoor to eugenics*. New York: Routledge; Duster, T. (1998). Persistence and continuity in human genetics and social stratification. In T. Peters (Ed.), *Genetics: Issues of social justice* (pp. 218-238). Cleveland: Pilgrim Press; Holtzman, N. A. (1989). *Proceed with caution: Predicting genetic risks in the recombinant DNA era*. Baltimore, MD: Johns Hopkins University Press; and, Nelkin, D., & Tancredi, L. (1994). *Dangerous diagnostics: The social power of biological information* (2nd ed.). Chicago: University of Chicago Press.

pituitary dwarfism in the United States. By manipulating perceptions about normal shortness to transform it into a disease, Genentech increased the size of its annual market to potentially encompass the 90,000 children born annually in the United States who fall in the third percentile for height (Willison & MacLeod, 2002). As the 'genetic revolution' gathers momentum the social sway of biological information seems positioned to increase in importance, which, if left to the commercial imperatives of the neoliberal market might result in a simplistic and overly deterministic view of genetic information (Caulfield & Feasby, 1998). There thus arises the potential for biotechnology and genetic research to result in an emphasis on genes rather than environmental factors as the source of medical problems (Eisenberg, 1992, 1997a, 1997b; Heller & Eisenberg, 1998). Such a perspective is increasingly congruous with the current conjuncture of advanced capitalist society, in which disease and other ailments tend to be examined and addressed from the market perspectives of capitalist dominated medical science and technology rather than through an examination of preventable environmental causes that tend to flow from capitalist industrial and work processes (Maskus & Reichman, 2004, p. 297).

Biotechnology has the capacity to provide capital with mechanisms to manage behaviour and bodies (Heller & Eisenberg, 1998; Rai, 2007). In order to avoid the high costs associated with worker illness and disease, employers have an incentive to test and screen employees for genetic sensitivity to particular chemicals or other substances associated with a job. Those found to be genetically susceptible to illness could then easily find themselves subject to employment and insurance discrimination. In the

United States *Norman-Bloodsaw v. Lawrence Berkeley Laboratories*[64] and *EEOC v. Burlington Northern and Santa Fe Railway Co.*[65] are examples of cases in which employers used genetic screening without the knowledge or consent of their workers in an attempt to exercise greater control over their workforces. As a number of commentators have argued, such abuses are inherent to genetic technology, which offers a new technique for employers to manifest their power (Eisenberg, 1992, 1997a; Klein, 2007; Long & Johnson, 1997). As one critical observer notes, "[i]n addition to yielding economic benefits, genetic engineering was conceptualised as a potential contribution to a broader social stabilization, mainly by virtue of its expected capacity to control behavior and bodies" (Organisation for Economic Co-operation and Development, 2006, p. 5). Gottweis has also referred to genetic engineering as a "new technology of power" that possesses the potential to fundamentally transform society (Blumenthal, Causino et al., 1996; Caulfield & Feasby, 1998; Cohen, 1995b).

In the specific context of biotechnology, Herbert Gottweis (1995a) analyses the impact of the discourse of molecular biology and genetic technologies on the conceptualisation of subjectivity, including the relation of this process to production patterns and capitalist restructuring. He argues that the new discourse developing around biotechnology has resulted in genetics changing and normalising new patterns of human self-recognition and the understanding of nature. In turn, this has helped to give impetus to social movements that have arisen to counter the biotechnology strategies employed by

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[64] *Norman-Bloodsaw v. Lawrence Berkeley Laboratory*, 135 F.3d 1260 (9th Circuit, 1998).
[65] *EEOC v. Burlington Northern and Santa Fe Railway Co.*, No.01-4013 (N. Iowa filed Feb. 9, 2001). In this case it was alleged that the railway company engaged in surreptitious genetic testing of its train engineers to identify a genetic marker for carpal tunnel syndrome due to a high incidence of repetitive stress injuries among its workforce. The suit also alleged that at least one employee was subjected to disciplinary measures for refusing to submit to a genetic test. The case was ultimately settled before the court issued a judgement.

capital (Mowery, Nelson, Sampat, & Ziedonis, 1999). Although Gottweis employs an analytical framework that concentrates on the discursive power of modern biology, his theme of the rise of resistance movements to counter the capitalist appropriation of biotechnology and its discourses would seem to align with an autonomist Marxist perspective.

Hallam (2004) is also critical of biomedical approaches to healthcare because of their failure to consider the complex social, economic, and environmental influences that combine with biological factors to impinge on human health. She contends that the commercial underpinnings of genetic medical technologies will render the genetic model of health impervious to effective challenge, leading her to ponder whether the future holds in store a biomedical version of *Gattaca* and its genetic 'valids' and 'invalids' (as cited in Loeppky, 2005, p. 138).[66] According to other observers,

> The body business [through biotechnology] is becoming a pivotal, though often unnoticed, part of the American economy. ...market mania encourages actions that violate body integrity, exploit powerless people, intrude on community values, distort research agendas, and weaken public trust in scientists and clinicians (Caulfield & Feasby, 1998).

The power of genomics, which has only been made possible through the technological advancements in computing power, rests in its capacity to extract information from genetic material and subsequently employ this disembodied information to develop a risk profile for every individual; thus transforming every

[66] David Coburn points to the established literature that posits health status is determined as much by social factors such as socio-economic class and income as it is by access to healthcare infrastructure. See, Coburn, D. (2001). Health, health care, and neo-liberalism. In P. Armstrong & H. Armstrong & D. Coburn (Eds.), *Unhealthy times: Political economy perspectives on health and care* (pp. 45-65). Don Mills: Oxford University Press. This line of argument is particularly well developed in the work of Vincent Navarro. See, for example, Navarro, V. (1976). *Medicine under capitalism.* New York: Prodist.; Navarro, V. (1986). *Crisis, health and medicine: A social critique.* New York: Tavistock Publications.; and, Navarro, V., & Muntaner, C. (Eds.). (2004). *Political and economic determinants of population health and well-being: Controversies and developments.* Amityville, NY: Baywood Publishing.

individual into a potential patient and ultimately a potential consumer of medical diagnostics and various treatment regimes developed and marketed by the life sciences industry. Discussing this vital nexus between genetic information and information technologies, Thacker (2005) asserts that what is emerging in contemporary society is a bioinformatic montage that exerts social normalising tendencies based on three related areas: genetic reductionism premised on unsophisticated notions of biological causality and determinism; genetic homogenisation that either pathologises or marginalises polymorphisms (point mutations); and, the application of statistics to compute genetic models that correspond to and support the dominant concepts of normalcy and health. Following Foucault, one commentator contends that this represents an implosion of the economic and the epistemic, in which "the very grammars of the life sciences and of capital are co-constituted; life becomes a business plan. And the symptom is at the heart of this configuration" (Eisenberg, 1997a).

In his book, *Biocapital: The constitution of postgenomic life*, Kaushik Sunder Rajan (2006) relies on Marxian political economy and Foucault's theorisations of the biopolitical to examine the relationship between biotechnological innovation, particularly in the pharmaceutical industry, and what he considers to be contemporary transformations in globalised capitalism. Following Marx's work in *The eighteenth Brumaire of Louis Bonaparte*,[67] Sunder Rajan (2006) approaches his research from the perspective that science and technological research and society are mutually constituted. He seeks to elaborate the connections between this co-production of the life sciences and political economic regimes. For example, questions about the patentability of DNA

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[67] Marx, K. (1977). *The eighteenth Brumaire of Louis Bonaparte*. New York: International Publishers.(Marx, 1977). This pamphlet was originally published in 1852.

sequences only rose to prominence on the policy agenda once automated sequencing technology had advanced to a level capable of generating sequences at speeds and resolutions hitherto impossible. Conversely, use of these sequences for further research depends in large part on their legal status, as part of either the public or proprietary domains. That is, the legal status of DNA was constituted by the technological advances that facilitated their production, while production and use of the resulting sequences were dictated by their legal status. Sunder Rajan (2006) understands biocapital as a particular, yet historically and spatially contingent, manifestation of contemporary capitalism, which itself is considered mutable. In somewhat overstated terms, biocapital represents for Sunder Rajan (2006, p. 3) what he believes to be the "new face" and "new phase" of capitalism that is the result of the apparent recent implosion of the market economy and the life sciences industry. Following Foucault, he also views the life sciences as contributors to what he calls the "foundational epistemologies for our time", which he believes specify the biopolitical dimensions of modern capitalism (May, 2004; May & Sell, 2006; McNally & Wheale, 1998). The biopolitical, according to Sunder Rajan (2006), indicates the mutual constitution of particular modernist epistemologies that help us apprehend not only specific institutional structures but also biology, political economy, and the grammar of life (or life, labour, and language). The interesting theme developed by Sunder Rajan (2006) as it relates to the current work is his recognition that the technological advances in biological information processing software and hardware has meant that the metaphor of life as information can now be given material reality that lends itself to commodification. "One of the things that genomics fundamentally enables is a particular type of materialization of information, and its decoupling from its material biological source (such as tissue or cell line)" (Packer & Webster, 1996, p. 441). Ultimately, however, Sunder Rajan's (2006) promising attempt to subject biotechnology and the life sciences industry to a critical political economic analysis fails to deliver, instead concluding on a rather equivocal note that neither engages in a thorough critique of the way capital has and continues to wield power in a manner that transforms the very "grammar" through which life is understood, nor opens any spaces for dissent and resistance.

Agriculture is another sector of biotechnology that has been heavily appropriated by capital.[68] Jack Kloppenburg (1988a, 2004) provides a detailed political economic analysis of the commodification of the seed in service of capitalist accumulation and reproduction. His historical narrative is structured according to an analysis of the interplay between scientific innovation and commodification of the seed, the social division of labour between public and private plant breeding, and the global imbalances in seed commerce and trade between the North and South.[69] Kloppenburg (1988a, 2004)

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[68] For an account that examines specifically the economics of agricultural biotechnology, see Gaisford, J. D., Hobbs, J. E., Kerr, W. A., Perdikis, N., & Plunkett, M. D. (2001). *The economics of biotechnology*. Cheltenham, GB: Edward Elgar Publishing. For an early work that goes beyond the science to consider the social, economic, and ethical issues that surround agricultural biotechnology, see Busch, L., Lacy, W. B., Burkhardt, J., & Lacy, L. R. (1991). *Plants, power, and profit: Social, economic, and ethical consequences of the new biotechnologies*. Cambridge, MA: Basil Blackwell. Indeed, these authors demonstrated a certain degree of prescience, contending that "[a]nother aspect of the new biotechnologies is the enormous concentration of economic and therefore political power that is likely to become possible" (Busch et al., 1991, p. 190). For a more recent and engaging critical account of the various detrimental aspects of biotechnology as they impact on people, agriculture, and the environment, see Walker, C. (Ed.). (2000). *Made not born: The troubling world of biotechnology*. San Francisco: Sierra Club Books.

[69] The anthology *Seeds and sovereignty: The use and control of plant genetic resources* offers a collection of essays that tend to discount the dangers of commodification and the thesis that the global North has plundered the South of its genetic resources (Kloppenburg, 1988b). Although claiming to offer a "useful, balanced background for the FAO [United Nations Food and Agriculture Organization] debate over sovereignty of seeds" (Harlan, 1988, p. 362), the reader is confronted with much rhetoric similar to what one would expect from industry apologists, cloaked in the garb of science that stubbornly refuses to consider broader social, political, and economic issues. This position is made no clearer than in the following statement of scientific arrogance at its apogee: "it should be recognised that plant scientists can deal much more effectively and objectively with the appropriate sharing of genetic resources than can social activists and politicians, whose understanding of the problem is minimal at best" (Brown, 1988, p.

traces the way that capital, over the last century, has successfully surmounted two traditional hurdles that precluded plant breeding from being privately appropriated: the reproducibility of the seed, which allowed farmers to compete directly with seed companies by keeping some of the seed from a harvest in order to plant the following season (known as "bin-run" seed because it comes from the bin of the farmer's harvester rather than from a seed company), and the active involvement of the state in plant breeding, which positioned public plant breeders as competitors to private breeders. Capital has responded to the first obstacle through scientific innovations that began with hybridisation and today involve the development and application of Genetic Use Restriction Technologies. The second encumbrance has been reduced through intensive lobbying efforts to extend intellectual property rights to plant germplasm. Moreover, as the private seed sector has grown in size and economic clout it has been successful in efforts to re-jig the traditional social division of labour in plant breeding, relegating public research to areas that complement but do not directly compete with private sector interests (as cited in Packer & Webster, 1996, p. 441). According to Kloppenburg (1988a), biotechnologies proffer new means to expand the capitalist appropriation of plant breeding. This increasing capitalist control of agriculture, which began before the development of biotechnologies, facilitates capitalist dictates as to research agendas and the type of products to be developed, a situation Kloppenburg very much opposes:

> ...a small, authoritarian minority ought not to dictate what kinds of research are permissible and which technologies and products should be available in the marketplace. Yet this is precisely what is happening in the plant biotechnology

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229). See, for example, Brown, W. L. (1988). Plant genetic resources: A view from the seed industry. In J. R. Kloppenburg, Jr. (Ed.), *Seeds and sovereignty: The use and control of plant genetic resources* (pp. 218-230). Durham, NC: Duke University Press.; and, Harlan, J. R. (1988). Seeds and sovereignty: An epilogue. In J. R. Kloppenburg, Jr. (Ed.), *Seeds and sovereignty: The use and control of plant genetic resources* (pp. 356-362). Durham, NC: Duke University Press.

> sector as corporate capital has, since 1988, significantly extended and consolidated its capacity to shape how the new genetic technologies are used, who uses them, and for what they are used (Packer & Webster, 1996, p. 442, emphasis in original).

According to Jeffrey Smith (2003), major American corporations are crafting strategic plans to control the world's food supply.

> This was made clear at a biotech industry conference in January 1999, where a representative from Arthur Anderson Consulting Group explained how his company had helped Monsanto create that plan. First, they asked Monsanto what their ideal future looked like in fifteen to twenty years. Monsanto executives described a world with 100 percent of all commercial seeds genetically modified and patented. Anderson Consulting then worked backward from that goal, and developed the strategy and tactics to achieve it. They presented Monsanto with the steps and procedures needed to obtain a place of industry dominance in a world in which natural seeds were virtually extinct (Eisenberg, 1987; Shiva, 2001b).

Table 2-1 outlines the world's top ten seed companies according to seed revenue, which together account for 55% of a commercial seed market worth US$22.9 billion in 2006. This level of control by the top ten seed companies has increased from 49% in 2005 and 37% of the world market in 1996. The degree of control by these transnational corporations over the proprietary seed market (i.e. seed varieties subject to intellectual property restrictions) is even more pronounced – these companies control 64% (US$12.6 billion) of a US$19.6 billion market. Monsanto alone controls more than 20% of the global proprietary market and the top three companies (Monsanto, Dupont, and Syngenta) together control 44% of this market (Packer & Webster, 1996). Moreover, control over this critical step in the agricultural production process conveys on the provider of this input substantial ability to extract value from other inputs in the production process, thus appropriating more of the surplus in agriculture (Etzkowitz & Webster, 1995, pp. 480-481).

Table 2-1 Worlds' Top Seed Companies Based on 2006 Seed Revenues

Rank	**Company**	**2006 Seed Revenue (US$ millions)**
1.	Monsanto (US)	$4,028
2.	Dupont (US)	$2,781
3.	Syngenta (Switzerland)	$1,743
4.	Groupe Limagrain (France)	$1,035
5.	Land O'Lakes (US)	$756
6.	KWS AG (Germany)	$615
7.	BayerCropScience (Germany)	$430
8.	Delta Pine & Land (US - now owned by Monsanto)	$418
9.	Sakata (Japan)	$401
10.	DLF-Trifolium (Denmark)	$352

Source: ETC Group

From a theoretical perspective, these developments in modern agriculture have broader implications. For if we can construe the conditions and limitations that attach to the use of genetically engineered seeds as rendering farmers "mere sowers of seeds", as de la Perrière and Seuret (2000, p. 16) assert, then an argument can be developed that speaks to the proletarianisation of farmers and the separation of conception and execution. Though not the focus of the present research, this line of analysis begs the (future) question about the ways biotechnology is contributing to the proletarianisation of farmers, and whether this technoscience represents merely a quantitative shift in how value and control is being moved off the farm or whether it represents a qualitative break in favour of capital. Ruivenkamp (2005) develops similar arguments from a modified critical theory perspective that traces the appropriation of biological activities from farmers by corporations and the substitution of traditional food products with products developed through industrial, biochemical (i.e. corporate controlled) processes. According to him, "farmers may become increasingly 'workers in the open air' remotely controlled by life-science companies" (Hardt & Dumm, 2000, ¶ 27). "The rural labor process is now not so much machine-paced as governed by the capacity of industrial capitals to modify the more fundamental rhythms of biological time" (Marx, 1970, pp. 20-21, emphasis added). Already in the mid-nineteenth century Marx recognised that farmers were losing their ability to autonomously reconstitute their own means of production: "agriculture no longer finds the natural conditions of its own production within itself, naturally, arisen, spontaneous, and ready to hand, but these exist as an independent industry separate from it" (Cleaver, 1979, p. 27). Such prospects are exacerbated by capitalist control over seed technology, which strips farmers of traditional agrarian knowledge and nudges them even further into debt so high that independent ownership over the means of production remains firmly beyond their reach (Marx, 1992, p. 932).

In his analysis of capitalist control of agriculture, Richard Lewontin (2000) outlines how the increasing vertical and horizontal integration of multinational agribusinesses, in conjunction with new biotechnologies, has enabled industrial capital to impose a suite of high-cost inputs on farmers while simultaneously exerting pressure on farmers to produce products demanded by a handful of major purchasers who possess enough market clout to obtain prices for agricultural outputs that serve the interests of capital's bottom line rather than that of farmers. That is, agriculture is increasingly characterised by near monopsony and monopoly at the input and output stages, respectively, of production. Despite still owning the land, buildings, and equipment, farmers are not in a position to exploit these means of production in alternate economic ways. The result is that "the farmer becomes a mere operative in a determined chain whose product is alienated from the producer. That is, the farmer becomes proletarianized.... What the farmer has gained is a more stable source of income, at the price of becoming an operative in an assembly line" (Bonefeld, Gunn, & Psychopedis, 1992, 1995).

The success of capital in furthering its capture of agricultural biotechnology notwithstanding, Kloppenburg (2004) does hold out the promise of resistance in the second edition of his book. In fact, he posits that because so many of the issues that surround agricultural biotechnology possess such an astounding degree of symbolic and material potency (e.g. "Frankenfoods", "Golden Rice", "Terminator Technology", "biopiracy", "Gene Giants") that this area of biotechnology has become a central hub in broader resistance movements organised against corporate-dominated agricultural biotechnology.

2.7 Patenting

A 2005 report developed for the CBAC about the impact of intellectual property on biotechnology indicates that a significant number of clinical laboratories have scrapped efforts to introduce new genetic tests or have stopped offering them because of patent and licencing concerns (Negri, 1988). A case cited quite often in the literature pertains to the test for the BRCA1 and BRCA2 genes[70], which has been patented by the American firm Myriad Genetics. Myriad charges US$ 3,500 for its test, which,

[70] It is important to point out that the presence of a particular gene does not cause a specific disease, as is often incorrectly assumed by laypeople. Instead, it is the mutated version of a gene that triggers the onset of genetic disease. For example, BRCA1 and BRCA2 are often equated with breast cancer. However, everyone possesses these two types of genes, which, when they function normally, actually suppress tumour growth in breast and ovarian tissue. It is only when a person inherits a mutated allele of these genes that s/he runs the risk of developing breast cancer. For a fuller explication, see, for example, Australian Law Reform Commission. (2003). Gene patenting and human health: Issues paper. Canberra: Paragon Printers Australasia.; and, Ridley, M. (1999). *Genome: The autobiography of a species in 23 chapters.* London: Fourth Estate.

according to Canadian estimates, is more than double what public sector laboratories would need to charge to conduct the test (Loeppky, 2005, p. 39). Aside from an inflated test price, Myriad has implemented a highly restrictive licencing system, and stringently controls both which laboratories may conduct the tests as well as the resulting information generated from such tests. This latter constraint that Myriad can impose on other companies as a result of its patents allows the company to develop an exclusive and expanding database of health information that it can harness to reinforce and solidify its research agenda and intellectual property portfolio in respect of mutations in these genes (Loeppky, 2005, p. 95).[71]

A French study of Myriad's test determined that its patented detection method for BRCA1 mutations, as compared to 19 other methods, was between four and seven times more expensive than alternative detection strategies. On the basis of their empirical findings these authors conclude that broad patents inhibit health care systems from developing and employing the most efficient genetic testing strategies (Loeppky, 2005, p. 173). It has also been determined that Myriad Genetics' indications for its BRCA tests are much wider than those recommended by independent academic institutions. That is, Myriad is trying to create a market for its product among women who demonstrate no clinical need (Held, 1980; Jay, 1996). Similar concerns have emerged around the patents issued for the gene sequence for Apolipoprotein E (associated with Alzheimer's disease), Canavan disease, haemochromatosis, and CCR5 (the primary receptor used by the HIV virus to infiltrate the body). Given the concerns articulated by some about the increasing medicalisation of society as a result of direct-to-consumer advertising, the potential for

[71] Citing failure to satisfy the inventiveness criterion, the European Patent Office revoked Myriad's BRCA1 patent in May 2004. Cancer Research UK now holds the patent and licences it quite broadly.

industry assuming a dominant role in shaping societal attitudes about the scope of application for particular genetic tests appears that much more daunting (Held, 1980; Jay, 1996; Wiggershaus, 1994). Despite statements to the contrary, it is questionable whether scientific, social, or psychological criteria figure prominently in business decisions about expanding markets.

Rebecca Eisenberg (1992, 1997) is a prominent intellectual property theorist critical of the increased commodification of biomedical research. She asserts that the practical result of an emphasis on patent protection is a privatisation of upstream biomedical research through patent thickets[72] that could potentially limit innovation further downstream as users are required to navigate multiple regulatory and financial roadblocks in order to secure the inputs necessary for product development (Held, 1980; Robins & Webster, 1985; Wiggershaus, 1994). "A growing thicket of rights surrounds gene fragments, research tools, and other upstream inputs of scientific research, and the resulting transaction costs impede and delay research and development undertaken in both the public and private sectors" (Levidow & Young, 1981, p. 5).

In a reversal of Garret Hardin's (1968) notion of the 'tragedy of the commons', some writers suggest that the concept of the 'tragedy of the anticommons' more aptly characterises the contemporary privatisation of biomedical research in which rigid upstream intellectual property protection circumvents downstream practical innovations that hold out the potential promise of significant medical advancement (Marcuse, 1964). Strict intellectual property protection of basic biomedical research, which would impose licencing and royalty burdens on downstream firms, might serve to slow down or even

[72] The term 'patent thickets' refers to multiple and overlapping patent claims that force people to obtain licences from these multiple patent holders if they wish to use or commercialise new technology (or increasingly merely to conduct research).

impede the aggregate research enterprise (Cleaver, 1979, p. 39). Responding to such concerns, the OECD published voluntary guidelines in 2006 that pertain to licencing genetic inventions used for the purpose of human health care, which, it claims, are "based on economically-rational practices that help eliminate high transaction costs while complying with competition law and that serve the interests of society, shareholders and other stakeholders" (Organisation for Economic Co-operation and Development, 2006, p. 5).

As noted previously, if researchers concentrate on exploiting their discoveries through intellectual property devices, there is often a tendency to defer publication of findings until the patent issues, which circumscribes the dissemination of new knowledge, thus defeating one of the fundamental premises for granting patents in the first place (Ruivenkamp, 2005; Vroom, Ruivenkamp, & Jongerden, 2007).[73] A number of American researchers who have conducted a study on the effects of the *Bayh-Dole Act*[74] on American university research and technology transfer conclude that patents and licencing arrangements are not as effective as publication and other less restrictive approaches to information dissemination in ensuring that society benefits as widely as

[73] This argument is not meant to romanticise some previous era in which sharing was a universal, absolute norm. It is, in fact, the case that information or materials have, in the past, also been withheld from competitors. The point is that while such practices are not new, they are exacerbated by the burgeoning application of patents to scientific knowledge and innovation.

[74] The American *Bayh-Dole Act* of 1980 requires federally-funded organisations to report any potentially patentable discoveries made as a result of the sponsored research. The institutions are permitted to retain title to their inventions only if they agree to file patent applications and exploit any patent granted. If they fail to do so the government reserves the right to grant licences to other entities in an attempt to ensure practical application of the invention. Clearly, this law assumes that patents are necessary to facilitate the transfer of technological discoveries from government labs to universities and on to the private sector. This perspective clashes with the traditional justification for patents as a means of spurring innovation in the first place. Instead it employs patent rights to ensure commercial dissemination of products that embody prior research rather than offering the prospect of future patent rights to stimulate additional research. We do not *yet* have similar legislation in Canada, though as pointed out in chapter one, federal government policies in respect of science and technology advocate a more rapid and broader degree of commercialisation of federally funded research. See, for example, Government of Canada. (1996). *Science and technology for the new century: A federal strategy*. Ottawa: Government of Canada.

possible from publicly-funded research (Bijker, 1995; Feenberg, 1999; Ruivenkamp, 2005; Vroom et al., 2007). In testimony before a 1981 United States Congressional hearing on commercialisation of academic biomedical research, Jonathan King summed up part of the problem as follows:

> Once patenting becomes the mode, then individuals have a vested interest in keeping strains and techniques secret until the patent is granted. This may be up to a year; but even if less, it establishes a destructive element in scientific relations, secrecy and barriers to information flow, which retard overall biomedical progress. I will tell you that the atmosphere around biology department coffee pots has changed in the last few years. It is clear this is a new element coming in there (Ruivenkamp, 2005, p. 20, emphasis added).

Aside from hindering collaborative work among researchers, including science graduate students who are under pressure to publish in a timely fashion, a concern arises about whether the confidentiality agreements that surround patent applications could have negative implications for the reporting of adverse events that might occur during clinical trials (Midnight Notes Collective, 1992b). Moreover, genetic information tends to have a short half-life so that it could potentially lose much of its value by the time it makes its way into the public domain (Cleaver, 1979; Holloway, 1995, p. 159). Ultimately, it is feared that the race to obtain patent protection is creating a vicious cycle in which even those researchers opposed to intellectual property rights for biological products and processes are nonetheless compelled to seek protection for their work in an effort to establish their own revenue streams that can finance their continued research (Moulier, 2005, p. 19).

While it is true that the patent system does require disclosure of the information required to make and use a patented invention, the patent application process can be quite lengthy and obscure. Packer and Webster's (1996) study demonstrates that very few scientists actually make use of patents as a source of information for their research:

"...when asked whether she used patents as a source of information [a researcher] said, "Having written patents and knowing the way you write them is to make it impossible to reproduce the work, no"" (Cleaver, 1979; Tronti, 1979b). It should also be kept in mind that the rationale for obtaining patent protection is to stake a property right in order to prevent competitors from reproducing and marketing the invention. Thus, patent applications tend to be drafted in an opaque manner. According to one scientist who examined a patent, the documentation was "deliberately obscure and I think the reason it was obscure was because the thing doesn't work" (Bell, 1977). In fact, a number of scientists have advanced the claim that patents often contain "claims that *resist translation*" and often lay out a causal chain that is "over the top" in terms of plausibility (Tronti, 1979a, p. 1). Packer and Webster (1996, p. 442) declare that "[i]n some cases, an education in the patent system can seem to be rather like a crash course in strategic lying." These two authors determined in their empirical study that patents are often employed as weapons to manage the competition involved in external relations rather than as a mechanism for disseminating information. Companies can develop extensive patent portfolios in an attempt to circumvent potential licensees from using competitive technology or to limit the ability of competitors from inventing around[75] the original patent. Patent holders might also refuse to licence competitors in order to preserve exclusivity in future research projects (Dyer-Witheford, 2001).

[75] According to one prominent intellectual property scholar, ""[i]nventing around" is normally a safety valve in intellectual property policy, the possibility of which operates to reduce drag on progress caused by prior rights, and to create downward pressure on the price of licenses. One particular (though disputed) concern with the human genetic patents is the extent to which there may be no feasible way to innovate around a particular patent, precisely because of the fundamental quality of the subject matter" (Boyle, 2003a, p. 105). See, for example, Boyle, J. (2003). Enclosing the genome: What squabbles over genetic patents could teach us. In F. S. Kieff & J. M. Olin (Eds.), *Perspectives on properties of the Human Genome Project* (pp. 98-124). Amsterdam: Elsevier.

Academic scientists are increasingly compelled to manoeuvre between two social worlds premised on very different foundations: the ostensibly collaborative environment of academic research and the realm of private rights encompassed by intellectual property rights, though the former is being increasingly circumscribed by the latter (Negri, 2005, p. 204). "[S]cience and property, formerly independent and even opposed concepts referring to distinctively different kinds of activities and social spheres, have been made contingent upon each other through the concept of intellectual property rights" (Tronti, 1973).[76]

While a number of the authors reviewed in this chapter are critical of the capture of biotechnology within the expansionary logic of capitalism, very few make any systematic attempt to theoretically situate this phenomenon. Those that do tend to develop arguments that arrive in the pessimistic cul-de-sac of accepting, albeit critically and unhappily, the apparent unstoppable trajectory of contemporary capitalist social relations. The notable exceptions are Lewontin and Kloppenburg (particularly in his second edition of *First the seed*), as well as Dyer-Witheford and Schiller, both of whom employ Marxist frameworks in their work of analysing the informational aspects of contemporary capitalist social relations, including an optimistic assessment of the potential for liberation. This research proposes to adopt a tack similar to autonomist Marxism by contemplating the political and economic power being exercised in respect of biotechnology, which has become a focal point of contemporary capitalist restructuring, as well as a flash point for resistance. Therefore, the conceptual framework

[76] For an opposing, though not wholly convincing, perspective in which the author tries to makes a case that patent law might be considered congruent with Mertonian scientific norms, see Eisenberg, R. S. (1987). Proprietary rights and the norms of science in biotechnology research. *The Yale Law Journal, 97*, 177-231.

designed to guide the current research is a neo-Marxist amalgam that selectively draws on various elements of autonomist Marxism in a manner that holds the promise of underwriting an analysis capable of theorising the production and reproduction of capitalist society, as well as the possibility for rupture within that same society.

Chapter 3. Theoretical Outlook I: A Neo-Marxist Biopolitics

As outlined in the introductory chapter, the current work seeks to provide a critical interrogation of Canada's federal Biotechnology Strategy and the developmental trajectory of biotechnology in this country, as viewed from the perspective of those people and groups mobilising in opposition to particular aspects of this technoscience. This and the subsequent chapter outline the theoretical constructs that inform the research project and the assessment of its empirical findings. A neo-Marxist biopolitical framework that draws on conceptual elements from the autonomist Marxist tradition[1] guides the analysis, which is intended to illuminate the extent to which the CBS facilitates the appropriation of biotechnology by capital in order to help sketch the scope of the social factory that characterises the contemporary conjuncture of capitalist social relations. Taking its cue from De Angelis, who himself follows Marx's usage of the term, this research avoids the *ism* of 'capitalism', discussing instead 'capital' and 'capitalist social relations'. Indeed Marx never referred to capitalism, instead preferring to talk about the capitalist mode of production.[2] Such a conceptualisation permits us to apprehend capital, or a capitalist mode of production, as one mode of organising livelihoods that co-exists with and is related to others. In this way, we can conceive of the social field as a space open to strategic contestation among different forces.

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[1] The history of autonomist Marxism in Italy is a complex one that involves both the earlier *operaismo* (workerism), which concentrated on the factory struggles of industrial workers, and the later strands of thought that coalesced into the broad social movement of *autonomia.* The work of Tronti and Panzieri fits within the *operaismo* tradition. Nonetheless, Negri, a key theorist in the *autonomia* tradition, based a good deal of his own work on that of Tronti. Overall, Dyer-Witheford has demonstrated a sufficient continuity of thought among all these thinkers to classify them under the broad rubric of "autonomist Marxists". See, for example, Dyer-Witheford, N. (1999). *Cyber-Marx: Cycles and circuits of struggle in high technology capitalism.* Urbana, IL: University of Illinois Press.

[2] See, for example, Smith, C. (1996). *Marx at the millennium.* London: Pluto Press.

The label 'neo-Marxist biopolitics' is the term we deploy to denote the fact that while autonomist Marxism figures prominently in the theory guiding our analysis, the ultimate framework brought to bear on the project chooses selectively from this tradition. As Harry Cleaver points out in the introduction he authored for Negri's *Marx Beyond Marx,* Marxists, whether admitting it or not, have always engaged in a selective process of choosing among the many ideas elaborated by Marx when developing their theoretical and interpretive frameworks. The great benefit of an autonomist Marxist rendering of Marx stems from its immutable focus on revolutionary struggle and the potential for change, which is grounded in the active agency of labour and its antagonistic opposition to the logic[3] of capital. Moreover, integrating different perspectives and theoretical concepts helps protect against the dangers of dogmatism. As Michael Hardt argues, "[d]edicating a tradition to a single thinker, rather than a set of methods, principles, and ideas, always runs the risk of precluding innovation and creating a new dogmatism" (Dyer-Witheford, 1999, p. 76). Our application of the term 'biopolitics' follows that of Foucault via Hardt and Negri; while biopower is the concept used to indicate that life itself, be it human, animal, or plant, has become the immediate object of control and modification through genetic engineering, biopolitics signifies the potential for social agents to constitute themselves as subjects on the disputed terrain of biotechnology.

In laying out the theoretical perspective adopted in this work, attention first turns toward a brief exposition of two dominant branches of Marxist thought, namely orthodox Marxism and Frankfurt School Critical Theory. The intent of this discursion is to identify some of the gaps in these applications of Marx's thought and thus their inability

[3] As outlined in the introductory chapter, by 'logic' we mean the consistencies and regularities characteristic of capitalist social relations as a whole beyond the actions of individual capitalists. They are the regularities of the class struggle that revolve around the content and form of social life.

to sufficiently undergird a rigorous analysis of biotechnology in this country. Having established some of the conceptual limitations of these Marxist accounts, focus will then move toward an explication of autonomist Marxism[4] in an attempt to demonstrate the analytical rigour of this strand of Marxist thinking for the project at hand. In particular, the discussion here will concentrate on the autonomist concept of the 'social factory', biopolitics and biopower (concepts that trace their lineage to Foucault but which have recently been imbued with an autonomist tinge), and universal labour and species-being. Having established the macro level of our theoretical framework, the following chapter will move down to an intermediate level that elucidates the relevance of enclosures and commons to the analysis of resistance and struggle in respect of biotechnology in this country.

3.1 Orthodox Marxism and its Limits

A basic premise of orthodox Marxism's analysis of capitalist society is that the mode of production is the outcome of the dialectical relationship between the material forces of production and the social relations of production. In turn, this economic "base" exercises a determining influence over a "superstructure" of political, judicial and

[4] Some caution must be invoked when speaking of autonomist Marxism as a distinct and coherent line of Marxist thought and theory. As Steve Wright, who has penned a detailed historical and analytical account of *operaismo* (workerism) and autonomist Marxism, points out, it is important to recognise that "[m]aking sense of Autonomia as a whole is no simple matter. Ideologically heterogeneous, territorially dispersed, organisationally fluid, politically marginalised: Giorgio Bocca's...analogy of an archipelago is an apt one. Never a single national organisation, much less the mass wing of the armed groups, as certain judges would later charge, the 'Area' of autonomist organisations and collectives would begin to disintegrate almost as soon as it had attained hegemony within the Italian far left" (Wright, 2002, p. 152). See, Wright, S. (2002). *Storming heaven: Class composition and struggle in Italian autonomist Marxism*. London, GB: Pluto Press. It is precisely because of this heterogeneity among some of the dominant thinkers who identify with the autonomist tradition that the present work, rather than attempting to rigidly apply all of the theoretical propositions that have emerged from autonomist theorists, instead makes selective use of some of the dominant concepts they have resuscitated from Marx.

cultural activity. Marx provides a clear articulation of this position in *A contribution to the critique of political economy*[5]:

> In the social production of their existence, men inevitably enter into definite relations, which are independent of their will, namely relations of production appropriate to a given stage in the development of their material forces of production. The totality of these relations of production constitutes the economic structure of society, the real foundation, on which arises a legal and political superstructure and to which correspond definite forms of social consciousness. The mode of production of material life conditions the general process of social, political and intellectual life.... *The changes in the economic foundation lead sooner or later to the transformation of the whole immense superstructure* (Cleaver, 1982).

Engels, and those who followed him, celebrated the base/superstructure dichotomy as offering a scientific analysis of the capitalist mode of production and its attendant exchange relations that corrected the errors and deficiencies of the classical political economists. Given the prominence attributed to the economic base, theorists in the orthodox tradition tended to associate the base exclusively with industrial and manufacturing industries, which brought with it an emphasis on the 'classic' definition of the working class as comprised of the 'industrial proletariat'. But as discussed below, such a blinkered conception of the working class limited the ability of orthodox Marxists in the late 1960s and beyond to comprehend, let alone respond to, new constellations of class composition that were occurring in society.

As Holloway (1995) notes, the base/superstructure dualism inherent in the orthodox Marxist tradition grew increasingly untenable. The deficiency of such renderings of Marx is both that they tend to privilege the economic base, or political economy, over the politics of the superstructure, and that they tend to invest the unfolding

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[5] *A contribution to the critique of political economy* was originally published in 1859, eight years prior to the first volume of *Capital*. The Preface to the first edition of *Capital* refers to it as a 'continuation' of the *Critique*.

of the capitalist organisation of society with a teleological inevitability according to the well-known logic of economic determinism. For this reason, Cleaver (1979) considers these orthodox Marxist and neo-Marxist categories to be "reified".

> They are "reified" in that instead of being understood as designating social relations between the classes they have been turned into designations of things, things within capital separate from the social relation. In fact the concept of capital itself in these models usually designates not the class relation (that is sometimes thrown in as an afterthought) but rather the means of production, money capital, commodity capital, and labor power, all circulating as mindless entities through the ups and downs of their circuits (Beintema et al., 2008).

Such theories ignore Marx's admonition in Volume I of *Capital*[6] that "capital is not a thing, but a social relation between persons which is mediated through things", and that at the level of class, economic relations are, in fact, political relations of force between class subjects (Dyer-Witheford, 1999, 2001).

Moreover, the theoretical fidelity this variant of Marxism exhibits toward the economic sphere of the base/superstructure dichotomy results in an analytical myopia that fails to discern the importance of actors beyond the waged proletariat of the capitalist factory. The effect is to exclude from analysis precisely those groups and social spheres where from the 1960s onwards social struggles began to arise and be fought – students, the family, the healthcare sector, the media, etc. (Alquati, 1974; Panzieri, 1976; Tronti, 1977). Those theorists who focused primarily on the economic base found themselves ill-equipped to account for the multitude of workers, students, the unemployed, women, minorities, and a variety of other groups in the new social struggles being waged beyond the factory gates. One response by orthodox Marxists was to theorise such sites of struggle as being epiphenomena since they did not emanate from what they considered to

[6] Volume I of *Capital* was originally published in 1867. Volumes II and III remained in manuscript form throughout Marx's life and were published posthumously by Engels.

be the working class. The neo-Marxists of the New Left recognised the importance of such new movements to their revolutionary ideas, but they committed the theoretical solecism of accepting the orthodox division of these groups from the traditional working class. In general, these strands of Marxist analysis were significantly weakened in their ability to conceptualise the new social struggles of the late 1960s and early 1970s because their reading of Marx as political economy restricted any analysis to the terrain of the factory (Government of Canada, 2004, p. 2).

3.1.1 A Traditional Marxist Account of Biotechnology

Despite such limitations, this type of Marxist analysis does find contemporary application in interpreting various sectors of capitalist society, including the biotech industry. Bemoaning what he believes to be a lack of critical treatments of the development of biotechnology, Rodney Loeppky (2005) offers a conventional Marxist analysis specific to this science in his book, *Encoding capital: The political economy of the Human Genome Project*. Though certainly a critical account of biotechnology in general, and the Human Genome Project in particular, his analytical framework is driven by an historical materialist rendering that relies for its explanatory power on the so-called 'capitalist logic of motion' and its systemic contradictions, such as overproduction and the increasing difficulty of turning a profit. Disparaging the teleology inherent in the 'scientific progress' or 'technological necessity' theses, Loeppky (2005) asserts that the Human Genome Project can only be comprehended properly when analysed as a function of the capitalist 'logic of motion': the systemic requirement to expand value accumulation through innovation. According to Loeppky (2005), in the context of economic stagnation, both real and perceived, pharmaceutical and chemical companies actively sought new forms of innovation through biotechnology and other scientific and knowledge-based activities. He contends that "[s]cience and technology serve each [sic] capital in its inherently antagonistic relation with labor and its competitive relation with other capitals. It is not merely that the capitalist 'opts' to use science and technology as a tool. Rather, s/he must do so" (Loeppky, 2005, p. 39). However, Loeppky fails to develop the implications of this argument, thus completely missing the potential for oppositional tendencies to emerge around this new science and its attendant technological innovations. One is left wondering whether the ultimate 'logic of capital' of which he speaks is not an expression of the class struggle inherent in capitalist society.

Moreover, in the specific case of the Human Genome Project, which is the emphasis of his work, the state is regarded as the institutional actor that serves the needs of capital by erecting the research infrastructure necessary to the project and thus valuable to capital. "The HGP [Human Genome Project] represented a significant attempt by the state to secure the foundations for ongoing capitalist development in biotechnology and other genome-related industrial development" (Loeppky, 2005, p. 95). Interestingly, Loeppky (2005) never articulates a wholly convincing rationale for why the state acts in support of capital. Instead, his argument devolves, in places, into a functionalist account in which the state acts merely because capital needs it to. Loeppky (2005) similarly fails to develop adequately the implications for the political realm that flow from the apparent necessities and limitations imposed on the political by these capitalist laws of motion. To be fair, he does contend that the state constitutes a site of active political struggle, but his theoretical framework predisposes him to dismissing the state as a "political terrain open to contestation, but historically structured in a manner that was weighted in favor of capital's interests" (Loeppky, 2005, p. 173).

Given the theoretical blind spots that inhere in an orthodox Marxist approach, can Critical Theory provide deeper analytical traction?

3.2 Critical Theory and its Limits

Critical Theory, which is associated with the return to Hegel and consideration of the dilemmas of consciousness, alienation, and culture, roughly locates its genesis in the Institute for Social Research (known popularly as the Frankfurt School) that was housed at the University of Frankfurt am Main when Max Horkheimer became director in 1930.[7] Although the breadth of work carried out by the many thinkers associated with the Frankfurt School renders challenging any attempt to distil some taxonomy of overall themes, it is clear that these scholars were very interested in cultural issues that both implicitly and explicitly touched on Marxist elements of political economy.[8] In particular, there was significant debate among different members as to the issue of capitalist crisis and its inevitability, including the political implications that followed from each respective position. Yet regardless of where a position landed in terms of its assessment of the inevitability of the crisis of capitalism, all accepted the underlying

[7] The Institute left Germany for Geneva in 1933, the year Hitler rose to power. Its members subsequently moved from Switzerland in 1934 to New York, where the Institute became associated with Columbia University. In 1951 the Institute returned to Frankfurt and as of 2005 it is once again affiliated with the University of Frankfurt am Main. For a comprehensive historical account of the Frankfurt School, see Wiggershaus, R. (1994). *The Frankfurt School: Its history, theories and political significance* (M. Robertson, Trans.). Cambridge, MA: MIT Press. See also, Jay, M. (1996). *The dialectical imagination: A history of the Frankfurt School and the Institute of Social Research, 1923-1950.* Berkeley: University of California Press.

[8] Anything more than an introductory treatment of a few of the Frankfurt School thinkers lies beyond the scope of the present work. For a more detailed account, see David Held, who has produced a very good, albeit dense, discussion of the work of the major thinkers associated with the Frankfurt School: Held, D. (1980). *Introduction to critical theory: Horkheimer to Habermas.* Berkeley: University of California Press.

assumption that capital held domain over the economic realm; capital was the despot of the factory (Held, 1980; Jay, 1996).

But the critical theorists of the Frankfurt School went beyond traditional Marxist political economy by analysing both technological domination and capitalist planning. In part this was a natural response to the events of the day, which witnessed the ascendance of European fascism, state-driven accumulation in the Soviet Union, and the Keynesian state of Roosevelt's 'New Deal' era – thus Horkheimer's notion of state capitalism as an authoritarian state form, regardless of whether the ostensible method of organising the state was liberal, fascist, or socialist. One of the chief insights offered by the Frankfurt School was that systematic economic planning, which included state intervention, whether by the *apparatchiks* in the Soviet Union or by the capitalist states in the West, was critical to surmounting the economic crises of the 1920s and 1930s. As developed particularly by Friedrich Pollock, the accumulation of capital, especially given the increasing concentration of capital, was viewed as a centrally administered process that constituted the foundation of 'state capitalism' and the 'authoritarian state' (Held, 1980; Jay, 1996; Wiggershaus, 1994). Pollock theorised that this situation facilitated the extension of the despotic factory model of control to society as a whole, especially as processes of automation were further extended, which he viewed as a means of organising technology as domination. The assumption of complete capitalist control in the factory, coupled with the belief that the authoritarian state was similarly extending that hegemony to the rest of society helps explain why a number of Frankfurt School theorists began developing analyses of the cultural sphere, where, it was posited, the new means of domination that helped facilitate this extension were emerging. Capital was seen to be expanding its realm of control from the sphere of production to encompass increasing realms of consumption and reproduction (Held, 1980; Robins & Webster, 1985; Wiggershaus, 1994). Capitalist development aimed "at a more directly political control over the production and reproduction of daily life, extending methods of factory discipline into the state's management of the social totality" (Levidow & Young, 1981, p. 5).

Pollock's ideas were taken up and developed most forcefully by Herbert Marcuse in his book *One dimensional man*. Marcuse elaborated the notion of the Keynesian state as collective capitalist responsible for directing both the collective factory and consumption.[9] According to him, the sphere of consumption and its inherent consumerist logic provide capital a weapon that it can wield to subjugate working class demands (Marcuse, 1964). While the Keynesian bargain relies on satisfying worker demands for higher wages, so long as these do not outstrip productivity, advanced capital possesses the capacity to shape those demands qualitatively. The overall result, according to critical theorists, is a situation in which capitalist social relations succeed in integrating working class economic struggles within a market economy, thus mitigating the development of any sense of class-consciousness among workers. As progressively more realms of existence succumb to imposition of the commodity form, growing regions of the cultural sphere come to be controlled through the manipulation of consumption. "It is no longer the game of crushing workers' wage struggles through periodic crises but

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[9] Post-World War II Keynesianism involved an explicit acceptance of the welfare state and the social services this encompassed, macro-economic policy designed to achieve 'full' employment, and the right of labour to engage in collective bargaining. Keynesianism, as a social contract, came to be accepted by the dominant political parties and social interests until the economic crises of the mid-1970s. For an account of the defeat of social Keynesianism particular to Canada, see Bradford, N. (2000). The policy influence of economic ideas: Interests, institutions and innovation in Canada. In M. Burke & C. Mooers & J. Shields (Eds.), *Restructuring and resistance: Canadian public policy in an age of global capitalism* (pp. 50-79). Halifax: Fernwood Publishing.

rather of managing working class needs quantitatively and qualitatively so that they do not challenge the system" (Cleaver, 1979, p. 39).

Although the critical theorists of the Frankfurt School, as well as Baran & Sweezy (1966), provided astute analyses of the shortcomings of economic and cultural hegemony exercised by Keynesian capitalist social relations in the 1960s that went beyond orthodox Marxism, they ultimately failed to recognise the full implications of the social struggles in the 1960s or capital's counteroffensive in the 1970s. Critical Theory's notion of the hegemony of bourgeois culture falls prey to the weakness of failing to theorise the potential for the emergence of antagonistic class power capable of mobilising resistance against capital. Thus, in order to maintain theoretical consistency these authors were unable to locate the struggles of their day within the logic of capital and class struggle. Instead, they perceived such conflagrations as revolts against racial and sexual repression and what they perceived to be the broad irrationality of the capitalist system. These one-sided conceptualisations rendered such theorists incapable of apprehending the successes scored by working class struggles or their interactions with the social conflicts orchestrated by the unwaged. Such theorists fail to comprehend the power that workers can exercise not only in circumventing capital's attempts at restructuring, but in threatening the latter's very existence. While Critical Theory surpasses orthodox Marxism in seeing beyond the factory, it tends only to glimpse a context of domination that precludes it from contemplating the potential for revolutionary movement.

3.2.1 Critical Theory and Biotechnology

As we saw in the literature review chapter, Andrew Feenberg is a prominent scholar who adapts Critical Theory to questions of technological development and transformation. Specific to biotechnology, Guido Ruivenkamp (2005) has produced recent work that considers the value-laden political dimensions of biotechnological development. He and his colleagues endeavour to respond to questions about the ways that the ideological and political content of biotechnologies permit such technology to structure or mediate particular social relations (Ruivenkamp, 2005; Vroom, Ruivenkamp, & Jongerden, 2007). Such concerns can trace their origin to an emphasis within the Frankfurt School on a perceived inherent tendency within technology and technological development toward social and ideological domination based on technological rationality that serves to legitimate extant forms of social domination. Yet similar to Feenberg, Ruivenkamp (2005, 2007) recognises the tendency in Critical Theory to overemphasise structural constraints at the expense of human agency when contemplating technological development. The solution, according to Ruivenkamp (2005), is to combine elements from social constructivism that admit agency with those from Critical Theory that stress the cultural and historical structural constraints that similarly impact the social negotiation practices through which technological development occurs. Viewed broadly, Ruivenkamp (2005, 2007) develops a theoretical approach to biotechnology that synthesises the social constructivist concept of 'socio-technical ensemble', as elaborated by Wiebe Bijker (1995), with Feenberg's (1999, 2002) notion of 'technical code'. Construing technologies as 'socio-technical ensembles' admits the co-constructive roles technical and social elements have in the development of technology, while 'technical codes', as the reader will recall, offers a conceptualisation of technological development that marries technical aspects of this process to the broader social, political, and economic system within which it is embedded (Bijker, 1995; Feenberg, 1999; Ruivenkamp, 2005; Vroom et al., 2007). In his own words,

> ...it is also necessary to understand through which social processes the hegemonic position of the actual bio-power system is maintained and even reproduced by those who are subject to it, *and where openings for an increased democratization of the biotech development can be found* (Ruivenkamp, 2005, p. 20, emphasis added).

Thus, similar to the critiques we have levelled against Critical Theory, Ruivenkamp (2005, 2007) makes selective use of the critical analytic capacity of this school of thought in a manner that avoids defeatism by admitting the possibility to reconstruct 'technical code'. The point to be taken from this brief discussion is that even those few contemporary scholars conducting research into biotechnology from a Critical Theory perspective recognise that the totalising tendency inherent in a veracious application of this theory prematurely forecloses important avenues of theoretical and empirical investigation into the developmental trajectory and deployment of biotechnology.

Given the totalising cul-de-sac inherent in orthodox Marxism and the inability of Critical Theory to advance beyond 'mere ideological critique' (i.e. interpreting technology as materialised ideology that embeds and reinforces inequitable social relations in a manner that leaves such domination unquestioned by those being subjugated), the current project looks broadly to an alternative Marxist tradition, namely autonomist Marxism, as the territory on which to develop a suitably rigorous theoretical framework.

3.3 A Overview of Autonomist Marxism and its Theory

While the resurgence of Marxism in the 1960s in the United States was dominated predominantly by neo-Marxism, the situation was rather different in France and Italy, where an open rift developed between the Communist party and workers, students, and intellectuals. The empirical landscape of the day, which was increasingly characterised by workers' struggles operating autonomously from, and often in opposition to, the party and trade unions, therefore demanded new conceptual frameworks for theorising resistance to capital. Drawing on these new realities, the theorists of these groups recognised the inherent power of the working class as an active agent that, through its own actions and tactics, was strategically positioned to put capital on the defensive, forcing it to reorganise itself in response to worker resistance. While the members of the Frankfurt School had theorised capital's domination through its control over the organisation of labour, and the writers of the Johnson-Forest Tendency[10] and *Socialisme ou Barbarie*[11] carried that insight further by postulating the resistance power the working class could exercise against such domination, it was the leading thinkers of the Italian New Left who worked out the thesis that the impetus for successive technological innovation by capital derived from its conflict with the working class.

At this point we would like to make clear that we recognise the conceptual difficulties that inhere in contemporary usage of the term 'working class'. Autonomist Marxist scholars admit the conceptual baggage that attends this category, as demonstrated

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[10] The Johnson-Forest Tendency, which derives its name from the pseudonyms J.R. Johnson and F. Forest that were assumed by C.L.R. James and Raya Dunayevskaya, developed in the United States within the Trotskyist movement in the 1940s but split from it in 1950.

[11] *Socialisme ou Barbarie* (1949 - 1965) also developed in response to growing unhappiness with Trotsky's analysis of the Soviet Union and the role of the Party. What began as an oppositional faction by a number of members of the French section of the Fourth International quickly transformed into a completely separate group that published the review entitled *Socialisme ou Barbarie*, hence the name of this group.

by the various iterations of theorising labour over the past forty years, moving from the 'mass worker' to the 'socialized worker' to 'immaterial labour', all of which have attracted critique from both within and without the autonomist tradition. For the sake of continuity we continue to employ the term 'working class' when providing exegetical accounts of existing Marxist theory. However, in conceptualising the notion of 'class', this research agrees with De Angelis's (2007) admonition against the sort of postmodern Marxism advanced by Laclau and Mouffe and orthodox Marxism because of their reductionist concept of class *qua* waged labour. Taking a cue from the work of Dalla Costa, James, Federici, and the Wages for Housework movement of the 1970s, we propose a conception of class that recognises and encompasses not only waged labour but also the multiple forms of unwaged labour that are critical to the reproduction of waged labourers and thus constitutive of the surplus value extracted by capital. Class struggles should therefore be conceived of as those acts of resistance that endeavour to circumscribe capitalist appropriation of paid and unpaid labour along the circuit of capital. We hasten to add that while such a definition might be construed as reductionist, we do recognise the great heterogeneity among the various types of wage and non-wage earners encompassed by such a conception of the working class. The point is not to homogenise different strata or their various struggles, but rather to offer a thread capable of comprehending their basic commonality (Midnight Notes Collective, 1992b). We elaborate this further in the section devoted to biopower and biopolitical production, in which we discuss recent attempts to re-invigorate Marx's concept of 'species-being' and Dyer-Witheford's notion of 'universal labour' that promises to avoid such vacuous reductionism.

Autonomist Marxism, which owes a good deal of debt to Harry Cleaver for introducing it to the English-speaking world, concerns itself, in a classical Marxist fashion, with the exploitative relationship between labour and capital. Autonomist Marxists took note of Marx's own analysis that asserted the power of labour, rather than capital, in constituting and in potentially remaking society (Cleaver, 1979; Holloway, 1995, p. 159). Commenting on the importance of this rediscovery of the central role that the working class has to play in the struggles against capitalist production, another commentator maintains that, "[i]f the metaphor had not already been done to death, we would be tempted here to talk about a Copernican inversion of Marxism" (Moulier, 2005, p. 19).

Taking their cue from Marx's writings in volume I of *Capital*, autonomist Marxists incorporate into their own theories the distinction between labour power and working class. The former represents capital's attempts to objectify labour as an element in its valorisation process, the proletariat as so much labour power. As long as labour works for capital it exists as labour power within capital. But labour is, in fact, not a passive subject that can be organised and controlled completely by capital. Instead, labour is an active agent able to resist capital's reduction. It is precisely in these struggles that labour becomes the working class (Cleaver, 1979; Tronti, 1979b). The great benefit of this position that juxtaposes labour power (assimilation within capital) to working class (autonomy from capital) as conflicting possibilities is that it throws open to analysis the entire span of the capitalist labour force.

3.3.1 Autonomist Marxism and The 'Social Factory'

The insight of the autonomist perspective, aside from surmounting the dualism inherent in the orthodox tradition, rests in its ability to discern the power of class struggle to respond to and check capitalist development. By rejecting the separation of theory and practice, this strand of Marxism is able not only to comprehend the machinations of capitalist society but also to develop strategies that actively oppose capitalist reproduction processes (Bell, 1977). Unlike objectivist Marxists who interpret capital's apparent 'laws of motion' in an unyielding, teleological manner, autonomists refer back to Marx and demonstrate that these putative laws are, in fact, the outcome of a collision vector between two competing historical subjects. That is, objectivity in a society of two antagonistic subjects flows from their conflicts. As Tronti points out, "at the level of socially developed capital, capitalist development becomes subordinated to the working class struggles; it follows behind them and they set the pace to which the political mechanisms of capital's own reproduction must be tuned" (Tronti, 1979a, p. 1). Following this logic, the capacity of working class groups to engage in active struggle and make demands on capital demonstrates the degree to which such conflagrations move beyond economics to manifest themselves as contests for power at the political level. As Negri (1984) teaches us in his analysis of the *Grundrisse*, politics do not exist in a separate sphere, but instead are omnipresent in the arena of class struggle. Working class struggles thus become crises for capital that, in turn, elicit strategic responses by the latter, giving rise to a cycle of struggles between labour and capital. The different struggles are often not external to one another but instead overlap in a web of relations akin to a *matryoshka* doll in which investigation of a particular conflict reveals others nested within it (Dyer-Witheford, 2001). The circulation of such struggles mirrors and subverts the circulation of capital.

Following from these cycles of struggle, capital seeks to expand its ambit of control to encompass ever-greater swaths of society; a process that results in what Mario Tronti labels the 'social factory'. The 'social factory' thesis asserts that advanced capitalist social relations come to mirror the relations of production to such an extent that society becomes an extension of the factory, or, put another way, that the logic of the factory comes to dominate social life beyond the gates of the factory. The actual extent to which capital has subsumed the social goes, in Negri's (2005) estimation, beyond what Marx had envisioned in his own day. In fact, "capital, having itself become social" is optimally positioned to obscure "the contours of the totality" in order "to disguise its hegemony over society and its interest in exploitation, and thus to pass its conquest off as being in the general interest" (Negri, 2005, p. 204). This notion of the 'social factory' can be viewed as a development of Marx's concept of the deepening 'real subsumption' of society by capital.

Tronti's (1973) concept of the social factory, which recognises capital as social control, provides a potential bridge between autonomist Marxism and the Frankfurt School's emphasis on the 'cultural sphere' and consumption, a theoretical focus that seemed to attenuate the relevance of Marxism. By positing 'consumption' to involve the production and reproduction of labour power, Tronti, like the critical theorists, recognises capital's drive to engulf all of society. Unlike Frankfurt School theorists, however, Tronti interprets such manoeuvrings by capital as its response to working class struggles that have spread beyond the factory to the wider community – into the social factory.

The result is a situation in which capitalist relations of production increasingly subordinate social relations, which, in turn, demands that the traditional Marxist focus on the immediate point of production yield to a broader analysis of the complete circuit of capital. Yet similar to what was happening in the factory, Tronti discerns the substantial peril that mutiny in the social realm poses for capital's strategies of control and domination. Within the broader context of the social factory, the potential becomes so much greater for workers' revolts against their position as worker to spill over into the cultural sphere or community to destabilise the production of labour power (Tronti, 1973).

However, it fell to other thinkers in the *autonomia* tradition to flesh out the theoretical contours of the unwaged part of the working class, which remained somewhat underdeveloped in Tronti's work. The writers who took up this task, including the prominent intellectual Mariarosa Dalla Costa, examine the role exercised by the wage in obfuscating the unpaid labour appropriated by capital both within and outside the factory. This development and expansion of the category of unwaged labour also provided a welcome link between autonomist Marxism and feminist thought. These theorists recognise that reproducing labour power is an integral, although perhaps not explicit, part of capitalist planning. They emphasise the severing effect on the working class as a whole exercised by the wage, which divides the class into waged and unwaged (students, housewives, etc.) segments. Since the latter group does not draw a wage, it often appears to exist outside of the working class. Dalla Costa and her comrades sought to dismantle this artificial division through their analysis of the work activities involved in reproducing labour power, activities that occur in homes and other social institutions such as schools and hospitals throughout the social factory.[12] Aside from reducing the cost of necessary labour, such activities contribute to the production of surplus value beyond the direct point of production. By extending the reach of the autonomist Marxist framework to include those unwaged groups beyond the factory, groups that were and continue to lead many of the major anti-capitalist struggles, Dalla Costa, James and others offer a theoretical perspective capable of comprehending such conflict as points of resistance in the international cycles of struggle against capital that encompass the social factory as a whole. That is, this expanded theoretical framework made it possible to integrate the analysis of the struggles being conducted by unwaged workers with those of the working class, while simultaneously recognising the autonomy of such struggles.

3.3.1.1 Autonomist Analyses of Biotechnology

These insights are of particular importance to this research project; autonomist analysis of the conflicts arising throughout the social factory brings into focus the thread that interweaves these diverse points of resistance: different sectors of waged and unwaged labour struggling in a broad uprising to break free of the caste structure imposed on them by the social factory. They "involve a destabilization of the entire capitalist organization of society as a mechanism of surplus extraction....The result is a circulation of struggles that starts, at multiple points, to threaten the whole intricate equilibrium of the social factory" (Dyer-Witheford, 1999, p. 76). While the current project is, as far as we are aware, the first attempt to treat biotechnology in extended detail along autonomist

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[12] This recognition of the wage as an instrument for hierarchically dividing the working class also facilitated the analysis of the role of sexism and racism in capital, which is beyond the scope of the present work. For examples of this kind of inquiry, see Dalla Costa, M., & James, S. (1972). *The power of women and the subversion of the community.* Bristol: Falling Wall Press.; James, S. (1975a). *Sex, race and class.* Bristol: Falling Wall Press.; and, James, S. (1975b). Wageless of the world. In W. Edmond & S. Fleming (Eds.), *All work and no pay: Women, housework and the wages due* (pp. 25-34). Bristol: Falling Wall Press.

Marxist lines, it should be noted that *autonomia* has grappled with some of the issues being examined in this research. For example, the prominent North American autonomist thinker, Harry Cleaver (1982), has engaged in an autonomist analysis of the Green Revolution, demonstrating how the agricultural technologies imposed on the peasant countryside were designed and implemented based on political goals that themselves were mystified by the publicly articulated claims of increasing food yields. These new technologies, ostensibly designed to increase available food stocks, might also be conceived in terms of the secondary goal of stilling peasant unrest in the countryside in order to facilitate social reorganisation amenable to capitalist development (Cleaver, 1982). Although a significant change to the political structure of the countryside was achieved, the Green Revolution ultimately failed to pacify the countryside; a failure that Cleaver (1982) attributes to the resistance of workers against accepting the changes the Green Revolution sought to impose. The Green Revolution, which attempted to implement industrialised models of agriculture in developing countries, actually failed in resolving world famine issues, and instead mimicked Western economic and political forces by concentrating wealth and power among a privileged elite in many of the countries involved. In fact, one of the twenty-two findings contained in an extensive report issued in April 2008 by the International Assessment of Agricultural Science and Technology for Development concludes that large-scale industrial agriculture is becoming increasingly unsustainable given its dependence on cheap oil, its catastrophic impacts on ecosystems, and the mounting scarcity of water (Beintema et al., 2008). With the tab for the Green Revolution 1.0 rapidly coming due, one wonders what will be the future costs of the Green Revolution 2.0 that is being promoted so ardently by the biotechnology industry.[13]

Nick Dyer-Witheford, another leading North American autonomist scholar, has engaged in more recent work specific to biotechnology.[14] In his estimation the Human Genome Project represents not only a potential fount of hyper-profits for the biotechnology industry but perhaps more importantly it holds the promise of providing corporate and state leaders a potent tool for identifying and segregating those citizens *qua* workers with apparent predispositions to diseases that could become a drag on public healthcare budgets and corporate productivity (Dyer-Witheford, 1999, 2001). Though his work tends to focus on medical biotechnology, Dyer-Witheford (2001, 2004) does engage with struggles around agricultural biotechnology, particularly those in respect of Terminator technologies (elaborated more fully in chapter five) and genetically engineered food. The most interesting aspect of his work, and which helps inform the present research, is the way he interprets aspects of biotechnological development and the resistance it engenders through the optic of Marx's 'species-being' (a point taken up in the following section).

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[13] The Bill and Melinda Gates Foundation and the Rockefeller Foundation are currently undertaking a new Green Revolution, dubbed Green Revolution 2.0. Together they have established a US$150 million five-year fund to develop 400 varieties of high-yield seeds for use in sub-Saharan Africa. However, this programme, called Program for Africa's Seed System, is encountering widespread opposition from African farming organisations. Canadian groups that are supporting the Africans include ETC Group, the Canadian Biotechnology Advisory Network, the National Farmers Union, and the Canadian Food Security Policy Group. See, for example, Gillis, A. (2007). Sowing seeds of revolt. *Maclean's, 120(12),* 53.

[14] The theme of biotechnology runs throughout a variety of Dyer-Witheford's work. See, in particular, Dyer-Witheford, N. (1999). *Cyber-Marx: Cycles and circuits of struggle in high technology capitalism.* Urbana, IL: University of Illinois Press. (especially chapter 5); Dyer-Witheford, N. (2001). The new combinations: Revolt of the global value-subjects. *CR: The New Centennial Review, 1*(3), 155-200.; Dyer-Witheford, N. (2004). Species-being resurgent. *Constellations, 11*, 476-491.; and, Dyer-Witheford, N. (2006). Species-being and the new commonism: Notes on an interrupted cycle of struggles. *The Commoner, 11*(Spring/Summer 2006), 15-32.

What also becomes clear is that new social movements are not an indication of the contemporary irrelevance of Marxism but rather of its relevance. Of course, capital does not stand idly by in the face of confrontation. While this is not the place to discuss the accuracy of the claim about an apparent transition from Fordism to post-Fordism,[15] it is worth noting at this point that the decimation of the Fordist organisation of the social factory might, in part, be understood as an attempt by capital to decompose the social resistance of the time utilising both technological and political means.[16] Dyer-Witheford (1999), building on the Herbert Gottweis (1995), suggests that biotechnology can be viewed as an important element in capital's post-Fordist restructuring efforts that responded to the industrial unrest and struggles against Fordism. Given the crisis of Fordism in the 1970s, biotechnology has been co-opted by capital as one of the investment strategies designed to underwrite its expansion.[17]

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[15] Agreement is far from universal as to whether the political and economic changes that occurred in society from the mid-1970s onward are profound enough to be construed as a definitive break between epochs of social organisation and thus to warrant the appellation 'post-Fordist'. For a recent and incisive critique of the periodisation explicit in this approach, see Gambino, F. (2007). A critque of the fordism of the Regulation School. *The Commoner, 12*, 39-62., in which he claims that rather than having transitioned to a post-Fordist model, contemporary society has been subject to "a continuous recombination of old and new elements of domination in order to decompose labour power politically within a newly flexibilised system of production" (Gambino, 2007, p. 57).

[16] For an informative discussion of the attacks by capital on the post-war compromise between labour and capital that had linked labour and welfare interests, see Panitch, L. (1994). Globalisation and the state. In R. Miliband & L. Panitch (Eds.), *Between globalism and nationalism: Socialist register 1994* (pp. 60-93). London: Merlin Press.

[17] Herbert Gottweis and Edward Yoxen offer clear accounts of the way in which biotechnology has figured in post-Fordist restructuring. See, for example, Gottweis, H. (1995). Genetic engineering, democracy, and the politics of identity. *Social Text, 42*, 127-152.; and, Yoxen, E. (1981). Life as a productive force: Capitalising the science and technology of molecular biology. In L. Levidow & B. Young (Eds.), *Science, technology and the labour process: Marxist studies* (Vol. I, pp. 66-122). Atlantic Highlands, NJ: Humanities Press.

3.3.2 Biopolitics and Biopower

As we have seen, those theorists who helped develop *operaismo* (workerism), which would later evolve into *autonomia*, in particular Romano Alquati, Raniero Panzieri, and Mario Tronti, have long emphasised the importance for analysis to advance beyond capital's dominative power to also contemplate workers' struggles, including their genesis, their interconnections with or disconnects from one another, the degree to which they align with 'official' workers' organizations, and their adeptness at opposing capitalist control (Alquati, 1974; Panzieri, 1976; Tronti, 1977). This accent on the autonomy of labours' struggle continues to be the red thread that weaves its way through contemporary autonomist Marxist accounts of technological development and labour/capital antagonism. While the foundations for an autonomist Marxist critique of biotechnology have existed for some time, a major addition to this body of theory came recently with Michael Hardt and Antonio Negri's adaptation of Michel Foucault's work. The concepts of 'biopolitics' and 'biopower', as developed by Foucault and subsequently elaborated by Michael Hardt and Antonio Negri in their books *Empire* and *Multitude: War and democracy in the age of empire*, are theoretical constructs that lend themselves to an analysis of biotechnology, the impact of which, as outlined by the CBS, "is predicted to be more dramatic and far-reaching than that of telecommunications and computers in the last [century], because it deals with life and living things which permeate all aspects of our own lives" (Government of Canada, 2004, p. 2). The following schematic overview of these concepts is intended to illustrate their relevance to the current research project.

Despite general tension and frequent animosity between Marxist and postmodernist/poststructuralist thinkers, Hardt and Negri (2000, 2004) admit the influence of Michel Foucault's work on their own elaboration of the concept of 'biopower'. As employed by Foucault (1980),[18] biopolitics and biopower involve the technology, discourse, politics, and praxis that produce and manage a state's population. Foucault's (1980) development of the concept of 'biopolitics' demonstrates a recognition that life and living being are becoming increasingly integral to new political struggles and new economic strategies. 'Biopower' is the term Foucault (1980) develops to discuss the relationships between the human body and institutions of power. Biopower, according to Foucault (1980), is a mechanism capable of analysing, regulating, and controlling the human subject, both its body and its behaviour. That is, people are both produced by and subject to the forces of biopower. Biopower thus serves to create self-regulating subjects who conform to the various institutional contexts and discursive norms of society. Foucault (1980) does, however, offer the possibility for resistance, contending that people recognise that the multiple discourses and institutions in a state are part of the effects of power. Without some final authority to make people believe a particular discourse, no authoritative truth can emerge to dominate society (Danaher, Schirato, & Webb, 2000). If biopower appropriates life as the object of its control, Foucault (1980) situates it as the foil to what he calls 'biopolitics', which designates the capacity to develop alternative forms of subjectification that resist and evade the command of biopower. That is, the governance of biopower can be reversed through biopolitical actions and relations that endeavour to produce and govern new forms of life (Lazzarato, 2006).

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[18] Foucault elaborates his concepts of 'biopower' and 'biopolitics' most explicitly in Volume I of *The history of sexuality*.

Maurizio Lazzarato (2006) believes that Foucault's work on biopower and biopolitics, in fact, furnishes a new ontology that admits the freedom of the subject. Thus, any analysis of power relations must commence from the dynamic of forces and the freedom of subjects, rather than from the dynamics of institutions. "Power, the condensation of strategic relations into relations of domination, the contraction of the spaces of freedom by the desire to control the conduct of others, always meets with resistance" (Lazzarato, 2006, p. 17). In Foucault's own words, "[r]esistance was conceptualised only in terms of negation. Nevertheless, as you see it, resistance is not solely a negation but a creative process. To create and recreate, to transform the situation, to participate actively in the process, that is to resist" (Foucault, 1997, p. 168). Because biopolitics represent "the strategic coordination of these power relations in order to extract a surplus of power from living beings", a biopolitical political economy must therefore go beyond the traditional political economic focus on labour and capital to consider and interrogate the range of power relations that infiltrate the social body (Lazzarato, 2006, p. 12). Similar to a theme integral to autonomist Marxist scholarship, Foucault goes on to demand that a sufficient analysis of these power relations requires a conceptualisation in which "...resistance comes first, and resistance remains superior to the other forces of the process; power relations are obliged to change with the resistance" (Foucault, 1997, p. 167).

Nonetheless, Hardt and Negri ultimately fault Foucault for failing to comprehend the "real dynamics of production in biopolitical society" (Hardt & Negri, 2000, p. 28). They seek to extend Foucault's use of the term 'biopolitics' by infusing it with ontological, productive, and collective qualities. Hardt maintains that he and Negri believe Foucault's "notion of biopower is conceived only from above" while they

> attempt to formulate instead a notion of biopower from below, that is, a power by which the multitude itself rules over life. (In this sense, the notion of biopower one finds in some veins of ecofeminism such as the work of Vandana Shiva, although cast on a very different register, is closer to our notion of biopower from below.) What we are interested in finally is a new biopolitics that reveals struggles over forms of life (Hardt & Dumm, 2000, ¶ 16).

Despite differences in interpretation, Hardt and Negri's (2000) account is really an extension of Foucault, arguing that power in the era of what they refer to as 'postmodernity' (or real subsumption) has morphed into biopower, which represents capital's appropriation, beyond labour power, of life itself. The implication of this life-encompassing nature of biopower is that the social factory comes to operate at the level of biopolitical production. That is, in contrast to biopolitical production, which, according to Hardt and Negri (2004), is immanent to society and serves to establish social relationships given its basis in collaborative types of labour, biopower is a form of sovereign authority poised above society that, in fact, transcends society to impose its own order by producing and reproducing all aspects of social life. Biopower thus represents a tendency for sovereignty to develop into power over life.

> It [the capitalist regime] no longer produces through factories alone, but makes the whole of society work for its own enrichment; it no longer exploits only workers, but all citizens; it does not pay, but makes others pay it to command and to order society. Capitalism has invested the whole of life; its production is biopolitical (Negri, 2003, p. 136).

The important point that Hardt and Negri (2004) stress in their work is that the imposition and exercise of biopower over the multitude can be resisted thanks to the immaterial, cooperative, and collaborative forms of labour that characterise the increasingly biopolitical landscape of contemporary society.

Hardt and Negri's (2000, 2004) thesis that society is experiencing a postmodern trend toward a general socialisation of all forms of labour postulates that the traditionally discrete categories such as farmer, service worker, industrial worker, etc. are blurring and gradually disappearing as a result of the informationalisation of production processes, which bring with them an increasing emphasis on communication that can be appropriated by these various types of labourers. In the "biopolitical postmodern", labour is transformed through the enrichment of productive processes but in the context of a society subsumed by capitalist expropriation (Negri, 2003, p. 136). This does not mean that the singular existence of these various forms of labour disappears: tool and die makers still execute very different functions than the barrista at Second Cup, "but this multiplicity tends to be inscribed in a common substrate. In philosophical terms we can say that these are so many singular modes of bringing to life a common labouring substance: each mode has a singular essence and yet they all participate in a common substance" (Hardt & Negri, 2004, p. 125). It is, according to Hardt and Negri (2000, 2004), precisely because all these various singularities as active subjects are subsumed in biopolitical production that they are potentially so dangerous to capital, threatening to circumvent its contemporary ontological constitution. The coincidence of social production and reproduction encompassed by biopolitical production occurs in the new sphere of the common. Biopolitical production is infused with the common in that it not only relies on human capacities of communication, cooperation, innovation, and affect but it also produces new social subjectivities and forms of social life.

While Hardt and Negri's (2000, 2004) reworking of Foucault's concepts of 'biopower' and 'biopolitical production' provide exciting conceptual entry points for our analysis of biotechnology in Canada, their 'immaterial labour' thesis raises a number of insurmountable challenges.[19] One of the arguably most controversial tasks involved in elaborating a political economic analysis of contemporary society is how to define the concept of class. It has become almost commonplace on the Right to enunciate invectives against the apparently obsolete notion of this concept. As no doubt clear, our position is that Fukuyama (1992) was rather premature in expounding his 'end of history' thesis. Yet even the Left is plagued by a certain degree of discordance about not only the relevance of class analysis but also about what exactly is the nature of contemporary class composition. Autonomists, who are similarly at odds over the term, have moved from the 'mass worker' of the factory in the 1960s through to the 'socialized worker' in the era of real subsumption within the 'social factory' in the 1970s and early 1980s to the current 'multitude' ostensibly toiling under conditions of 'immaterial labour'. Unfortunately, the category of 'immaterial labour', similar to Negri's concept of the 'socialized worker', tends to offer a theoretical union of a fairly diverse collection of labourers that, in reality, may not be so amenable to mutual organisation in terms of resistance to Empire. One might even find this vaguely evocative of the privilege accorded the 'knowledge worker' by Bell (1973), albeit certainly from a different ideological position. George Caffentzis

[19] Initially we proposed employing the notion of immaterial labour in order to situate biotechnology, particularly given the integral role information, information processing, and advanced information technologies play in this science and its technological applications. Biotechnology appeared to embody an archetypal form of immaterial labour. While some of the critiques that have been levelled against the immaterial labour thesis did induce a certain degree of caution about the analytical strength of this concept to undergird the present analysis, the main motivation to jettison the immaterial labour construct emerged during the interview process and subsequent evaluation of the empirical findings. It became clear that the optic offered by the immaterial labour thesis provides little clarity in attempts to comprehend and theoretically situate contemporary Canadian opposition to biotechnology. What instead became apparent was that the notions of enclosure through biopower and efforts to establish and re-establish commons are the motivating ideas driving much of the struggle against biotechnology being mobilised in this country. To be sure, very few of the informants who participated in this research articulated their opposition to biotechnology utilising the terminology of 'enclosure' and 'commons', but the concerns they voiced about corporate domination of agricultural biotechnology and their suggestions for countering such control anticipate much of the conceptual terrain inherent in these concepts.

(1998) is particularly critical of what he interprets to be Negri's privileging of high-tech, male workers in metropolitan centres, to the exclusion of the new masses of dispossessed workers subject to intense forms of capitalist exploitation reminiscent of the stage of primitive accumulation, or what he provocatively refers to as "the renaissance of slavery" (Caffentzis, 1998, ¶ 8).[20] Another commentator offers a parallel critique of the immaterial labour thesis that faults it for considering immaterial workers in isolation from the production chains in which they continue to be related to material workers (Nunes, 2007). Harry Cleaver (2006) also has voiced recent opposition to the term 'immaterial labour', arguing that the adjective qualifier is confusing since all work, including the mental work involved in producing and processing information and communication, continues to be grounded in manual labour. Cleaver (2006) goes on to assert that the same is true of 'affective' labour. Overall, he develops the argument that much of what Hardt and Negri develop in *Empire* and *Multitude* is easily traced back to Marx's own work and thus not particularly groundbreaking (Cleaver, 2006).

3.3.2.1 Universal Labour and Species-Being

In point of fact, in order to encompass the multiple and variegated types of waged and unwaged labour constitutive of what they term the insurgent multitude, Hardt and Negri (2000), in this latest iteration of class composition, have tended to stretch the concept of immateriality to the point of being all-encompassing. However, the broad scope of such a formulation is purchased at the expense of analytical depth and precision. In an effort to overcome some of the theoretical difficulties encountered in Hardt and

[20] For a convincing and most disturbing account of contemporary practices of slavery, see Bales, K. (1999). *Disposable people: New slavery in the global economy*. Berkeley: University of California Press.

Negri's *Empire* (2000), particularly their emphasis on immaterial labour, Dyer-Witheford (2005) proposes that the concept be re-positioned within the broader category of 'universal labour', which Marx very briefly outlines in Volume III of *Capital*: "Universal labour is all scientific labour, all discovery and all invention. This labour depends partly on the co-operation of the living, and partly on the utilisation of the labours of those who have gone before" (Marx, 1967, p. 104). Building on Marx, Dyer-Witheford (2005, 2006) suggests that universal labour and general intellect[21] should be theorised as components of the concept of 'species-being'. In elaborating his reading of 'universal labour', (Dyer-Witheford, 2005, 2006) suggests a taxonomy comprised of 'immaterial labourers', 'material labourers', and 'immiserated workers' as a substitute for the conceptually taxed 'immaterial labour' and 'multitude' categories. Immaterial labour involves communicational and affective activity, while material labour encompasses those tasks that remain focussed on the production of a physical product. Immiserated labour includes those workers subject to the exigencies of the labour market and who thus fill out the ranks of the short- and long-term reserve army of the unemployed. Workers in this category are considered by capital as contingent and surplus to its requirements (Dyer-Witheford, 2005).

While there is not a sharp distinction between these categories and, in fact, the contemporary capitalist workforce tends to toil close to the intersection of all three, the globalisation of capital has contributed to a certain degree of polarisation of different strata of labour around a particular category. For example, the archetypal immaterial labourer involved in the networked, information-technology intensive biotech

[21] 'General intellect' is the term Marx employs in the *Grundrisse* to encapsulate the various types of abstract knowledge, mainly though not exclusively of a scientific nature, that were beginning to comprise the epicentre of production and thus affect all aspects of social life.

laboratories can be distinguished from the material workers subject to Taylorist industrial manufacturing conditions in the production facilities within that same industry. Both of these types of worker stand in stark contrast to the swelling ranks of immiserated labour characterised by a subsistence and peripatetic existence, in which category we might position agricultural workers, including farmers, whose livelihood is being rendered increasingly precarious by the high level of control large agribiotech companies like Monsanto, Syngenta, and Bayer exercise over biotechnological seed and pest management systems.[22] Disaggregating the concept of 'universal labour' in this manner removes the privilege Hardt and Negri accord to 'immaterial labour', thus opening up to analysis a wider range of potential insurgence as a focus for investigation, while still allowing an emphasis on knowledge and the corresponding figure of the universal labourer dependent on and constitutive of the general intellect. As Dyer-Witheford (2001, 2005) contends, revolts among 'material' or 'immiserated labour' might find affinity among some of the more radical 'immaterial labourers', leading to a convergence of struggles united in support of principles of basic social justice as well as the perhaps self-interested motive of avoiding a 'global race to the bottom'. Contemplated in the context of struggle, we recognise that universal labour emerges to the extent that the instances of opposition mobilised against capital by 'immaterial', 'material', and 'immiserated' labourers link up with one another. That is, the 'universal worker' is not

[22] We recognise that this grouping of farmers and farm workers within the substrate of immiserated labourers is not completely unproblematic, particularly given some of the major distinctions and tensions between large-scale and family farmers. Indeed, situating farmers and agricultural workers within a particular class category has proved challenging for leftist conceptual schemata of class composition from Marx onwards. The point of the present research, however, is not to resolve this dilemma but rather to open up to analysis those issues in respect of biotechnology around which various subjects are mobilising resistance. At the risk of occluding some of the important differentiation and complexities that attend class formation in the agricultural sector, we contend that for present purposes the concept of 'universal labour' as a component of 'species-being' provides a sufficient heuristic device for identifying and elaborating those subjects involved in opposition to various agricultural biotechnology issues in this country.

an ontological given but the product of an active project of political recomposition (Dyer-Witheford, 2005).

By describing this class of labourers as universal, the category assumes a broad and encompassing nature that avoids the amorphousness inherent in the 'immaterial labour' thesis while still remaining consistent with Hardt and Negri's (2000, 2004) notion of the multidimensional character of biopower harnessed and employed by contemporary capital throughout the social factory. In fact, an argument might be made that the basic elements of the 'universal labour' thesis are adumbrated in Hardt and Negri's work (2004, p. 187), in which they contend:

> ...the right or title to property is undercut by the same logic that supports it because the labor that creates property cannot be identified with any individual or even group of individuals. Immaterial [Universal] labour is increasingly a common activity characterised by continuous cooperation among innumerable individual producers. Who, for example, produces the information of genetic code? Or who, alternatively, produces the knowledge of a plant's beneficial medical uses? In both cases, the information and knowledge is produced by human labor, experience, and ingenuity, but in neither case can that labor be isolated to an individual. Such knowledge is always produced in collaboration and communication, by working in common in expansive and indefinite social networks – in these two cases in the scientific community and the indigenous community.

While the class concept of 'universal labour' is at a relatively nascent stage of development, thus rendering it susceptible to critiques of being undertheorised, we believe that for the reasons just cited it possesses sufficient conceptual fortitude to stand in as the category we propose to employ that catches those subjects involved in anti-biotechnology struggles in Canada. As Dyer-Witheford (2005, 2006) suggests, the scope and depth of contemporary struggles around control of a technoscience now capable of altering fundamental parameters of human existence renders the traditional terminology of 'counter-globalisation' or 'global justice' movements somewhat lacking. In referring to the subjects engaged in anti-biotechnology struggles in this country we therefore propose to make use of the more reflective terms 'species-being movements' and 'universal labour'.

As Dyer-Witheford (2005, p. 159) passionately informs us, "[w]hat is at stake in the development of 'universal labour' and 'general intellect' is nothing less than the trajectory of 'species-being'." The potential for human self-transformation inherent in Marx's notion of 'species-being' finds its contemporary apotheosis in the context of biotechnology and the increasing drive by capital to appropriate this science and its technological applications within its own logic. Thus, rather than accept Althusser's (1969) dismissal of the early Marx and his humanism, we should embrace the work of writers like Gayatri Spivak (1999), David Harvey (2000), and Nick Dyer-Witheford (2004, 2005 2006a), all of whom are re-generating interest in the concept of 'species-being' that brings with it a demand to open up to collective social debate the way that technoscience is developed and controlled in the twenty-first century and beyond (Althusser, 1969; Dyer-Witheford, 2005, 2006; Harvey, 2000; Spivak, 1999).

The notion of 'species-being' comes to us from Marx, who developed it as the central element in his discussion of alienation in the *Economic and philosophic manuscripts of 1844*.[23] According to Marx, private ownership of the means of production impoverishes human existence by estranging people from the products of their labour, eliminating relationships based on cooperation between people, transforming nature through human activity, and circumscribing individuals' historical opportunities for self-development, or species-being. By 'species-being' Marx meant the transformative

[23] Like so many of Marx's other works, this series of notes (also known as *The Paris Manuscripts*), written by Marx between April and August 1844, remained unpublished until 1932.

capacity of humanity through active social agency, rendering "life-activity itself the object of ... will and ... consciousness....Conscious life-activity directly distinguishes man from animal life-activity. It is just because of this that he is a species-being" (Marx, 1988, p. 76). Marx differentiates between this concept and what he refers to as 'species life', a term meant to capture the biological nature of humanity's subsistence needs for things like food, water, shelter, and sex (Spivak, 1999). Species-being, though embodied in this biological existence, elaborates and expands these physiological needs in a process of individual and collective self-development; a constitutive and iterative process dependent upon material capacity (including technoscientific competencies), self-consciousness, and social cooperation (Dyer-Witheford, 2006; Margolis, 1992).

As a species, humans, like many other species that inhabit the world, are equipped with a particular set of physical and cognitive attributes that provide the capacity to modify their environment in ways that help ensure their survival and continued reproduction. Moreover, such adaptation occurs in a reflexive manner as humans adjust to the transformed conditions of the environments that they themselves construct. As Harvey (2000, p. 207) points out, "[w]e are sensory beings in a metabolic relation to the world around us. We modify that world and in so doing change ourselves through our activities and labours." What differentiates humans from other species is the higher level of transformation and adaptation the former can effect. Arguably most critical is the capacity to engage in practices designed to organise the social world, as manifested in such structures as divisions of labour and class. Moreover, the cognitive facilities possessed by humanity facilitate the development of language and thus the creation of historical memory and the accumulation of knowledge that can be drawn upon in an iterative manner for future action and development. The reflexivity embedded in the human species provides individuals the opportunity to learn from their own, as well as others', experience. That is, species-being instantiates a process of reciprocal access to both social and individual powers. Such cognitive powers are complemented by the physical capacity to build tools and other mechanisms to surmount the physiological limitations imposed through biological composition (Harvey, 2000). In a reflexive and iterative manner that draws on both their intellectual and physical endowments, humans are able to transform and adapt to both their own species-being and the environment in which they are embedded. Such a transformation of humanity is driven equally by the respect exhibited by humans in their interactions with one another and the natural environment, and the use made of applied science as the source of technological innovation for industry (Dyer-Witheford, 2006). Aside from imploding the traditional Cartesian mind/matter binary, Harvey (2000) contends that this formulation opens the way to considering not only 'species-being' but also 'species potential', which aligns with the general analytical position adopted in the current research.

In elaborating his reading of species-being, Harvey (2000, p. 209) posits six elements that he believes comprise a 'basic repertoire' possessed by humans at our current historical conjuncture that both constrains and enables human activity: "competition and the struggle for existence"; "adaptation and diversification into environmental niches"; "collaboration, cooperation, and mutual aid"; "environmental transformations"; "spatial orderings"; and, "temporal orderings". In applying the concept of 'species-being' to the present work, we believe that a focus on competition, cooperation, and environmental modification is particularly apposite. We need not only to recognise but also to make explicit the complementarity between competition and cooperation at the level of species-being and within capitalist social relations. Market proponents would certainly have us believe that competition furnishes the fundament upon which all-else rests. But competition might also be conceptualised as an adapted form of cooperation. "We do not want to negate self-interest, this would ultimately mean to capitulate to moralism. However, we want to negate the self-interest of the monad, *the self-interest of the isolated individual* which is the real fundamental construction of the «economic man»" (De Marcellus, 2003, p. 10, fn 20, emphasis in original). As discussed above in respect of biopolitical production, capitalist accumulation is driven increasingly by innovation that depends upon cooperation and mutual collaboration. Moreover, and despite capitalist rhetoric to the contrary, accumulation similarly relies on a significant amount of social organisation and regulation that enables the production and continued reproduction of a collaborative and ostensibly consensual market infrastructure amenable to competition. In turn, such collaborative actions subsequently impact upon nature and our physical environment through active attempts to transform and construct 'nature', actions that themselves often induce unintended consequences. As we will see in later chapters, the interaction of all three of these elements of Harvey's (2000) proposed repertoire in respect of agricultural biotechnology is generating crucial implications for not only our own species-being but also for the environment and other species that co-inhabit our natural environment.

In a way that contemplates our following discussion of enclosure and the commons, the above juxtaposition between cooperation and competition yields space for the development of our 'species potential' by allowing us to recognise that it is a specific mode of competition that defines contemporary capitalist social relations, rather than competition *per se*. By demystifying the level of cooperation inherent in a putatively competitive capitalist marketplace, we can begin to reverse the direction of causality and emphasis attributed to each respective form of social interaction. By actively reconfiguring the balance between competition and cooperation we need not jettison the former (not only difficult but probably unrealistic) in order to construct a form of social organisation with alternate objectives more conducive to the actualisation of our species-being. As the segmented immaterial, material, and immiserated labour involved in these processes begin to interact with one another and metamorphose into a participative 'general intellect', then universal labour arises as a political force able to exert control from below over the development of species-being, a process that capital has substantially usurped over the last three decades. It is for this reason that Dyer-Witheford (2006) considers the *1844 Manuscripts* to represent a political economy (or perhaps an anti-political economy) of humanity that, applied from a Marxist rather than Foucauldian perspective, throws open the door to autonomy and liberation in our contemporary networked and biotechnological society. We believe that the concept of 'species-being' offers a suitable theoretical complement to the notion of biopolitical production that together promise to provide the requisite analytical capacity sufficient to the aims of the present research project.

Chapter 4. Theoretical Outlook II: Primitive Accumulation, Enclosures, and Commons

While the concepts of 'the social factory', 'biopower' and 'biopolitical production', and 'universal labour' and 'species-being' provide a high-level conceptual lens through which we can situate contemporary struggles around biotechnology, a meso level set of theoretical categories consonant with this optic is provided by the concepts of primitive accumulation, enclosure, and commons – concepts that preoccupied Marx's thinking when he articulated his notion of 'species-being' in the *Economic and philosophic manuscripts of 1844*. Although very few of the informants who participated in this research articulated their opposition to biotechnology utilising the terminology of 'enclosure' and 'commons', these concepts nonetheless resonate strongly with the concerns they expressed (as elaborated more fully in the chapter on resistance) about their desire to rescue and reinvigorate agricultural products and processes from expanding corporate encroachment. Moreover, the concepts offered in this chapter provide the additional advantage of bridging concerns over biological enclosures with those of information and knowledge enclosures. In the following pages we therefore propose a contemporary reworking of Marx's notion of 'primitive accumulation' as a theoretical entry point for interrogating current resistance against capitalist enclosures of both the biological and informational commons.

4.1 Conceptualising Primitive Accumulation

Primitive accumulation provides the origin of the separation between producers and the means of production, a separation that is responsible for the alienated character of labour and thus for defining the opposition inherent in capitalist social relations. This divorce, which, as we note from Marx, is a continuous feature of capital's mode of production, is achieved through a variety of actions, including the "forcible usurpation" of common property through "individual acts of violence" as well as the "Parliamentary form of robbery" such as the Acts of Enclosure, through which "the landowners grant themselves the people's land as private property" (Marx, 1992, p. 885).

While there is a varying array of literature that elaborates particular examples of capital's enclosure of the commons[1] that might be interpreted as instances of contemporary primitive accumulation, it is only recently that a small number of scholars

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[1] For a few examples of some of this literature, see Silvia Federici for an account of how the debt crisis of the 1980s and the successive structural adjustment programmes of the 1990s provided a convenient justification for the massive land privatisation schemes forced on a great number of African nations: Federici, S. (1992). The debt crisis, Africa and the new enclosures. In Midnight Notes Collective (Ed.), *Midnight oil: Work, energy, war, 1973-1992* (pp. 303-316). Jamaica Plains, MA: Autonomedia. See James Boyle's work on intellectual property and enclosure of the human genome: Boyle, J. (2003a). Enclosing the genome: What squabbles over genetic patents could teach us. In F. S. Kieff & J. M. Olin (Eds.), *Perspectives on properties of the human genome project* (pp. 98-124). Amsterdam: Elsevier.; Boyle, J. (2003b). The second enclosure movement and the construction of the public domain. *Law and Contemporary Problems, 66*(1&2), 33-74. See Vandana Shiva on intellectual property rights and the enclosure of indigenous knowledge: Shiva, V. (1997). *Biopiracy: The plunder of nature and knowledge.* Boston: South End Press.; Shiva, V. (2001). *Protect or plunder?: Understanding intellectual property rights.* New York: Zed Books. Shiva also offers examples of the enclosure of common resources like water: Shiva, V. (2002). *Water wars: Privatization, pollution, and profit.* Cambridge: Cambridge University Press. On the struggles against the enclosure of water resources in Bolivia, see Olivera, O. (2004). *¡Cochabamba!: Water war in Bolivia.* Cambridge, MA: Southend Press. A variety of websites outline and discuss the impact of dams in the Narmada Valley (a US$ 5 billion project to construct more than 3000 dams) on the local populations, including their struggles against such projects. See, for example, http://www.umich.edu/~snre492/Jones/narmada.html and http://www.narmada.org/. Hansen and Wallach discuss the system of enclosures being wrought on Central America through the Plan Puebla-Panama: Hansen, T., & Wallach, J. (2002). Plan Puebla-Panama: The next step in corporate globalization. *Labor Notes*(277), http://labornotes.org/archives/2002/2004/a.html. In addition to the work by the World Development Movement (http://www.wdm.org.uk/campaigns/past/gats/index.htm) and GATSwatch.org (http://www.gatswatch.org/), see Erik Wesselius for a critique of the way the General Agreement on Trade in Services (GATS) functions as an international agreement designed to both consolidate past and facilitate future corporate enclosures of the commons: Wesselius, E. (2002). *Behind GATS 2000: Corporate power at work.* Amsterdam: Transnational Institute. Jubilee South, a network of debt campaigns, social movements, people's organisations, communities, NGOs and political formations, not only provides a critical assessment of the effects of debt on the Global South, but also calls on countries to repudiate and nullify debt claims imposed on debtor nations by creditor nations and international organisations such as the World Bank and IMF. The Jubilee South website (http://www.jubileesouth.org/) offers a wealth of information on this issue. For a poignant discussion of the effects of and struggles against the enclosures imposed on countries and people through structural adjustment policies, see Walton, J., & Seddon, D. (1994). *Free markets and food riots: The politics of global adjustment.* Cambridge, MA: Blackwell.

has begun to engage in systematic theorisation of this phenomenon and its critical importance to the production and reproduction of capital. Basic to this emerging line of theory is a rejection of the traditional genealogical accounts of primitive accumulation. Sharing the autonomist Marxist conception of capital as a social force that must exist in society alongside opposing forces, which, through their own autonomous struggles, seek to limit it, these scholars interpret primitive accumulation and its attendant enclosures of the commons as continuous characteristics and strategies that are integral to capital accumulation.[2] Harvey (2003) emphasises the dialectical relationship between expanded reproduction and accumulation by dispossession, asserting that even though the latter represents the dominant contradiction inherent in capitalist accumulation that must be confronted in contemporary society by resistance movements, this should occur in a manner that admits the dialectical relation to struggles within expanded reproduction. Ultimately, however, Harvey (2003) attributes the rise in importance of accumulation by dispossession to the chronic problems of overaccumulation of capital that resulted from expanded reproduction, which were exacerbated by a political failure to develop internal

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[2] Depending upon the theorist to whom one refers, the nominal term employed to reflect the phenomenon of primitive accumulation differs. Glassman discusses 'primitive accumulation', 'accumulation by dispossession', and 'accumulation by extra-economic means', though he seems to favour the original term coined by Marx, 'primitive accumulation'. See, for example, Glassman, J. (2006). Primitive accumulation, accumulation by dispossession, accumulation by 'extra-economic' means. *Progress in Human Geography, 30*, 608-625. McCarthy speaks of accumulation by 'extra-economic means'. See, McCarthy, J. (2004). Privatizing conditions of production: Trade agreements as neoliberal environmental governance. *Geoforum, 35*(327-341). Bonefeld and Massimo DeAngelis remain true to Marx, employing the term 'primitive accumulation'. See, for example, Bonefeld, W. (2001). The permanence of primitive accumulation: Commodity fetishism and social constitution. *The Commoner, 2*(September), 1-15.; Bonefeld, W. (2002). *History and social constitution: Primitive accumulation is not primitive*. The Commoner. Available: http://www.commoner.org.uk/debbonefeld01.pdf [Accessed December 8, 2007].; De Angelis, M. (2001). Marx and primitive accumulation: The continuous character of capital's "enclosures". *The Commoner, 2*(September), 1-22.; and, De Angelis, M. (2007). *The beginning of history: Value struggles and global capital*. London: Pluto. David Harvey prefers to substitute the updated predicate 'accumulation by dispossession' for what he believes is the dated 'primitive accumulation': Harvey, D. (2003). *The new imperialism*. Oxford: Oxford University Press.; and Harvey, D. (2006). *Spaces of global capitalism*. New York: Verso.

reforms in response to such problems. That is, Harvey (2003) ascribes the cause of the problem and its solution to the internal contradictions of capitalist development rather than admitting class struggle as the possible impetus for a new composition of capitalist accumulation strategies.

Regardless of the difference in nomenclature, most writers tend to agree on three basic points about this concept as a theory for comprehending contemporary capitalist development: First, primitive accumulation should be understood as a continuous process that remains vital for capitalist accumulation. Primitive accumulation, according to Massimo De Angelis (2001, 2007), is the extra-economic prerequisite to capitalist production that not only endures in contemporary society but also has been extended across the globe. Both Bonefeld (2001, 2002) and De Angelis (2001, 2007), in analysing Marx's discussion of primitive accumulation, posit a basic ontological connection between primitive accumulation and expanded reproduction, believing that, for Marx, accumulation in general is a form of intensified primitive accumulation. As Marx (1992a, p. 874) argues, "[t]he capital-relation presupposes a complete separation between the workers and the ownership of the conditions for the realisation of their labour. As soon as capitalist production stands on its own feet, it not only maintains this separation, but reproduces it on a constantly expanding scale." That is, the separation between producers and the means of production, which represents a central category of Marx's critique of political economy, is the constitutive presupposition of accumulation and thus common to both primitive accumulation and accumulation in general – capital presupposes this separation. As Marx again points out in Volume 3 of *Capital*, accumulation is really nothing more than primitive accumulation – which he conceptualises in Volume 1 in terms of separation – "raised to the second power" (Marx, 1967, p. 246).[3] "The result of primitive accumulation, that is the separation of labour from its means, has to be posed continuously in capitalist accumulation, rendering separation the premise and result of accumulation proper" (Bonefeld, 2002, p. 4). In Part III of his *Theories of surplus value*[4], Marx (1972, p. 315) is even more explicit about the continuous nature of primitive accumulation, contending that accumulation "reproduces the separation and the independent existence of material wealth as against labour on an ever increasing scale." For this reason, accumulation "merely presents as a *continuous process* what in *primitive accumulation* appears as a distinct historical process" (Marx, 1972, p. 272, emphasis in original). The *Grundrisse*[5] similarly weighs in on the issue: "Once this separation is given, the production process can only produce it anew, reproduce it, and reproduce it on an expanded scale" (Marx, 1993, p. 462).

Similar in principle, the two types of accumulation differ in their historical basis and their intensity. Whereas primitive accumulation entails an *ex novo* separation, accumulation proper follows from the expanded reproduction of the separation between producers and the means of production. The *ex novo* separation is produced through forcible, extra-economic means that set the context for the opposition between producers and the means of production, and which give rise to the particular alien character of social labour under the capitalist mode of production. "Direct extra-economic force...[such as] the power of the state...is an essential aspect of so-called primitive accumulation" (Marx, 1992, pp. 899-900). Put more explicitly, Marx conceives of

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[3] Volume III of *Capital* was originally published by Engels in 1894 after the death of Marx.
[4] Marx worked on the three volumes of *Theories of surplus value* in the 1860s. Considered by some to be the fourth volume of *Capital*, this work was published posthumously by Karl Kautsky.
[5] The *Grundrisse* was largely a collection of unedited notes that Marx completed in 1858. It remained unpublished until 1941.

primitive accumulation as a social process that entails a relation of expropriation, but one that has not yet been normalised by capital and thus more readily susceptible to challenge (De Angelis, 2007).

As we have seen, capitalist social relations are not only historically premised on this separation, but the capitalist exploitation of labour presupposes it (Bonefeld, 2001, 2002). Because class struggle is an inherent phenomenon in capitalist production relations, capital is compelled to continually develop new strategies of primitive accumulation that ensure the basis of accumulation can continue to contribute to capitalist valorisation. Capital, according to DeAngelis (2001), must employ strategies of primitive accumulation designed to respond to and check the autonomous self-activity of the working class when the latter attempts to wrest control over the means of production away from capital.

> ...primitive accumulation has been a universal process in every phase of capitalist development. Not accidentally, its original historical exemplar has sedimented strategies that, in different ways, have been re-launched in the face of every major capitalist crisis, serving to cheapen the cost of labor and to hide the exploitation of women and colonial subjects (Federici, 2004, pp. 16-17).

The second point about primitive accumulation is that it assumes a variety of forms, including the privatisation of public goods that had been transferred into the public domain through prior social struggle, which has the ultimate effect of re-organising class relations in favour of capital. De Angelis (2007) labels 'social commons' those areas of existence that emerged as commons through active social movements in the past and that were subsequently formalised through institutional norms and practices. For example, the rights and provisions typically associated with the welfare state, such as health, education, pension, and unemployment benefits provide access to social wealth without a corresponding labour requirement. In a similar vein, John McMurtry (1998, p. 24) speaks of a "civil commons", which signals "what people ensure together as a society to protect and further life, as distinct from money aggregates." As both Harvey (2003) and McCarthy (2004) point out in respect of this aspect of primitive accumulation, international trade regimes, which impinge on domestic governance, facilitate capital's appropriation of the conditions of production. International trade agreements, particularly the WTO and TRIPs, and their associated administrative bodies increasingly circumscribe the ability of sovereign states to enact laws and regulations within their territories. These international trade agreements, which are enforced by private adjudication bodies that focus solely on neoliberal accumulation imperatives, offer transnational corporations a back door to circumvent national regulators who are 'forced' to respond, even if only nominally, to broader societal interests. For example, the contemporary intellectual property system functions as an important mechanism for primitive accumulation by striping indigenous populations of their rights to natural resources that have been developed in common over centuries. In what can only be regarded as blatant acts of biopiracy, a few transnational corporations are instead appropriating rights of control over and access to such resources and the information and knowledge embodied in these physical artefacts. In fact, Harvey (2003, p. 148) speaks of "the wholesale commodification of nature in all its forms."

> The rolling back of regulatory frameworks designed to protect labour and the environment from degradation has entailed the loss of rights. The reversion of common property rights won through years of hard class struggle (the right to a state pension, to welfare, to national health care) to the private domain has been one of the most egregious of all policies of dispossession pursued in the name of neo-liberal orthodoxy (Harvey, 2003, p. 148).

In this constructed environment (not the result of naturally functioning free markets) the rights of trade and investment enjoy precedence over all other rights

(McCarthy, 2004). Any object that threatens the historically contingent balance of power between classes represents an obduracy that threatens to impede capitalist accumulation and is thus susceptible to capitalist strategies of primitive accumulation. Capital is capitalising the right to reconstruct and valorise social nature in a manner that is detrimental to the rest of society (Harvey, 2003; McCarthy, 2004). Based on his reading of Marx, De Angelis (2001, 2007) concludes that primitive accumulation, beyond establishing the social conditions conducive to capitalist development and thus occurring temporally prior to accumulation, also includes "the preservation and expansion of the capitalist mode of production *any time the producers set themselves as an obstacle to the reproduction of their separation to* [sic] *the means of production*" (De Angelis, 2001, p. 13, emphasis in original).

The third feature of primitive accumulation relates to its spatial ambition. Though long a feature of capitalist expansion in the global South, primitive accumulation today is once again assuming an integral role in capitalist accumulation processes in the global North, particularly given the vital importance information and knowledge play in value generation for corporations in the developed countries. Having historically extended the territorial reach of capitalist social relations through colonialist expansion and the imposition of private property rights across the globe, primitive accumulation in the twenty-first century has become both more extensive and intensive, affecting an enormously broad range of spatio-social activity. According to some observers, the intensity of this spatial and social diversity encompassed by contemporary practices of primitive accumulation poses substantial challenges for social movements mobilising against various aspects of capitalist development (Glassman, 2006). Both inchoate and often internally contradictory, "...the variety of such struggles was and is simply stunning. It is hard to imagine connections between them" (Harvey, 2003, p. 166). Examples of attempts to develop international solidarities include efforts to facilitate an international social movement unionism ("Special issue on labour internationalism," 2001; Waterman, 2003), global environmental activism that opposes neoliberalism ("Special issue on neoliberal nature and the nature of neoliberalism," 2004), international feminist activism (Eschle, 2001), and anti-corporate global activism, including the so-called 'movement of movements', the World Social Forum (Leite, 2003; Mertes, 2004).[6]

In practice primitive accumulation motivates efforts by capital to enclose more and more areas of social existence – material, immaterial, and biological existence. Given the increasing importance of information to capitalist production processes, as manifested in one instance through increasingly stringent intellectual property protections that have long betrayed any of the original sense of balance between creators'[7] and users' rights, it is perhaps not surprising that information and knowledge commons are under direct threat from contemporary capitalist accumulation strategies. It is to enclosures and resistance to enclosures, commons, that attention now turns.

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[6] There is a wide variety of literature that examines the emergence and character of the social movements opposed to neoliberalism. See, for example, Bello, W. F. (2002). *Deglobalization: Ideas for a new world economy.* London: Zed Books.; Brecher, J., Costello, T., & Smith, B. (2000). *Globalization from below: The power of solidarity.* Cambridge, MA: South End Press.; Gills, B. K. (Ed.). (2000). *Globalization and the politics of resistance.* New York: St. Martin's Press.; Mertes, T. (Ed.). (2004). *A movement of movements.* New York: Verso.; and, Wignaraja, P. (Ed.). (1993). *New social movements in the South: Empowering the people.* London: Zed Books.

[7] Of course, this itself is not an uncontested notion, as demonstrated by the critiques of the concept of the 'romantic author' and other similar constructs based on the idea of the genius of the individual creator. For two well-known examples of such criticism see, Bettig, R. V. (1996). *Copyrighting culture: The political economy of intellectual property.* Boulder, CO: Westview Press.; and Boyle, J. (1996). *Shamans, software, and spleens: Law and the construction of the information society.* Cambridge, MA: Harvard University Press.

4.2 Conceptualising Enclosures and Commons

The Midnight Notes Collective articulates quite forcefully the conceptual and practical link between enclosures and primitive accumulation:

> The Enclosures, however, are not a one time process exhausted at the dawn of capitalism. They are a regular return on the path of accumulation and a structural component of class struggle. Any leap in proletarian power demands a dynamic capitalist response: both the expanded appropriation of new resources and new labor power and the extension of capitalist relations, or else capitalism is threatened with extinction (Midnight Notes Collective, 1992a, p. 318).

This same group (1992, p. 321) goes on to articulate five different modes of enclosure in what it refers to as the "pentagon of enclosures": first, and similar to historic acts of enclosure, enclosures rob local communities of their control over the means of subsistence; second, and again exhibiting an historic continuity, the catastrophe of enclosure is effected through seizures of land for debt service and retirement; third, contemporary enclosures, by dispossessing peasants and indigenous people, create a new mobile and migrant population; fourth, modern enclosures presupposed the demise of state socialism in Soviet Union, China, and other countries in order to increase international competition among workers; and fifth, new enclosures have induced an array of ecological and biological depredations that threaten the vitality of the terrestrial commons (Midnight Notes Collective, 1992a).

De Angelis (2007) collapses this quintuplet into two main modes of capitalist enclosure: enclosure that is achieved through a concerted strategy, such as privatisation, public spending austerity, structural adjustment, etc.; and enclosure that emerges as a by-product of a particular accumulation process, or what economists tend to refer to as a 'negative externality'. In both cases, enclosing the commons augments the disciplinary processes of capital because such practices render greater numbers of people dependent upon the market in order to reproduce their livelihoods. The former case is relatively straightforward, with the acts of enclosure in England offering perhaps the most celebrated historical archetype of this mode of enclosure. Contemporary examples occurred in the last decade of the twentieth century throughout Africa as a direct result of the various Structural Adjustment Programmes imposed on heavily indebted African nations that, among other things, transformed traditional land tenure systems to facilitate the privatisation of vast expanses of once common lands (De Marcellus, 2003; Federici, 1992; Midnight Notes Collective, 1992a).[8] In a recent example from Brazil, security forces employed by Syngenta killed a peasant farmer on October 21, 2007 when attempting to forcibly remove a group of about 150 farmers and activists affiliated with MST[9] and La Via Campesina[10] who were occupying Syngenta lands in protest against genetically engineered maize. Prior to this incident seventy peasant families had been occupying the field trial land for about sixteen months, until they were forcibly evicted and relocated in July 2007. The latter case is a little more complex. Negative externalities are those costs associated with the production of a particular product that are

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[8] For a discussion of some of the resistance movements arising in the global South against various contemporary examples of land enclosure, see De Marcellus, O. (2003). Commons, communities and movements: Inside, outside and against capital. *The Commoner, 6*(Winter), http://www.commoner.org.uk/demarcellus06.pdf. For an outline of various indigenous movements' struggles over the commons, which represent a core foundation of their traditional social organisation, see De Angelis, M. (2003). Reflections on alternatives, commons and communities or building a new world from the bottom up. *The Commoner, 6*(Winter), http://www.commoner.org.uk/deangelis06.pdf.; and, Routledge, P. (2004). Convergence of commons: Process geographies of People's Global Action. *The Commoner, 8*(Autumn/Winter), http://www.commoner.org.uk/08routledge.pdf.

[9] Brazil's Landless Workers Movement (Movimento dos Trabalhadores Rurais Sem Terra – MST), which began organising in 1984, is the largest social movement in Latin and South America. With an estimated 1.5 million landless members, the MST has organised formally in 23 of 27 Brazilian states. For an overview of the MST perspective on class struggle in Brazil over land ownership and increasing corporate control of agriculture, including an assessment of the economic and environmental dangers wrought by genetically engineered seeds, see Stédile, J. P. (2008). The class struggle in Brazil: The perspective of the MST. In L. Panitch & C. Leys (Eds.), *Global flashpoints: Reactions to imperialism and neoliberalism - Socialist register 2008* (pp. 193-216). London: Merlin Press.

[10] La Via Campesina is an international movement that coordinates peasant organisations in Asia, Europe, and the Americas. Founded in 1993, it includes small and medium sized producers, agricultural workers, rural women, and indigenous peoples.

borne by actors external to the producer and any transaction involving that product. Pollution is a typical example of a negative externality since it is the environment and people in the surrounding area of a plant, rather than the producers, that suffer the effects of pollution damage. These types of negative externalities pose grave consequences for the survival of independent producers, which, through the analytical lens being applied in this research, can be considered a form of enclosure that separates producers from their means of production.

As discussed above with regard to the second element of the theory of primitive accumulation, enclosures represent the insinuation of the *ex novo* separation between producer and the means of production into fresh realms of social existence. Again, the well-known historical example is the enclosure of common lands in England, with more contemporary instances ranging from water privatisation to the enclosure of knowledge through overly restrictive intellectual property regimes. However, the imposition of an *ex novo* separation represents a social process that in practice is susceptible to contestation by oppositional social forces that seek to recover those social spaces appropriated by capital and re-invigorate them as spaces of commons. Capital is thus compelled to wage a two-front war in its battles for enclosure; invading and enclosing new realms of social existence that can be subverted into service of capital's accumulation priorities in the face of resistance, and defending those enclosed areas governed by accumulation and commodification imperatives against *ex novo* guerrilla movements struggling to liberate enclosures from capitalist control. The point to take from this discussion, and which corresponds closely to autonomist thought, is that not only does separation occur *ex novo*, but that *ex novo* opposition can also form in response to capitalist enclosure. "Therefore, around the issue of enclosures and their opposite – commons – we have a foundational entry point of a radical discourse on alternatives" (De Angelis, 2007, p. 139).

Enclosures thus represent strategic problems for capital in that they pose limits that must be overcome if capital is to be successful in colonising new areas of social existence or in sustaining those areas already enclosed from attacks by alternative social forces seeking to de-commodify such spheres and transform them back into commons. That is, any time capital reconnoitres a new sphere of social existence for enclosure, it must also circumvent any opposition that might be posed by what capital considers 'enclosable' subjects.

> Capital has from the start sought to enclose the commons. From colonization to slavery, from the work day to the home, from activity to the deepest thoughts and feelings, the history of capital is its extension into the human commons. In fighting what we in Midnight Notes term the "new enclosures," the working class is not seeking simply to defend what human commons remains from the past or what commons was created under variants of twentieth-century socialism, but also to reassert, redefine, and extend the commons (Neill, Caffentzis, & Machete, n.d., ¶ 46).

In the case of challenges to current enclosures, any time that capital is confronted with constraints on its production processes, it must respond strategically in order to either raze or co-opt such barriers to accumulation (De Angelis, 2003, 2007).[11] We see, therefore, that limits to capital are both endogenous and exogenous. In the former, capital itself identifies and defines a limit that it must overcome, and in the latter instance that limit is defined for capital by the oppositional social forces that strive to liberate an already enclosed space. But regardless of how limits are identified, it is critical to recognise that counter-enclosures (read commons) represent alternatives to capital that

[11] This is similar to Polanyi's theorisation of the 'double movement of society', although without Polanyi's emphasis on institutions. See, Polanyi, K. (2001). *The great transformation: The political and economic origins of our time* (2nd ed.). Boston: Beacon Press.

seek to circumscribe accumulation imperatives either by erecting barriers to enclosure strategies or by liberating existing enclosed areas of social life. Commons therefore tend to emerge out of struggles against their negation (De Angelis, 2003).

The attempt to produce commons problematises established property relations (both material and immaterial) while efforts to defend existing commons problematise the threat of new enclosures posed by capital and the state. Because enclosures make possible M-C-M',[12] as well as its continued reproduction, they all share the basic common character of forcibly separating people from access to any social wealth that falls outside the purview of competitive markets and money as capital. "New enclosures are thus directed towards the fragmentation and destruction of 'commons', that is, social spheres of life the main characteristics of which are to provide various degrees of protection from the market" (De Angelis, 2007, p. 145). Struggles against enclosure, with their goal of fostering common access to the means of existence, seek to develop new modes of social co-production and value practices that remain autonomous of capital and its market measures that seek to individualise and normalise.

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[12] Traditionally, capital accumulation is denoted by the following formula: M-C-M′, where M denotes an amount of money invested by individual capitalists in the market to buy commodities, given by C in this formula. The transformation of money into commodities, shown as M-C, represents the act of 'buying'. Individual capitalists, however, purchase such commodities not to satisfy their particular needs but to generate a profit, which occurs when M′ is greater than the amount of money originally invested. In order to realise this potential profit, the commodity C must be placed back on the market to be sold. If buyers are found and the sale is made (C-M′) at a price where M′ is greater than M, the individual capitalist is able to record a profit. Thus, $M' = M + \Delta M$, where ΔM represents the change in the amount of money in the possession of the individual capitalist after the sale of the commodity. While an individual capitalist might terminate investment at this point, as a system the 'class' of capitalist investors, driven by the profit motive, will generate a new cycle of accumulation in a process that repeats *ad infinitum*: M′-C′-M′′. That is, commodities of a greater value are bought (C-M′) and placed back on the market to be sold for a greater amount of money, which provides investors with a new sum of money available for purchase and subsequent sale of commodities in an endless cycle of accumulation. For a fuller explication, see, for example, Bell, P., & Cleaver, H. (2002). Marx's theory of crisis as a theory of class struggle. *The Commoner, Autumn*, 1-61.

A typical neoliberal argument touted in response to opposition against new forms of capitalist enclosure derives from Garret Hardin's now (in)famous argument about the 'tragedy of the commons', according to which commons-based property arrangements based upon 'free' and 'unmanaged' access encourage people to engage in over-consumption and other detrimental behaviour that ultimately results in environmental catastrophe and exhaustion of natural resources. The reason for this, according to Hardin (1968), is that within a commons-based property framework no one has an incentive to assume responsibility for managing and caring for the commons. Implicit in Hardin's analysis is the classical economic assumption of '*Homo economicus*', according to which atomised individuals compete with one another to achieve their optimal personal advantage, regardless of the cost to others or the broader environment. He thus constructs an argument in favour of privatisation of the commons; an argument that, by relying on the fundamental assumption of the 'dismal science' about the putative nature of 'man', appears to respond to a natural necessity (Hardin, 1968). Yet building on Carol Rose's (1986) 'comedic commons'[13] and Elinor Ostrom's (1990) discussion of 'governing the commons', a number of authors suggest that Hardin's analysis neglects to consider the fact that commons exist within communities that establish the norms and practices that govern access to common spaces and resources (Anderson & Simmons, 1993; De Angelis, 2007; Federici, 2004; Hess & Ostrom, 2007; Ostrom, 1990; Perelman, 2000).[14] Moreover, as at least one intellectual property scholar points out, given the

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[13] The 'comedic commons' thesis suggests that use and management of resources is more efficient under collective ownership rather than individual ownership regimes. See, Rose, C. (1986). The comedy of the commons: Custom, commerce, and inherently public property. *University of Chicago Law Review, 53*, 711-781.

[14] Social relations might also be organised according to principles of reciprocity found in 'gift economies'. While the present work does not engage with this, an interesting article that argues commons might be considered to emerge from extreme forms of 'gift economies' is offered by Olivier De Marcellus: De

inherent nature of information in consumption (i.e. non-rivalrous, non-exhaustive, and often expands in 'value' through 'consumption' by multiple people) the argument about the 'overuse' of this particular resource does not hold (Boyle, 2003a, 2003b). In fact, according to the now well-known riposte to Hardin's thesis, collaboration and sharing in the creation and use of immaterial and informational products tends to beget an "inverse commons" characterised by a larger and more robust number of goods (Raymond, 1999, p. 37).[15]

In contradistinction to the 'tragedy of the commons' thesis, DeAngelis (2007) poses the decidedly sanguine notion of the 'beginning of history', which represents a contemporary opportunity to defend and re-appropriate the commons, including relations between humans, objects, and the natural world as a means of superseding the individualising and normalising tendencies of capital. That is, the 'beginning of history' postulates a struggle between the 'life-colonizing force' of capital that positions individual against individual in pursuit of the capitalist *telos* of accumulation and the 'life-reclaiming forces' of people and movements that strive to construct value practices independent of capital, despite claims by many that alternatives are no longer possible

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Marcellus, O. (2003). Commons, communities and movements: Inside, outside and against capital. *The Commoner, 6*(Winter), http://www.commoner.org.uk/demarcellus06.pdf. There is a fairly substantial body of literature that treats the concept of the gift economy. See, for example, Bollier, D. (2002). *Silent theft: The private plunder of our common wealth.* New York: Routledge.; Cheal, D. J. (1988). *The gift economy.* London, GB: Routledge.; Harvie, D. (2004). Commons and communities in the university: Some notes and some examples. *The Commoner, 8*(Autumn/Winter), http://www.commoner.org.uk/08harvie.pdf.; Terranova, T. (2000). Free labor: Producing culture for the digital economy. *Social Text, 63*, 33-58.; and, Vaughan, G. (Ed.). (2007). *Women and the gift economy: A radically different worldview is possible.* Toronto: Inanna Publications and Education.

[15] A variety of responses to Hardin's thesis has also emerged from the environmental literature. See, for example, Andelson, R. V. (Ed.). (1991). *Commons without tragedy: Protecting the environment from overpopulation -- A new approach.* London, GB: Shepheard-Walwyn.; Bromley, D. W., Feeny, D., McKean, M., Peters, P., Gilles, J., Oakerson, R., Runge, C. F., & Thomson, J. (Eds.). (1992). *Making the commons work: Theory, practice, and policy.* San Francisco: ICS Press.; Feeny, D., Berkes, F., McCay, B. J., & Acheson, J. M. (1990). The tragedy of the commons: Twenty-two years later. *Human Ecology, 18*, 1-19.; and, Hanna, S. S., Folke, C., & Mäler, K.-G. (Eds.). (1996). *Rights to nature: Ecological, economic, cultural, and political principles of institutions for the environment.* Washington, D.C.: Island Press.

(De Angelis, 2007). In a dialectical fashion, and similar to the prospects and hopes Hardt and Negri (2000, 2004) attach to the 'multitude', De Angelis (2007) situates the potential for resistance precisely in the contradictions of capital, which relies on individual subjectivities to drive accumulation while simultaneously demanding social cooperation in production. Though capital strives to capture that social cooperation for its own accumulation purposes, these various social forms of cooperation can be subverted to disrupt capital's circuits of accumulation and open up alternative spaces that pose real limits to capitalist accumulation (De Angelis, 2007; Hardt & Negri, 2000, 2004). However, following this logic, and recalling the potential for re-appropriation outlined by the 'cycle of struggle' thesis, one must remain cognisant of the fact that struggles against enclosure open up questions of the commons rather than automatically ensuring their emergence. Capital often refuses to remain idle when challenged by such resistance, always strategising to develop means of subsuming struggle into novel forms of accumulation.

De Angelis (2007) therefore clearly articulates the need to make visible those value practices that are situated beyond the value practices of capital. Despite the discourse of many neoliberals that would deny an *outside* to the economic calculus that apparently guides social co-production, social struggle today demands that we open up these outside dimensions to scrutiny as alternative value practices among a range of possible actions and processes that can compete with those of capital to guide social co-production.

> It is through the production of commons that new value practices emerge and *divide-and-rule* strategies dividing the social body on the basis of material interests can be contrasted. That process of reflection/communication/negotiation aimed at identifying and crafting a specific contingent commons is a philosophy

> born in struggle, a necessary moment of the production of struggle itself, a philosophy that is grounded, but also that aspires, and hence *develops* a strategic look that helps to make clear what it is up against; hence it has the potential to be a material force 'that grips the masses', because the same struggling 'masses' (i.e. a 'whole' of relating subjects) are the producers and the products of this philosophy. Also, we must recognise that the ability to identify and generate a common means to go to a *deeper* level, the effect of which is to achieve a 'higher' organisational reach, to travel towards the root of things, is to 'kick asses' at the top (De Angelis, 2007, p. 238, emphasis in original).

John McMurtry (1998) develops similar sentiments with his argument that the market system should be conceptualised as an ethical system that involves value judgements and corresponding relations to the 'other', although that 'other' is often unseen: "economists explicitly deny that any value judgment is at work in their analyses, even though they presuppose a value system in every step of the analysis they make" (McMurtry, 1998, p. 13). All market decisions express the values of the market system. Because we as individuals are embedded in this system, and to the extent that we accept its codified and normalising language and conform to its parameters, we are only able to attain cognitive clarity by conceptually exiting the value system given by the market and by refusing to accept its normalisation (McMurtry, 1998). This conceptual 'stepping outside' of market values finds practical corollaries in the manifest instances of actual social practices designed and executed to oppose the value practices of the market. The conflict between different value practices as "*value struggles* – as constituting an ongoing tension in the social body. This means that there is an 'outside' and, to paraphrase Hardt and Negri (2000), it is 'in the flesh of the social body', in its own practices, and is not confined to the conceptual realm" (De Angelis, 2007, p. 30, emphasis on original).

> *The* problem of alternatives therefore becomes a problem of how we disentangle from this dialectic, of how within the social body conflict is not tied back in to capital's *conatus*, but instead becomes a force for the social constitution of value practices that are *autonomous* and independent from those of capital (De Angelis, 2007, p. 42, emphasis in original).

Although capital, as a social force, aspires to appropriate the complete ambit of life practices in service of its accumulation imperatives, the critical perspective that drives the autonomist Marxist position recognises that discussions of capital must avoid proceeding into the theoretical and practical cul-de-sac that would attribute a fixed state or condition to capital in its actual manoeuvres to colonise the totality of life practices. Instead, we must not only recognise that capital's attempts at colonisation of the life world provoke struggles by opposing subjects, we need to elevate such resistance to a primary position both in theory and practice.

4.3 Towards a 'recombinant' Neo-Marxist Biopolitical Framework

Although the proposed theoretical frame applied in this work might expose itself to the same charge of "conceptual promiscuity" levelled against Hardt and Negri (Parry, 2003, p. 27), we suggest that our synthetic rendering of what we term a neo-Marxist biopolitical framework avoids the fatalism of Critical Theory in respect of subjective consciousness in material structures of economic and political power without succumbing to voluntarism. The critical analysis of the contemporary moment provided here is designed to offer relevant theoretical and political acuity that simultaneously opens entry points to social transformation. We therefore choose selectively from the theoretical libraries found in the broader Marxist tradition and more specifically from *operaismo* and *autonomia* in order to support our interrogation of the power relationships involved in capital's attempts to appropriate and control biotechnology.

As outlined in the introductory chapter, the overarching goal of this work is to provide a critical analysis of biotechnology in Canada from a perspective that provides a voice to those subjects, universal labourers, who are engaging in direct resistance against what they believe to be an agenda of corporate capture of this science and its attendant technological applications. The current project might therefore be construed as a response to the 'violent cartographies'[16] of capitalist-controlled biotechnology by endeavouring to construct alternative maps (admittedly as contingent as the ones they seek to challenge) and border crossing points that reveal the apparent and largely unquestioned givens as socially contingent, all in an effort to reveal our current conjuncture as a social construct susceptible to alternative constellations. After all, as Best and Kellner (2001, p. 46) caution, "[a] cognitive mapping that explored various lines of force and domination would do little but reinforce submission to power if it did not thematize these lines in terms of possibilities of resistance and transformation." The analysis of biotechnology offered here therefore necessarily eschews those accounts that would reduce science and technology to one-dimensional reason and a means of ineluctable social domination.

The appropriation of 'life itself' as conceptualised by the concept of 'biopower' refers at its most basic level to the appropriation and mobilisation of the totality of human faculties in service of capital accumulation, as initially proposed by Marx's concept of real subsumption, which, in turn, was revitalised by the autonomist theorisation of the 'social factory'. The extension of the social factory has been facilitated significantly by neoliberal governance, which, consonant with the theoretical perspective adopted in this research, is understood as a response to the emergence of alternative value practices by universal labour that resist capital's intent to normalise market values as common values

[16] We borrow this descriptor from Michael Shapiro: Shapiro, M. J. (1997). *Violent cartographies: Mapping cultures of war*. Minneapolis: University of Minnesota Press.

across the entire social body. Neoliberal governance is really a strategy of co-optation that seeks to respond through market modes of redress to the problems articulated by social struggle (De Angelis, 2007). We therefore contend that there is a certain degree of conceptual continuity between the 'social factory' and 'biopower' theses. What was implicitly anticipated in the former becomes much more explicit in the latter – that is, there is a movement away from labour-power toward biopower and biopolitical production by universal labour that de-emphasises the traditional accent placed on work at the immediate point of production. What instead emerges is a wider analytical lens that admits interrogation at the level of the capitalist circuit as a whole. Both biopower and biopolitical production encompass the entire gamut of species-being, though from different positions. "Biopower stands above society, transcendent, as a sovereign authority and imposes its order. Biopolitical production, in contrast, is immanent to society and creates social relationships and forms through collaborative forms of labor" (Hardt & Negri, 2004, pp. 94-95). But the disciplinary and control mechanisms adopted by capital in response to such opposition are never able to fully co-opt resistance struggles being waged by universal labour, meaning that contests between these opposing forces remain open, historically contingent, and dependent upon the balance of forces each side is able to muster (De Angelis, 2007). As capital moves beyond the factory into the social factory, direct actions aimed at self-valorisation – the project to re-appropriate the world of use values – become more generalised, *more common*, in nature. 'Biopower' and 'biopolitical production' are useful concepts to the extent that they engender a language that reveals and politically problematises the expansion of capitalist circuits of accumulation into ever-greater areas of social existence while also recognising the way capital is increasingly externalising the risks associated with this expansion to universal labour (e.g. flexibilisation, precarisation) and humanity (e.g. negative externalities of environmental degradation) (Nunes, 2007).

Similarly, and again maintaining fidelity to the autonomist Marxist tradition, we underscore the point that struggle is inherent to capitalist social relations, whether at a micro level that remains obscured from widespread view or at a macro level of open confrontation. A critical element in Marx's writings was the recognition that technological development is a contradictory process that gives rise to opportunities for opposing agents. Put another way, universal labour might find real use-values, including subversive ones, for new technologies in its struggle against capital. This relates to Marx's concept of the circuit of capital, which postulates that to survive, capital must go beyond the exploitation of the immediate workplace to continually include new series of social sites and activities in what can be understood as a recurrent process of primitive accumulation that temporally seeks to encompass the full range of 'life time' of universal labour beyond the confines of the workday, while simultaneously engaging in spatial colonising tendencies that strive to infiltrate not only new territories across the globe but also areas of existence that reach back to the molecular level of organic existence. However, it is exactly these new sites that open up additional points of resistance. Reflecting on the lessons drawn from the 'cycle of struggles' thesis, we affirm that the diffusion of capitalist command throughout the social domain brings with it an attendant antagonism that is not only ubiquitous in nature but is dispersed and generalised in terms of its sites of struggle. The plunder and enclosure of a range of biological artefacts (biological commons) and information (informational/knowledge commons), ranging from the protein sequences contained in DNA to particular genes, genetically engineered seeds, and entire plant species, through capitalist control of biotechnology is remaking nature-society relations in a way that ignites resistance, precisely because it has implications for people's relationships to themselves, to others, to nature, and for their existence – that is, for our species-being.

The contemporary counter response emerging to the enclosures being executed as part of broader capitalist strategies of primitive accumulation remains the commons. "This becoming common…is the biopolitical condition of the multitude" (Hardt & Negri, 2004, p. 114). In elaborating their concept of the multitude, Hardt and Negri (2004) make reference to the 'common', though making it clear that their use of the term differs from its typical application that refers to the destruction of pre-capitalist shared spaces through the expansion of private property. "The common we share, in fact, is not so much discovered as it is produced" (Hardt & Negri, 2004, p. xv). The production of the common through collaborative communication and cooperation develops in a helical manner that yields expanding social relationships. Hardt and Negri (2004) go so far as to assert that production of the common infiltrates every type of social production and, in fact, embodies the leading types of contemporary labour. As we will see in the subsequent chapters, biotechnology brings with it all of these issues and has implications for both material (biological) and immaterial (knowledge) commons. Political recomposition in the conditions of our historical conjuncture is the problematic we continue to face; we need to figure out how to produce commons beyond capital's measure and value practices. That is, how do we develop commons that are not constituted by capitalist social relations of production? As the empirical chapters will show, the concept of the commons, its erosion through enclosure, and attempts at defending it are themes brought out by a number of the interview informants who participated in this research.

The benefits of commons derive from the fact that they are not confounded by the traditional asymmetric constraints involved in proprietary systems of control that limit command over the inputs necessary for effective production. Put another way, commons avoid the objectification of others that flows from the legal mechanisms nested in proprietary information systems (Benkler, 2006).[17] The discourse constructed by capital around biotechnology seeks to veil those value practices that do not serve accumulation processes – that is, practices and struggles that strive to maintain and/or re-establish commons. To the extent that capital is successful in normalising and naturalising practices driven by primitive accumulation, alternative value practices can be rendered invisible to the co-producers. "This condition of invisibility of social subjects, life practices, aspirations and lived experiences is a necessary condition for capital's self-preservation" (De Angelis, 2007, p. 57). Conceiving of ourselves only as *singular* actors with no choice but to participate within the disciplinary and normalising processes of the market, we remain blind to the *outside* world of social processes that we similarly inhabit. This blindness acclimatises us to the capitalist social mode of production. By 'outside' we mean not a particular spatial realm but rather a set of value practices whose boundaries are defined autonomously by the subjects involved and which refuse appropriation by capital. Developing alternative modes of social production in common

[17] Similar themes are developed in Goldman's edited collection of works that treats global struggles over the commons that aspire to transform existing nature-society relations into non-exploitive, socially fair, and ecologically sound relationships. See, Goldman, M. (Ed.). (1998). *Privatizing nature: Political struggles for the global commons.* London, GB: Pluto Press.

depends upon rendering transparent those value practices capital prefers to keep invisible (De Angelis, 2007). And as the chapter on resistance demonstrates, through emerging 'lines of flight' (Deleuze & Guattari, 1987) or fight biocapital is encountering resistance and demands for alternatives.

4.3.1 Assessing the Relevance of our Neo-Marxist Biopolitical Framework to Biotechnology and Knowledge Commons

The evolution of the 'social factory', through which daily life has been insinuated increasingly within the circulation of capital, has been facilitated by neoliberal policy discourses that lay claim to a universality designed to normalise and legitimise the structures and institutions that embed political subjects in that circulation. The exploitation of biotechnology for its informational content and technological applications has meant that the human body and other living organisms now provide accumulation strategies in service of capitalist valorisation processes – in what we might perceive of as an assault on species-being. The analytical constructs we employ in our interrogation of biotechnology and the resistance it engenders in Canada share an affinity with what Karl Polanyi, building on Marx, pointed out so many years ago:

> To allow the market mechanism to be sole director of the fate of human beings and their natural environment...would result in the demolition of society. For the alleged commodity 'labor power' cannot be shoved about, used indiscriminately, or even left unused, without affecting also the human individual who happens to be the bearer of this particular commodity. In disposing of man's labor power the system would, incidentally, dispose of the physical, psychological, and moral entity 'man' attached to that tag. Robbed of the protective covering of cultural institutions, human beings would perish from the effects of social exposure; they would die as victims of acute social dislocation through vice, perversion, crime and starvation. Nature would be reduced to its elements, neighborhoods and landscapes defiled, rivers polluted, military safety jeopardized, the power to produce food and raw materials destroyed (Polanyi, 2001, p. 73).

Here Polanyi re-iterates Marx's immanent criticism of capital, that left to its own devices a completely unregulated free market would actually destroy the land and labour commodities that underpin its wealth generation. This internal tension gives rise to struggles by subjects (universal labour) seeking to mitigate the dislocations and destruction caused by unbridled commodification. Attempts to erect the 'protective coverings' of which Polanyi speaks take the form of active travails to defend social relations and processes of social reproduction, as well as our natural environment – that is, social and terrestrial commons. Though when speaking of the commons in respect of biotechnology we need to emphasise that these include both immaterial and material elements. Thus, unlike much of the work that has emerged from autonomist scholars such as Cleaver (his noted 'electronic fabric of struggle') and Dyer-Witheford, in the case of biotechnology digital resistance and networked knowledge are not sufficient in themselves. While all such movements can hardly be categorised as anti-capitalist, a great many share the underlying goal of responding to and resisting the destructive repercussions that accompany the expansion of capitalist enclosures enveloping increasing swaths of biological existence (terrestrial commons). This point is made not to reduce the diversity of the various struggles emerging in response to the social factory and primitive accumulation; indeed, the manner in which such struggles define themselves is both historically and politically contingent. Rather the intent is to establish a basis of commonality through which we can identify and map the potentialities for transversal interlinkages among such groups that might give rise to a broad-based and global attack on capitalist social relations (Harvey, 2006).

In order to facilitate such enclosure capital and government have sought to confine debate about biotechnology to aspects of health and science since such discourses are, by their nature, technical and abstract, which renders them opaque and seemingly foreign to the majority of the population, and thus typically beyond 'popular' critique. It is precisely this imposed gulf between the abstract science of biotechnology and the world of material production and consumption that critical research needs to bridge by throwing open to scrutiny the broader political, social, environmental, cultural, and economic issues implicated in this science, including the way that such concerns impact the lives of political subjects. By employing concepts such as biopolitical production, primitive accumulation, universal labour/species-being, enclosures, and commons, the proposed theoretical framework is able to account for the struggles being waged by both capital and its opponents in the context of biotechnology in a way that apprehends equally the informational and terrestrial commons implicated in contemporary engagement around biotechnology. As we will see, the concept of biopolitical production provides a route to link struggles around biological and informational commons. The dual material and immaterial nature of biotechnology is perhaps most easily comprehended in the form of patents on germplasm, which allow capital to appropriate the labour, common knowledge, and creativity of generations of universal labourers and then circulate it back to them in the commodity form in order to extract surplus value.

Moreover, conceptualising confrontation around biotechnology through the lens of commons provides an antidote to the almost normalised sense of anomie and atomisation bemoaned by increasing numbers of people in contemporary society. The notion of the commons allows us to pose the question whether our implicit acceptance of the individual rights discourse that forms the basis of the ideological justification for neoliberalism prevents us from imagining, let alone developing and implementing, an alternative social vision? That is, if we truly want to organise society in a way that is not dependent upon capital accumulation through market exchange, must we first instantiate a conception of social justice and corresponding set of rights that supersede the individualism inherent in neoliberalism? Assuming this to be the case, we need to advance away from the neoliberal insistence on the individual as the essentialist element in political economic discourse and instead re-insert notions of social solidarity, equality, and democracy founded on socially informed rights that eschew that neoliberal reductionist set of rights and freedoms ultimately derived from the belief in the inalienable right to private property and profit (Harvey, 2006). As Harvey (2006, p. 56) convincingly contends, "the objection to this regime of rights is quite simple: to accept it is to accept that we have no alternative except to live under a regime of endless capital accumulation and economic growth no matter what the social, ecological or political consequences."

Keeping in mind our starting point of resistance, a neo-Marxist biopolitical theory permits us to trace lines of flight and fight in a manner that not only questions dominant knowledge paradigms but also strives to produce oppositional and antagonistic knowledge. By substituting an emphasis on the entire circuit of capital and cycles of struggle for the traditional focus on the working class (which, as we have seen, is today a rather contested category) and the immediate point of production, our conceptual apparatus allows us to develop ideas for exodus and resistance appropriate to the current level of political-technical composition of (class) struggle by universal labour.

Articulated in broad strokes, we propose to invoke an analysis of biotechnological information in a manner that exposes its material contradictions and possibilities, which both obscure and confound attempts at hegemony and domination. We situate our critical analysis of biotechnology and its attendant informational issues within the context of the dominant economic, social and historical relations of capitalist society. We will also devote some consideration to the way biotechnology and biotechnological information are culturally constructed and how capital and government are disseminating globally an ideology of biotechnological information and communication. We want to attempt to prise apart the ideological limitations imposed by capital on the concepts, vocabulary, and tools necessary to interrogate the nature of biotechnology, which is touted by capital and government alike as one of the latest drivers of economic growth and prosperity in our current social conjuncture. We similarly seek to reveal the contradictions and exclusions imposed by biotechnology (or at least that could be potentially imposed) that are masked by prevailing capitalist-directed discourses. We are less interested in rendering a normative assessment of the ontology of biotechnological information, instead preferring to outline how certain discursive constructs of biotechnological information are being privileged over others, which brings with it a plethora of social, cultural, political, economic, and environmental implications as certain renditions and their attending values are elevated over others.

Having foregrounded our theoretical outlook and outlined its applicability to an analysis of biotechnology, including the informational and knowledge issues implicated in this technoscience, we can now proceed to an assessment of contemporary capitalist enclosures of biotechnology and the corresponding struggles to assert and/or maintain commons that they provoke in this country.

Chapter 5. Biotechnology and the Enclosure of the Knowledge Commons

> Few enclosures of the commons threaten to usher in as many profound changes as the commodification and privatizing of genetic structures....There are many *complicated dimensions to biotechnology*, but one worrisome trend is the conversion of our shared genetic heritage into a privately owned inventory managed for commercial gain. The genetic structures of life, which have "belonged" to everyone from time immemorial, are being propertized in order to move them from the public commons to private markets, with all the shifts in power, accountability, and moral norms that that conversion entails (Bollier, 2002, pp. 74-75, emphasis added).

Drawing on documentary analysis[1] of government and corporate reports and other texts in respect of biotechnology, as well as the findings from interviews conducted with fourteen key informants involved in organised movements opposed to various aspects of biotechnology in this country, this and the following chapters seek to elucidate the 'complicated dimensions to biotechnology' that Bollier (2002) articulates by sketching out the contested landscape of this science and its technological applications. In doing so, we seek to illustrate the parallels and connections between enclosures of biological commons and knowledge/informational commons. For ease of presentation, the empirical part of this research is organised thematically into a number of chapters, although there is some overlap in places where a strict separation would unduly interrupt the flow of the narrative. This and the following two chapters, which derive from our documentary analysis, illustrate contemporary corporate and state strategies designed to

[1] A major goal of documentary research is to help clarify and define issues of interest so that they may be made more amenable to analysis. See, for example, Putt, A. D., & Springer, J. F. (1989). *Policy research: Concepts, methods, and applications*. Englewood Cliffs, NJ.: Prentice Hall. A key component of this research was devoted to sorting out how far biotechnology in Canada has been subsumed within the capitalist logic of the social factory. By examining and analysing policy documents of government, as well as evidence outlining the contours of the biotechnology industry as an economic sector, we were able to gain depth and insight into the dimensions of capital's appropriation of biotechnology in this country.

bring agricultural[2] biotechnology firmly within the purview of corporate control, while the subsequent chapter, drawing substantially on interviews with activists opposed to various aspects of biotechnology, outlines the species being movements emerging in response to such corporate and state manoeuvring. In all of these chapters we attempt to develop a discussion that integrates the theoretical with the empirical. That is, we reach back to our theoretical chapters in order to account conceptually for the issues that emerge from the empirical investigation.

In outlining the dominant corporate and governmental strategies being employed in Canada to render biotechnology subservient to capitalist accumulation imperatives, attention turns first toward the biotechnological control of seeds and agriculture being exercised by the major transnational corporations that have tried to re-invent themselves as so-called life science companies. Building on this, the subsequent chapter illustrates how the dominant corporate players involved in agricultural biotechnology are exploiting intellectual property policy and protections to facilitate their control over both genetic information and genetically engineered products. The following chapter demonstrates the extent of regulatory capture in this country in respect of the approval process for genetically engineered organisms. To a large degree the ease with which major corporations have come to dominate biotechnology in Canada stems from their control of public debate around this science and its technological applications, to which attention turns in the second part of that chapter. But before proceeding to our empirical exposition and analysis we propose to first articulate explicitly our conception of the

[2] Organised resistance to biotechnology in Canada focuses predominantly on issues related to agriculture and food.

commons and the interplay between it and contemporary enclosure efforts that seek to circumscribe both biological and information resources.

5.1 The Knowledge Commons

As the reader will recall, the motivation driving our particular selection of theoretical constructs was to develop a composite analytical framework possessive of enough conceptual robustness and flexibility so as to be sufficient to an interrogation of not only the multiple issues insinuated in the biological commons and the knowledge commons, but also those that traverse the rather porous borders between the two. At this point we would like to specify our understanding of the term 'commons', which is adapted from the various discussions conducted in *Understanding knowledge as a commons* (Hess & Ostrom, 2007), *The beginning of history* (De Angelis, 2007), and *The wealth of networks* (Benkler, 2006). At its most basic, 'commons' refers to a specific institutional form that structures the way resources, be they material or immaterial, are accessed, used, and managed by a group of people beyond the logic of the capitalist market (Benkler, 2006; Hess & Ostrom, 2007). We would, however, in agreement with DeAngelis (2007) go further and conceive of 'commons' not merely in relation to the resources they embody but also as social practices that produce meanings and values through active engagement between subjects who struggle to maintain or regain social control over social wealth through opposition to capitalist and state practices of enclosure. This more active conceptualisation allows us to pose a limit to capital that simultaneously throws open to debate the possibility of alternatives and their problematisation, which, in turn, reduces their susceptibility to capitalist co-optation.

This notion of the commons thus similarly admits the dialectical relationship between enclosures and commons.

Such an understanding of the commons also permits us to consider attempts at enclosure that in our contemporary context go beyond the traditional debates around land and terrestrial resources to include discussions of communication, information, and knowledge. As outlined in the previous chapter, the archetypal historical example invoked in discussions of early primitive accumulation is the enclosure movement in Great Britain that began as early as the fifteenth century and reached its zenith between the late seventeenth and early nineteenth centuries. During this period once common lands, to which attached traditional rights of access and use for all, were appropriated by members of the aristocratic class and transformed into deeded, private property. The eradication of traditional rights by legal rights of property manifested itself through the erection of fences and eviction of peasants from their land in order to make way for the more lucrative practice of sheep grazing that provided the wool for an expanding textile industry. As we also saw in the previous chapter, land and natural resource privatisation, particularly in the Global South, continues unabated even today.

But as a growing body of literature demonstrates, within the last three decades capital has also come to recognise the strategic importance of information, knowledge, and communication as immaterial sources of accumulation (Benkler, 2003; Bettig, 1996, 1997; Boyle, 2003b; Drahos & Braithwaite, 2002; Dyer-Witheford, 2002; Lessig, 2002; Mosco, 1996; Schiller, 1988, 2007). David Harvey, in his analysis of the information society, argues that "knowledge itself becomes a key commodity to be produced and sold to the highest bidder" (Harvey, 1989, p. 159). As early as 1973 Daniel Bell, by privileging knowledge and information as crucial variables in the post-industrial society, seemed to ascribe to information economic functions that are easily captured by capitalist categories of economic theory. As such, he lends legitimacy to the commodification of information (Bell, 1973). Of course, Bell has not been the only writer to discuss the importance of knowledge and intellectual capital as a resource for economic growth.[3] The intensification of the commodification process inherent in advanced capitalist society stems in part from the opportunities for selling information that advanced technologies provide by transcending the limits that space and time impose on the packaging and repackaging of information in a marketable form (Mosco, 1988; Sussman, 1988). For example, a newspaper story can be repackaged in a television report, a magazine article, a radio report etc., all of which provide a return for essentially the same content (Mosco, 1988; Sussman, 1988). Such limits on its use, coupled with rapid obsolescence (which tends to characterise most commodities at the present conjuncture of capitalist social relations), have facilitated the subsumption of information within the neo-classical economic model such that it functions as a commodity exploited for its commercial value. In the dominant neo-classical economic paradigm information therefore assumes a dual role; it is both a necessary analytical element of the model and a commodity to be traded within it. "[K]nowledge is now increasingly subject to the relations of private

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[3] See, for example, Aronowitz, S., & DiFazio, W. (1994). *The jobless future: Sci-tech and the dogma of work.* Minneapolis: University of Minnesota Press; Drucker, P. (1993). *Post-capitalist society.* New York: Harper Business; Edvinsson, L., & Malone, M. S. (1997). *Intellectual capital.* New York: Harper Business; Florida, R., & Cohen, W. M. (1999). Engine or infrastructure? The university role in economic development. In L. M. Branscomb & F. Kodama & R. Florida (Eds.), *Industrializing knowledge: University-industry linkages in Japan and the United States* (pp. 589-610). Cambridge, MA: MIT Press; Leonard-Barton, D. (1995). *Wellsprings of knowledge: Building and sustaining the sources of innovation.* Boston: Harvard Business School Press; Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company.* New York: Oxford University Press; Sigurdson, J. (1993). Global companies as generators and controllers of knowledge: The new challenge for developing countries. In C. Brundenius & B. Göransson (Eds.), *New technologies and global restructuring: The Third World as a crossroads* (pp. 52-77). London, GB: Taylor Graham; and, Stewart, T. (1997). *Intellectual capital: The new wealth of organizations.* New York: Currency/Doubleday.

property. This means that knowledge that has been subject to mental transformation is now either an element of production or a commodity of exchange, the value of which is realised as a price in the market" (Loeppky, 2005, p. 49). Information has always been important; the difference in the contemporary context is the greatly expanded extent to which information is treated as a commodity, and in ways that were unimagined only a few decades ago.

But information as an artefact exhibits certain structural properties that preclude it from conforming to the characteristics of a traditional, tangible commodity – it is non-rivalrous in consumption[4] and non-exclusive, such that consumption by one person does not detract from that of someone else and use of information, under natural conditions, is available to everyone. Alternatively, one might argue that rather than final consumption and depletion of information there is instead accumulation, dissipation or transformation. Expanding on the non-depletive and transformative nature of information, Babe (1995) opines that information can therefore never be an input in the production process nor a final output for consumption, which stands in opposition to the assumptions about information inherent in the neo-classical model. This may in part explain why economists have empirical difficulties with information and often invoke the concept of externalities when contemplating its place within the neo-classical model. The positive externalities of information include, among other things, its capacity to: generate

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[4] It bears pointing out that certain *forms* of information might provoke rivalry, particularly when possession of some type of information conveys a strategic advantage on the owner (for example, in arbitrage). It is precisely the construction of a market advantage that intellectual property rights facilitate through the imposition of rivalrousness. Viewed from the perspective that the social good depends upon widespread information and knowledge dissemination inherent in a knowledge commons, we note that the rivalry constructed through intellectual property protection promotes the ability to derive a profit from the use or sale of knowledge at the expense of aggregate social utility. See, for example, May, C. (2004). Justifying enclosure? Intellectual property and meta-technologies. In S. Braman (Ed.), *Biotechnology and communication: The meta-technologies of information* (pp. 119-143). Mahwah, NJ: Lawrence Erlbaum Associates.

additional wisdom and knowledge; mitigate conflict; encourage relationships based on sharing; facilitate democracy; and, contribute to employment and productivity (Priest, 1985). Bettig (1996, p. 107) considers these externalities to be "qualities of information that affect all aspects of our daily lives: its ability to produce wisdom, to reduce conflict, to encourage sharing relations, to promote democracy, to entertain, to promote employment and productivity, and so on – in general to raise the level of human welfare." Yet neo-classical economic analyses tend either to neglect or discount the positive externalities of information or to apply the efficiency criterion to these non-market values. It therefore becomes clear that the externalities associated with the information commodity render the neo-classical model unable to account for all value of the information good, and thus ineffective in ensuring efficiency and maximum social welfare with regard to information production, distribution, and consumption in the marketplace (Bates, 1988). Given the non-exclusive and non-rivalrous nature of information, it, unlike physical property, cannot naturally derive its inherent value from scarcity. In the context of a market economy an artificial control mechanism is therefore required to create and preserve scarcity. The instrument developed to facilitate scarcity is the intellectual property regime – particularly patents in the case of biotechnology. In this way, intellectual property furnishes a metaphorical link between property in knowledge and the legal constructs that have been developed in defence of material property rights (May, 2004). Although as we will also see in this chapter, capital has learned how to manipulate genetic properties and processes to circumscribe the reproductive abundance built into nature in order to render seeds an increasingly scarce and corporate-controlled commodity. As we will examine in greater depth below, the contemporary enclosure of seeds and the genetic information contained within them is being executed through a dual-pronged strategy that employs genetic engineering and intellectual property rights.

Similar to Hardt and Negri's (2000, 2004) arguments that networks are intrinsic to immaterial labour and biopolitical production, Yochai Benkler (2006) offers an account of what he refers to as the "networked information economy", asserting that the physical and creative capital necessary for production in such an economy is dispersed throughout society.[5] In this context, Ned Rossiter (2006, p. 33) makes the claim that "the ontics of labour becomes inseparable from the ontology of information." "The result is that a good deal more that human beings value can now be done by individuals, who interact with each other socially, as human beings and as social beings, rather than as market actors through the price system" (Benkler, 2006, p. 6). All of these theorists share in their recourse to the discourse of 'commons' and 'enclosure': "...the fight over the enclosure movement...is the main institutional battleground where the conflict between the industrial information giants and the emerging networked information economy is being fought" (Benkler, 2003, p. 1275). The difference between these theorists lies in the logical conclusion they derive from their arguments: Benkler (2006) provides an in-depth analysis of some of the major projects occurring outside the parameters of the capitalist market that engage the collective knowledge and creativity of multiple individuals and which are characterised by openness and sharing, but ultimately he

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[5] See also the article by Tiziana Terranova, 'Free labor: Producing culture for the digital economy'. Her study of the free labour involved in the Internet, traces some of the connections between what she calls the digital economy and the social factory, demonstrating how the gift economy that characterises much activity on the Internet serves an important function in reproducing the labour force for capitalist purposes. An expanded treatment of this line of inquiry can be found in her later book: Terranova, T. (2004). *Network culture: Politics for the information age.* London, GB: Pluto.

positions such collaborative production as an adjunct to the capitalist market that might moderate some of capital's negative excesses. Unlike Hardt and Negri (2004) who glimpse the demise of Empire in the birth and development of the Multitude, Benkler's account is tainted by an implicit acceptance of Imperial rule, albeit mitigating the harshness of its rule through the new projects organised by the barbarians at the gates.[6]

The enclosure metaphor that weaves itself throughout the work of many of the above mentioned authors poignantly draws attention to the various ways in which capital is responding to Lester Thurow's recent admonition that "[t]he Industrial Revolution began with an enclosure movement that abolished common land in England. The world now needs a socially managed enclosure movement for intellectual property rights..." (Thurow, 1997, p. 101). Yet as we will see in the following chapter, and as a burgeoning literature devoted to issues of knowledge and communication commons demonstrates, a variety of anti-enclosure movements and projects have emerged in response to capital's attempts to corral such immaterial resources. Within the discipline of Library and Information Studies there is wide familiarity with projects designed to protect and foster a vibrant knowledge commons such as: Project Gutenberg, a resource for free electronic books that relies on the participation of tens of thousands of volunteers; the Creative Commons licencing system that makes creative works available for a variety of public uses specified by the creator; Linux and other open-source movements that make their operating code publicly available for review, comment, use, and improvement; a variety

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[6] This might be an unfair comparison given the different starting points these authors assume for their analysis. Hardt and Negri, unlike Benkler, approach their study from a class perspective grounded in Marxist theory. As such the trajectory of their argument is almost necessarily different from that advanced by Benkler, which posits a complementary co-existence between private property and the common. Aronowitz and DiFazio (1994), in their book *The jobless future: Sci-tech and the dogma of work*, are also guilty of resigning themselves to the presupposition that redistribution of any sort is only possible within the parameters of capitalist social relations.

of open-access scholarly archives, including the Budapest Open Access Initiative, which makes research articles from any academic discipline freely available on the Internet; and collaborative computing projects that rely on the unused capacity of an expansive network of volunteer computers to carry out complex and processing-intensive activities, such as the SETI@home project that is aimed at discovering signs of extraterrestrial life and the Folding@home project that aids protein folding research. Specific to biotechnology, for example, the potential anti-commons effects of patents on basic biological building blocks such as single nucleotide polymorphisms (SNP) have emerged as a source of contention between different sectors in the life sciences industry. While biotechnology companies have a material interest in advocating stringent intellectual property protection for DNA sequences and other similar basic units of genetic information, the pharmaceutical industry, which relies on easy and cheap access to such downstream resources, has adopted a contra position. In fact, some of the major players in the pharmaceutical industry have, in a somewhat ironic twist, engaged in projects that seek to insert basic genetic information into the public domain, thus defeating on the basis of novelty patent claims over such material. Aside from public databases of SNP information, a number of pharmaceutical firms have allied with the microarray manufacturer Affymetrix to develop the Genome Association Information Network, known as GAIN. This public-private project researches and makes public information about the associations and relationships between haplotypes and particular diseases (Rai, 2007).[7] Other proposed solutions to circumvent patent thickets and their deleterious effects on research include collaborative licencing arrangements, patent pools, and

[7] For an overview of the GAIN project, see The GAIN Collaborative Research Group. (2007). New models of collaboration in genome-wide association studies: The Genetic Association Information Network. *Nature Genetics, 39*, 1045-1051.

clearing houses similar to those that exist in the realm of copyright (Van Overwalle, van Zimmeren, Verbeure, & Matthijs, 2007).

An example of efforts to maintain DNA sequence information within the public domain is the International Nucleotide Sequence Database Collaboration. For just over 20 years, the three members of the International Nucleotide Sequence Database Collaboration (GenBank in Bethesda, Maryland; European Molecular Biology Laboratory's European Bioinformatics Institute in Hinxton, UK; and, the DNA Data Bank of Japan in Mishima, Japan) have engaged in a collaborative repository effort through which the DNA and RNA sequence data produced by institutions around the world are made publicly accessible. In August 2005 the three repositories reached a significant milestone by collecting and disseminating 100 gigabases of sequence data. As a frame of reference, one hundred billion bases is about equal to the number of nerve cells in a human brain and a bit less than the number of stars in the Milky Way. The free access to this information allows scientists to study and compare the same data as their colleagues nearly anywhere in the world, and makes possible collaborative research that hopefully will lead to cures for diseases and improved health. More importantly, at least from the perspective of the discussion offered in the following intellectual property chapter, these types of public access databases defeat the 'novelty' criterion required for patentability, thus serving to keep such information securely within the knowledge commons. The point of this brief list of commons-based activities in the face of capitalist imposed enclosures is to demonstrate that both lines of flight and increased lines of fight are being generated in an antagonistic process that remains very much open.

As will be shown in this and the following chapter, biological artefacts occupy a somewhat peculiar liminal space at the nexus between the material and immaterial. Given the ability of emerging information and communication technologies to transform fundamental genetic and biochemical properties, the tradition of valuing biotechnological materials solely as material resources must be expanded to accommodate an assessment that simultaneously reflects the inherent informational aspects of biological artefacts. In fact, the often-contradictory binary division implicit in the corporeal informational dichotomy breaks down in those instances when an artefact retains properties of both. For example, the engineered material that is produced during DNA sequencing remains a form of matter while simultaneously functioning as a source of information that can be transformed into a textual format. At an even more basic level, the genetic information embedded in the physical material of DNA is often conflated with the DNA itself. Many of the issues subsumed by biotechnology and genetic engineering encompass the physical biological material, the informational content contained within and derived from that material, or the completely disembodied information, such as that maintained in biological databases, that, in turn, can be recombined and synthesised using information technologies and genetic engineering techniques to produce additional novel information and biological creations. What differentiates biotechnology from other industries is that genetic information can be further recombined to produce novel instantiations of biological materiality in the form of cell cultures, human tissue, or genetically engineered plasmids, among other things. We thus agree with Bowker (2000), Parry (2004), and Thacker (2005) that the interplay between these three activities or manifestations of DNA demonstrates the way that biotechnology mediates between the biological/material and the informational.

Yet as we will discuss in the following chapter it is precisely the contention that equates biological material with information that helps facilitate the appropriation of biotechnology within the logic of the social factory through the intellectual property system. The conceptual re-definition of nature as information, communication, and control supports and reinforces its increasing commercial exploitation, a process that has been facilitated by the application of chemistry and biology as the instruments to link the interpretation of organic processes with their technological and commercial exploitation (Guattari, 1992; Yoxen, 1981). While biotechnology is certainly not the only economic sector in which material resources are increasingly viewed as informational resources, genetic material has from the outset of the modern growth of biotechnology been referred to using terms such as 'code' and 'language', while genetic engineering processes have often been conceived of through such concepts as 'translation' and 'information transfer'. The result has been an isomorphic treatment of material biological resources and genetic information. "As an expression of what may be called "the advanced capitalization of nature," biotechnology represents the attempt of informational capital to profit from and transcend the limits of a biological nature that has been greatly compromised by industrial capitalist production" (Heller, 2001, p. 413).

Having established our concept of the 'commons', we must also address a certain degree of discursive slippage in our sometimes seemingly conflated interchange of the terms 'information' and 'knowledge'. While we recognise the diverse literature that attempts to differentiate ontologically and epistemologically between the two, for present purposes we adhere to the relatively straightforward data-information-knowledge trichotomy, through which data are understood to be those raw elements that combined and organised into some context give rise to information, that, in turn, can be assimilated and applied for some use that typically involves a cognitive process, thus constituting knowledge. Information might therefore be conceived of as a flow of messages that may or may not expand or restructure a particular stock of knowledge, although knowledge itself can be acquired through cognitive processes (i.e. thinking) without the input of additional information (Machlup, 1983). This usage is also fairly similar to that offered by Benkler (2006, p. 313), who conceives of information as "raw data, scientific reports of the output of scientific discovery, news, and factual reports." Knowledge, for Benkler (2006), involves using cultural practices and other capacities to process and transform information in ways that can help produce improved actions or results from such actions. By subsuming information within the concept of knowledge, this definition has the advantage of capturing in our use of the term 'knowledge commons' all data, information, and ideas that are created, used, and preserved as a shared resource, regardless of their form of expression.[8]

What we would like to impress upon the reader when reviewing the material presented in this and the following chapters is that biotechnology affords capital a scientific instrument to enclose genetic resources that have been cultivated in common for millennia. It seems to us the situation in respect of agricultural biotechnology illustrated below confirms the basic ontological connection between primitive

[8] For a detailed discussion of various contemporary 'knowledge commons' projects germane to libraries, see Kranich, N. (2007). Countering enclosure: Reclaiming the knowledge commons. In C. Hess & E. Ostrom (Eds.), *Understanding knowledge as a commons: From theory to practice* (pp. 85-122). Cambridge, MA: The MIT Press.

accumulation and expanded reproduction, as originally articulated by Marx. In an instance of primitive accumulation facilitated by technological development and state intellectual property policy, capital has succeeded in subverting the product of countless generations of common labour (domesticated crops) for its own valorisation purposes. Nature, according to one geography scholar,

> ...is consequently now undergoing an 'involution' much as space did in the first few years of the twentieth century when planetary expansion was effectively at an end...when productions of space no longer pushed the borders of the unknown so much as re-worked its internal subdivisions. Faced with the loss of extensive nature, capital re-grouped to plumb an everyday more intensive nature (Katz, 1998, pp. 47-47).

Moreover, by wresting more control away from agricultural producers through Terminator technologies, capital is progressively imposing its own relations of production on agriculture. This represents one further area of social existence in which capital, through the exercise of biopower, is actively seeking to subordinate social relations within the social factory. In place of traditional divisions of labour, which once sought to organise human existence through waged work, we might argue a new form of biopower is emerging; a form of power premised on organising life through capitalist command that endeavours to permeate the full range of human existence. This new form of biopower exacts an appropriation of labour power, or perhaps more accurately, the productive activity of universal labour at the molecular, genetic, and informational levels in a way that expands human biological life activity (labour power) into forms of nonhuman production. Biology is no longer merely science, but has become a productive technology that appropriates the labour power of cells, enzymes, and DNA. Put another way, biotechnological production relies on the organism itself as a factory in which human labour is supplemented by production at the molecular, enzymatic, and genetic level (Thacker, 2005). Through its tight control over biotechnology, which itself is facilitated through acts of pilfering both our genetic heritage and the knowledge commons in respect of seeds and plant breeding developed across generations through human cooperation, capital is able to harness this form of biomaterial labour in service of its own accumulation imperatives.

We propose that this capitalist accretion of biopower through biotechnology can be apprehended through the logic of 'general intellect'. As briefly outlined previously, in the so-called 'Fragment on Machines' in the *Grundrisse*, Marx articulates the concept of 'general intellect', a collective, social intelligence developed through progressive advances in knowledge and technical innovation. For Marx, this was the knowledge objectified in fixed capital and transfixed in the automated system of machinery:

> Nature builds no machines, no locomotives, railways, electric telegraphs, self-acting mules etc. These are products of human industry; natural material transformed into organs of the human will over nature, or of human participation in nature. They are *organs of the human brain, created by the human hand*; the power of knowledge, objectified. The development of fixed capital indicates to what degree general social knowledge has become a *direct force of production*, and to what degree, hence, the conditions of the process of social life itself have come under the control of the general intellect and been transformed in accordance with it. To what degree the powers of social production have been produced, not only in the form of knowledge, but also as immediate organs of social practice, of the real life process (Marx, 1993, p. 706, emphasis in original).

Thus Marx recognised already in the mid 19th century the importance of abstract knowledge for capitalist production processes. Marx went on to discuss in the *Grundrisse* the calamitous impact that the rising prominence of knowledge in the production process would have for the capitalist mode of production. As opposed to discussions in his other texts, Marx asserted in this work that the capitalist crisis would stem no longer from the intrinsic, exploitive contradictions inherent in the mode of production or from the inconsistencies associated with his theory of the law of value.

Instead, the contradiction that would lead to rupture was based on the fact that production increasingly relies on science and technology while the measure of wealth generation remains firmly rooted in the amount of labour embodied in the product (Virno, 1996). The era of general intellect ushers in a period in which "capital thus works toward its own dissolution as the form dominating production" (Marx, 1993, p. 700). As one contemporary commentator points out, science remains critical to capitalist accumulation: "The integration of scientific labor into industrial and tertiary labor has become one of the principal sources of productivity, and it is becoming a growing factor in the cycles of production that organize it" (Lazzarato, 1996, p. 137). Similarly, the ascendance of the productive value of intellectual and scientific labour means not only that knowledge becomes a principal productive force but that it also offers the potential to re-socialise everything (Vercellone, 2007).

Marx similarly informs us that scientific innovation alone does not spur productivity. Rather, scientific knowledge relies on technological application in order to be applied to the realm of production (Rosenberg, 1981). According to Marx, science and technology have always been closely intertwined:

> But to the degree that large industry develops, the creation of real wealth comes to depend less on labour time and on the amount of labour employed than on the power of the agencies set in motion during labour time, whose 'power effectiveness' is itself in turn out of all proportion to the direct labour time spent on their production, but depends rather on the *general state of science and on the progress of technology, or the application of this science to production.* (The development of this science, especially natural science, and all others with the latter, is itself in turn related to the development of material production.) (Marx, 1993, pp. 704-705, emphasis added).

This insight is particularly applicable to the science of biotechnology, which only became an economically viable factor of production with the advent of powerful computer and communication technologies within the last two and a half decades, and which is progressively blurring the traditional distinction between basic and applied research.

But, the coincidence of social production and reproduction encompassed by biopolitical production occurs in the new sphere of the common. Biopolitical production is infused with the common in that it not only relies on human capacities of communication, cooperation, and innovation but it also produces new social subjectivities and forms of social (and biological) life. As will become clearer in the chapter that treats the resistance being mobilised against capitalist control of biotechnology, the subjects subsumed within the universal labour category are struggling to inject precisely these points into contemporary debates around this science and its technological applications in acts that might be considered attempts to actualise our species-being.

5.2 Corporate Biotechnological Control of Seeds and Agriculture

As we saw in chapter two, attempts by capital to gain increasing control of agriculture are not new phenomena. According to Kloppenburg (1988, 2004), capital has been successful over the last century in overcoming the two traditional obstacles that precluded plant breeding from being privately appropriated: the reproducibility of the seed, which allowed farmers to compete directly with seed companies by keeping some of the seed from a harvest in order to plant the following season (known as 'bin-run' seed because it comes from the bin of the farmer's harvester rather than from a seed company); and, the active involvement of the state in plant breeding, which positioned public plant breeders as competitors to private breeders.[9] Capital has responded to the first obstacle through scientific innovations that began with hybridisation and today involve the development and application of Genetic Use Restriction Technologies, on which attention now focuses. The second encumbrance has been reduced through intensive lobbying efforts to extend intellectual property rights to plant germplasm, a topic taken up in the following chapter.

5.2.1 Terminator Technology

The term 'Genetic Use Restriction Technology' (GURT – popularly known as 'Terminator technology'[10]) is actually an umbrella term that encompasses a fairly wide array of interactive or interdependent genes that work in combination with some form of chemical or environmental catalyst (e.g. ethanol or heat shock) to regulate the expression

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[9] On this second point about the shifting focus from public to private plant breeding programmes, see also Busch, L., Lacy, W. B., Burkhardt, J., & Lacy, L. R. (1991). *Plants, power, and profit: Social, economic, and ethical consequences of the new biotechnologies*. Cambridge, MA: Basil Blackwell.

[10] "Terminator technology" is the term used in oppositional discourse. "The technology terminates the reproductive viability of seed. It terminates the long-standing relative autonomy of farmers from the commercial seed market. And in the Third World it could very well terminate people's ability to feed themselves by destroying "the 12,000-year tradition of farmers saving, adapting and exchanging seed in order to advance biodiversity and increase food security" (Kloppenburg, 2004, p. 319). See, Kloppenburg, J. R., Jr. (2004). *First the seed: The political economy of plant biotechnology* (2nd ed.). Madison: The University of Wisconsin Press. It bears pointing out that seed hybridization, which can be traced to the early part of the twentieth century, was an earlier form of scientific and technological development designed to integrate farmers more fully into commercial seed markets. Terminator technology has also been referred to as "the neutron bomb of agriculture" (Shiva, 2001b, p. 81). See, Shiva, V. (2001b). *Protect or plunder?: Understanding intellectual property rights*. New York: Zed Books. RAFI (Rural Advancement Foundation International, now known as ETC) has labelled terminator technology 'traitor technology'. Speaking about the patents Novartis applied for between 1997 and 1998 on terminator-related technologies, RAFI asserts that: "The patents explicitly propose that the suicide sequence within the seed could be triggered by herbicides or even fertilisers. More to the point, the patents note that the inducible promoted strategy proposed would have the effect of weakening the plant's natural resistance to pests and diseases. Novartis, of course, is in the business of manufacturing the chemicals necessary to compensate for the weaknesses it also manufactures. Farmers are sold addict seeds with junkie genes that will not perform well without chemical (or, for that matter, biological) supplements – including the purchase of augmented herbicides that trigger the seed's sterility. This is truly traitor technology" (as cited in de la Perrière & Seuret, 2000, p. 33). See, de la Perrière, R. A. B., & Seuret, F. (2000). *Brave new seeds: The threat of GM crops to farmers* (M. Sovani & V. Rao, Trans.). London, GB: Zed Books.

of the plant's genetically engineered trait, or traits in the case of stacked seeds.[11] There are two types of GURTs, varietal (V-GURTs) and trait-specific (T-GURTs). The former type of technology controls the reproductive functions of the seed, while T-GURTs are designed to regulate control over the functionality of a particular transgene that has been inserted into the seed, such as herbicide or insect tolerance (ETC Group, 2007a). These biotechnologies involve the genetic manipulation of seeds to render them infertile after first harvest so that farmers have to purchase new seed each year from a handful of international seed suppliers rather than save and reuse them, as they have been doing for millennia. The ultimate danger from this planned form of organic obsolescence is that

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[11] Besides Monsanto, Syngenta (Syngenta was formed in November 2000 through the merger of the agrochemical and seeds units of Novartis and AstraZeneca; Novartis itself being the result of the 1996 merger between Ciba-Geigy and Sandoz), DuPont/Pioneer (DuPont acquired Pioneer Hi-Bred in 1999), Aventis (Aventis, which was acquired by Bayer in 2003, was created through the 1999 merger between Hoechst and Rhône Poulenc), and BASF have also developed terminator technology, which, depending on which company you consult, is known as 'gene protection', 'gene expression control', or 'genetic use restriction'. Interestingly, the first patent on this technology was filed by the Delta and Pine Land Company, one of the leading breeders and producers of cotton and soybean seed in the United States, and the Agricultural Research Service of the United States Department of Agriculture. As Lewontin (2000a, p. 102) points out, "[w]e could hardly ask for a more blatant case of state support of private property interests to the exclusion of any public benefit." See, Lewontin, R. C. (2000a). The maturing of capitalist agriculture: Farmer as proletarian. In F. Magdoff & J. B. Foster & F. H. Buttel (Eds.), *Hungry for profit: The agribusiness threat to farmers, food, and the environment* (pp. 93-106). New York: Monthly Review Press. In fact, according to the agreement between these two partners, the Department of Agriculture will receive five percent of the profits from sales that derive from the patent. Delta Pine and Land Company has issued repeated public statements about its intention to market its terminator technology, with a focus on markets in Africa, Asia, and Latin America. It was announced on August 15, 2006 that Monsanto would make a second attempt to acquire this company for $1.5 billion. The deal received shareholder approval while regulatory approval was contingent upon the divestiture of the Stoneville (its American cotton seed company that accounted for 14% of the American cotton seed market) and NexGen businesses. The American Justice Department gave final approval to the deal on June 1, 2007, thus paving the way for the full integration of Delta Pine and Land Company into Monsanto. Despite having to sell Stoneville, Monsanto's acquisition of Delta and Pine Land Company gives it control of 44% of the cottonseed market in the United States. Delta Pine and Land Company has subsidiaries in thirteen countries, including such major markets as China, India, Brazil, Mexico, Turkey, and Pakistan. Monsanto's acquisition positions it as the dominant player in cotton production, the world's leading plant fibre crop. It also means Monsanto has acquired Canadian, European, and American patents on terminator technology. See, for example, ETC Group. (2006b). *Monsanto announces takeover of Delta & Pine Land and terminator seed technology (again)*. Ottawa: ETC Group. Although Monsanto has pledged on its website not to "develop or utilize sterile seed technology", the company has no plans to renounce the patents on the technology. The pressure such a market position will allow Monsanto to exert on farmers around the world to adopt its genetically engineered seeds will be tremendous. In March 2008 Monsanto agreed to pay €546 million for De Ruiter Seeds Group B.V., a Dutch holding company that owns and operates De Ruiter Seeds, a leading vegetable seed provider, particularly within the protected-culture (greenhouse) vegetable seed market.

multinational seed and agrochemical companies (which Drahos and Braithwaite (2002) colourfully refer to as biogopolists) will acquire the capacity to control the food chain and the world's food supply (Heller, 2001; Shiva, 2001b). According to one critic, Terminator technology symbolises "corporate greed and lack of concern for the social and environmental impacts of genetic engineering" (Kloppenburg, 2004, p. 292). "In one broad, brazen stroke of his hand, man will have irretrievably broken the plant-to-seed-to-plant-to-seed cycle – the cycle that supports most life on the planet. The new technologies and system mean no seed and no food unless you buy more seed" (Shiva, 2001b, p. 82).

Industry, in its attempts to mitigate negative public opinion surrounding such technology, asserts that genetically induced seed sterilisation offers a safety mechanism to prevent gene flow and cross-fertilisation. That this admission confirms the charge that such technology creates a vicious circularity, causing conditions that demand additional dangerous technology in response, apparently remains lost on industry. These types of industry contentions notwithstanding, there is some concern that the genome from these genetically engineered crops, which does have a small window of fertility, might escape into other crops or the natural environment. Given the ability of nature to adapt, coupled with the fact that such technology has yet to be tested on any large scale, there remains the possibility for the spread of sterility in seeding plants throughout the environment, which would have catastrophic consequences for the world's food supply (de la Perrière & Seuret, 2000; Shiva, 2000). In truth, the upside of this technology for multinational seed companies is that they will neither have to rely on pressuring farmers to sign contracts that prohibit the replanting of harvested seeds, nor expend resources to police such contracts. "Contractual sterility has been wiped out by biological sterility" (de la Perrière & Seuret, 2000, p. 27). Moreover, Terminator technology provides multinational seed companies a means of valorising genetically engineered seeds in countries where the Western standard of intellectual property rights are poorly developed or haphazardly enforced (Kloppenburg, 2004). In a study that examined the potential financial impact of Terminator technology on just seven countries (Canada, Brazil, Argentina, Pakistan, Philippines, Ethiopia, and Iran), the ETC Group estimates that the commercialisation of Terminator seeds could cost farmers in these nations over US$1.2 billion annually. Though Canadian farmers do not engage in seed saving on the same scale as farmers in poorer countries, the bill could still run around US$85 million for farmers in this country, a not insubstantial sum when one considers the squeeze on farming profit margins by large transnationals discussed in the literature review chapter (ETC Group, 2006d).

In a manner that highlights the connections between biological and knowledge commons, one legal scholar draws an interesting analogy between GURTs and digital rights management systems, both of which employ technological mechanisms to restrict access to and use of their underlying technologies, be they genetically engineered seeds or digital media (Burk, 2004). As a number of commentators point out, these types of access restriction technologies can be particularly insidious if developed by rights holders in such a manner that they curtail legitimate uses enshrined in and protected by public access doctrines such as fair dealing or exemptions for farmers and researchers enshrined or read into patent and plant breeders' rights legislation. Similar to debates now raging in respect of technical protocols and their potential to circumscribe access to information, technical standards in the biological realm also have the capacity to constrain the behaviour of users and their legitimate use of a technology in ways that overstep the intellectual property rights established through legislation (Lessig, 1999; Reidenberg, 1998).

> Producers who employ such lock-out technology may in essence become private legislatures, imposing rules of usage without regard to the broader public interest that informs democratic rule making.... The instantiation of a proprietary rule in genetic code, which following Reidenberg, we might call "lex genetica", is the first example of regulation through genetic code, but it is unlikely to be the last (Burk, 2004, p. 1567).

That having been said, it is difficult to imagine the courts upholding a constitutional right to save seed or engage in agricultural research (Burk, 2004). Perhaps more practically, even if the enforcement of a patent for a GURT creates a situation in which the rights holder overreaches in its control when attempting to stop people from 'hacking' its technological lock-out system, it probably remains well beyond the ability of laypeople to circumscribe GURTs. No group of biological hackers akin to those who have succeeded in reverse engineering many digital rights management systems has yet emerged to provide the wider community with a toolbox of GURT circumvention tools (Burk, 2004).[12] As one critical group points out, "[a]t the end of the day, the public will not have any more control over medical policy, nor any means by which this new technology could be used for resistant purposes on a general level. The commodity always favors capital, not the consumer" (Critical Art Ensemble, 2002, p. 118).

[12] Though not specific to the circumvention of GURTs, Thacker (2005) mentions the Biotech Hobbyist project, Personal bio-Computing (PbC), which seeks to develop a low-tech DNA computer that employs standard biotechnology techniques such as PCR and gel electrophoresis. The ultimate goal of such hobbyist pursuits is to reappropriate biotechnology and repurpose it for uses beyond those determined solely by capital. See, Thacker, E. (2005). *The global genome: Biotechnology, politics, and culture.* Cambridge, MA: The MIT Press. Members of the Critical Art Ensemble also discuss such projects and their potential for subverting capitalist control of biotechnology. See, Critical Art Ensemble. (2002). *The molecular invasion.* Brooklyn: Autonomedia.

Despite opposition from Canadians (for example, in an effort to emphasise the need for government accountability, a group of about a thousand people in Ottawa staged a public 'trial' of Terminator technology on March 20, 2006), the Canadian Government lobbied in February 2005 to overturn the *de facto* international moratorium on GURTs that had been adopted by the United Nations CBD in 2000. The Canadian government advocates a 'case-by-case risk assessment' for seed sterilisation technologies, which, according to the ETC Group, "would open the door to field trialing and commercialisation of sterile seed technology" (ETC Group, 2006d, ¶ 3). The case-by-case approach has been staunchly rejected by a large number of European countries as well as the United Nations CBD. Paragraph 23 of the decision made by the Eighth Conference of the Parties to the Convention on Biological Diversity[13] reads as follows:

> ...in the current absence of reliable data on genetic use restriction technologies, without which there is an inadequate basis on which to assess their potential risks, and in *accordance with the precautionary approach*, products incorporating such technologies should not be approved by Parties for field testing until appropriate scientific data can justify such testing, and for commercial use until appropriate, authorized and strictly controlled scientific assessments with regard to, inter alia, their ecological and socio-economic impacts and any adverse effects for biological diversity, food security and human health have been carried out in a transparent manner and the conditions for their safe and beneficial use validated. In order to enhance the capacity of all countries to address these issues, Parties should widely disseminate information on scientific assessments, including through the clearing-house mechanism, and share their expertise in this regard (Conference of the Parties to the Convention on Biological Diversity, 2000, section III).

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[13] The Conference of the Parties is the governing body of the United Nations Convention on Biological Diversity. It is responsible for the implementation of the Convention based on the decisions it makes at its periodic meetings. To date the Conference of the Parties has held 8 ordinary meetings, and one extraordinary meeting (the latter, to adopt the Biosafety Protocol, was held in two parts). Between 1994 and 1996 the Conference of the Parties held its ordinary meetings annually. Since 2000, when a change in the rules of procedure was agreed upon, these meetings have been held bi-annually. As of the end of 2007, the Conference of the Parties has taken a total of 216 procedural and substantive decisions. The ninth meeting of the Conference of the Parties to the Convention on Biological Diversity will be held in Bonn, Germany from May 19 – 30, 2008.

In spite of lobbying efforts by the Government of Canada in March 2006 at the CBD to rescind the moratorium on Terminator technology, the majority of members voted instead to preserve and strengthen it (Conference of the Parties to the Convention on Biological Diversity, 2006). Nonetheless, a number of commentators expect that Terminator technology will continue to be developed by the biotechnology industry and that it will maintain a place on the agenda of the CBD at its next meeting in 2008. According to Pat Mooney, "[t]he only solution is a total ban on the technology once and for all....The next step is for all national governments to enact national bans on Terminator as Brazil and India have done" (ETC Group, 2006c, ¶ 8). The global peasant farmer movement, La Via Campesina, has demanded that "governments and...international institutions...prohibit biopiracy[14] and patents on life (animal, plants, parts of the human body) including the development of sterile varieties through genetic engineering" (as cited in King & Stabinsky, 1999, p. 86). Similarly, the Consultative Group on International Agricultural Research (CGIAR),[15] which is an international organisation concerned with developing ways to achieve sustainable food security and reduce poverty

[14] Vandana Shiva (2001a, p. 49) defines biopiracy as "the use of intellectual property systems to legitimize the exclusive ownership and control over biological resources and biological products and processes that have been used over centuries in non-industrialized cultures. Patent claims over biodiversity and indigenous knowledge that are based on the innovation, creativity and genius of the people of the Third World are acts of 'biopiracy'." See, for example, Shiva, V. (2001a). Biopiracy: The theft of knowledge and resources. In B. Tokar (Ed.), *Redesigning life?: The worldwide challenge to genetic engineering* (pp. 283-289). Montreal: McGill-Queens's University Press. Since 1995 the Coalition Against Biopiracy has been holding the 'Captain Hook Awards for Biopiracy'. This annual global award ceremony recognises the work of the most courageous cogs (this term comes from the Middle Ages when small ships known as cogs were constructed with high sides to provide some degree of protection from marauding pirates) battling against biopiracy while also bestowing citations of shame on those groups and organisations that have committed the most heinous acts of biopiracy. See, ETC Group. (2006a). *Communiqué: Issue #92: Captain Hook awards for biopiracy 2006*. Ottawa: ETC Group.

[15] The CGIAR is the largest consortium of seed banks in the world. There are about 1,400 national and regional seed banks dispersed around the globe. The most recent, and highly publicised, seed bank opened in late February 2008 in Svalbard, Norway. Dubbed the 'Doomsday vault', this project will house seeds from almost all the recognised varieties of 150 food crops grown by humans. The British Millennium Seed Bank Project, which has a target of storing seeds from more than 24,000 wild plant species, is the only other international storage facility. See, for example, Hopkin, M. (2008). Frozen futures. *Nature, 452*, 404-405.

in developing countries through scientific research and research-related activities in the fields of agriculture, forestry, fisheries, policy, and the environment, declared in 1998 that it would not facilitate the introduction of Terminator technologies into farmers' field:

> The CGIAR will not include in its plant-breeding material any genetic system aimed at preventing the germination of seeds because of the potential risks of a sterilising gene flow through pollen, the non-viability of exchange or sale of seeds, the potential negative impact on genetic diversity and the importance of the breeding programme and reproduction on the farm for agricultural development (as cited in de la Perrière & Seuret, 2000, p. 31).

Instead, the CGIAR advocates policies that promote local seed saving, practices which it believes contribute to the sustainability of local food systems, protect biodiversity, and serve to maintain or re-establish food security. For these same reasons, the CGIAR contends that international aid programmes could be improved if they were to incorporate efforts to ensure local seed independence (Cummings, 2008).[16]

The agreed CBD moratorium on Terminator technology notwithstanding, a significant amount of research is still being conducted on seed sterilisation technologies. An emerging hub for such research activity is Europe, where the European Union is investing millions of Euros in its Transcontainer Project, which is tasked with developing genetic technologies capable of containing transgenes.[17] This three-year project, which commenced in May 2006 and has a budget of €5.38 million, involves 13 public and

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[16] The CGIAR has, however, come under increasing scrutiny and criticism for its close ties to corporate interests, which also have access to the germplasm in the CGIAR vaults, most of which comes from farmers in the developing world. Moreover, according to GRAIN, the apparent benefits of 'improved' varieties that are developed as a result of CGIAR seed banks and research fail to consider the higher purchase and growing costs of such varieties and the fact that they tend to replace local varieties. See, for example, Cummings, C. H. (2008). *Uncertain peril: Genetic engineering and the future of seeds*. Boston: Beacon Press. At least one commentator has accused CGIAR of becoming "an agricultural research outsource for the multinational corporations" (Sharma, as cited in Hisano, 2005, p. 94). See, Hisano, S. (2005). A critical observation on the mainstream discourse of biotechnology for the poor. *Tailoring Biotechnologies, 1*(2), 81-105.

[17] In fact, within the scientific literature some work is beginning to emerge that posits molecular biocontainment as a biosafety solution for genetically engineered crops. See, for example, Hills, M. J., Hall, L., Arnison, P. G., & Good, A. G. (2007). Genetic use restriction technologies (GURTs): Strategies to impede transgene movement. *Trends in Plant Science, 12*, 177-183.

private research partners and is driven by the underlying assumption of 'co-existence', a controversial notion that genetically engineered crops and traditional crops can mutually co-exist (or that it is possible to determine some level of 'acceptable' GM contamination – as one organic farmer points out, "'[c]oexistence' is a nice term, but it turns out that coexistence means we put up with their contamination" (Jenkins, 2007, ¶ 57)). "In other words, it is a publicly funded initiative to help the biotechnology industry overcome the European public's rejection of GM foods and crops" (ETC Group, 2007a, p. 6). This apparent new need for genetic innovation confirms the prognosis by many early critics of genetic engineering that such technology will give rise to a 'genetic treadmill' in which new technologies have to be developed to respond to the hazards inflicted on the environment and human health by first generation biotechnology. The one upside is that the fears about gene flow and ill-effects on human health have thus far thrown up a major impediment to industry plans to commercialise pharmacrops, genetically engineered industrial crops designed to produce chemical compounds for industrial use, and genetically engineered trees (ETC Group, 2007a).

More insidious, however, is the fact that these new containment technologies can easily substitute for Terminator technologies. As outlined at the outset of this section, Terminator technology has been continually refined since its initial introduction in the early 1990s, with researchers now experimenting with environmental or chemical 'switches' that can turn on or off a plant's reproductive abilities (dubbed 'Zombie seeds' by the ETC Group). Significant research is also being conducted on developing means to excise[18] transgenes from a genetically engineered plant at a particular time in its growth

[18] Current gene excision technology, which, similar to other GURTs, can be induced by chemical or environmental triggers, leaves behind one of the two excision sequences that becomes part of the plant's

cycle (christened 'Exorcist seeds' by ETC Group), as well as ways to kill a plant that contains 'conditionally lethal' transgenes (referred to as 'Pull-the-plug plants' by the ETC Group).[19] One of the most significant benefits to industry from such genetic technologies (along lines similar to genetically modified seed tolerant of particular herbicides) is that they will compel farmers to accept responsibility for trait control. Farmers will be forced to purchase these new proprietary inducers (most likely chemical) that will be required for the plants to either express or repress the desired genetic trait, including fertility.[20] Should excision techniques become more advanced, it is quite probable that companies will lobby vigorously to have their products categorised as GE free in order to avoid labelling requirements in those jurisdictions that have them, such as the European Union (ETC Group, 2007a). As Jim Thomas of the ETC Group argues, gene giants such as Monsanto and Dow are trying to do an end run around the moratorium on Terminator technology. "They're going to go to the next [biodiversity] convention, and argue that sterile seeds are not a problem any more because the sterility is reversible" (as cited in Patterson, 2007). If they succeed it will "open the floodgates", according to Thomas, to other sectors of the biotechnology industry that are currently too controversial such as pharmacrops and genetically engineered plants that produce industrial products (Patterson, 2007).

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chromosome, which could have negative effects on the plant's health. Moreover, the altered chromosome will be inherited by progeny, thus transmitting potential dangers down the reproductive line.

[19] 'Conditionally lethal' genes would kill a plant only if triggered by a chemical or environmental inducer. The conditionally lethal gene could either code for the expression of a toxin itself or for an enzyme that would convert an applied chemical into a toxin. Dow Agrosciences and the National Research Council of Canada own a patent on such technology.

[20] For a list of which companies and universities own patents on all the types of GURTs discussed in this section, see ETC Group. (2007a). *Communiqué: Issue #95: Terminator: The sequel.* Ottawa: ETC Group.

5.3 Corporate Control of Agricultural Biotechnology as the Alienation of Life Itself

The biologically induced sterility being deployed by the Monsantos, Syngentas, Bayers, and BASFs of the world to wring maximum surplus value out of agricultural production chains seems to bear out Marx's contention that accumulation in general is a form of intensified primitive accumulation. Recalling our characterisation of primitive accumulation as any action by capital (or the state on behalf of capital) that seeks to reintroduce and reinforce the separation between producers and the means of production, we contend that Terminator technology qualifies as a new modality of capitalist primitive accumulation that strives to circumscribe natural cycles of reproducibility in a manner that forces agricultural producers to purchase from an oligopolistic set of supposed life science companies a vital input that for millennia was freely given by nature. This suite of technological mechanisms represents the extra-economic prerequisite to biocapitalist production that not only endures in contemporary society but that also is being extended across the globe. We further agree that Terminator technology represents the biological instantiation of those digital exclusionary technologies seen in the music and software industries. Similar to the way information today is easily copied, transformed, and circulated beyond the control of intellectual property rights' holders, the natural progenitive capacity of seeds renders strict control over the genetic information they contain quite difficult. But Terminator technology, or to carry the analogy further, these 'biological rights management systems' provide their owners with the penultimate form of control in mediating the relationship between people and not only information and knowledge but also the 'stuff of life' in a manner that encloses both the biological and the knowledge commons. Through this powerful technology that corrupts the natural rhythms of nature in service of accumulation imperatives we truly can discern the emergence of a type of capitalist biopower capable of regulating and controlling life at the molecular level. Though it does not employ the same terminology, the CBS recognises the biopolitical character of biotechnology, the impact of which, as outlined by the CBS, "is predicted to be more dramatic and far-reaching than that of telecommunications and computers in the last [century], because it deals with life and living things which permeate all aspects of our own lives" (Government of Canada, 2004, p. 2).

In general we might argue that the co-optation by capital of the general intellect as it relates to biotechnology and genetic engineering is robbing living organisms of their natural commonness (free reproducibility), highlighting the paradox inherent in genetically engineered seeds: on the one hand, it is claimed that genetically engineered seeds will deliver increased yields and great abundance while, on the other hand, those who refuse or are unable to pay for access are simultaneously excluded. Perhaps more importantly, if biotechnology companies are successful in infiltrating the market with Terminator technology we can, based on past experience, expect that more and more seed varieties will be engineered to express these traits. Because the transnational seed companies exercise such great control over the world seed market they are in a position to eliminate the supply of many traditional varieties, thus compelling farmers to purchase Terminator technology. Not only will this reduce the number of different types of seeds available to farmers, thus threatening biodiversity and the biological commons, but it will similarly exercise a ripple effect on the knowledge commons as agricultural producers are further removed from their traditional relationship to seeds and plant breeding, including all the knowledge this entails. We are witnessing the emergence of 'biolords', the biological version of Roberto Verzola's 'cyberlords' – "the propertied class of the information society, [who] control either a body of information or the material infrastructure for creating, distributing or using information" (Verzola, 2000, p. 92).

We suggest that Terminator Technology helps illuminate the nexus between biological and knowledge commons implicated in biotechnology and its attendant technological applications. In part this concatenation follows from the nature of biotechnological research and development, which is dependent upon the complex computing and informational power made possible by advanced information and communication technologies. Biotechnologies provide instruments to extract both genetic material and information from living organisms, which can be processed in ways that replicate, modify, or even transform that material or information. Moreover, this processed material or information can be combined with other biochemical information or material to produce new genetic information or resources that, in turn, can be commodified in service of capitalist accumulation imperatives. The concept of biopolitical production offers a concept that encompasses the intersection between the emphasis on informatisation inherent in biotechnology with the new ways that life forms are being recontextualised by the technologies of the biotechnology industry – all in a capitalist-led manner that portends to have profound implications for the environment and humanity in its capacity as both universal labour and species-being. This avoids one of the dangers of succumbing to the immaterial labour thesis in respect of biotechnology – the potential to lose sight of the materialised instantiations of biological artefacts once they are rendered immaterial through digitalisation.

Through the optic of biopolitical production we might glimpse a shift in the universal labour-capital relation such that living labour now refers to molecular levels of life being employed by capital, such as cell lines, transgenics, recombinant DNA, etc., to produce material goods and services in the form of genetic diagnostics, genetic drugs, genetically engineered seeds, genetic databases, gene-based therapies, etc.. 'Life itself' has been rendered productive, living labour by the biotechnology industry. Biological, cellular, enzymatic, genetic labour complements the intellectual, communicational, affective labour of species-being, whether in the form of immaterial, material, or immiserated labour. The biotechnology industry draws on a synthesis of the immaterial labour of scientists and researchers employing computer and information technologies with the biomaterial labour of cells, enzymes, and DNA, while also relying on material workers to produce these commodified biotechnological products on the assembly lines in biotech factories or farmers in the fields to employ these inputs in their own production processes, and on the immiserated labour of the global South to deliver the original biological artefacts from which to derive the required molecular information and other building blocks from which this cycle of biological production starts. At an ontological level perhaps we can now speak of biological alienation, or the alienation of life itself. This would particularly appear to be the case when we consider examples of germplasm derived from plants cultivated and bred by various producers in common for extended periods of time that are being patented by transnational corporations; genes and germplasm appropriated without knowledge and/or benefit and then sold back to various strata of universal labour in the form of commodified seeds (Thacker, 2005).[21]

[21] Though not the focus of the present work, similar things are happening in respect of human genetic material, which is being patented without the consent of the person or persons from whom the genes are extracted. One of the most widely publicised cases of human genes being appropriated without permission of and benefit to the individual producing the genetic material is the case of John Moore. See, for example, Boyle, J. (1996). *Shamans, software, and spleens: Law and the construction of the information society.* Cambridge, MA: Harvard University Press.

Chapter 6. Intellectual Property Policy: Facilitating Capital's Command over Biotechnology

> The international effort to convert the genetic blueprints of millions of years of evolution to privately held intellectual property represents both the completion of a half-millennium of commercial history and the closing of the last remaining frontier of the natural world (Rifkin, 1998, p. 41).

In addition to the commodification threat posed by Terminator technology, capital, as briefly outlined in the previous chapter, has achieved significant success in subverting agricultural production toward its own valorisation purposes by engaging in direct competition with public plant breeding programmes. But beyond direct competition with public sector research, capital has made assiduous use of the intellectual property system to secure monopoly protection, albeit for a limited term, for its genetically engineered products and the knowledge embodied therein. Similar to the concerns voiced in the Library and Information Science literature about the chilling effect of overly stringent copyright protection on the dissemination of information, a number of scholars are questioning the current heavy use of patents within the biotechnology industry. Aside from questions about the validity of a number of patents that have issued on basic biological 'building blocks', some commentators worry that the resulting patent thickets will impede research and the dissemination of research findings (Eisenberg, 1997b; Heller & Eisenberg, 1998; Klein, 2007; Long & Johnson, 1997; Maskus & Reichman, 2004). Perhaps more germane to the theoretical position being applied to the current research, it bears emphasising what sometimes tends to be overlooked in much literature on intellectual property, or at least only implicitly accepted, namely that the value generated through the creation and exploitation of intellectual property relies on an *a priori* exploitation of labour-power (Rossiter, 2006; Schiller, 2007; Trosow, 2003).

With these types of issues in mind, the intent of this chapter is to illustrate how the contemporary intellectual property protection system is being applied by capital to facilitate its accumulation processes in ways that not only overstep the conceptual justification for intellectual property, but that also offend a number of the normative and practical elements of agriculture that have existed for millennia. We will first provide a basic outline of the intellectual property system, including a discussion of its underlying rationale. Having established the general nature of the system, focus will narrow to consider the concerns articulated in respect of intellectual property protection, particularly patents, for genetically engineered organisms. The final section will examine these issues in the context of two of the arguably most famous intellectual property protection battles over genetically engineered organisms that have been waged to date in this country – the Harvard oncomouse decision and the lawsuit brought against Percy Schmeiser by Monsanto for patent infringement of its genetically engineered canola seed.

6.1 A Conceptual Overview and Critique of the Intellectual Property System

The intellectual property regime of Canada, which is the umbrella term that includes copyright, patents, trademarks, and industrial design, is, like that in most other developed nations, premised on utilitarian considerations of efficiency that seek to balance the incentives assumed necessary to promote the creation of intellectual works with a public interest in access to these works. Douglass North (1990) argues that the institution of property developed as a mechanism to ensure the efficient allocation of social benefits and costs that attach to the mobilisation of useful resources. Property rights, including those in intellectual resources, are thus construed as being a required instrument to facilitate the allocation of resources among people. As property rights came to replace social relationships of trust, expanded trade relationships, according to this argument, could be forged across vast distances (North, 1990). The emphasis on property rights and efficient allocation in this account of intellectual property suggests that markets offer the best mechanism for exchanging and transferring such rights among those able to make best use of them. Viewed from this perspective, the efficient use of intellectual output is considered best regulated by markets, thus opening the way for the commodification of information and knowledge. In fact, this logic becomes self-reinforcing in its insistence that the efficient use of knowledge is achieved only through markets and that markets can only develop if information and knowledge are transformed into property (May & Sell, 2006). Proponents of patent protection for biological products and processes often attempt to legitimate their demands for strict intellectual property rights through the argument that biotechnological innovation is assuming an increasingly important role in ensuring economic growth. In turn, this strand of argumentation is linked to the worn-out claim that innovation would stall without stringent monopolistic safeguards (McNally & Wheale, 1998). The contemporary privatisation of life forms such as human, animal, and plant genomes, cell lines, and agricultural plants and livestock, through intellectual property instruments is a qualitatively new dimension of capital's expropriation of social resources (King & Stabinsky, 1999). In part, the genetic reductionist paradigm discussed in the literature review chapter, which posits the gene as a discrete and easily transferable unit of information, provides discursive support for gene patenting based on the putatively exact science of genetic engineering. But as one critic of genetic reductionism points out, "the first reductionist fallacy in the patenting of genes is that DNA by itself can specify anything at all, as DNA depends for its replication on the entire cell" (Ho, 1999, p. 111).

Such functional arguments steeped in concerns about allocative efficiency fail to admit any of the myriad social and political facets of the commodification debate. Intellectual property rights thus function as particularly forceful forms of social power (Anawalt, 2003). As members of the Critical Art Ensemble (2002, p. 9) point out, "[t]he assumption that efficiency is a totalising good is nothing more than a disgraceful example of the particular values of the powerful being represented and internalized as universal." Perhaps more damaging to this species of argumentation is the immanent critique that creative production relies on a bountiful public domain or commons, which this logic would stymie through stringent intellectual property protections (Boyle, 2003a). Along these lines, in 1995 the Human Genome Organization (HUGO) stated that it opposes patent protection for cDNA on the grounds that this would hinder the free flow of basic scientific information necessary to facilitate research:

> HUGO is worried that the patenting of partial and uncharacterised cDNA sequences will reward those who make routine discoveries but penalize those who determine biological function or application. Such an outcome would impede the development of diagnostics and therapeutics, which is clearly not in the public interest. HUGO is also dedicated to the early release of genome information, thus accelerating widespread investigation of functional aspects of genes (Peters, 2003, pp. 131-132).

The notion of the individual, spontaneous genius of an individual creator is the myth that substantiates this system. Advocates of strong protection uncritically accept that the state is obliged to endow creators with monopoly rights in order to ensure creative development and societal progress. Drawing in part on Locke's 'just deserts' thesis,[1] this perspective on intellectual property reifies economic rationalism as a natural human characteristic and therefore fits well within the expansionary logic of capital in its drive to stimulate consumer demand and pursue new markets. Noted economist Kenneth Arrow informs us that if:

> Information is not property, the incentives to create it will be lacking. Patents and copyrights are social innovations designed to create artificial scarcities where none exist naturally.... These scarcities are intended to create the needed incentives for acquiring information (Arrow, 1996, p. 125).

With regard to agriculture, at least one commentator takes issue with this logic:

> The patenting of these ... [genetically engineered agricultural] products ... can no longer be interpreted as an economic recognition of an individual innovation, but should rather be seen as a political action to give companies an exclusive right to introduce new social relations in global food systems (Ruivenkamp, 2005, p. 13).

In respect of genetic knowledge and research this rationale that the limited ownership rights provided by intellectual property protections furnish the incentives presumed necessary to entice individuals to innovate and expand knowledge tends to break down. For even before the United States Supreme Court decided in *Diamond v. Chakrabarty*[2]

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[1] Building on his contention that a person has "a Property in his own Person", John Locke postulated that a person' labour power is also her own. Therefore, "...whatsoever then, he removes out of the State that nature hath provided, and...hath mixed his Labour with, and joyned to it something that is his own, thereby makes it his Property" (Locke, 1988, p. 27, originally published in 1690). In the context of intellectual property, the argument invoked by proponents of strict protection is that once an individual has applied his labour to even intangible things, some form of monopoly protection is warranted – what Gordon labels a Lockean 'I made it – it's mine' justificatory pattern. See, Gordon, W. J. (1993). A property right in self-expression: Equality and individualism in the natural law of intellectual property. *Yale Law Journal, 102*, 1533-1609.

[2] *Diamond v. Chakrabarty*, 447 U.S. 303 (1980). In 1972 Ananda Chakrabarty, a scientist employed by General Electric, filed a patent application for a bacterium he had genetically engineered to break down crude oil. The United States Patent Examiner (his name was Diamond, hence the name of the case), while allowing some of the claims for which Chakrabarty had filed, rejected the claim for the bacterium, arguing that microorganisms are 'products of nature' and that living organisms are not patentable subject matter under article 35, section 101 of the U.S. Constitution. Chakrabarty appealed the decision to the U.S. Patent Office Board of Appeals, which upheld the examiner's decision on the second ground. In 1980 the Supreme Court of the United States overturned the decision by the Patent Office, ruling that although the bacterium was a natural material, it was a non-naturally occurring organism that was a product of human ingenuity. By virtue of combining four plasmids and successfully inserting them into a bacterium, Chakrabarty was deemed to have invented the microorganism. It should be noted that four of the nine Supreme Court Justices dissented from the majority opinion, arguing that Congress had "chosen carefully

that genetically engineered organisms are patentable, there was a prolific amount of research and corresponding publication of results in the fields of molecular biology and genetics (Long & Johnson, 1997). Part of the reason for this history of research productivity absent patent protection could be that economic gain alone might not always motivate scientists. Perhaps more importantly, the subject matter of genetics and molecular biology occupies such an elemental level of discovery that overprotection could constrain future innovation, thus vitiating one of the oft-cited salutary effects of intellectual property systems (Long & Johnson, 1997). Our traditional system of property rights applied to information thus threatens to retard future development and innovation.

The Chakrabarty decision in the United States in 1980 opened the way for the United States Patent and Trademark Office, under heavy lobbying pressure from pharmaceutical, agricultural, and biotechnology sectors, to begin issuing patents on genes, human cell lines, and plant strains.[3] "In the aftermath of that historic decision, bioengineering technology shed its pristine academic garb and bounded into the marketplace, where it was heralded by many analysts as a scientific godsend, the long-awaited replacement for a dying industrial order" (Rifkin, 1998, p. 43). A similar decision by the European Court of Justice in 2001 meant that EU member states had to

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limited language granting protection to some kinds of discoveries but explicitly excluding others, including living material". The rationale for such careful language was to prevent anyone from "securing a monopoly on living organisms, no matter how produced or how used" (*Diamond v. Chakrabarty*, 447 U.S. 303 (1980), p. 320). For a good discussion of this case, as well as *Ex parte Hibberd* (227 USPQ 443 [PTO Board of Patent Appeals and Interferences, 1985], involving genetically engineered plants), *Ex parte Allen* (2 USPQ 2d 1425 [PTO Board of Patent Appeals and Interferences, 1987], dealing with oysters), and Harvard's oncomouse, including their political economic implications for gene patenting, see Kevles, D. J. (1998). Diamond v. Chakrabarty and beyond: The political economy of patenting life. In A. Thackray (Ed.), *Private science: Biotechnology and the rise of molecular sciences* (pp. 65-79). Philadelphia: University of Pennsylvania Press.

[3] Drahos and Braithwaite (2002) contend that American patent attorneys were submitting applications for micro-organisms (though the claims were made in conjunction with a solution or some inert matter in order to avoid challenges based on discovery or living matter) for some time prior to the Chakrabarty decision, and that the United States Patent Office was issuing such patents. See, for example, Drahos, P., & Braithwaite, J. (2002). *Information feudalism: Who owns the knowledge economy?* London: Earthscan.

begin permitting the issuance of patents on plants, animals, and their component parts (King & Stabinsky, 2005).[4] Through international trade organisations such as WTO and trade agreements like TRIPs, the United States is successfully exporting its broad interpretation of suitable subject matter for patent protection (Drahos & Braithwaite, 2002; Loeppky, 2005). It has accomplished this through trade leveraging, a practice employed by successive United States Trade Representatives that made access to American import markets conditional upon strict protection of American intellectual property rights by the prospective trade partner, and which moved the enforcement of such a governance regime from the relatively benign World Intellectual Property Organization to a much stronger and more rigorous WTO dispute settlement system (Drahos & Braithwaite, 2002; May & Sell, 2006). One of the most damaging consequences of expanding intellectual property rights protection is the progressive enclosure of the intellectual and artistic commons (Bettig, 1996). The result is an increasingly restricted realm in which to conduct biotechnological research (King & Stabinsky, 2005). Intellectual property protection today is considered vital not only as an instrument by which to spur domestic innovation but also as a means to gain entrance to world markets of innovation, without which it becomes progressively more arduous for an economy and society to flourish (Doern & Sharaput, 2000).[5]

Doern and Sharaput (2000) have linked the growing importance of intellectual property as a policy area in Canada to global change in general. Canadian economic and

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[4] The European Court of Justice dismissed an application for the annulment of the European Union Directive on the Legal Protection of Biotechnological Inventions (98/44/EE). The Directive requires Member States to grant patent protection for newly discovered gene sequences and for genetically engineered organisms.

[5] Industry Canada articulates precisely this theme, arguing in the context of biotechnology that "Canada must adapt its delivery of intellectual property services to the competitive conditions of a global, technology-intensive, fast-paced industry (Industry Canada, 2000, p. 30).

industrial policies increasingly seek to move beyond the traditional exploitation of natural resources toward an expanded culture of invention and innovation. As a direct consequence intellectual property policy has been increasing in dominance, leading to a consolidation of power by trade and industry departments such as Industry Canada and the Department of Foreign Affairs and International Trade, where the focus of mandarins is on intellectual property protection, trade imperatives, including trade-related intellectual property norms, and the innovation policy paradigm – the CBS being a prime example of the latter. The burgeoning predominance of 'trade' ministries in the drafting of intellectual property policy is quite telling of the extent to which the dissemination function and concepts of the public domain have been rendered increasingly less germane to intellectual property policy debates in Ottawa (Doern & Sharaput, 2000). Of course, it should be recognised that in part this emphasis responds to demands at the international level where institutions and agreements such as the WTO and TRIPs embody a set of norms based on the belief that information and knowledge should be treated as any other commodity.

Bettig's (1996) careful analysis of intellectual property[6], however, questions the validity of the traditional normative justifications for the issuance of intellectual property rights. Instead, his work demonstrates that such rights are unequally distributed, resulting in a system that conveys the greatest share of benefits on capitalists rather than on society or even on the actual creators of the intellectual and creative products. The outcome has thus been an assiduous appropriation of all tangible forms of such creativity within the

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[6] Although Bettig concentrates on copyright, the broader conceptual issues he raises in his analysis are germane to patents.

context of the intellectual property regime and the marketplace.[7] The fact that intellectual property rights can be transferred gives rise to the exchange value of informational and cultural commodities. But the rhetoric of property "sounds a lot less pleasant if...we turn the matter around and say we are imposing *duties*, restricting *freedom* and inflicting *burdens* on certain individuals for the sake of the greater social good" (Waldron, 1993, p. 862, emphasis in original).

However, the problem with a system of scientific innovation driven by a stringent intellectual property system is that its commercial focus will tend to concentrate investment activity and attendant research agendas on areas of interest that benefit primarily the developed world since patent-based R&D is driven more by ability to pay than demand. This is particularly the case in agricultural and pharmaceutical research and development (Benkler, 2006; Drahos & Braithwaite, 2002; King, 1997; King & Stabinsky, 1999; Moser, 1995). Moreover, once such knowledge is captured by intellectual property devices its price as a research input hinders the efforts by local researchers to conduct their own work into adapting and improving products to local conditions, thus contributing to the cycle of dependence on transnational corporations

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[7] Important instances of government policy in Canada that have facilitated this include the extension in 1990 by the federal government of patent-type protection for plant varieties to public and private breeders through the *Plant Breeders Rights Act* (1990, c. 20). Other examples include passage of Bill C-22 and Bill C-91, in 1986 and 1992 respectively, which eliminated compulsory licencing from Canadian patent legislation and then increased the length of patent protection to 20 years from the filing date (s. 44, *Patent Act*, R.S.C. 1985, c. P-4. Canada first introduced compulsory licencing legislation in 1923 in respect of the right to manufacture drugs and food products in this country. In 1969 the legislation was amended to permit compulsory licences for importation of pharmaceuticals. C-22 weakened the legislation, despite protests from consumer advocates and Canadian generic drug manufacturers, by imposing a seven to ten year exclusivity period for drug patent holders. Under heavy pressure from American and European pharmaceutical manufacturers and in the context of the free trade treaties being negotiated between Canada, the United States, and Mexico, the federal government, through Bill C-91, subsequently revoked compulsory licencing provisions completely in 1992. In return the transnational drug companies promised to conduct drug R&D activities in Canada in proportion to Canada's contribution to world drug sales, and to abide by 'reasonable price controls' stipulated by the Canadian Patented Medicine Prices Review Board (Canadian Biotechnology Advisory Committee, 2006a).

experienced by developing countries. One prominent observer notes that patents on biological organisms will render seeds and medicines too expensive to be accessible to the world's poor, thus further threatening their survival and diminishing the sovereignty developing countries enjoy over their resources (Shiva, 2001b).

As information becomes a key commodity in the market, mechanisms to ensure proprietary control of the information commodity assume added consequence in the context of advanced capitalism. "[T]he consumption of knowledge is easily collectivized but is difficult to privatise. Capital has responded by trying to use the political arena to guarantee its private appropriation of socially produced knowledge" (Kenney, 1997, p. 89). Ned Rossiter (2006, p. 19) refers to intellectual property as "an architecture of control...[that] refuses the social relations that make possible the development of intellectual action, and it therefore refuses the potential for social transformation because of the way knowledge is enclosed within a property relation." Copyright[8] and patents have become the pre-eminent mechanisms by which to launch and sustain the monopolization of the production and dissemination of informational and cultural artefacts. This is particularly egregious in industrial sectors that have been heavily subsidized through publicly financed research, which, as the section on biotechnology and the academy outlined, characterises biotechnology. "Patents, instead of being a reward for inventors who place private information into the public domain, have become

[8] Every original literary, dramatic, musical and artistic work is protected by copyright whatever may be the mode or form of its expression. Copyright in works includes the sole right to: produce, reproduce, perform or publish any translation of the work; convert [a dramatic work] into a novel or other non-dramatic work; convert [a novel or other non-dramatic work] into a dramatic work, by way of performance in public or otherwise; make any sound recording, film or other contrivance by means of which the [literary, dramatic or musical] work may be mechanically reproduced or performed; reproduce, adapt and publicly present the [literary, dramatic, musical or artistic] work as a cinematographic work; communicate the [literary, dramatic, musical or artistic] work to the public by telecommunication (and others regarding public exhibition of art and the rental of computer programs and sound recordings); and, authorize any of the above.

a means of recycling public information as private monopolies" (Drahos & Braithwaite, 2002, p. 165). Despite the claims by proponents of strict intellectual property protection for information and knowledge, scant empirical evidence is offered to support the claim that absent such proprietary rights innovation would grind to a standstill:

> But the case for enclosure is at its strongest with arable land; even if one gives no weight at all to the contrary evidence there, the commons of the mind is very different and most of the differences cut strongly against the logic of enclosure – at least without considerably more evidence than we currently possess (Boyle, 2003b, p. 49, fn 70).

With the exception of commercially vibrant crops such as wheat and soybean, as well as ornamentals, similar doubts about the empirical validity of the connection between intellectual property rights and innovation levels have been raised in respect of plant variety protection (Dutfield, 2008).

6.1.1 Assessing Elements of Patentability in Respect of Genetically Engineered Organisms

The predominant intellectual property protection device applied throughout the biotechnology industry is the patent. As set out in subsection 27(1) of the *Patent Act*,[9] a patent shall be issued to the inventor of an invention, or the inventor's legal representative, if an application is filed in Canada in accordance with the Act and it meets all the other requirements specified by the Act. According to section 2 of the Act, which sets out definitions, an invention "means any *new* and *useful art, process, machine, manufacture or composition of matter, or any new and useful improvement* in any art, process, machine, manufacture or composition of matter" (emphasis added). Based on this definition we can derive three substantive elements that must be met in order for

[9] *Patent Act*, R.S.C. 1985, c. P-4.

something to meet the statutory definition of an 'invention' and thus attract patent protection: novelty,[10] utility, and patentable subject matter, meaning that the subject must fall within the definition of an invention in order to be patentable. Subsection 27(8) exempts from patentability "any mere scientific principle or abstract theorem." A fourth condition for patentability inferred from the requirement of novelty is that of non-obviousness (also referred to as inventiveness), which is similarly established by section 28.3 of the Act. Section 42 of the *Patent Act*[11] stipulates the scope and rights that attach to patent ownership:

> Every patent granted under this Act shall contain the title or name of the invention, with a reference to the specification, and shall, subject to this Act, grant to the patentee and the patentee's legal representatives for the term of the patent, from the granting of the patent, the exclusive right, privilege and liberty of making, constructing and using the invention and selling it to others to be used, subject to adjudication in respect thereof before any court of competent jurisdiction.

Patents thus convey on the rights holder the exclusive right, privilege and liberty to *make*, *construct*, and *use the invention*, as well as the right to *sell it to others* to be used. The duration of patent protection in Canada, and most other signatories to TRIPs,[12] is currently 20 years from the date of filing the patent application.

A 1988 Committee of Experts on Biotechnological Inventions and Industrial Property, established under the auspices of the World Intellectual Property Organisation (WIPO), voiced its approval of patent protection for biological products and processes so long as they satisfied the traditional criteria for patent protection, as outlined above (McNally & Wheale, 1998). However, based on these four requirements, which are

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[10] The novelty requirement is further reinforced through section 28.2 of the *Patent Act*, which rules that the subject matter of a patent application must not have been previously disclosed.
[11] *Supra* note 9.
[12] See section 2.5 for a fuller discussion of TRIPs and the global regulation of intellectual property in the context of biotechnology.

universal across member countries of the Paris Convention[13] and WTO, a number of people suggest that biological materials should not attract patent protection, arguing that patent policy

> has more or less evolved through dialogue within a limited circle of participants. Commercial interests, which are well represented to the patent office, have not been counterbalanced by those who represent the broader public interest. The result has been an innate tendency for the patent system to "creep" in the direction of extending patentability to biotechnology inventions for which the thresholds for novelty, inventiveness and utility have been lowered (Bobrow & Thomas, 2001, p. 763).

In the following subsections we discuss the various critiques that have been developed against patents for biotechnological products based on the 'novelty', 'utility', and 'non-obviousness' elements of patentability.

6.1.1.1 Assessing the 'Novelty' Criterion in Respect of Genetically Engineered Organisms

A report issued by the Nuffield Council on Bioethics[14] (United Kingdom) in 2002 asserts that most DNA sequences for which patents are sought lack an inventive step and should, therefore, be precluded from receiving patent protection. Similarly, a 2002 report released by the World Health Organization, entitled *Genomics and World Health*, concluded that "[t]he current position regarding DNA patenting is retarding rather than stimulating both scientific and economic progress. The monopolies awarded by patents

[13] The *Paris Convention for the Protection of Industrial Property* was the first international agreement in respect of patent protection. Subsequent to a diplomatic conference held in Paris in 1880, the following eleven countries signed the Convention in 1883: Belgium, Brazil, France, Guatemala, Italy, the Netherlands, Portugal, El Salvador, Serbia, Spain and Switzerland. The major motivation behind the Convention was to ensure that nationals of any member country of the union would receive in all the other countries of the union the same treatment as nationals of the latter. Since 1883 the Convention has been revised at Brussels on December 14, 1900, at Washington on June 2, 1911, at The Hague on November 6, 1925, at London on June 2, 1934, at Lisbon on October 31, 1958, and at Stockholm on July 14, 1967. It was last amended on September 28, 1979. As of writing (April 2008), 172 nations are contracting member countries of the Paris Convention. The World Intellectual Property Office (WIPO) administers the Paris Convention. A copy of the Convention can be found on the WIPO website at the following URL: http://www.wipo.int/treaties/en/ip/paris/trtdocs_wo020.html#P71_4054.

[14] The Nuffield Council on Bioethics is the pre-eminent body in the United Kingdom responsible for identifying, examining, and reporting on the ethical issues that arise from biological and medical research.

on genes as novel chemicals, therefore, are not in the public interest" (Shand, 2005, p. 42).

> Indeed, the selling, marketing, and commodification of DNA constitute perhaps the most striking element in recent trends. Mapping is the process of claiming territory – that was its historical purpose, and it remains so today in molecular genetics. The "commons" of human heredity has been divided up among the mappers, and the human genome is, essentially, entirely patented, with patents held about equally by private and public entities (Nelkin & Lindee, 2004, p. xii).

Another problem at the other end of the spectrum is the scope of some patents that seek to acquire monopoly protection for entire species. For example, Agracetus received an American patent in 1992 on all genetically modified cotton and a European patent in 1994 on all transgenic soybean plants, leading one commentator to liken such a practice to an attempt by Henry Ford to seek patent protection for all automobiles (van Wijk, 1995).

Vandana Shiva (2001b) is similarly critical of intellectual property protection for biological resources, asserting that the appropriation of indigenous knowledge and biodiversity fails at a creative, intellectual, and material level to satisfy adequately traditional patent requirements. Intellectually the innovation is already a part of an indigenous knowledge system. From a material perspective, the traits and properties for which patent protection is claimed already exist in nature, thus defeating the novelty claim. The assertion that isolating these traits and properties represents an inventive step can only be justified through an appeal to an epistemological foundation that treats non-Western cultures as inferior and nature as inert. That is, only by negating other cultures and nature can their creativity be appropriated as an act of creation that attracts patent protection (Boyle, 2003a; Shiva, 2001b).

6.1.1.2 Assessing the 'Utility' Criterion in Respect of Genetically Engineered Organisms

Although the World Health Organization has issued recommendations against the issuance of patents on DNA outside of the context of credible utility, patenting activity in genomics research has progressed (regressed) from genes associated with protein products to expressed sequence tags (ESTs), which are fragments of genes comprised of DNA sequences that contain hundreds of nucleotides, and single nucleotide polymorphisms (SNPs), which are DNA sequence variations that occur when a single nucleotide in the genome sequence is altered. One use made of ESTs is to act as a probe to detect genes that are either active or expressed under certain conditions or in certain tissues. SNPs can be used as markers to locate disease genes. In many of the cases where ESTs have been patented, the patent application fails to describe the exact location of the original gene on the chromosome, or its biological function. Patents on the basic knowledge revealed by ESTs and SNPs have the potential to inhibit further research that can only proceed if these genomic building blocks are readily available. One of the major controversies that erupted in the field of genetic research revolved around attempts by the American National Institutes of Health (NIH) in 1991 to obtain patents on ESTs. Although the NIH, under significant pressure from a number of scientists opposed to this idea, eventually abandoned its patent applications, private biotechnology firms submitted dozens of similar applications for patent protection (Hubbard & Wald, 1993; Long & Johnson, 1997). Corralling this basic knowledge within the confines of an intellectual property regime will also have negative implications for downstream product development (Thorsteinsdóttir, Daar, Smith, & Singer, 2003). According to members of the Human Genome Project:

> Some say that patenting such discoveries is inappropriate because the effort to find any given EST is small compared with the work of isolating and characterizing a gene and gene product, finding out what it does, and developing a commercial product. They feel that allowing holders of such 'gatekeeper' patents to exercise undue control over the commercial fruits of genome research would be unfair. Similarly, allowing multiple patents on different parts of the same genome sequence – say on a gene fragment, the gene, and the protein – adds undue costs to the researcher who wants to examine the sequence. Not only does the researcher have to pay each patent holder via licensing for the opportunity to study the sequence, he also has to pay his own staff to research the different patents and determine which are applicable to the area of the genome he wants to study (Australian Law Reform Commission, 2003, p. 43).

Given the fact that ESTs are new they might legitimately meet the non-obviousness criterion, but they would appear to fail the test of utility since their function is not known. Such patents are known as submarine patents designed to remain submerged, but pending, until another patent surfaces that also reveals a use. The holder of the submarine patent is then in a position to vitiate the new patent by demonstrating the prior patent, while simultaneously capturing the benefit through the revealed use (May, 2004). According to at least one observer, biotech patenting strategies involve attempts to "seek the broadest patent scope possible and to place considerable emphasis on the use of compromising language to maximise the reach-through claims of partial sequences" (Thomas, 1999, p. 138). In an effort to circumscribe this new enclosure movement, the UK Wellcome Trust, a non-profit, non-governmental organisation, and ten major pharmaceutical companies established in 1999 a non-profit foundation to map 300,000 common SNPs. Known as the SNP Consortium Ltd., this foundation has made SNP information available through a public database managed by the National Institutes of Health in the United States. By making this information publicly accessible the foundation hopes to facilitate further genetic research by avoiding duplicated effort and by preventing companies from applying for patents on this basic research information of the human genome (Government of Ontario, 2002).

Drahos and Braithwaite (2002) and James Boyle (2003a, 2003b) therefore contend that a strict application of the utility criterion might defeat many patent applications on DNA given that the applicant often does not have a complete understanding of the function of the DNA nor how it might be applied to produce an actual product. Other patents lay claim to DNA sequences that function as probes to facilitate research and therefore should be construed as research intermediaries rather than actual end products when assessing the utility criterion (Boyle, 2003a).

6.1.1.3 Assessing the 'Non-Obviousness' Criterion in Respect of Genetically Engineered Organisms

The rationale in support of gene patenting relies on the methods by which genes are 'isolated'. This process requires that a piece of DNA be removed from its original source on a chromosome and placed in a vector, which is a special DNA segment arranged in such a manner that the inserted DNA will express a particular protein. On the basis of this procedure it is argued that because the gene is not present in the human body in precisely that form, the gene is man-made rather than natural, and thus eligible for patent protection. This same line of argument has been employed in support of patent applications for subparts of genes, as well as gene mutations (Andrews & Nelkin, 2001). This situation is beginning to impact upon the ability of medical personnel to conduct testing. In the case of a conventional medical diagnostic tool, physicians can avoid a patented test kit but still check for a condition through other means. Patents at the molecular level, however, provide their holders with instruments that effectively preclude others from even testing for genetic illness, thus making them especially odious.

Andrews and Nelkin (2001) suggest that patent applications for human DNA should be rejected on the basis of either being a product of nature, or, given the significant advances in automated DNA sequencing, as failing to satisfy the non-obviousness criterion.[15] Aside from the fact that genetic sequencing methods tend to render additional steps in the process obvious from those conducted prior, the patents on such sequences are, in actuality, issuing on the basis of the factual raw data of DNA and their particular arrangement as acquired through the labour of sequencing. That is, such patents are based on 'sweat of the brow' justifications, which are not supposed to attract intellectual property protection (Boyle, 2003a).

Moreover, to the extent that the intellectual property system functions according to its traditional justifications, as outlined above, it can be considered to provide a social good by stimulating intellectual creativity and an expanded rate of progress (Bettig, 1996; Boyle, 1996; Vaver, 1991). Yet "the identification and consolidation of claims as patentable is *never* a singular event – despite the "eventful" image of "discovery" – but rather an iterative *process*" (Basalla, 1989; Packer & Webster, 1996, p. 431). In fact, Packer and Webster's (1996) empirical study demonstrates that scientists tend to believe in the incremental expansion of knowledge. "Although some advances were seen as more significant than others…they were all considered novel and contributing to progress in the field" (Packer & Webster, 1996, p. 435). This perspective obviously contradicts the conception of an invention as set out by the patenting process, which requires 'novelty' and 'non-obviousness'. For example, citations are a trusted mechanism within

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[15] For an extended analysis of the failure of genetic materials and information to satisfy traditional patent criteria, see May, C. (2004). Justifying enclosure? Intellectual property and meta-technologies. In S. Braman (Ed.), *Biotechnology and communication: The meta-technologies of information* (pp. 119-143). Mahwah, NJ: Lawrence Erlbaum Associates.; and May, C., & Sell, S. K. (2006). *Intellectual property rights: A critical history*. Boulder: Lynne Rienner Publishers.

academia to apportion credit and support the legitimacy of one's own work. In the context of patents, however, citations vitiate the non-obvious nature of a particular invention. Scientists seeking patent protection therefore tend only to cite work that patent examiners are likely to know, making sure that such works do not establish any close relationship between the subject matter of the patent application. This process of "constructing nonobviousness" is perhaps most subversive of the collaborative understanding of scientific praxis (Packer & Webster, 1996, p. 439).

6.2 Canadian Government Reports on Biotechnology and Patents

A 2002 report by the Government of Ontario to First Ministers makes the point that genetic innovation should attempt to strike a balance between the public and private good (Government of Ontario, 2002). The private good advocacy contained in the report focuses mainly on protecting the interests of children with regard to genetic testing and the privacy of genetic information when used in the context of employment or insurance. The public good championed by the report is most concerned with the role biotechnology can play in the Canadian economy and healthcare sector. In fact, the report envisions a more prominent role by federal and provincial governments in promoting Canada's biotechnology sector as a motor for economic growth. Part of this strategy includes patent reform in respect of genetic material.[16] The report rejects the recommendation made by the Federal Standing Committee on Health in December 2001 to ban gene

[16] What is termed patent reform has long been advocated by federal S&T policy. For example, a 1996 Industry Canada report argues that Canada needs to position itself "competitively within emerging international regulatory, standards, and intellectual property regimes by...ensuring that intellectual property policy relating to federally supported research increases private sector commercialisation and partnership opportunities" (Industry Canada, 1996b, p. 7). In this context, patent reform equates to stricter protection for intellectual property rights holders and circumscribed rights for users.

patenting and instead insists that the current patent system should be reviewed in order to determine how, and in what form, patents on human genetic material should issue. Some of the options the report considers for revamping the patent regime in respect of genetic material include: unambiguous exemptions that would shield both healthcare providers and researchers from patent infringement liability when engaging in non-commercial clinical use and general research; narrowing the subject matter for genetic patents, with special emphasis on determining under what conditions SNPs and ESTs may be patented; permitting patents only if specific uses for the genetic material are identified; the ability to reject patent applications on processes or procedures that offend against Canadian morality or ethics;[17] the introduction of a nine month opposition period after the issuance of genetic patents, within which time the scope, content, or validity of a new patent could be challenged; and, compulsory licencing of patents on genetic diagnostic and screening tests (Government of Ontario, 2002).

A 2005 report by the Expert Working Party on Human Genetic Materials, Intellectual Property and the Health Sector, which was established by the CBAC voices similar concerns about the impeding effects that strict intellectual property protection can have on research. It traces such deterrent problems to excessively broad patents, the lack of a legislated experimental use exemption against patent infringement (the report considers subsection 55.2(6)[18] of the *Patent Act* to be somewhat unambiguous), refusal of

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[17] The recommendation is to develop a *public ordre* morality clause based on European Union experience.
[18] The relevant sections of the *Patent Act* stipulate as follows:

> 55.2 (1) It is not an infringement of a patent for any person to make, construct, use or sell the patented invention solely for uses reasonably related to the development and submission of information required under any law of Canada, a province or a country other than Canada that regulates the manufacture, construction, use or sale of any product….
>
> (6) For greater certainty, subsection (1) does not affect any exception to the exclusive property or privilege granted by a patent that exists at law in respect of acts done privately and on a non-commercial scale or for a non-commercial purpose or in respect of any use,

patentees to licence their patents, onerous licencing fees, and excessive transaction costs associated with negotiating licences caught up in patent thickets. In response the report calls for more rigorous application of the four criteria for patentability and increased scientific expertise among Federal Court justices (one suggestion is to establish an Intellectual Property Division of the Federal Court) (Expert Working Party on Human Genetic Materials Intellectual Property and the Health Sector, 2005). Some of the Expert Working Party's recommendations, though disappointing, are not particularly surprising given that part of its mandate included the following statement:

> The objective of an effective and balanced intellectual property regime is to act as an important stimulus for innovation, by protecting and nourishing creativity and investment, to the mutual advantage of producers and users of such innovation, and in a manner conducive to economic and social benefits (Expert Working Party on Human Genetic Materials Intellectual Property and the Health Sector, 2005, p. vi).

The main message of this report is that Canada's patent regime should be strengthened, sped-up, and made more flexible in order to benefit inventors, investors, and producers. The report therefore rejects calls to move DNA beyond the scope of patentable subject matter, particularly since this would place Canada offside its major trading partners. The report urges the Canadian Intellectual Property Office to adopt interpretive guidelines for the patentability criteria in respect of biotechnology innovations based on American guidelines. The report drafters also rebuff the notion that morality or public ordre considerations should figure into patent examinations, instead arguing that other methods of social control, which are not particularly well defined in the report, should be employed. Fearing a reduction of innovation in the field, the report also argues against excluding diagnostic methods from patentability, although no

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manufacture, construction or sale of the patented invention solely for the purpose of experiments that relate to the subject-matter of the patent.

empirical evidence is mustered in support of this conclusion. Finally, the report, citing a lack of use of sections 19 and 65 of the *Patent Act*[19] contends that there is no current need to reintroduce compulsory licencing provisions into the legislation. Sections 19 and 65 of the *Patent Act*[20] permit governments and other potential licensees, respectively, to apply to the Commissioner of Patents for permission to use a patented invention without the approval of the patentee in cases where they have been unsuccessful in securing a licence on reasonable terms (Expert Working Party on Human Genetic Materials Intellectual Property and the Health Sector, 2005). Reading the report, however, one is left wondering whether its drafters engaged in any analysis of how 'reasonable' is measured and whether that has exercised any effect on decisions to bring actions based on these two sections of the Act. As a number of authors point out, patent holders are often large corporations with deep pockets able to withstand costly litigation, which often serves as a deterrent to challenges. The few recommendations made in the report that might be considered to support the public interest side of the intellectual property protection equation include the call to establish an experimental use exemption that would shield researchers from infringement claims and the idea of developing a "more open and responsive" process for requesting a re-examination of issued patents (Expert Working Party on Human Genetic Materials Intellectual Property and the Health Sector, 2005, p. x). With the addition of some qualifications and supplementation, the CBAC accepted the substantive recommendations made by the Expert Working Party when drafting its own report about intellectual property protection for human genetic materials that it presented to Industry Canada and Health Canada in 2006 (Canadian Biotechnology

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[19] *Supra*, note 9.
[20] *Ibid.*

Advisory Committee, 2006a). It bears pointing out that the CBAC has long advocated for the patentability of other higher life forms such as seeds, plants, and animals as long as they meet the utility, novelty, and non-obviousness criteria (Willison & MacLeod, 2002).

6.3 Canadian Case Law on Biotechnological Patents

Canada presents somewhat of a mixed picture in that the Supreme Court of Canada rejected Harvard University's patent application on the oncomouse but affirmed Monsanto's patent on its Roundup Ready canola.

6.3.1 Harvard College v. Canada (Commissioner of Patents)[21]

Harvard College applied for a patent on an invention entitled "transgenic animals". According to the application, a cancer-promoting gene ("oncogene") is injected into fertilized mouse eggs as close as possible to the one-cell stage. The eggs are then implanted into a female host mouse and permitted to develop to term. After the offspring of the host mouse are delivered, they are tested for the presence of the oncogene and those that contain it are referred to as "founder" mice. Founder mice are mated with mice that have not been genetically altered. Fifty per cent of the offspring will have all of their cells affected by the oncogene, making them suitable for animal carcinogenic studies. In its patent application, Harvard College sought to protect both the process by

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[21] *Harvard College v. Canada (Commissioner of Patents)* [2002] 4 S.C.R. 45, 2002 SCC 76. For detailed analysis of this case, see Scassa, T. (2003). A mouse is a mouse is a mouse: A comment on the Supreme Court of Canada's decision on the Harvard mouse patent. *Oxford University Commonwealth Law Journal, 3*, 105-117. For a similarly detailed account that clearly disagrees with the majority position, see the article written by two of the lawyers who represented Harvard College: Morrow, A. D., & Ingram, C. B. (2005). Of transgenic mice and roundup ready canola: The decisions of the Supreme Court of Canada in *Harvard College v. Canada* and *Monsanto v. Schmeiser. University of British Columbia Law Review, 38*, 189-222.

which the oncomice are produced and the end product of the process, i.e. the founder mice and the offspring whose cells contain the oncogene. The process and product claims extended to *all* non-human mammals genetically engineered to develop cancer.[22] In his decision,[23] the Patent Examiner allowed the process claims (13-26), agreeing that they were produced completely under the control of the inventor and were readily reproducible, thus qualifying as patentable subject matter as a manufacture or composition of matter within the statutory definition of 'invention'. However, the Commissioner found that the product claims (1-12) on the actual mice were too greatly influenced by the laws of nature, which removed from the inventor complete control over all the characteristics of the resulting mice. These claims were thus rejected on the grounds that whole organisms reach beyond the scope of the definition of 'invention' under section 2 of the *Patent Act*.[24] The appellant Commissioner subsequently confirmed the refusal of the product claims.

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[22] Patent claims are the definitions included in a patent application that set out the scope of the exclusive right for which the patentee seeks intellectual property protection. Most patent applications contain a number of consecutive claims that define the various aspects of the intervention in more detail. Establishing claims is a statutory requirement set out in subsection 27(4) of the *Patent Act* R.S.C. 1985, c. P-4, which states that "The specification must end with a claim or claims defining distinctly and in explicit terms the subject-matter of the invention for which an exclusive privilege or property is claimed." The United States patent issued in April 1988 and covers *all* non-human 'onco-animals'. The European Patent Office issued a patent on the genetically modified mouse in 1992, which immediately attracted an oppositional filing. The European Patent Office finally ruled in 2001 that the patent is valid but that it should be restricted to rodents.

[23] Decision of the Commissioner of Patents (4 August 1995) in *Harvard College v. Canada (Commissioner of Patents)* [2000] 4 FC 528 [17].

[24] *Supra* note 9. For purposes of assessing patentable subject matter the Canadian Patent Office distinguishes between uni-cellular life forms and higher life forms (section 12.04.01). Uni-cellular life forms that are new, useful, and inventive are patentable. In general, a process to produce, or which utilizes these organisms is patentable. Uni-cellular life forms include: microscopic algae; moulds and yeasts; bacteria; protozoa; viruses; cells in culture; transformed cell lines; and, hybridomas. Higher life forms are not patentable subject matter. However, a process for producing higher life form may be patentable provided the process requires significant technical intervention by man and is not essentially a natural biological process which occurs according to the laws of nature, for example, traditional plant cross-breeding. Higher life forms include: animals; plants; seeds; and, mushrooms. This is a revised version that relies on the jurisprudential precedents established by the Supreme Court of Canada in the Harvard oncomouse and Schmeiser decisions (Canadian Intellectual Property Office, n.d., p. 12-7). In its previous

Harvard proceeded to appeal the decision to the Federal Court Trial Division, which upheld the ruling of the Patent Office that the oncomouse did not meet the definition of an 'invention' under the *Patent Act*.[25] In reaching this conclusion, Justice Nadon applied four indicia to his interpretation of 'invention', ultimately determining that the inventors lacked control over the invention beyond the presence of the oncogene, that the creation of the oncomouse, beyond the human intervention involved, relied to a significant degree on the laws of nature, that these laws of nature, in turn, introduced such a degree of variation into the process in terms of which offspring would actually be carriers of the oncogene, among other natural characteristics, that reproducibility was significantly vitiated, and finally, that as a matter of policy higher life forms are not patentable.[26]

The respondent's (Harvard) further appeal to the Federal Court of Appeal was allowed, with the majority of that Court ruling that the oncomouse fits the definition of 'composition of matter' since the fertilized mouse egg is a form of biological matter, together the egg and the DNA are a composition of matter, and the resulting mouse is the product of that composition of matter that evolves from a single cell to a multi-cellular level.[27] Moreover, the Appeal Court decision, as opposed to the analysis offered by Justice Nadon at the Federal Court Trial Division, reasoned that the progeny of any oncomouse were also to be considered compositions of matter for purposes of the Act because they possess a genetic trait not present in nature and they are linked through

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iteration the manual defined higher life forms as "multi-cellular differentiated organisms" (Morrow & Ingram, 2005, p. 190).

[25] *Supra* note 9. As outlined in the discussion above about the elements of patentability, section 2 of the Act stipulates that an ""invention" means any new and useful art, process, machine, manufacture or composition of matter, or any new and useful improvement in any art, process, machine, manufacture or composition of matter".

[26] [1998] 3 FC 510.

[27] [2000] 4 FC 528.

heredity to the original composition of matter. Justice Rothstein, who penned the Appeal Court's majority opinion, contends that the scope of 'composition of matter' should not be interpreted as excluding living things and that decisions about whether patents may issue for life forms must reject the animate-inanimate dichotomy and instead distinguish between discovery and invention. The Patent Office was thus instructed to grant the refused claims.[28]

The Commissioner of Patents subsequently appealed that decision to the Supreme Court of Canada. In December 2002 the Supreme Court overturned the ruling made by the Federal Court of Appeals, upholding the decision made by the Commissioner of Patents not to allow the product patent claims, arguing that based on the wording of the *Patent Act*[29] non-human mammals were beyond the scope of the Act. The Court did, however, refrain from commenting on whether life forms should be patentable or not, arguing that is a decision that can only be made by Parliament.[30]

> The sole question in this appeal is whether the words "manufacture" and "composition of matter", within the context of the Patent Act, are sufficiently broad to include higher life forms. It is irrelevant whether this Court believes that higher life forms such as the oncomouse ought to be patentable. The words of the Patent Act "are to be read in their entire context and in their grammatical and ordinary sense harmoniously with the scheme of the Act, the object of the Act, and the intention of Parliament".[31]

In drafting the majority opinion, Mr. Justice Bastarache is clear in characterising the decision before the court as one of interpretation and not public policy:

> Patenting higher life forms would involve a radical departure from the traditional patent regime. Moreover, the patentability of such life forms is a highly contentious matter that raises a number of extremely complex issues. If higher

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[28] *Ibid.*
[29] *Supra* note 9.
[30] Determining the boundary between lower and higher life forms for purposes of patentability has been a continuing debate in Canadian jurisprudence. See, for example, *Re Application of Abitibi Co.* (1982) 62 C.P.R. (2d) 81, and *Pioneer Hi-Bred Ltd. v. Canada (Commissioner of Patents)* [1989] 1 S.C.R. 1623.
[31] *Supra* note 21, para. B.

> life forms are to be patentable, it must be under the clear and unequivocal direction of Parliament. For the reasons discussed above, I conclude that the current Act does not clearly indicate that higher life forms are patentable. Far from it. Rather, I believe that the best reading of the words of the Act supports the opposite conclusion – that higher life forms such as the oncomouse are not currently patentable in Canada.[32]

While accepting that the definition of 'invention' should be interpreted broadly, Justice Bastarache nonetheless refuses an unlimited definition:

> In drafting the Patent Act, Parliament chose to adopt an exhaustive definition that limits invention to any "art, process, machine, manufacture or composition of matter". Parliament did not define "invention" as "anything new and useful made by man". By choosing to define invention in this way, Parliament signalled a clear intention to include certain subject matter as patentable and to exclude other subject matter as being outside the confines of the Act. This should be kept in mind when determining whether the words "manufacture" and "composition of matter" include higher life forms.[33]

In response to the admonition Justice Bastarache articulates in the last sentence of the previous quote, he goes on to add that ""composition of matter" does not include a higher life form such as the oncomouse" and that "[t]he words "machine" and "manufacture" do not imply a conscious, sentient living creature. This provides prima facie support for the conclusion that the phrase "composition of matter" is best read as not including such life forms."[34]

Quite telling of the extent to which neoliberal perspectives permeate Canada's judiciary is the rhetoric employed by Justice Binnie in the opinion he drafted for the minority in this case, which begins by proclaiming that "[t]he biotechnology revolution…has been fuelled by extraordinary human ingenuity and financed in significant part by private investment."[35] Ho goes on to stress the importance of

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[32] *Ibid.*, para. 166.
[33] *Ibid.*, para. 158.
[34] *Ibid.*, paras. 160-161.
[35] *Ibid.*, para. 1.

monopoly patent rights, maintaining that "[i]nnovation is said to be the lifeblood of a modern economy. We neglect rewarding it at our own peril."[36] Justice Binnie continues by pointing out the revenue potential of the global biotechnology industry, including Canada's place within that market, ultimately arguing that Canada must be onside with its major trading partners or risk losing out on economic opportunities: "The mobility of capital and technology makes it desirable that comparable jurisdictions with comparable intellectual property legislation arrive (to the extent permitted by the specifics of their own laws) at similar legal results".[37] Aside from trotting out tired statements about the apparent necessary link between pecuniary incentives and innovation, the discourse of Justice Binnie seeks to firmly situate debate about biotechnological innovations within the dominant context of capitalist social relations and private enterprise. This is particularly dangerous because "the values and perspectives of judges…are ones that ultimately inform the interpretive outcome. It is in this way that judicial values influence interpretation" (Scassa, 2003, p. 117). It would be precisely this perspective that carried the day in the subsequent *Monsanto v. Schmeiser* Supreme Court decision, a decision that, as discussed below, undergirds the privatisation functions of the intellectual property system in rendering increasing areas of biological existence as exclusive and alienable cogs in the machinery of capitalist value production.

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[36] *Ibid.*, para. 4.

[37] *Ibid.*, para. 13. The American-based Biotechnology Industry Organization (BIO) placed Canada on its "watch list" in February 2004 because of concerns about the strength of Canada's intellectual property regime, particularly in light of the 'Harvard Mouse' decision. In its brief to the Office of the United States Trade Representative, BIO claims "[t]he developments on patent eligibility compound an ongoing problem of erosion in protection of intellectual property in pharmaceutical and medical technology in Canada. For example, the ability of companies to realise the full value of their intellectual property rights is limited by restrictive practices governing pricing of new, patented pharmaceuticals. In addition, health authorities in Canada interpreted regulations promulgated to implement the NAFTA provision on undisclosed test and other data in a manner that essentially removes any protection for these data associated with pharmaceutical products and that is inconsistent with that Agreement and the TRIPS [sic] Agreement" (Biotechnology Industry Organization, 2004, p. 15).

6.3.2 Monsanto v. Schmeiser aka David versus Goliath

The other major patent dispute in respect of a genetically engineered organism in this country involves the lawsuit brought by Monsanto Canada against Percy Schmeiser for apparent patent infringement. Monsanto has developed and vigorously markets canola[38] and soybean[39] seeds in Canada that have been genetically engineered to be resistant to its 'Roundup' herbicide (glyphosate is the active ingredient in these herbicides) – its line of glyphosate resistant seeds are marketed and known as 'Roundup Ready'. In 1993 Monsanto acquired a Canadian patent for, among other things, the process it had developed to create and insert glyphosate resistant genes into canola seed. Farmers who wish to plant Roundup Ready canola must contract with Monsanto to pay for the seed as well as a technology fee of $15 per acre. Farmers who choose to grow any of Monsanto's Roundup Ready products are also contractually compelled to use only Monsanto's glyphosate (Roundup) herbicide. Because Monsanto's patent on Roundup was set to expire in 2000, Monsanto engaged, and continues to do so, in contractual bundling practices in order to maintain its dominant position in the agrochemical market (de la Perrière & Seuret, 2000; McNally & Wheale, 1998). As one observer notes, the

[38] Canola is a particular species of the broader rapeseed genus that was developed in Canada in the 1970s. Prior to the development of canola, rapeseed oil was used mainly as an industrial lubricant. Dr. Baldur Stephannson and Dr. Keith Downey crossbred rapeseed to develop this new variety, canola, that contains important nutritional elements and which has become a major food oil crop. The name canola is actually the abbreviation for *Can*adian *O*il *L*ow *A*cid, which is registered as a trademark by the Western Canadian Oilseed Crushers' Association (Busch, Gunter, Mentele, Tachikawa, & Tanaka, 1994; Tanaka, Juska, & Busch, 1999). Monsanto received regulatory approval from Health Canada to market its first line of glyphosate tolerant canola (GT73) on November 21, 1994. A complete, and relatively up-to-date, list of all genetically engineered organisms approved by Health Canada (in Canadian Government parlance the discussion revolves around 'novel foods' rather than genetically engineered organisms) can be accessed at the following URL: http://www.hc-sc.gc.ca/fn-an/gmf-agm/appro/index_e.html. The list provides no information about products currently being reviewed by the department; in fact, Health Canada considers such information proprietary and refuses not only to disclose details about a particular application, but also rejects access to information requests that seek confirmation about whether or not a company has submitted an application for regulatory approval of a particular product.

[39] Health Canada granted Monsanto regulatory approval to market its first line of glyphosate resistant soybean seeds (GTS 40-3-2) on April 9, 1996.

success of such tactics helps explain why large pesticide companies were prompted to move into agricultural biotechnology (Kuyek, 2002, pp. 77-78). In addition to the stipulation that only Roundup Ready herbicide be used, the Technology Use Agreements that accompany all of Monsanto's Roundup Ready seed varieties, and which farmers purchasing the seed must sign, contain terms that prohibit the re-use of seeds, limit Monsanto's liability for any loss incurred from using the product, dictate how farmers must proceed if they launch a claim, and provide Monsanto complete access rights to farmers' fields (Kloppenburg, 2004).

Monsanto has also made it publicly clear that it will launch civil suits against farmers who refuse to adhere to the terms it imposes on the sales of its genetically modified seeds. In June 1998 Monsanto released the following warning to farmers in various newspapers:

> When a farmer stores and sows biotech seeds (genetically modified seeds) patented by Monsanto, he should understand that he is in the wrong. This holds true even if he is has not signed any contract at the time of procuring seeds (that is, if he recycles or if he buys seeds illegally from a neighbour). He is pirating.... Moreover, this pirating of seeds could cost the farmer hundreds of dollars per acre by way of damages, interest and legal costs, apart from having to undergo the inspection of his fields and records over many years (as cited in de la Perrière & Seuret, 2000, p. 12).

True to its word, Monsanto has successfully sued a number of Canadian and American farmers.[40] In its most recent victories, two Ontario farmers have been slapped with punitive damages for growing Roundup Ready soybeans without a licence. In June 2007 a federal court judge ruled that Edward Wouters, of Northspruce Farms, has to pay

[40] According to the Center for Food Safety in Washington, D.C., Monsanto has launched patent infringement lawsuits against almost 100 farmers in the United States. In January 2008 the United States Supreme Court let stand, without comment, a lower court ruling that awarded Monsanto $375,000 in damages against a farmer the company sued for planting seeds saved from the Roundup Ready crops he had 'legally' acquired the previous year.

Monsanto more than $107,000 ($274 per acre) for knowingly growing, harvesting, and selling 392 acres of Roundup Ready soy (Coad, 2007). In November 2007 Monsanto successfully sued another Ontario farmer, Paul Beneteau, for infringing its Roundup Ready patent. Beneteau was ordered in the Federal Court of Canada to pay Monsanto punitive damages in the amount of $8,800 (55 acres at $160 per acre) and turn over to the company any of the genetically engineered soybeans still in his possession (Romahn, 2007). Monsanto is currently pursuing patent infringement lawsuits against three other Ontario farmers. The most well-known example of Monsanto suing a farmer involves Percy Schmeiser.

Percy Schmeiser, who has been farming for over fifty years in Bruno, Saskatchewan, engages in the practice of saving and crossbreeding seed for use in future plantings. In 1997 he planted a crop of canola using seed he had saved from the previous year. Over the course of the growing season Schmeiser determined that parts of his fields were contaminated with Roundup Ready canola, which he would allege at trial was 'volunteer' canola.[41] In 1997 Monsanto inspectors, acting on an anonymous tip from a neighbouring farmer, confirmed that Schmeiser had Roundup Ready canola growing in his fields without Monsanto's permission.[42] Monsanto subsequently sued Schmeiser in

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[41] Volunteer canola is considered by farmers to be a weed and, in fact, herbicide tolerant volunteer is now prevalent across much of the prairies.

[42] The assay of crops, commonly referred to as 'genome control' by seed producers, is becoming a major activity of these seed corporations, who devote significant laboratory resources to developing detection tools to aid in enforcing their Technology Use Agreements. See, for example, Lewontin, R. C. (2000b). The maturing of capitalist agriculture: Farmer as proletarian. In F. Magdoff & J. B. Foster & F. H. Buttel (Eds.), *Hungry for profit: The agribusiness threat to farmers, food, and the environment* (pp. 93-106). New York: Monthly Review Press. According to a report issued in 2005 by the Center for Food Safety, Monsanto has an annual budget of US$10 million and a staff complement of 75 people who are dedicated to investigating and prosecuting farmers. As of 2005 Monsanto had been awarded over US$15 million in the United States against farmers, though that number underestimates the true amount collected by Monsanto from American farmers since it does not include those sums included in the large number of lawsuits settled out of court (The Center for Food Safety, 2004).

Federal Court[43] for patent violation and won its case because Schmeiser had failed to alert Monsanto to the presence of its product on his land. In his judgement, Mr. Justice McKay of the Federal Court Trial Division wrote that the evidence suggested Schmeiser "knew or ought to have known" that the seeds he saved and planted the following year contained Monsanto's patented invention, thus establishing infringement.[44] In reaching its decision the Federal Court Trial Division disregarded the facts that Schmeiser did not sell the resulting seed, had not sprayed his crops with Roundup herbicide, and ultimately had received no financial gain from the Roundup Ready plants in his fields (McGiffen, 2005; Phillipson, 2005). The court concluded that Monsanto could not control how the gene was dispersed throughout the countryside – incidentally, trying to establish corporate liability for the agricultural, economic, and environmental ramifications of its genetically engineered seeds is precisely the issue around which the Organic Agriculture Protection Fund suit revolves.[45] Schmeiser was ordered to pay $15,450 in royalties and up to $105,000 for the profit from his 1998 crop.

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[43] Because Monsanto, as the plaintiff in this case, is incorporated pursuant to the *Canada Business Corporations Act* (R.S., 1985, c. C-44) it was permitted to choose which court to use to enforce its patent. Monsanto elected to pursue its claim in Federal Court, which makes strategic sense for a couple of reasons: Federal Court judges have greater expertise in patent law than lower court judges, but more importantly for Monsanto, the Federal Court has no jurisdiction in tort actions between individuals. As a result, Schmeiser was not permitted to launch a counterclaim in Federal Court against Monsanto based on liability for crop contamination. Schmeiser was thus compelled to incur the additional time and expense of filing a separate claim for damages against Monsanto in Saskatchewan's Court of Queen's Bench.

[44] *Monsanto Canada Inc. et al. v. Schmeiser et al.* (2001), 12 C.P.R. (4th) 204 (F.C.T.D.), 2001 FCT 256 [*Schmeiser – FCTD* cited to C.P.R.], para. 120. The *et al.* indicates that the plaintiffs in the case were Monsanto Company, as owner of the patent at issue, and Monsanto Canada Inc., its Canadian subsidiary and licencee under the patent. The defendants technically included Percy Schmeiser and the corporation that owns and operates his farming enterprise.

[45] Canola, unlike corn and wheat, has not been domesticated and continues to possess a number of wild species traits. Canola seeds can remain dormant for anywhere between six and ten years and they can germinate at any point in the season, not just in the spring. The physical characteristics of the seed (small, round, and smooth) allow it be transported easily by wind. Moreover, canola, although mainly a self-pollinating species, is subject to outcrossing (to cross animals or plants by breeding individuals of different strains but usually of the same breed) in the range of 20%-30% and its pollen can be moved several kilometres by insects. Also, once a field has been planted with Roundup Ready Canola the soil remains contaminated with shattered seeds from that year's harvest, even if in subsequent years conventional canola

Although the Federal Court of Appeal unanimously rejected Schmeiser's appeal, on May 8, 2003 he was granted leave to appeal to the Supreme Court of Canada, which heard the case in January 2004.[46] At least one observer contends that Schmeiser's failure at the Federal Court of Appeal would normally have meant the end of the case, but that the Supreme Court of Canada decision in *Harvard College v. Canada*[47] opened the door to its consideration of the *Monsanto v. Schmeiser* case. In its decision from May 2004, the Supreme Court upheld the validity of Monsanto's patent, finding Schmeiser guilty of patent infringement. Though not a completely surprising decision given the findings of fact at trial, at first glance it seems to contradict the oncomouse decision made in 2002 that refused the patentability of higher life forms. This point was made by the dissenting judges in the Schmeiser case, who asserted that patents on genes or cells, when reproduced naturally as part of an entire organism could, in fact, confer *de facto* intellectual property rights over whole organisms:

> The heart of the issue is whether the Federal Court of Appeal's decision can stand in light of this Court's ruling that plants as higher life forms are unpatentable. A purposive construction that limits the scope of the respondents' claims to their "essential elements" leads to the conclusion that the gene claims and the plant cell claims should not be construed to grant exclusive rights over the plant and all of its offspring. This interpretation is fair and predictable because it ties the respondents to their claims; the respondents specifically disclaim plants. Patents must be interpreted from the point of view of the person skilled in the art who must also be taken to know the law. A person skilled in the art could not reasonably have expected that patent protection extended to unpatentable plants and their offspring.[48]

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seed is planted. See, for example, Clark, E. A. (2001). On the implications of the Schmeiser decision: The crime of Percy Schmeiser. *The Genetics Society of Canada Bulletin, 32*, 19-22. Kloppenburg (1988, 2004), in his study of agricultural biotechnology, outlines a number of cases in the United States in which genetic contamination from pollen flows from field to field has occurred in self-pollinated crops like soybeans as well as open-pollinated crops like corn and canola, all of which have proven that the buffer zones between genetically modified and traditional crops recommended by government are wholly insufficient.

[46] *Monsanto Canada Inc. v. Schmeiser*, [2004] 1 S.C.R. 902, 2004 SCC 34.

[47] *Supra*, note 21.

[48] *Supra*, note 46, pp. 5-6.

The 5:4 majority decision, written by Madame Chief Justice McLachlin and Justice Fish, reasoned that Monsanto's patent is valid because it is limited to the genetically engineered genes and the modified cells without including the plant itself.

> The patent is valid. The respondents did not claim protection for the genetically modified plant itself, but rather for the genes and the modified cells that make up the plant. A purposive construction of the patent claims recognises that the invention will be practiced in plants regenerated from the patented cells, whether the plants are located inside or outside a laboratory. Whether or not patent protection for the gene and the cell extends to activities involving the plant is not relevant to the patent's validity. The appellants have failed to discharge the onus to show that the Commissioner of Patents erred in allowing the patent.[49]

Concluding that both the majority and minority opinions in the 'Harvard mouse' decision provided support for Monsanto's patent, the majority decision asserted that Schmeiser's reliance on that precedent as a rejection of patents on higher life forms failed to meet his burden of proving that Monsanto's patent should not have issued.

> Whether or not patent protection for the gene and the cell extends to activities involving the plant is not relevant to the patent's validity. It relates only to the factual circumstances in which infringement will be found to have taken place.... Monsanto's patent has already been issued, and the onus is thus on Schmeiser to show that the Commissioner erred in allowing the patent.... He has failed to discharge that onus. We therefore conclude that the patent is valid.[50]

As such, by cultivating plants that contained validly patented material vital to the growth of the plant (i.e. since the genes exist throughout it), the majority reasoned that Schmeiser necessarily infringed Monsanto's patent.

> Case law shows that infringement is established where a defendant's commercial or business activity involving a thing of which a patented part is a component necessarily involves use of the patented part. Infringement in this case therefore does not require use of the gene or cell in isolation. Infringement also does not require that the appellants have used Roundup herbicide as an aid to cultivation. First, this argument fails to account for the stand-by or insurance utility of the properties of the patented genes and cells. Second, the appellants did not provide sufficient evidence to rebut the presumption of use. While a defendant's conduct

[49] *Ibid.*, p. 3.
[50] *Ibid.*, para. 24.

> on becoming aware of the presence of the patented invention may assist in rebutting the presumption of use arising from possession, in the circumstances of this case, this presumption stands unrebutted. The appellants actively cultivated Roundup Ready Canola as part of their business operations. In light of all of the relevant considerations, the appellants used the patented genes and cells, and infringement is established.[51]

This position is disputed by the minority opinion, which, citing a CBAC report (Canadian Biotechnology Advisory Committee, 2002b, p. 12), maintains that:

> The use of biologically replicating organisms as a "vehicle" for genetic patents may overcompensate the patentee both in relation to what was invented, and to other areas of invention....Because higher life forms can reproduce by themselves, the grant of a patent over a plant, seed or non-human animal covers not only the particular plant, seed or animal sold, but also all its progeny containing the patented invention for all generations until the expiry of the patent term (20 years from the priority date). In addition, much of the value of the higher life form, particularly with respect to animals, derives from the natural characteristics of the original organism and has nothing to do with the invention. In light of these unique characteristics of biological inventions, granting the patent holder exclusive rights that extend not only to the particular organism embodying the invention but also to all subsequent progeny of that organism represents a significant increase in the scope of rights offered to patent holders. It also represents a greater transfer of economic interests from the agricultural community to the biotechnology industry than exists in other fields of science.[52]

Justices MacLachlin and Fish went on to write, "[i]nfringement through use is thus possible even where the patented invention is part of, or composes, a broader unpatented structure or process."[53] The Supreme Court also rejected Schmeiser's claim that he was not guilty of infringement because he did not spray his crops with Roundup Ready herbicide and thus made no use of Monsanto's patented gene. According to the majority opinion,

> Whether or not a farmer sprays with Roundup herbicide, cultivating canola containing the patented genes and cells provides standby utility. The farmer

[51] *Ibid.*, pp. 4-5.
[52] *Ibid.*, para. 165.
[53] *Ibid.*, para. 43.

> benefits from that advantage from the outset: if there is reason to spray in the future, the farmer may choose to do so.[54]

The Supreme Court did, however, reduce the damages awarded to Monsanto in the lower courts. It set aside the requirement to pay Monsanto the profits from his 1998 crop, arguing that Schmeiser did not earn any additional profit from using Monsanto's variety above the profit he would have earned by growing non-genetically engineered varieties. One legal commentator contends that the Supreme Court overstated the case of Schmeiser's infringement since the invention at issue is the genetically engineered resistance of canola to glyphosate, which Schmeiser did not make use of since he did not spray his crops with Roundup herbicide (Mgbeoji, 2007). Given the mixed results of the appeal each party was ordered to bear their own costs throughout.[55] The Schmeiser case continues to serve as a rallying point around which opposition to genetically engineered seeds is mobilised. In fact, the case, according to one interview informant, has spawned the neologism of 'getting Schmeisered', by which is meant being sued by transnational agribusiness for patent infringement. It is worth noting that Schmeiser's very public struggles against Monsanto were recently recognised when he and his wife were awarded a Right Livelihood Award, also known as the 'alternative Nobel Prize', which is bestowed annually in a ceremony in the Swedish Parliament to honour and support those "offering practical and exemplary answers to the most urgent challenges facing us today". The award is normally given to four recipients who share the prize money (two million Swedish kronor, or about US$310,000) to help them with their work. According to the Right Livelihood Foundation, the Schmeisers

[54] *Ibid.*, para. 84.
[55] *Ibid.*, para. 106.

> have given the world a wake-up call about the dangers to farmers and biodiversity everywhere from the growing dominance and market aggression of companies engaged in the genetic engineering of crops. The Jury honours the Schmeisers "for their courage in defending biodiversity and farmers' rights, and challenging the environmental and moral perversity of current interpretations of patent laws" (see http://www.rightlivelihood.org/).

In analysing the decisions made in this case at both the lower court and Supreme Court levels, a number of observers re-iterate the argument made by the dissenters on the Supreme Court that the majority decision provides Monsanto a backdoor opportunity to acquire patent protection over an entire organism, which otherwise is not permitted under current patent legislation. These same commentators chide the majority ruling for failing to employ alternative legal mechanisms that could have responded to Monsanto's commercial interests without embarking on this particularly slippery path (Gold & Adams, 2001, p. 587; Phillipson, 2005). Phillipson (2005), who is critical of the imbalance in patent law between the expanding rights and corresponding lack of responsibilities that attach to patents on genetically engineered organisms, further contends that the Supreme Court decision in *Monsanto v. Schmeiser*[56] vitiates the so-called 'farmers privilege' read into the *Plant Breeders' Rights Act*[57], under which farmers may, in certain prescribed circumstances, save and re-use seed.

What has been a millennial duty, saving and exchanging seed, is becoming a crime of intellectual property theft (Shiva, 2001a). However, the Public Patent Foundation, an American non-profit organisation that works to protect the public from undeserved patents and flawed patent policy, has been successful in challenging four Monsanto patents that the company has used in lawsuits against American farmers.

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[56] *Ibid.*, note 46.

[57] To be precise, such a right is not expressed specifically in the *Plant Breeders' Rights Act,* S.C. 1990, c. 20. Instead, such a right has been read into the Act because it does not expressly prohibit such practices in certain situations.

Between February and July 2007, the United States Patent Office revoked all four patents on the basis of prior art.[58] Further relief was won recently in Munich, where the European Patent Office, after thirteen long years of review, on May 3, 2007 revoked Monsanto's species-wide patent on all genetically engineered soybeans (EPO0301749) on the grounds that it failed to meet the 'novel' criterion and was not described in sufficient detail to permit a person skilled in the art to repeat it (ETC Group, 2007b). The patent challenge was initiated by ETC Group in 1994 (then known as RAFI) and supported by Greenpeace, the European initiative "No Patents on Life!", and Dr. Ricarda Steinbrecher, of the UK-based group EcoNexus. Paradoxically, Monsanto actually initially opposed the patent, which was originally held by Agracetus, until Monsanto purchased that company in 1996 and acquired the rights to the patent. The satisfying irony of this story is that arguments made by Monsanto scientists in 1994 about insufficient description of the Agracetus patent ultimately helped defeat the patent 13 years later. In the past, ETC Group has also scored successes in challenging and defeating patents on genetically engineered cotton varieties issued to Agracetus in India and the United States (ETC Group, 2007b).

To summarise the main arguments presented in this section, it is questionable whether the conceptual justifications for intellectual property in respect of biotechnology can withstand empirical scrutiny. At a technological level, most contemporary patent claims on genetically engineered organisms are premised on the increasingly disputed postulate within the scientific community that one gene codes for one function (Caruso,

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[58] Three patents claimed DNA constructs to enhance the efficiency of transcription (5,164,316; 5,196,525; 5,322,938) and the fourth made claims over chimeric genes expressed in plant cells and the plants that contain those genes (5,352,605). More detailed information about the revocation of these patents can be found on the Public Patent Foundation website, at the following URL: http://www.pubpat.org/monsantovfarmers.htm.

2007). At a conceptual level there is a disconnect between the monopoly rights conferred by intellectual property and the normative objective of fostering the flow of information and the development of useful arts. This disconnect is exacerbated by the increasingly oligopolistic structure of the biotechnology industry. As biotechnological capital expands its control over markets, either through new technologies or in new territories, it is the transnational corporations rather than the actual inventors of artefacts who hold the patents and are thus profiting through the "work for hire" doctrine ensconced in most intellectual property statutes. Against a backdrop of the 'information economy', intellectual property resources become increasingly vital and broadly held within the capitalist economic structure, and thus serve to unify the interests of the capitalist class as a whole (Bettig, 1996). The asymmetrical power relationships imbricated in intellectual property regimes is particularly evident in the context of biotechnology, where the genetic material found in the Global South fails to attract protection, while the finished products developed in the industrialised countries on the basis of these biological inputs are subject to stringent legal safeguards (May & Sell, 2006). Moreover, the putative assumption about the need for pecuniary incentives that undergirds the intellectual property regime overlooks those actors who produce informational or cultural artefacts for reasons other than financial recompense. In particular, the traditional Mertonian model of wide dissemination of scientific findings would seem to betray the purported need to grant a scientist/inventor a monopoly right as an incentive to create.

6.4 Accounting for Corporate Command Through Intellectual Property Policy

Following the argument laid out in the previous chapters about the growing preponderance of science in production processes as a source of productivity and value throughout the capitalist circuit, we recognise that the contemporary intellectual property system, particularly patenting, has proven to be an effective instrument employed by capital to ensure that scientific and technological developments in the realm of biotechnology serve capitalist valorisation purposes. Public sector plant breeding research and a number of the fundamental enabling technologies (transformation methods, selectable markers, and constitutive promoters) employed in genetic engineering that were developed in the public sector have been licenced exclusively to biotechnology companies that, in turn, have appropriated such publicly produced knowledge to develop their product lines that subsequently receive intellectual property protection through patents (Graff, Cullen, Bradford, Zilberman, & Bennett, 2003).[59] Specific to biotechnology, one argument advanced by proponents of patent protection is that this type of protection safeguards the underlying information rather than the life form. That is, the genes remain a part of the commons and 'only' the information that describes them and their use attracts protection. In part this contention flows from the

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[59] The authors of this 2003 study indicate that in the United States, private companies hold 74 percent of agricultural biotechnology patents. Moreover, 41 percent of all agricultural biotechnology patents are held by the biggest five companies: Monsanto owns 14 percent, DuPont 13 percent, Syngenta seven percent, Bayer four percent, and Dow three percent. The authors caution that these numbers could, in fact, underestimate the level of private intellectual property control of agricultural biotechnology because of the exclusive licencing arrangements often negotiated between public sector researchers and private companies. See, Graff, G. D., Cullen, S. E., Bradford, K. J., Zilberman, D., & Bennett, A. B. (2003). The public-private structure of intellectual property ownership in agricultural biotechnology. *Nature Biotechnology, 21*, 989-995. For an account (albeit somewhat uncritical) of the increasing trends toward agricultural technology transfer from the public to the private sector in the United States and a number of developing countries, see Fuglie, K. O., & Schimmelpfennig, D. (2000). *Public-private collaboration in agricultural research: New institutional arrangements and economic implications.* Ames: IA: Iowa State University Press.

traditional notion inherent in intellectual property regimes that the commons remain because of disclosure requirements and limited terms of monopoly protection. However, what these proposed justifications deliberately neglect to consider is that the relatively standardised structure of the biotechnology industry that relies on a common set of expensive techniques to manipulate biochemical information renders most current patents an effective rent that must be paid if further research and innovation is to be conducted (May, 2004).

In point of fact the intellectual property system facilitates the appropriation of knowledge that has been developed in the commons for centuries, separating universal labour from its own knowledge, thus serving not only to reduce living knowledge to abstract knowledge, but also to actually devalue the former – which usually occurs along North South divisions. Reflecting on our theoretical framework, we recognise that the diffuse nature of the knowledge encompassed in the general intellect confounds efforts of appropriation by capital through an intensified division of labour along Taylorist lines. This is so because such an expropriation would require that the general level of education of labour be reduced but capitalist accumulation depends increasingly on high levels of general intellect (Vercellone, 2007).

> In cognitive-labour-producing knowledge, the result of labour remains incorporated in the brain of the worker and is thus inseparable from her person. That helps explain, together with other factors, the pressure exercised by enterprises in order to attain a strengthening of the rights of intellectual property and to re-enclose, in a new phase of the primitive accumulation of capital, the social mechanisms at the base of the circulation of knowledge (Vercellone, 2007, p. 33).

We might therefore rightly construe contemporary intellectual property regimes, both nationally and internationally (the latter impinges on the former), as the legal mechanisms or instances of state support of modern enclosures in much the same way that the state facilitated historical terrestrial enclosures. The difference today is that the knowledge enclosures around biotechnology being achieved through the intellectual property regime have very real implications for our biological resources that up until about the last two decades remained a common species-being resource largely beyond the purview of capitalist commodification. Following Hardt and Negri (2004) as well as Benkler (2006), we contend that efforts by capital and various state governments to extend intellectual property protection terms should be construed as the result of the struggle of biopolitical production by universal labourers seeking to promote a vibrant knowledge commons.

Bearing in mind the exposition of capitalist control of biotechnological agriculture presented in the previous chapter, we would also explicitly articulate the fairly obvious link between Terminator technology and intellectual property. These new biotechnologies, the consummate manifestation of biopower, can be interpreted as a response to what we, somewhat inelegantly, term the 'leakiness' of intellectual property protection. Some form of property protection, be it through patents or plant breeders' rights, have long been available to seed sellers. And while the rights attached to such legal mechanisms do exercise a certain form of control over producers who, out of fear of prosecution, might elect to purchase seed anew each planting year, the seed itself refuses such control, spreading its progeny across farmers' fields. In effect, nature spurns the artificial enclosures of the intellectual property system, permitting its seed to leak out around the edges of this artificial enclosing construct. As we have detailed in some length in this and the previous chapter, transnational corporations, particularly Monsanto (a company that recently re-stated its projected earnings upwards for 2008, predicting gross profits from its Roundup herbicide to reach US$1.8 billion, up from US$854 million the previous year, and gross profits from seed sales are set to surge by 23 percent to US$3.7 billion (Kaskey, 2008)), are rabidly undertaking measures to plug the holes in the contemporary intellectual property regime. Terminator technology moves the fight for control over nature and seeds to a completely new level – to the molecular level in an emerging ensemble of legal and technological measures that will effect a new enclosure movement at the level of the organism never imagined by even the most ruthless of feudal lords. Viewed from a conceptual perspective, we recall that because class struggle is an inherent phenomenon in capitalist production relations, capital is compelled to continually develop new strategies of primitive accumulation that ensure its bases of accumulation can continue to contribute to capitalist valorisation. Capital must employ strategies of primitive accumulation (in this case stringent intellectual property protection and Terminator technology) designed to respond to and check the autonomous self-activity of universal labour when the latter attempts to wrest control over the means of production away from capital. As De Angelis (2001, p. 13, emphasis in original) tells us, primitive accumulation encompasses "the preservation and expansion of the capitalist mode of production *any time the producers set themselves as an obstacle to the reproduction of their separation to* [sic] *the means of production*" (De Angelis, 2001, p. 13, emphasis in original). From the perspective of transnational biotechnology corporations, saving, trading, and reusing seeds present substantial obstacles to one of their main business lines.

At a more basic level these increasing enclosures of the knowledge commons through intellectual property confer on rights' holders the ability to restrict the use of information and technologies that themselves increasingly possess fundamental implications for social existence in contemporary society. Because such resources in their natural state tend to be freely available as part of the knowledge commons, capital is reliant upon the intellectual property regime as a mechanism that encloses the commons and introduces scarcity among socially useful knowledge. As May (2004, p. 128) confirms, "[i]n the last 200 years or so, this [intellectual property] has led to a continual diminuation of the possibility of a knowledge commons (a realm where information and/or knowledge is not subject to any form of private ownership)." If we accept the idea that the knowledge and resources being appropriated by capital through the imposition of property rights has significant implications for social existence, then we can further conclude that the ability to control access to such resources conferred by intellectual property rights is a form of biopower. As discussed previously, this is particularly ironic given that one of the rhetorical foundations offered up in support of the intellectual property regime is its putative ability to secure a vibrant pool of knowledge that facilitates intellectual and technological innovation. Increasingly, the knowledge commons is becoming a residual category that contains only whatever private owners have not appropriated through intellectual property rights.

This enclosure of the knowledge commons is partly facilitated by the incongruent power relationships that inhere between the various actors involved in such struggles. In our neoliberal context national patent offices, at least in most Western countries, have typically been transformed to function as special operating agencies that rely on cost recovery to finance their operations. Similar to the confused regulatory situation in this country (which will be explored in greater detail in the following chapter), patent offices are now responsible for reviewing applications from applicants who legitimately might be construed as customers. The United States Patent and Trademark Office articulates its mandate in the following terms: "The primary mission of the Patent Business [sic] is to help customers get patents" (as cited in May, 2004, p. 133). While the Canadian Intellectual Property Office avoids such blatantly corporate-driven language, its commitment to a barrage of service standards designed to facilitate an efficient and effective review system for the benefit of potential patentees clearly demonstrates that any commitment to the public domain or knowledge commons has long been relegated to subaltern status. This already inequitable situation is further exacerbated by an overburdened and sometimes underqualified review staff, leading ultimately to an intellectual property terrain in which examiners tend to issue patents, even if not wholly substantiated, believing that any potential problems can be sorted out by appeal tribunals and the courts (May, 2004). Yet it is precisely once the courts become involved that the power differentials between supporters of the knowledge commons and intellectual property rights' holders, typically deep-pocketed transnational corporations, becomes most apparent. Patent litigation is incredibly time and resource intensive, which serves as a very effective deterrent against launching patent challenges – though as discussed above there are public institutions taking up such challenges.

Recalling our discussion of primitive accumulation, we note that this process provides the origin of the separation between producers and the means of production, a separation that is responsible for the alienated character of universal labour and thus for defining the opposition inherent in capitalist social relations. Capitalist social relations are not only historically premised on this separation, but the capitalist exploitation of labour presupposes it.

> ...primitive accumulation has been a universal process in every phase of capitalist development. Not accidentally, its original historical exemplar has sedimented strategies that, in different ways, have been re-launched in the face of every major capitalist crisis, serving to cheapen the cost of labor and to hide the exploitation of women and colonial subjects (Federici, 2004, pp. 16-17).

Through this optic we can interpret the intellectual property regime, particularly in its expanded contemporary manifestation, as expediting the private expropriation of some or all of the value that is produced in common through the cooperative relationships of biopolitical production (Hardt & Negri, 2004).[60] For example, in light of the American decision in *Chakrabarty* and the Harvard/DuPont oncomouse case as well as the Canadian Schmeiser case, what were once considered natural elements of common property are now deemed to be products of human labour and ingenuity to which private property rights of exclusion and enclosure attach.

Yet might it not also be argued credibly that people who develop their ideas and inventions based upon those that have come before them are engaged in personal appropriation of the public domain? Are these creators, similar to Newton, not standing on the shoulders of those giants who came before them? Is the notion of the 'autonomous invention' thus a myth employed to discursively construct an uneven system based on individuating alienable 'things' that can circulate as exchange values (Haraway, 1997)? Should one not heed the Lockean proviso of 'no loss to others'?[61] As one commentator

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[60] For a critical assessment of the way public research is appropriated by the private sector through intellectual property protection in a manner that leads to an imbalance in the generation and use of biotechnological information, see Çoban, A. (2008). Genomic information and the public-private imbalance. *Capital & Class, 94*, 71-105.

[61] Although Locke never discussed patents in his written work, proponents of strict protection for all aspects of intellectual property commonly apply the Lockean argument that property rights spur individual effort by offering ownership of the fruits of one's work. In fact, Adam Mossoff develops an historical

lyrically points out, "[t]he naked hubris that posits genes, biological processes, and whole organisms as alienable privatized inventions is quite evidently a multi-faceted theft and ought rightly to be named as such" (Prudham, 2007, p. 414). If the provision of property rights is considered to be the optimal means by which to spur intellectual innovation, then consideration must also be given to measures and limits on such rights to protect the common pool, or public domain, so that a net decrease in the production of informational and cultural artefacts does not ensue (Boyle, 1996; Hettinger, 1989). The contemporary intellectual property system, aside from undervaluing the sources and audiences of intellectual creations, provides protection at the expense of dissemination to such an extent that future creators find an increasingly limited public domain on which to draw for inspiration. The current system of intellectual property protection may actually give rise to its antithesis and come to retard artistic innovation and scientific progress while simultaneously stifling the flow of information so vital to free speech and ensuing public debate in a democratic society (Boyle, 1996). Moreover, and as a direct result of the current system, the transaction costs associated with clearing rights protected by the intellectual property regime is rendering biotechnological research prohibitively more expensive. This is perhaps the ultimate irony in that the expanded breadth of intellectual property rights is curtailing the very process upon which proponents of strict intellectual property protection base their argumentation. However, as the work of May and Sell (2006) and this research contend, intellectual property devices are not natural and

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argument that Locke's philosophy exercised substantial influence, particularly in the eighteenth century, on patents being construed as, at least in part, natural rights. See Mossoff, A. (2001). Rethinking the development of patents: An intellectual history 1550-1800. *Hastings Law Journal, 52*, 1255-1322. For a detailed account based on a close reading of John Locke that disputes the common use of Lockean justifications for intellectual property, see Shiffrin, S. V. (2001). Lockean arguments for private intellectual property. In S. R. Mumzer (Ed.), *New essays in the legal and political theory of property* (pp. 138-167). Cambridge, UK: Cambridge University Press.

inevitable but are instead political economic constructions that, though perhaps with some difficulty, can be challenged and reformed to suit the social and political needs of universal labour.

The level of misappropriation inherent in stringent intellectual property protection is magnified when viewed through the lens of the common. The production of ideas, knowledge, images, etc. relies on collaboration with both previous and contemporary labourers, as Marx points out in his brief discussion of universal labour . Similarly, the products developed through these collaborative processes spawn subsequent collaboration and cooperation, partly as a result of the positive externalities inherent in biopolitical production processes and their corresponding products. Moreover, the common is necessary in biopolitical production since its processes are themselves collaborative and communicative (Hardt & Negri, 2004). Production today therefore has a triple relation to the common. But if today value is produced increasingly in terms of the common, then we must also recognise that exploitation is effected at the level of the common. This is so because the very same characteristics that impute value to such products, coupled with their often-ethereal manifestation that renders them easily replicable, complicate, at least from capital's perspective, their fit within a private property model – hence capital's reliance on intellectual property systems.

Chapter 7. Regulatory Capture and Control of Biotechnology Discourse

Having elucidated the strategic use made by capital of both genetic engineering and intellectual property mechanisms in establishing its command over biotechnology in this country, this chapter turns to an examination of the ways that the regulatory system and public discourse in respect of this technoscience are being subverted in service of capitalist accumulation imperatives. Emphasis is placed on locating the major gaps in our regulatory approval processes that have emerged as a result of the failure on the part of Canadian regulators to map emerging scientific evidence onto the system by which products are approved for unconfined environmental release and human consumption. Despite mounting evidence about the deficiencies of a linear model of scientific assessment, including exhortations by the Royal Society of Canada, the Canadian regulatory regime remains committed to an unsophisticated review system that both regulators and the companies being regulated ardently refuse to expand so as not to admit the variety of additional concerns being articulated by citizens and scientists in respect of biotechnology. The second part of this chapter examines the narrow focus within which government and industry attempt to constrain the discourse around biotechnology in Canada. We also set out to refute on their own scientific terms some of the marketing myths propagated by the biotechnology industry.

7.1 Regulatory Capture

We begin our discussion with a review of the current state of the Canadian regulatory regime in respect of genetically engineered organisms. Technological change is presumed to be progressive unless proven regressive. The burden of proof therefore typically falls on those who would seek to regulate new technologies rather than those who profess its benefits. Although the environmental movement of the 1970s resulted in the introduction of some prospective technological assessments, the neoliberal agenda introduced in many Western countries, particularly in North America, has resulted in a general mood hostile to regulatory initiatives (Krimsky, 1991). Both industry and government are quick to emphasise the potential negative economic implications of stringent regulation on the commodification of genetic research and development. Speaking about the European context, Pfizer Ltd. has stated that

> A perceived unwillingness to lead the world in exploiting new genetic knowledge will have a major impact on Europe's future competitivity [sic] in the health care market. This in turn will lead to increased out-sourcing of biotech manufacturing and research capabilities, which in the long term will undoubtedly affect both the employment prospects and the quality of care available to our citizens (Caulfield & Feasby, 1998, p. 386).

Similarly, the Alberta Science and Research Authority has made a call to "reduce, simplify and standardize regulations in the Province for biotechnology," claiming that "current delays and regulatory uncertainties are discouraging new research and investment, driving up the cost of innovation and undermining public confidence" (Caulfield & Feasby, 1998, p. 386). The call to streamline regulations and adopt new approaches to regulation has long been made by the architects of Canada's Science and Technology Policy (Industry Canada, 1996a).[1] Couched in the rhetoric of facilitating the

[1] The federal government's latest initiative in this direction is the development of so-called 'smart regulations'. According to the Public Service Modernization Portal, "Smart Regulation is a government-wide initiative aimed at improving the Government of Canada's regulatory performance. It involves a series of projects that strengthen the policy, processes, tools, and regulatory community that are needed to sustain high levels of regulatory performance and facilitate continuous improvement. The projects emphasise the importance of safeguarding the health and safety of Canadians, contributing to a healthy environment and securing the conditions for an innovative economy." (http://www.psmod-modfp.gc.ca/initiatives/sr-ri_e.asp). Based on our own, albeit limited, experience at Health Canada in the

public good of healthcare, such exhortations are thinly veiled rallying cries for the expanded commodification of health research and development. According to some observers, science, at an aggregate level, has been overtly complicit in all of this. "It is willing and able to exclusively serve the needs of capital, not just by generating knowledge that can be applied for profit, but also by *not* generating any knowledge or applications that could be detrimental to the maintenance and/or expansion of the system..." (Critical Art Ensemble, 2002, p. 41).

At the federal level in Canada there are two main entities with responsibility for the regulation of biotechnology. Health Canada, under the *Food and Drugs Act*[2] and the *Food and Drug Regulations*[3], is mandated with assessing the safety of genetically engineered foods meant for human consumption as well as veterinary drugs, pharmaceuticals, medical devices, cosmetics, biologics, radiopharmaceuticals, genetic therapies, and pesticides. The Canadian Food Inspection Agency (CFIA)[4], rather than Environment Canada, is responsible for assessing the environmental safety of genetically modified organisms under jurisdiction of the *Seeds Act*.[5] The CFIA approves field trials and commercial growing (i.e. unconfined release). The CFIA also maintains regulatory oversight of animal feed under the *Feeds Act*[6] and its *Regulations*, and assesses veterinary

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Policy and Strategic Planning Division of the Health Products and Food Branch Inspectorate, we would argue that the impetus for this project comes from concerns and complaints by the corporate sector that government is too slow in its regulatory review processes.

[2] R.S.C. 1985, c. F-27.

[3] C.R.C., c. 870. These regulations were amended in 1999 to add Division 28, which sets out the regulations in respect of novel foods, SOR/99-392, s. 1. Novel foods is the regulatory category to which the federal government assigns genetically engineered crops and other food products.

[4] The CFIA was created in 1997 to consolidate the delivery of federal food inspection and quarantine services, as well as plant protection and animal health programmes, all of which were previously delivered by the Deaprtments of Agriculture and Agri-Food, Fisheries and Oceans, Health, and Industry.

[5] R.S.C. 1985, c. S-8.

[6] R.S.C. 1985, c. F-9.

biologics under the auspices of the *Health of Animals Act*.[7] Finally, the CFIA enforces food safety standards through a system based on inspection and monitoring activities (see Table 7-1 for a list of which departments/agencies under the auspices of which legislation regulate which biotechnology products). The dual role of the CFIA, regulator and promoter of trade and commerce, continues to be a significant source of criticism and concern about how well the agency discharges its regulatory duties.[8] Leiss (2000) contends that Canadian governments must draw upon scientific evidence developed by independent bodies when managing the health and environmental risks associated with new technologies and their applications. He, like others, is therefore extremely critical of the dual functions (regulator and promoter) attributed by the CBS to the federal government (Leiss, 2000). In fact, these conflicting mandates at the CFIA have been a source of concern even among federal government bureaucrats. In 1999 a number of Health Canada employees petitioned then Health Minister Alan Rock to work to ensure that control over genetically modified foods remain within the purview of the health ministry. The petition pointed out the blatant conflict of interest involved in mandating the agricultural department with monitoring the same products that it is in the business of promoting, products that could pose human health risks (Riley, 1999).

[7] S.C. 1990, c. 21.

[8] Another inherent weakness of contemporary regulatory regimes, according to Liora Salter, is that regulatory agencies must establish a solid working relationship with the industries they regulate in order to ensure an effective and enforceable system of regulation. However, such a 'co-management' arrangement, as she terms it, leads to problems of capture of state regulators by industry. See, Salter, L. (1993). Capture or co-management: Democracy and accountability in the regulatory agencies. In G. Albo & D. Lagille & L. Panich (Eds.), *A different kind of state? Popular power and democratic administration* (pp. 87-100). Toronto: Oxford University Press.

Table 7-1 Legislative Responsibility for the Regulation of Biotechnology Products

Products Regulated	Department/Agency	Act	Regulation
Foods, including novel foods derived through biotechnology	Health Canada	*Food and Drugs Act*	*Novel Foods Regulation*
Feeds, including novel foods derived through biotechnology	Canadian Food Inspection Agency	*Feeds Act*	*Feeds Regulations*
Environmental release of plants with novel traits such as pest resistance or herbicide tolerance and, where required by the *Seeds Act*, variety registration	Canadian Food Inspection Agency	*Seeds Act*	*Seeds Regulations*
Plant pest risk assessment and permit to import plants, including plants with novel traits	Canadian Food Inspection Agency	*Plant Protection Act*	*Plant Protection Regulations*
Pest control products	Pest Management Regulatory Agency, Health Canada	*Pest Control Products Act*	*Pest Control Products Regulations*
All animate products of biotechnology for uses not covered under other federal legislation (as listed in *Canadian Environmental Protection Act* – Schedule 4	Environment Canada and Health Canada	*Canadian Environmental Protection Act*	*New Substances Notification Regulations*

The Royal Society of Canada, which was commissioned by the federal government to examine and analyse Canada's regulatory system in respect of genetically engineered food products, is critical in its report, *Elements of precaution:*

Recommendations for the regulation of food biotechnology in Canada, of the notion that genetic engineering is a 'precise' technique, asserting instead that inserting genes into new cellular environments carries with it the potential for unexpected and contingent consequences (see Appendix I for a summary of the recommendations made in the Royal Society report). As early as 1864 George Perkins Marsh recognised that humanity's attempts to master nature filter through what Harvey (2000) refers to as the 'web of life', a web of interconnections constitutive of the natural world that bring with them unintended consequences: "These intentional changes and substitutions constitute, indeed, great revolutions; but vast as is their magnitude and import, they are...insignificant in comparison with the contingent and unsought results which have flowed from them" (as cited in Harvey, 2000, p. 219). Scientific analysis, though proficient in synchronic explanation of a particular phenomenon, is ill-equipped to engage in prediction about the long-term consequences for a particular ecosystem that, for example, would occur as a result of the release of genetically modified organisms (Oreskes, Shrader-Frechette, & Belitz, 1994; Tansey, 2003). As Tansey (2003, p. 32) points out, scientific assessments of risk and the environment are "hybrid approaches that represent an 'uneasy marriage' between science and policy." Regulatory systems fail to adequately consider the secondary effects that accrue from manipulation of an organism at its molecular level, despite the fact that genetic engineering affects an organism's metabolic pathways in ways that are often quite difficult to detect and determine (Ferrara & Dorsey, 2001).[9]

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[9] In her Master's thesis, Lucy Sharratt employs Ulrich Beck's theory of the risk society to develop a trenchant critique of the structures and discourse of 'science-based' regulation of genetically engineered agricultural products in Canada. She contends that the regulatory system has been developed to deny and conceal the risks associated with biotechnology, as well as to exclude social and ethical issues from the

In fact, a four-year study conducted under the auspices of the United States National Human Genome Research Institute, which included 35 groups from 80 different international organisations, argues in its June 2007 report that contrary to the principles upon which recombinant DNA technology has been developed since 1973, the human genome is not a collection of independent genes for which each sequence of DNA codes for a single function. Rather, genes function in a complex network environment that involves interactions and overlap with each other as well as with other components not yet fully understood (Caruso, 2007). The now disputed traditional understanding of the human genome is what Dr. Jack Heinemann, professor of molecular biology at the University of Canterbury in New Zealand, refers to as the 'industrial gene', which is "one that can be defined, owned, tracked, proven acceptably safe, proven to have uniform effect, sold and recalled" (as cited in Caruso, 2007, ¶ 13). Dr. Heinemann goes on to add that "because gene patents and the genetic engineering process itself are both defined in terms of genes acting independently, regulators may be unaware of the potential impacts arising from these network effects" (as cited in Caruso, 2007, ¶ 24). As Harvard geneticist Richard Lewontin argues, "[w]hen DNA is inserted into the genome of a recipient by engineering methods, it may pop into the recipient's DNA anywhere, including in the middle of some other gene's regulatory element. The result will be a gene that is no longer under normal control." Such loss of control might result in the production of new substances or the induction of unanticipated changes in the manner in which the organism functions or interacts with other organisms or the environment. Lewontin therefore concludes that "the process of genetic engineering has a unique

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debate, all in order to facilitate the commercialisation of genetically engineered products. See, Sharratt, L. (2001a). *Deconstructing a science-based regulation: Towards rendering the risks of genetic engineering visible.* Unpublished Masters Thesis, Carleton University, Ottawa.

ability to produce deleterious effects and...this justifies the view that all varieties produced by recombinant DNA technology need to be specially scrutinized and tested" (as cited in Kloppenburg, 2004, p. 311).[10]

Genetic engineering techniques are themselves imprecise. The use of 'gene guns' (miniscule particles coated with DNA are fired from a gene gun directly into the cells of the organism receiving the gene) and viral vectors (genetic Trojan horses that have been engineered to surmount naturally evolved barriers against inter-species genetic exchange) to transfer genes between organisms is random. Because of this randomness, antibiotic resistant marker genes are typically used since they provide an easily recognizable location beacon for the inserted material. However, there is growing concern about the potential for such vectors to transmit their antibiotic resistance into the environment and food supply, which could have profound implications for the future effectiveness of antibiotics used in treating viral infections. Although precise placement of engineered

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[10] A study referenced quite often in the literature that contradicts the notion of 'substantial equivalence' for transgenic foods is the one conducted by the recognised lectin specialist, Dr. Arpad Pusztai. This study, which was carried out at the Rowett Research Institute in Scotland, was designed to investigate whether potatoes that had been engineered to express an insecticidal compound (lectin) present human health effects. Using rats, Dr. Pusztai compared the nutritional composition and effects of transgenic potatoes to non-altered potatoes. His research determined that protein, starch, and sugar levels in the genetically modified potatoes varied by as much as 20 percent compared to conventional potatoes. More importantly, the rats fed the altered potatoes experienced a reduction in the weight of their vital organs, including the intestine, pancreas, kidneys, liver, lungs, and brain. These same rats also suffered a significantly depressed immune system. Evidence of intestinal inflammation and infection was also detected. Dr. Pusztai, having found that potatoes sprayed directly with lectin did not produce the same effects in lab rats, concluded that the negative responses found stemmed from some other part of the DNA construct employed to facilitate the genetic engineering, such as the viral promoter from cauliflower mosaic virus that is commonly used to transport lectin genes into the recipient. See, for example, Ewen, S. W. B., & Pusztai, A. (1999). Effect of diets containing genetically modified potatoes expressing *Galanthus nivalis* lectin on rat small intestine. *Lancet, 354*, 1353-1354. For his efforts Dr. Pusztai was rewarded by a variety of attacks and assorted efforts to impugn the validity of his work, including some directly from the director of the Rowett Research Institute. Nonetheless, in light of his work the British Medical Association (BMA) issued a public call for a moratorium on planting genetically modified crops. The BMA has also come out in support of labelling for genetically modified products and made a plea to researchers to stop employing antibiotic-resistant marker genes. For a deeper discussion of this incident, see, for example, Ferrara, J., & Dorsey, M. K. (2001). Genetically engineered foods: A minefield of safety hazards. In B. Tokar (Ed.), *Redesigning life?: The worldwide challenge to genetic engineering* (pp. 51-66). Montreal: McGill-Queens's University Press.; and, Smith, J. M. (2003). *Seeds of deception: Exposing industry and government lies about the safety of the genetically engineered foods you're eating*. Fairfield, IA: Yes! Books.

genetic constructs is critical to proper gene expression, scientists are often unable to completely control where the introduced genetic material will be inserted, not to mention the possible interaction effects between the inserted genes and the thousands of other genes in the organism being genetically altered (Ho, 1999; Ho, Ryan, & Cummins, 1999; The Royal Society of Canada, 2001).

The scientific experts who authored the Royal Society report point out that gene flow, which can potentially occur between genetically engineered crops and their wild relatives, is particularly possible between genetically engineered and conventional crops of the same species, especially if grown in the same region given the "complete absence of breeding barriers" (The Royal Society of Canada, 2001, p. 126). It is also possible that different genetically engineered plants could cross breed when released into an uncontrolled environment, which, in turn, could result in 'gene stacking' that would compel farmers to employ more toxic herbicides in order to destroy volunteer plants (Snow, 2002). Despite such dangers, the Canadian government refuses to implement a post-market surveillance programme for genetically engineered products, contending instead that

> [i]f a product gains market approval, it is the legal responsibility of the proponent to provide the Government of Canada with additional information regarding any untoward observations or effects. The Government of Canada *may* carry out post-market sampling, auditing and testing, either as routine post-market surveillance or on a case-by-case basis, or change its regulatory decisions, in response to additional information provided by the proponents, the public, or advances in scientific knowledge (Office of the Auditor General of Canada, 2002, ¶ 55, emphasis added).

Given the challenges and constraints the federal government currently faces in enforcing its post-market surveillance programmes for food, drugs, and medical devices, it appears highly unlikely that the responsible regulatory bodies will engage in monitoring activities not legally mandated.

Because Canadian regulators adhere to the linear model and 'substantial equivalence', which are predicated on the belief that a particular gene codes for a particular characteristic and remains independent of other genes within the DNA of the targeted organism, it is the genetically engineered product rather than the process that is reviewed and regulated in Canada. But comparing transgenic products, such as Bt[11] products that produce toxins, to other products, even an insecticide, is to draw a false analogy. Certainly both can wreak havoc on the environment, but the latter does not pose the same threat of long-term genetic consequences, as does the former (Critical Art Ensemble, 2002). The report compiled by the Royal Society of Canada, which contains 53 recommendations (see Appendix I) for overhauling Canada's regulatory system in respect of genetically modified food, challenges the validity of a linear model of assessment, arguing that equivalence claims cannot be made *a priori* but instead require an integrated approach of rigorous scientific evaluation that seeks to uncover how phenotypes are affected by genomes and their variants at multiple levels (DNA structure, gene expression, protein profiling, and metabolic profiling) (The Royal Society of Canada, 2001; Wills, 2001).[12] The linear model employed to evaluate genetically

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[11] To refresh the reader's memory, we re-iterate that *Bacillus thuringiensis* is a naturally occurring soil bacterium genetically engineered into various crop seeds. Known as Bt prototoxin (crops that contain this gene are noted by the prefix 'Bt', e.g. Bt-Corn), the bacterium produces a crystal protein that destroys the digestive tract of certain Lepidopteran insects when ingested and mixed with stomach acid.

[12] An independent report published by the Institute on Governance questions whether the Canadian government possesses the requisite scientific capacity to adequately discharge its regulatory duties. This same report also outlines gaps in the science/policy interface in Canada. See, Boucher, L. J., Cashaback, D., Plumptre, T., & Simpson, A. (2002). *Linking in, linking out, linking up: Exploring the governance challenges of biotechnology*. Ottawa: Institute on Governance. Indeed, according to Statistics Canada the number of federal government personnel engaged in science and technology activities was significantly circumscribed (approximately 15% since 1990-1991) during the 'terror' of program review that began in

modified organisms, which supports the test of 'substantial equivalence',[13] incorrectly assumes that transferring genetic material into the DNA of another organism will only affect the genes transferred across species. But as the report admonishes:

> The Panel finds the use of "substantial equivalence" as a decision threshold tool to exempt GM agricultural products from rigorous scientific assessment to be scientifically unjustifiable and inconsistent with precautionary regulation of the technology. The Panel recommends a four-stage diagnostic assessment of transgenic crops and foods that would replace current regulatory reliance upon "substantial equivalence" as a decision threshold (The Royal Society of Canada, 2001, p. ix).

Dr. Rene Van Acker, Professor and Departmental Chair of the Department of Plant Agriculture at the University of Guelph, contends that genetic engineering is such a novel technology that scientists still do not fully understand whether 'substantial equivalence' is true. The reality, according to Van Acker, is that in countries like Canada the adoption of 'substantial equivalence' was based on argument rather than on empirical testing. There are few studies around the world on what the medical effects may or may not be of feeding genetically modified food to mammals. The only *bona fide* review that Dr. Van Acker has read is comprised of a mere ten research articles worldwide, which, from a

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the early 1990s (Statistics Canada, 2000). Though statistics beyond 2000 are not available, in-house scientific capacity does not appear to have recuperated in the federal government, a most startling situation given the breakneck speed of contemporary scientific innovation. On the science deficit in the federal government and its implications for risk, see also Doern, G. B., & Reed, T. (2000). Canada's changing science-based policy ad regulatory regime: Issues and framework. In G. B. Doern & T. Reed (Eds.), *Risky business: Canada's changing science-based policy ad regulatory regime* (pp. 3-28). Toronto: University of Toronto Press.

[13] As a decision threshold, 'substantial equivalence' is defined in the following manner: "A GM organism is "substantially equivalent" if, on the basis of reasoning analogous to that used in the assessment of varieties derived through conventional breeding, it is assumed that no changes have been introduced into the organism other than those directly attributable to the novel gene. If the latter are demonstrated to be harmless, the GM organism is predicted to have no greater adverse impacts upon health or environment than its traditional counterpart" (The Royal Society of Canada, 2001, p. 182). For an additional critique of the concept of 'substantial equivalence', see Millstone, E., Brunner, E., & Mayer, S. (1999). Beyond 'substantial equivalence'. *Nature, 401*, 525-526. They maintain that "[s]ubstantial equivalence is a pseudo-scientific concept because it is a commercial and political judgement masquerading as if it were scientific. It is, moreover, inherently anti-scientific because it was created primarily to provide an excuse for not requiring biochemical or toxicological tests. It therefore serves to discourage and inhibit potentially informative scientific research....the concept of substantial equivalence is being misapplied, even on its own terms, within the regulatory process" (Millstone, Brunner, & Mayer, 1999, p. 526).

research perspective, is negligible. As Van Acker laments, clearly more research needs to be conducted worldwide but without funding nobody is doing it.

Despite such warnings, the CBAC, in its 2002 report on regulating genetically engineered foods, recommends that Canada continue employing the 'substantial equivalence' criterion when assessing differences between conventional and novel food crops, asserting that in its review of various regulatory agencies it "found no evidence to indicate that substantial equivalence has been used as a decision threshold to exempt GM foods from appropriate regulatory oversight" (Canadian Biotechnology Advisory Committee, 2002a, p. 27). This contrasts rather starkly with the concern voiced by the Royal Society of Canada that the CFIA is incorrectly applying the concepts of 'familiarity'[14] and 'substantial equivalence' such that regulatory approvals are "based upon unsubstantiated *assumptions* about the equivalence of the organisms, by analogy with conventional breeding" (The Royal Society of Canada, 2001, p. 182). According to Lucy Sharratt (2002) in a report produced for the Polaris Institute, the Canadian Government developed the categories 'novel food' and 'plant with novel traits' to camouflage genetic engineering among a range of other technologies in order to reduce public attention to and knowledge of various processes of genetic engineering. Instead of examining the process, the product is evaluated in a manner that relies on comparisons through the use of concepts such as 'familiarity' and 'substantial equivalence'. The result of this system of assessment is that the dangers of genetic engineering are not sufficiently scrutinized during the regulatory review system.

[14] The CFIA defines 'familiarity' as "the knowledge of the characteristics of a plant species and experience with the use of that plant species in Canada. 'Substantial equivalence' is defined as the equivalence of a novel trait within a particular plant species, in terms of its specific use and safety to the environment and human health, to those in that same species, that are in use and generally considered as safe in Canada, based on valid scientific rationale" (Canadian Food Inspection Agency, 2006, ¶ 1).

> The industry and our government try to define genetic engineering as nothing new so that they do not have to develop new regulations and so that the public does not view genetic engineering as a new technology with new risks. This is a deliberately false representation that contradicts what many people think and know about genetic engineering (Sharratt, 2002, p. 12).

By asserting that genetic engineering processes yield no risk beyond those associated with conventional breeding and mutagenesis,[15] the CBAC is able to make the substantial equivalence claim.[16] However, such claims miss the point of contention voiced by opponents of 'substantial equivalence', including the Royal Society of Canada, that a system based on this principle is not sufficiently scientifically rigorous to assess genetically engineered foods.[17] In fact, the Royal Society report is quite critical of the overall lack of scientific rigour and transparency of the regulatory system for genetically modified food:

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[15] Mutagenesis relies on chemicals or irradiation to induce mutation. In fact, BASF, the world's largest chemical company, has been given regulatory approval by the CFIA for its herbicide tolerant CDC Imagine wheat. Rather than insert an altered gene, BASF uses chemicals to alter existing genes within the wheat seeds that prevents the herbicide from binding to an enzyme in the wheat. In 2005 more than 200,000 acres of this wheat were grown in Alberta, Saskatchewan, and Manitoba. With virtually no opposition, BASF has almost free reign in this country to market CDC Imagine as "the first and only non-genetically modified" herbicide tolerant wheat in Canada. This modified wheat is tolerant of BASF's imidazolinone broad-spectrum herbicides. See, Munro, M. (2005, December 29). Modified wheat takes root with little opposition: Keeps growing when sprayed with herbicides. *National Post,* pp. A8.

[16] It was on the basis of the substantial equivalence rationale (that genetically engineered products are not substantially different from conventional ones) that Agriculture Canada argued in 2002 that debates about mandatory labelling requirements for genetically modified crops and their food and feed products are marketing decisions and not health or nutrition issues. See, Wilson, B. (2002, November 21). Canada afraid to upset U.S. with GM labels. *The Western Producer*. For an example of similar arguments advanced by industry see, Uzogara, S. G. (2000). The impact of genetic modification of human foods in the 21st century: A review. *Biotechnology Advances, 18*, 179-206. Aside from uncritically accepting the beneficent claims advanced by industry about the health and safety of genetically engineered foods, an implicit claim made by the article is that people merely need to be properly educated, by industry, of course, and their apparently ill-founded fears will be allayed. Yet she presents no empirical proof in support of her claims, leaving the reader to accept her argument about the safety of genetically modified food simply because she says it is so!

[17] At least one observer has called for an indefinite moratorium on the release of all genetically engineered organisms into the environment until questions about how the environment responds to genetic change, including the effects on ecological stability that occur through complex interactions between genetically engineered organisms and non-altered species. See, Wills, P. R. (2001). Disrupting evolution: Biotechnology's real result. In R. Hindmarsh & G. Lawrence (Eds.), *Altered genes II: The future?* (2nd ed., pp. 53-68). Melbourne: Scribe Publications.

> ...the Panel has concluded that there is no means of determining the extent to which these information requirements are actually met during the approval process, or of assessing the degree to which the approvals are founded on scientifically rigorous information. The Panel attributes this uncertainty to a lack of transparency in the process by which GMOs are approved within the present regulatory framework (The Royal Society of Canada, 2001, p. 214).

The report goes on to argue that "there is no means for independent evaluation of either the quality of the data or the statistical validity of the experimental design used to collect those data. Furthermore, it appears that a significant part of the decision-making process can be based on literature reviews alone" (The Royal Society of Canada, 2001, p. 214). The Panel reaches the conclusion that

> ...the lack of transparency in the current approval process, leading as it does to an inability to evaluate the scientific rigor of the assessment process, seriously compromises the confidence that society can place in the current regulatory framework used to assess potential risks to human, animal and environmental safety posed by GMOs (The Royal Society of Canada, 2001, p. 215).

A later government publication mentions the work of the Royal Society but completely omits any discussion of how its findings were largely ignored by the recommendations made by the CBAC in 2002 (Government of Canada, 2004).[18] Ultimately, the CBAC develops a position that reinforces the status quo of the current regulatory regime, one that is biased in favour of industry (Magnan, 2006). At least one observer contends that the undue industry influence (i.e. regulatory approval decisions are based on data provided by product developers) and lack of transparency in the approval process are operational rather than policy matters[19] and thus possibly provide

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[18] For a detailed assessment of the Canadian Government's efforts, or lack thereof, to act on the recommendations made by the Royal Society of Canada for the regulation of biotechnology in this country see, Andrée, P., & Sharratt, L. (2004). *Genetically modified organisms and precaution: Is the Canadian Government implementing the Royal Society of Canada's recommendations?* Ottawa: Polaris Institute.

[19] It is established in Canadian jurisprudence that government officials are indemnified against legal repercussions for any actions they undertake in their professional capacity that relate to 'policy'. 'Operational' activities, however, do attract legal liability. See *City of Kamloops v. Nielsen*, [1984] 2

the basis for a tort action against the federal government (Matthews Glenn, 2004). As one critical observer notes, "[b]ecause the primary policy concern is to promote the industry, corporate representatives have had a strong voice in Canadian Government decision-making on genetic engineering from the very beginning" (Sharratt, 2002, p. 14). Though this would seem to contradict the CBS, which envisions a review process that emphasises science-based technical assessment methodologies when regulating biotechnology, it is not particularly surprising.[20] After all, in the context of rapid technological development characterised by large economies of scale populated by a few transnational juggernauts that seek to play off national economies against one another for the most favourable corporate conditions, a friendly regulatory regime assumes paramount importance (Jarvis, 2000).

Similar concerns about the efficacy of Canada's regulatory system in respect of genetically engineered organisms have been raised formally by a group that includes agricultural scientists Dr. E. Ann Clark and Dr. Bert Christie, the Council of Canadians, and the Canadian Institute for Environmental Law and Policy. In a petition submitted on May 9, 2000 to the federal government under the *Auditor General Act*,[21] these petitioners assert that Canadian regulations and policies concerning genetically engineered organisms fail to ally with the principles of sustainable development that have been

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S.C.R. 2, 12-13 (building construction inspection) (applying *Anns v. Merton London Borough Council*, [1978] A.C. 728).

[20] The report by the Institute on Governance (*supra*, note 12) is critical of the one-sided information the Government of Canada releases to the public. Such information often provides an unbalanced assessment of the benefits and risks of biotechnology, emphasising the former over the latter. The report urges the government to furnish the information necessary for ordinary Canadians to inform themselves of the issues involved in biotechnology in order to engage in active debate about this topic (Boucher, Cashaback, Plumptre, & Simpson, 2002). The Critical Art Ensemble emphasises the same point and, in fact, asserts that educating laypeople about the science of biotechnology in a comprehensible manner should form part of any resistance strategy designed to re-appropriate control over biotechnology from capital. See, Critical Art Ensemble. (2002). *The molecular invasion.* Brooklyn: Autonomedia.

[21] R.S., 1985, c. A-17.

designed to respond to social, economic, and environmental issues as adopted by the Government of Canada (Office of the Auditor General of Canada, 2000a). The petitioners outline the potentially adverse and irreversible environmental effects of genetically modified organisms that might include: the evolution of new pests, an exacerbation of the dangers posed by existing pests, ancillary harm to beneficial species, species extinction, and broader negative impacts on ecosystem processes and functions such as horizontal gene transfer and the accumulation of dangerous levels of residual endotoxins in soil.[22] This potential for broader effects on overall ecosystems is particularly troubling because it means that unconfined release into an environment can pose dangers that were untested or unanticipated during controlled trial releases since the testing stage only collects and measures data that were actually contemplated during the development of the study design. However, large-scale commercial release of genetically modified organisms into the environment can produce widely divergent effects on different ecosystems, in different years, with different crops, and at different scales of introduction. In support of their contention, the petitioners cite international research studies that have documented negative environmental impacts stemming from genetically engineered organisms, as well as other evidence that demonstrates the pesticide reduction and increased crop yield arguments touted as benefits of genetically engineered crops have been seriously overstated. As early as the late 1980s studies began emerging that weeds were evolving to become resistant to some new herbicides, thus calling into question the claims made by agrochemical companies that genetically altered seed strains

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[22] A recent study of glyphosate resistant soybeans in Nebraska suggests that glyphosate can exercise a detrimental effect on manganese metabolism and negatively impinge on populations of soil micro-organisms that are required to reduce manganese to plant-available form. See, Gordon, B. (2007). Manganese nutrition of glyphosate-resistant and conventional soybeans. *Better Crops With Plant Food, 91*(4), 12-13.

will reduce aggregate levels of herbicide use (Levidow & Tait, 1995). The petitioners also remind the Canadian government that the data it receives from companies seeking regulatory approval for their products, and upon which the approval process relies, fail miserably in addressing human health issues of toxicity and allergenicity; 70 percent of the available crops approved in Canada as of 2000 did not test or measure for human toxicity and no measure of allergenicity was provided for any of the 40 approved varieties. A further human health concern raised by the petitioners revolves around the creation of antibiotic resistant pathogens as a consequence of inserting marker genes into genetically modified organisms for antibiotic resistance (Office of the Auditor General of Canada, 2000a).

With regard to economic impact, the petitioners point out that while the agricultural supply industry has been subject to significant consolidation that has served to increase profits for large transnational firms, little investment has been devoted to the development and promotion of more sustainable forms of agricultural production such as organic farming and integrated pest management. In fact, certain biotechnologies pose dangers to the viability of such alternative types of agriculture. The social impacts of biotechnology, according to the petitioners, include concerns about interspecies genetic transfer, questions about the appropriateness of patents on genetic materials, issues of security of the person that attach to genetic testing technologies, and the pressure toward increased capital intensity of agriculture that flows from biotechnology and its attendant applications, which threatens the economic and social viability of rural communities (Office of the Auditor General of Canada, 2000a).

In addition to the inherent conflict of interest that emerges from the dual regulatory and promotional roles of the CFIA, the petitioners are extremely critical of the fact that the government relies on industry provided data and does not engage in any independent testing of products for which approval is being sought. This fact, combined with the basic assumption driving the regulatory system that genetically modified products do not differ in any substantial way from their natural correlates (i.e. acceptance of the concept of 'substantial equivalence'), establishes a relatively low safety and data requirement threshold for industry when seeking approval for its biotechnology products. These regulatory weaknesses are further aggravated by the lack of a labelling system for genetically modified products in this country, which curtails post-market epidemiological monitoring and study. The ultimate effect of such an anti-precautionary system is that the onus is shifted from business having to demonstrate adequate safety in the first instance to citizens having to demonstrate harm after the fact, which, in the case of genetically engineered organisms released into the environment, can have far-reaching and devastating consequences. The petitioners therefore recommend that the Government of Canada implement a mandatory labelling scheme and overhaul the product review process to ensure comprehensive safety assessments based on independent testing and broad and inclusive safety standards (Office of the Auditor General of Canada, 2000a). In its response, which was drafted jointly by the Ministries of Agriculture and Agri-Food, Fisheries and Oceans, Industry, Environment, Health, and Natural Resources, the Government of Canada contends that the existing regulatory system assesses the risk of biotechnology products from a sustainable development perspective (Office of the Auditor General of Canada, 2000b).

That Canada's regulatory risk assessment framework is heavily influenced by economic and commercial imperatives must be conceded given that the entire product review process relies on data supplied by crop developers that are not made publicly available, thus serving to underplay the ecological uncertainties associated with the environmental release of genetically modified crop varieties (Abergel, 2001; Barrett, 2000).[23] The willingness of some scientists to proffer answers about the dangers, or lack thereof, of releasing genetically engineered organisms into the ecosystem notwithstanding, science is currently unable to accurately predict the long-term effects that would accrue from the release of genetically modified organisms into the environment. Yet despite this limitation policymakers continuous to appeal to science as the neutral arbiter when deciding questions about biotechnology (von Schomberg, 1998).

> The hypothesis that GE [genetically engineered] crops will have no significant environmental impact may be a good method for the advancement of scientific knowledge. However, as a tool for making decisions about whether GE crops should be released into the environment, it lacks the caution necessary for responsible, long-term, environmental stewardship (Davies, 2004, p. 75).

According to Hans Bergmans, Secretary of the Commission on Genetic Modification in the Netherlands, existing field experiments with GMOs have only proven that the experiments were carefully planned and not, as proponents of GMOs maintain, their safety for widespread release (as cited in von Schomberg, 1998). Smith (2003) outlines a number of cases in the United States where biotechnology companies designed their studies in such a manner as to produce results that would not indicate problems with genetically engineered foods. For example, Aventis heated its StarLink corn four times longer than standard before it tested for intact protein; it also substituted protein derived

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[23] As the Critical Art Ensemble makes clear, the corporate bias of the regulatory system is just as evident in the United States. See, for example, Critical Art Ensemble. (2002). *The molecular invasion.* Brooklyn: Autonomedia.

from bacteria for protein from StarLink corn for testing purposes; Monsanto fed adult animals a diet that contained only ten percent of its protein derived from genetically engineered soy; in recombinant Bovine Growth Hormone (rBGH) tests, researchers injected cows with only one forty-seventh of the dosage of the growth hormone before testing for hormone levels in the milk and then pasteurized the milk 120 times longer than normal to see if the hormone was destroyed; sick cows were removed from Monsanto's rBGH tests and cows that conceived prior to the testing were included in the evidence to support the claim that the hormone does not affect fertility; the FDA ignored evidence of antibody reactions found in rats fed rBGH; in another study Monsanto used stronger acid and more than 1,250 times the amount of a digestive enzyme recommended by international standards in order to garner evidence of how quickly a particular protein degraded; and deaths of rats fed the FlavrSavr tomato were left unexplained, among a variety of dubious scientific data offered by industry in support of its regulatory applications (Smith, 2003, 2007).[24]

Moreover, the current approval regime has proven to be susceptible to industry hijacking: in 1999 Monsanto refused to provide scientists at CFIA and Health Canada with additional product data in respect of the company's application for review of two types of genetically engineered potatoes. "Monsanto objected to these requests believing that their data adequately supports their conclusions that these products present 'no significant environmental, feed or food safety risk'" (Tam, 1999). Rather than simply allow Monsanto's applications to lay dormant until the company provided what

[24] Smith's latest work is dedicated to providing a compilation of reports from academia through media, medicine, and eye-witness accounts that speak to the growing evidence of the negative effects of genetically engineered food on human health. See, Smith, J. M. (2007). *Genetic roulette: The documented health risks of genetically engineered foods*. Fairfield, IA: Yes! Books.

government scientists considered to be key scientific data, a deal was brokered by government officials that promised Monsanto a decision on its submissions within thirty days if it provided the requested information. According to Michele Brill-Edwards, a former drug regulator at Health Canada, this deal offers further evidence of the weaknesses of Canada's regulatory review system caused by industry interference in the system (as cited in Tam, 1999, p. A.1). As the Royal Society of Canada contends:

> In the judgment of the Expert Panel, the more regulatory agencies limit free access to the data upon which their decisions are based, the more compromised becomes the claim that the regulatory process is "science-based". This is due to a simple but well-understood requirement of the scientific method itself – that it be an open, completely transparent enterprise in which any and all aspects of scientific research are open to full review by scientific peers...(The Royal Society of Canada, 2001, p. 214).

According to one observer, "the bio-elites reside strategically as an influential network of allies – recombining behind the closed doors of increasingly complex and consistently stacked regulatory systems, of myopic and self-interested industry associations, and of government bureaucracies unrepresentative of the general public" (Hindmarsh, 2001, p. 51). Though one Canadian commentator, in an examination of the Cartagena Protocol on Biosafety to the United Nations Convention on Biological Diversity,[25] holds out the hopeful prospect that the emergence of the 'precautionary principle' in the Cartagena Protocol will result in more stringent assessments of

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[25] The Cartagena Protocol, which entered into force on September 11, 2003, covers the transport across borders of living organisms engineered by biotechnological processes, including the adverse effects such movement could exercise on a signatory country's biodiversity. It is important to recognise that the protocol applies only to living engineered organisms. Lobbyists from the biotech industry, with strong support from the Canadian and American governments, engaged in fervent efforts to weaken the treaty so that signatory countries would not be able to restrict the import of genetically engineered products on the basis of concerns that such products could exercise negative social, economic, health, and environmental impacts on their populations. See, for example, Dyer, G. (1999, February 20). Frankenstein foods: Eight days ago, 20 scientists from 13 countries demanded the reinstatement of a British researcher fired for warning that genetically modified foods could pose a danger to human health. That's when all hell broke loose. *The Globe and Mail,* pp. D1.

genetically modified organisms and their attendant risks (Andrée, 2003).[26] In point of fact, most companies have waged a relentless battle to ensure that the prevailing regulatory standard of substantial equivalence is not replaced by a more stringent system, such as the precautionary principle,[27] which places the burden of proof on the proponent of a particular technology for which regulatory approval is being sought. The situation in the United States is quite similar, where, according to Henry Miller, a Food and Drug Administration official heavily involved with biotechnology from 1979 to 1994, "[i]n this area, the U.S. government agencies have done exactly what agribusiness has asked them to do and told them to do" (as cited in Kloppenburg, 2004, p. 301).[28]

Part of the problem is the way that biotech proponents, who yield from industry, government, and science, frame biotechnology issues. "Biotechnology offers putative solutions which predefine the problems to be solved. Its reified problem-definition in turn influences forms of public participation and safety regulation" (Levidow, 1999, p. 64). Levidow (1999, p. 56) goes on to contend that "...the undemocratic character of

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[26] Others point to the Cartagena Protocol as an important instrument of which nations can avail themselves when confronting WTO-based pressures to open their markets to genetically modified organisms. See, for example, Egziabher, T. (2003). When elephants fight over GMOs... *Seedling*(October), 1-3.; and, Kloppenburg, J. R., Jr. (2004). *First the seed: The political economy of plant biotechnology* (2[nd] ed.). Madison: The University of Wisconsin Press.

[27] As set out in paragraph 2(1)(a) of the *Canadian Environmental Protection Act* (1999, c. 33) the precautionary principle means 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 is a widely accepted definition that was endorsed at the Earth Summit in Rio de Janeiro in 1992 and written into the Rio Declaration.

[28] Monsanto has been successful in the United States in portraying biotechnology as an industrial sector that could be threatened by public opposition and overly rigid government regulation, which, according to this message, would ultimately threaten America's international dominance in biotechnology. See, for example, Kleinman, D. L., & Kloppenburg, J., Jr. (1991). Aiming for the discursive high ground: Monsanto and the biotechnology controversy. *Sociological Forum, 6*, 427-447. For an account of industry influence on regulatory decision-making in the United States that resulted in the approval of genetically modified foods, despite overwhelming scientific evidence against the safety of such foods, see Smith, J. M. (2003). *Seeds of deception: Exposing industry and government lies about the safety of the genetically engineered foods you're eating.* Fairfield, IA: Yes! Books.

biotechnology arises from its self-perpetuating problem-definition, which biotechnologizes both nature and agriculture" (Levidow, 1999, p. 56).

> Moreover, official risk assessment evaluates environmental costs in biotechnological terms – e.g. by emphasizing any harm *to* intensive monoculture, not the broader environmental effects *of* such practices. Harm is defined as effects which may jeopardize the agrochemical control of weeds. At least implicitly, undesirable effects are deemed acceptable if they could be mitigated through the benefits of further technological progress; thus safety decisions internalize the genetic-pesticide treadmill. Such normative judgements exclude alternative definitions of the problem (Levidow, 1999, p. 65, emphasis in original).

But people's concerns about the risks of biotechnology encompass precisely such normative questions of social justice and economics, conceptions of nature, and cultural values (Levidow, 1995). Nonetheless, proponents of biotechnology from both industry and science steadfastly refuse to entertain such concerns, instead preferring to restrict debate about these new technologies to questions of safety.[29] Evidence of this is made abundantly clear through the use of discursive strategies designed to characterise all opposition to biotechnology as uninformed, irresponsible, and even hysterical. For example, biotechnology advocates have advanced the claim that opposition groups are "interweaving political, societal and emotional issues...to delay commercialization and increase costs by supporting political, non-science-based regulation, unnecessary testing, and labelling of foods" (as cited in Nestle, 2003, p. 140). The Conference Board of

[29] For an extended discussion of the social constructionist nature of science and scientific knowledge, including the differences between the restricted scope of issues articulated by scientific discourse and the broader issues considered by social groups, see, Wynne, B. (1995). Public understanding of science. In S. Jasanoff & G. E. Markle & J. C. Petersen & T. Pinch (Eds.), *Handbook of science and technology studies* (pp. 361-388). Thousand Oaks, CA: Sage Publications. Ultimately, he remains critical of science and scientific discourse for failing to "recognise these social dimensions of its own public forms or the fact that public readiness to "understand" science is fundamentally affected by whether the public feels able to identify with science's unstated prior framing" (Wynne, 1995, p. 377). Indeed, a major benefit of social constructionist approaches is that they remove the privilege scientific discourse has traditionally assigned itself, leading, in theory at least, to a situation in which all knowledges are granted epistemological equivalence.

Canada opposes any efforts to introduce non-scientific, ethical, or socio-economic issues into the regulatory review process out of fear that this would lengthen review and approval timeframes (Munn-Venn & Mitchell, 2005). Former Monsanto CEO, Robert Shapiro, has asserted that "[t]hose of us in industry can take comfort.... After all, we're the technical experts. We know we're right. The 'antis' obviously don't understand the science, and are just as obviously pushing a hidden agenda – probably to destroy capitalism" (as cited in Smith, 2003, p. 252). The Canadian federal government has voiced similar sentiments: "A complicating factor [to gaining public awareness and acceptance of biotechnology] is that people often do not know about or do not understand the benefits to them of various biotechnology applications" (Industry Canada, 1998). Completely disregarding the possibility that citizens might have legitimate concerns about biotechnology, the federal government would prefer to retain a paternalistic perception of Canadians, who, in its view, are merely ignorant of the advantages this apparently beneficent technology will reap for the country. Indeed, no Canadian policy document raises concerns about biotechnology and its applications, at least not in any substantial depth. The consistent government line is that biotechnology is largely safe and the Canadian regulatory system will protect Canadians. What such statements and positions miss is that social movements are interested in emphasising and interrogating those issues that professional science has excluded rather than merely debasing scientific knowledge *per se* (Cozzens & Woodhouse, 1995).

Of course, the problem is deeper and older than the advent of biotechnology. From the earliest phases of industrial development the social, political, and environmental effects of technological development were interpreted as secondary effects that would be resolved through additional technological innovation (Moser, 1995). Biotechnology and genetic engineering bring with them their own set of spiralling demands for ever-greater technological applications, leading many to suggest that the 'chemical treadmill' of industrial agriculture will be replaced by a 'genetic treadmill', in which corporations respond to the negative repercussions of biotechnology through new generations of the technology that created the problems in the first place. "Within this logic, new products may offer 'benefits' by solving problems caused by previous ones; conversely, undesirable effects are rendered acceptable by future technological progress" (Levidow, 1999, p. 64). The upside for biotechnology firms in such a circular system is that dependence on technological solutions ensures a continued generation of new markets (Levidow, 1999; Levidow & Tait, 1995; Schmitz, 2001).[30]

The dangers of biotechnology and genetic engineering are, in fact, much wider in scope than industry would have us believe. For example, genetic pollution, contamination (what industry and government regulators euphemistically refer to as 'adventitious presence') of traditional landrace[31] crop varieties, which themselves are vital to the maintenance of the genetic diversity that promotes sustainable agriculture, and the fear of monoculture agriculture that destroys biodiversity are all prominent themes

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[30] Though writing about scientific technology in general, John McMurtry (2002) is also critical of the implicit assumption made by proponents of technology that it can function as a *deus ex machina* to resolve disasters unleashed by initial technological applications. "Technology has in this way become to the global market system what divine intervention by Yahweh or Indra was to fundamentalist patriarchies of the past" (McMurtry, 2002, p. 98). See, McMurtry, J. (2002). *Value wars: The global market versus the life economy*. London, GB: Pluto Press.

[31] Landrace, also sometimes referred to as traditional varieties, are crops that have adapted to the natural and cultural environment in which they grow. The genetic diversity of landraces provides a natural form of insurance for peasant cultivars. See, for example, Kloppenburg, J. R., Jr. (2004). *First the seed: The political economy of plant biotechnology* (2nd ed.). Madison: The University of Wisconsin Press. The Soviet botanist N.I. Vavilov first recognized the importance of land races in the 1920s when he identified a number of such areas around the world that he considered to provide economically important crops. These areas of biological diversity continue to be referred to as the "Vavilov centres of genetic diversity", the majority of which are located in the Third World.

increasingly being taken up by concerned scientists (Ho, 1999; Jackson & Stich, 1979; Krimsky, 1982; Murray, 2003; Suzuki & Knudtson, 1988). See Appendix II for a discussion of some of the mounting research studies that demonstrate the adverse environmental and human health effects of genetically engineered crops.

Perhaps more damning is the mounting evidence that the basic precepts that form the foundation of the science involved in Canadian regulatory review processes are seriously flawed. In large part this is a result of government reliance on data supplied by the same companies seeking regulatory approval for their products. Thus not only do we have a situation in Canada in which the government sanctioned knowledge commons in respect of biotechnology remains unidimensional, but this putatively authoritative knowledge is insufficient to the task of stringent regulation. As a further indication of the degree to which capital and government shape and limit the knowledge commons this is in itself quite troubling as an informational concern, but once again we note that biotechnological issues extend beyond into the biological commons. It is precisely as a result of a purposely-circumscribed knowledge commons that genetically engineered organisms receive regulatory approval for unconfined release, which brings with it all the environment and health dangers that impact on our terrestrial commons. The following section of the chapter teases out some of these implications in further detail by considering the ways that capital endeavours to construct a circumscribed public discourse in respect of biotechnology in this country.

7.2 Capital's Control of Biotechnology Discourse in Canada

> Members of the public have been exposed to a rhetorical whirlwind, battering them from all sides. They are told that GM is good for them by a host of

> authoritative sources: the White House, the Vatican, Downing Street, other political and religious leaders, learned societies, university scientists, government commissions, international corporations, commercial leaders and some of the press. This onslaught has deployed every persuasive rhetorical strategy imaginable: from august oratory to the chattiest synthesised egalitarianism, from broadsheet bombast to tabloid humour, from complex philosophy to advertising and PR. It has compared GM with the greatest of human achievements, and its opponents to Nazis and terrorists. One might expect the combination of such power and persuasiveness to have succeeded.... A cause for optimism is that those without vested interests in GM technology remain critical of both GM and the language used to promote it (Cook, 2005, pp. 130-131).

Claims by transnational agrochemical (the self-styled 'life sciences' companies) corporations that their products are being designed to solve ecological and food shortage[32] problems provide ready discourses grounded in ethics that occlude the efforts

[32] One particular example offered up with relative frequency by both 'life science' companies and various governments is genetically engineered rice. The promise of higher nutritional values, particularly the increase in pro-vitamin A levels (Vitamin A deficiency is a major type of malnutrition in poor countries that contributes to partial or total blindness in between 250,000 and 500,000 children annually around the world), is one of the leading claims advanced most prominently in the media by the patent holders of genetically engineered rice. Known generically as Golden Rice (it has been dubbed 'Golden Rice' because its polished grain is yellow in colour), this product has been heavily promoted by the biotechnology industry throughout the Developing World for producing beta-carotene (pro-vitamin A) in the endosperm, despite the fact that its safety, its shelf life, and the exact amount of pro-vitamin A that it supplies have yet to be sufficiently established. Moreover, industry advocates neglect to consider that pro-vitamin A can only be absorbed by the body if a person has sufficient dietary fat in the intestinal tract. Without adequate protein and fat stores, a situation typical for children in developing countries, the body cannot properly metabolize the beta-carotene in Golden Rice – this assumes that Golden Rice, in an amount typically eaten by poor people, even contains enough pro-vitamin A to meet daily health requirements. In reality, most malnourished children lack a protein rich diet and suffer additionally from intestinal infections that circumscribe beta-carotene absorption or its conversion into vitamin A. Rather than learning from the experiences of the Green Revolution, industry, and many governments, ignore other established practices that respond to vitamin A deficiency, such as home gardening, mixed crop systems, and community gardens, all of which are low-tech and successful means of improving overall nutrition levels (recalling Cleaver's (1982) discussion of the 'Green Revolution', the agricultural practices implemented under its umbrella actually served to eliminate some of the indigenous plants rich in vitamin A). Small amounts of different fruits and vegetables, a number of which grow wild, would address vitamin A deficiency, among other nutritional concerns, while avoiding a solution that concentrates on one food staple, in this case genetically engineered rice. "Golden Rice is draining funding and attention from real solutions to malnutrition and vitamin A deficiency.... Genetic engineering technologies are portrayed as the 'only practical solution' yet the underlying causes of poverty and hunger and degradation of agricultural lands are studiously ignored" (Borromeo & Deb, 2006, p. 12). A 2006 report commissioned by Greenpeace International demonstrates that genetically engineered rice is less effective, more expensive, and poses more dangers to human health than do traditional rice breeding and production methods. Estimates place the number of different rice varieties in the world at around 140,000, many of which have been bred to thrive in conditions particular to a local environment. For example, rice resistant to a certain disease or insect predators; rice that grows in deep water or in drought stricken areas; rice adapted to local soil types, etc. It is precisely this type of natural diversity that will sustain the future of rice, and other similarly

made these same companies to secure state subsidies and a relaxed regulatory environment, in which, as was discussed in the previous section, genetically engineered organisms are assessed by governments in the same fashion as traditional health and food products. Biotechnology companies actively invoke information dissemination practices that predominantly emphasise the favourable and sanitized aspects of this new technology and its applications (Hindmarsh, 2001).[33] Monsanto engages in deliberate attempts to shape public debate around biotechnology in a manner not only propitious to its own product lines but one designed to deflate opposition. It does this through a combination of tactics that draw on technological determinism, the apparent infallibility of science and scientists, and the portrayal of biotechnology as completely natural.[34] Of course, resistance movements organised around biotechnology issues have also made effective use of popular images and symbolic resources in their attempts to sway public

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diverse crops, as well as the people who depend on them. Genetically engineered rice threatens to destroy this agricultural diversity. See, Borromeo, E., & Deb, D. (2006). *Future of rice 2006: Examining long term, sustainable solutions for rice production.* Amsterdam: Greenpeace International. And the Canadian government has been caught up in such efforts; Mary Alton Mackey, a member of CBAC, worked with the Canadian International Development Agency (CIDA) to help bring 'golden rice' to Bangladesh. See, for example, Ross, R. (2002, June 10). Boundless biotech; the booming industry promises to deliver huge benefits, but nagging concerns remain over ethical and economic issues. *Toronto Star,* pp. D05. The rhetoric employed by biotechnology proponents that genetically engineered crops are necessary to feed the poor of the world, aside from being completely blind to the real cause of malnutrition, namely poverty, belies an overwhelming sense of patriarchal imperialism in its failure to accept the strong voices of opposition to genetically engineered crops emanating from farmers and others, including some African governments, in a number of developing countries. See, for example, Hisano, S. (2005). A critical observation on the mainstream discourse of biotechnology for the poor. *Tailoring Biotechnologies, 1*(2), 81-105.

[33] For a critical assessment of the way government and industry actively seek to control the way discourse around by is framed in the United Kingdom, see Murdock, G. (2004). Popular representation and postnormal science: The struggle over genetically modified foods. In S. Braman (Ed.), *Biotechnology and communication: The meta-technologies of information* (pp. 227-259). Mahwah, NJ: Lawrence Erlbaum Associates.

[34] For a detailed and compelling analysis of this discursive strategy, see Kleinman, D. L., & Kloppenburg, J., Jr. (1991). Aiming for the discursive high ground: Monsanto and the biotechnology controversy. *Sociological Forum, 6*, 427-447.

opinion.[35] Such corporate strategies provides companies a window of opportunity to sell as much of their genetically engineered products as possible in an attempt to integrate them so deeply into markets that potential regulated withdrawal would result in such a degree of economic upheaval that it is no longer considered a viable policy option (Levidow, 1995).

> As always, capital makes techno-revolutions sound good, and to the extent that the interests of individuals and of capital overlap, the revolution will be good. Unfortunately, we do not know how big this overlap will be, and if we are to judge from past experience, we can expect much more to be worse than better. Further, while the utopian promises have yet to really manifest themselves, the numerous problems…are already manifesting themselves (Critical Art Ensemble, 2002, p. 53).

As we observed in the literature review chapter, Jeremy Rifkin (1998) is extremely critical of the often one-sided nature of the contemporary debate over biotechnology. His analysis of reports about biotechnology that have emanated from the trade, business press, and the general media reveals a picture of the media landscape heavily influenced by the messages circulated by geneticists and the biotechnology industry. Conversely, critical assessments of this new technology have received a dearth of coverage, a trend in both Canada and the United States that has been documented by other writers (Hornig Priest, 2006; Hornig Priest & Ten Eyck, 2004).[36] Informed by Krimsky's (1991) discussion, we note that media hype around biotechnology has tended to be designed to promote investor confidence and public support for these new

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[35] For an account of such opposition to genetically engineered foods in the United Kingdom, see Murdock, G. (2004). Popular representation and postnormal science: The struggle over genetically modified foods. In S. Braman (Ed.), *Biotechnology and communication: The meta-technologies of information* (pp. 227-259). Mahwah, NJ: Lawrence Erlbaum Associates.

[36] A very recent editorial in the science journal *Nature*, drawing on a Pew Research Center report entitled *The state of the news media 2008*, bemoans the fact that on average five hours of American cable news contain about only one minute of science and technology coverage. See, for example, n.a. (2008). Critical journalism. *Nature, 452*, 387-388. Moreover, as newspapers slash budgets in response to falling circulation numbers, science desks are typically among the first casualties.

technologies. "Indeed in the highly competitive cloning marketplace, where companies are scrambling to patent the first major breakthrough in stem cell research, PR and manipulation of media are lab tools as basic as a microscope" (Best & Kellner, 2004, 206). Those who do voice concerns about the trajectory of biotechnological development risk being marginalised by the 'scientific establishment' and biotechnology industry as heretics attacking the conventional wisdom developing around mainstream biotechnology (Rifkin, 1998). Though this should perhaps not come as a totally unexpected surprise – there is a substantial body of related literature demonstrative of the fact that the media tend to be sympathetic to dominant scientific discourses, acting to legitimate current policy that flows from both governments and the corporate sector. Rather than offering critical or even alternate perspectives, the bulk of news reports uncritically reproduces the assertions and assumptions made by scientists and the biotechnology industry, in part because of what Gandy calls 'information subsidies' provided by these actors – specific information that portrays new technologies in a positive manner.[37] Some observers propose that this lack of critical media coverage has lulled policymakers, at least in the United States, into a false sense that biotechnology has not engendered any popular resistance (Hornig Priest & Ten Eyck, 2004). Specific to Canada, one researcher has determined through a content analysis of Canadian newspaper coverage of biotechnology issues for 2004 that these same media trends and biases exist in this country (Knezevic,

[37] For critical accounts of media coverage of scientific issues, see, for example: Dunwoody, S. (1993). *Reconstructing science for public consumption: Journalism as science education.* Victoria: Deakin University; Gandy, O. H., Jr. (1982). *Beyond agenda setting: Information subsidies and public policy.* Norwood, NJ: Ablex; Hornig Priest, S. (1995). Information equity, public understanding of science, and the biotechnology debate. *Journal of Communication, 45*, 39-54; Nelkin, D. (1987). *Selling science: How the press covers science and technology.* New York: W.H. Freeman; Ward, I. (1995). *Politics of the media.* South Melbourne, Australia: Macmillan; and, White, T. (2001). 'Get out of my lab, Lois!': In search of the media gene. In R. Hindmarsh & G. Lawrence (Eds.), *Altered genes II: The future?* (2nd ed., pp. 69-82). Melbourne: Scribe Publications.

2005). As we will see in the following chapter, 2004 was an important year for biotechnology given the substantial opposition being generated against Monsanto's application for regulatory approval of its genetically engineered Roundup Ready wheat. Yet Knezevic (2005) determined that a mere 279 articles (of which 80 were duplicate articles that appeared in multiple newspapers) were published in seventeen newspapers. More troubling than this minimal coverage was the inherent industry slant found in the articles, which uncritically accepted the biotech industry's claims about genetically engineered organisms representing progress, aiding farmers, producing healthier foods, and serving environmental remediation purposes. Conversely, opponents of biotechnology and genetic engineering tended to be portrayed as self-serving and fundamentally uninformed activists promoting their own personal political agendas. For the most part, industry and government scientists were referred to as experts while scientists voicing critical assessments of this technoscience were often discredited as engaging in "junk science" (Knezevic, 2005, p. 108). The conclusion Knezevic (2005, p. 115) draws from her study is lack of public knowledge around biotechnology issues "…is not a case of voluntary ignorance; it is a systemic problem where those who are supposed to inform us [media] continue to obscure the truth not only about GMOs, but also about the wider context in which this industry has managed to flourish."

Similar to other accounts of mass media concentration, Benkler (2006) bemoans the fact that contemporary ownership structures of the means of communication limit the scope of issues that find public expression, that the owners possess an inordinate amount of power in shaping public opinion and limiting information flow that can be auctioned to the highest bidder, and that programming is reduced to the lowest common denominator that strips it of all complexity and political engagement.[38] Though not explicit, Benkler (2006) seems to adopt an Indymedia tack in his discussion of autonomy, speaking about the elements of equal access and active expression as being key to overcoming the stranglehold exercised by the owners of the means of communication over the messages disseminated throughout society. Put another way, the networked economy, which opens up to a networked public sphere, provides the means by which individuals can inject their own viewpoints into this public sphere outside of the control and corruption of mass media owners. In all of this, Benkler (2006) sees a number of newly developing communities of interest around which new sites of Internet traffic are emerging, although after reading his work one is left with the sense that Benkler (2006) is susceptible to the charge of being more concerned with immaterial reproduction than any type of radical reappropriation of networked production.

7.2.1 Genetically Engineered Language

Cook's (2005) study of British scientists involved with biotechnology reveals how they too restrict debate to safety issues and tend to discount the public as ill-informed, uncritical, and susceptible to manipulation by 'self-serving' NGOs and to a lesser extent the media. But in terms of educating the public scientists seem interested only in monologic communication. That is, scientists adopt a 'deficit model' when considering resistance to biotechnology, believing that opposition stems from a lack of knowledge

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[38] On these themes, see also McChesney, R. W. (1998). Media convergence and globalisation. In D. K. Thussu (Ed.), *Electronic empires: Global media and local resistance* (pp. 27-46). London, GB: Arnold.; McChesney, R. W. (1999). *Rich media, poor democracy: Communication politics in dubious times.* Urbana: University of Illinois Press.; and, Bettig, R. V. (1996). *Copyrighting culture: The political economy of intellectual property.* Boulder, CO: Westview Press. The classic exposition of the third point is, of course, Horkheimer, M., & Adorno, T. W. (1972). *Dialectic of enlightenment* (J. Cumming, Trans.). New York: Herder and Herder.

about biotechnology. Yet gunpowder, DDT, thalidomide, napalm, and nuclear weapons, among others, are all examples of technology that biotechnology proponents conveniently forget to mention when rhyming of litanies of beneficial technologies first opposed at the initial stages of their development and introduction.

Cook (2005) is critical of the substitution in much of the debate around biotechnology of the term 'genetic modification' for the initial term 'genetic engineering'. Although both terms refer to the same set of activities, the latter connotes mechanical and impersonal processes, perhaps even evoking memories of the now discredited ideas about 'social engineering', while the former term invokes the notion of unintrusive and minor adjustment of something already in existence. The subsequent abbreviation of 'genetic modification' to GM succeeds in further occluding from contemplation just what is at stake with the technical applications of this science, something George Orwell pointed out in *Nineteen Eighty-Four*: "It was perceived [in Newspeak] that in...abbreviating a name one narrowed and subtly altered its meaning, by cutting out the associations that would otherwise cling to it" (Orwell, 1987, pp. 263-264).[39] Following the work of Macnaghten and Urry in their book *Contested natures*, Cook (2005, p. 107) points out that

> [t]here are many reasons not to agree with the recurrent arguments that genetic engineering is the same kind of intervention as traditional breeding. Traditional breeding works together with Nature, slowly and sensitively, by serendipity and observation, harnessing rather than overturning natural forces. Genetic engineering, on the other hand, works against it, rushing change without consideration or reflection, in a way that is at odds with evolutionary time, overturning rather than respecting what it finds.

Opposed to industry's and government's uncritical exaltation of biotechnology we thus prefer to employ the term 'genetic engineering' in its full form throughout our work.

[39] Orwell originally published *Nineteen Eighty-Four* in 1949.

Part of the way government and industry confuse debate is through their use of terms such as 'sound science' and 'natural' versus 'unnatural'. The term 'sound science' is not a mere tautology – after all, is science not required to be sound in order to be considered science – but instead provides a rhetorical strategy for disarming biotechnology opponents, implying that in addition to 'sound science' there is also 'unsound science', the charge usually directed toward opponents of genetic engineering. Scientific research certainly can be methodologically flawed and thus unsound in its findings. Similarly, the terms 'natural' and 'unnatural' represent ideal types that are best considered as existing on a continuum comprised of degrees of naturalness, along which various phenomena can be situated. For example, a plant growing in the wild represents our prototypical understanding of natural, while a genetically engineered variety developed in a laboratory would be located at an opposite and fairly distant position on the continuum. An exact degree of 'scientific' distinction between the two terms is also rendered problematic because, aside from describing an attributed ontological status, they can also express an oftentimes-normative judgement (Cook, 2005). "The claim that a genetic sequence or GMO is artificial underscores the "tech" part of the biotech: it is in some minimal way the result of human intervention, industry, and technology" (Thacker, 2005, p. xviii). Yet these same companies that employ such arguments when justifying their intellectual property claims also market their products as being 'natural' and therefore safe for the environment, humans, and animals. The rhetoric disseminated by these transnational firms to market their genetically engineered products relies on a discourse that endeavours to situate biotechnology as a complement to the natural processes and rhythms of human health, nutrition, and the environment. The biotechnology industry has thus manoeuvred itself into an internally inconsistent logic, stressing the 'tech' part of biotechnology when seeking intellectual property protection and the 'bio' side of the biotechnology concept when promoting the range of applications derived from this science. "The advantage claimed for biotechnology is that it is more natural, a direct working with "life itself." In its ideal guise, biotechnology promises to bypass technology altogether, a biology working upon itself" (Thacker, 2005, p. xix).

Industry and government also make adept use of public relations campaigns designed to garner public acceptance of biotechnology, usually through various lobby groups that promote themselves as neutral arbiters in debates around this technoscience. For example, the International Life Science Institute, the AgBioWorld Foundation, the International Food Information Council, the Council for Biotechnology Information, and the Biotechnology Institute have all been involved in designing media campaigns aimed at various social groups, ranging from journalists to teachers, students, consumers, and farmers. This type of almost covert biotechnology advocacy is supplemented by more aggressive lobbying carried out by industry groups, such as BIOTECanada, the Biotechnology Industry Organization, the European Association for Bioindustries, the Business and Industry Advisory Committee to the OECD, CropLife International (formerly known as Global Crop Protection Federation), and the International Chamber of Commerce's Commission on Biosociety (Hisano, 2005).

Given the fairly substantial resources government and particularly industry can direct toward influencing public debate, the following subsection seeks to debunk on some of the myths being propagated in respect of biotechnology. Since government and industry are keen to limit potential critique to issues based only in science, our discussion relies on scientific studies to refute some of the myths propagated by the biotech industry. The tactic we employ here should not be construed as acceptance of the circumscribed parameters within which biotechnology proponents seek to confine debate, but rather as proof that even on such limited terms many of the supposed benefits of this technoscience cannot be legitimated.

7.2.2 Genetically Engineered Seed Myths

Dr. E. Ann Clark (2003), associate Professor in the Department of Plant Agriculture at the University of Guelph, forcefully asserts that proprietary genetic technologies address only the symptoms rather than the underlying management problems in contemporary agriculture. Ecologically dysfunctional crop rotation practices exacerbate selection pressure and contribute to the development of vigorous weeds, which creates opportunities for herbicide tolerant crop varieties. As Clark points out, the genetic traits inserted into such seeds to render them resistant to particular herbicides often promote additional weed resistance, thus exacerbating the initial problem even further.[40] The concerns articulated by Clark are reinforced by another recent Canadian study, in which scientists document the persistence and introgression of an herbicide

[40] Even the International Service for the Acquisition of Agri-Biotech Applications (ISAAA), an unapologetic mouthpiece for the agricultural biotechnology industry, admits, albeit in subdued tones, that "[t]he impact of GM HT [herbicide tolerance] traits has, however, contributed to increased reliance on a limited range of herbicides and this poses questions about the possible future increased development of weed resistance to these herbicides. Some degree of reduced effectiveness of glyphosate (and glufosinate) against certain weeds may take place. To the extent to which this may occur, this will increase the necessity to include low dose rates applications of other herbicides in weed control programmes (commonly used in conventional production systems) and hence may marginally reduce the level of net environmental and economic gains derived from the current use of the GM technology" (Brookes & Barfoot, 2006, p. xvi). See, Brookes, G., & Barfoot, P. (2006). *GM crops: The first ten years - Global socio-economic and environmental impacts* (ISAAA Brief No. 36). Ithaca, NY: The International Service for the Acquisition of Agri-Biotech Applications. As might be expected from a report issued by an ardent biotechnology industry promoter, this methodologically dubious and superficial work relies almost exclusively on industry literature to downplay the social, economic, and environmental concerns articulated against biotechnology (this despite its title).

resistant transgene into the gene pool of a weedy relative.[41] While the evidence does not indicate a substantial risk inherent in the particular plants studied, the authors make the point that such considerations (i.e. gene escape and introgression among wild relatives) must figure more prominently in risk assessments of transgenic hybrids, particularly in the case of fitness-enhancing traits such as disease and pest resistance and tolerance to cold, drought, and salinity. Not only are these latter types of genetically engineered organisms still not well understood ecologically, but gene escape and subsequent introgression could, in fact, pose dire consequences for the surrounding environment beyond farmers' fields (Warwick, Légère, Simard, & James, 2008). A recent study has determined that genetically engineered glyphosate resistant creeping bentgrass, a type of grass used on many golf courses, has not only transgressed the boundaries of the field trial area (genetically engineered grass was found up to 4.6 kilometres away from the test site) but has survived for three years after the genetically engineered grass was removed from the test plot and a mitigation programme had been conducted. Since grass is a perennial that subsists year after year, contamination by genetically engineered seeds could be impossible to control or eradicate (Zapiola, Campbell, Butler, & Mallory-Smith, 2008).[42] In the case of genetically engineered traits against pests, plant-produced

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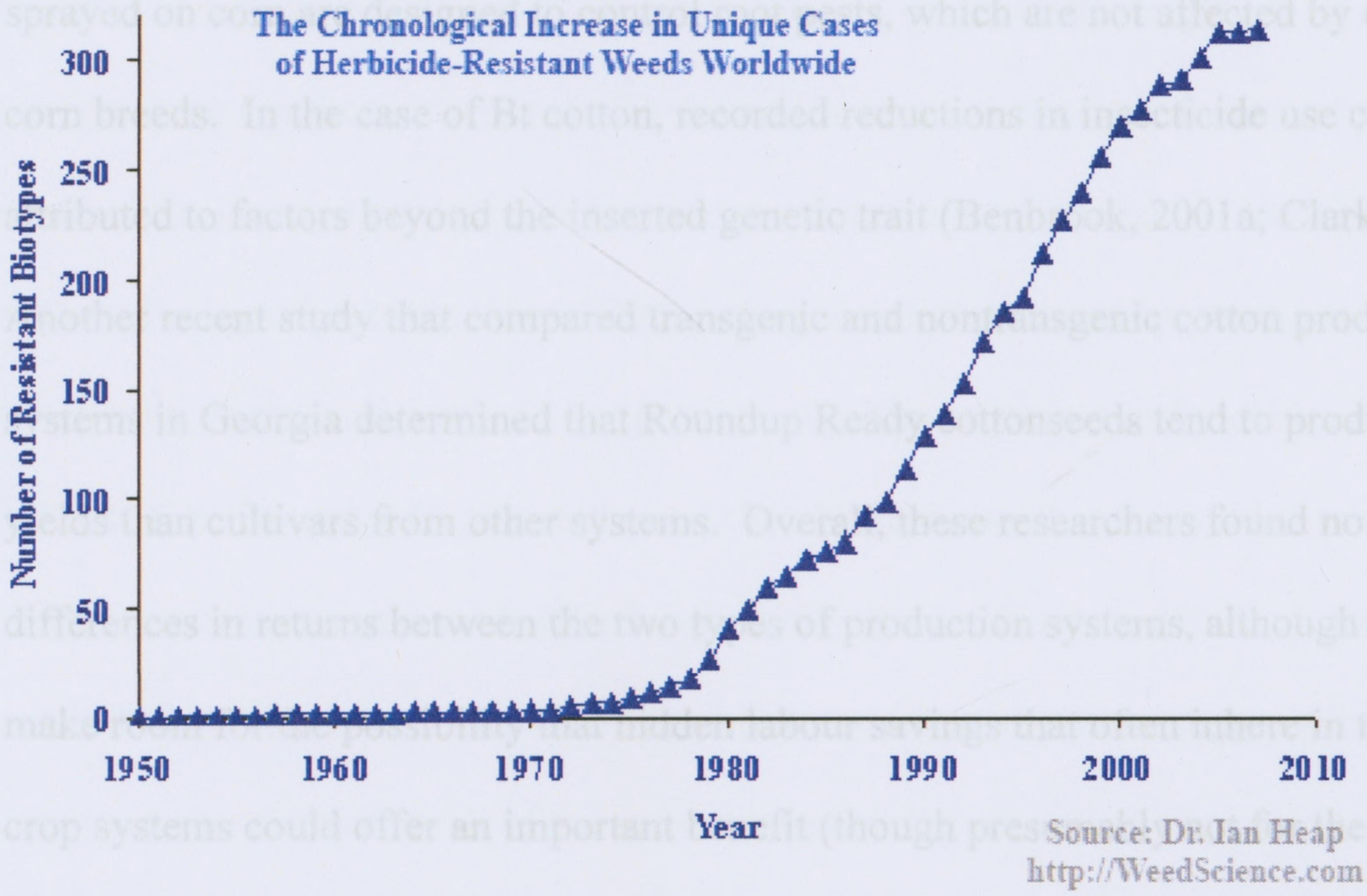
[41] The International Survey of Herbicide Resistant Weeds, a collaborative effort between weed scientists in over 80 countries, maintains a publicly accessible database that monitors the evolution of herbicide-resistant weeds across the globe, including an assessment of their impact. This collaborative effort is supported and funded by the Herbicide Resistance Action Committee, the North American Herbicide Resistance Action Committee, and the Weed Science Society of America. Its aim is to maintain scientific accuracy in the reporting of herbicide resistant weeds globally. As of March 2008 it had recorded 317 resistant biotypes among 183 Species (110 dicots and 73 monocots) and over 290,000 fields. The database can be accessed at the following URL: http://www.weedscience.org/in.asp.

[42] In 2006 the United States Environmental Protection Agency determined that genetically engineered bentgrass had moved as much as 3.8 kilometres away from the initial test plot through seed movement and by pollinating non-genetically engineered plants to form hybrids. In 2007 a federal district court in the United States ruled that the United States Department of Agriculture had illegally approved testing for Roundup Ready grass because it failed to comply with the *National Environmental Protection Act.* Under a licencing agreement with Monsanto, Scotts Grass Company owns this genetically engineered grass. Later

pesticides tend to induce selection pressure more vigorously than synthetic biocides, resulting in the 'genetic treadmill' discussed previously, in which continued dependence on proprietary genetic technology substitutes for sustainable agricultural management practices. See Figure 7-1 for a dramatic graphic account of the sharp rise in documented cases of herbicide resistance among weeds that corresponds chronologically quite closely to the development and marketing of seeds genetically engineered to be herbicide resistant.

Figure 7-1 Documented Cases of Herbicide Resistant Biotypes



Emerging studies prove that Roundup Ready[43] soybeans require more of the active ingredient glyphosate than competing herbicides. Even more damaging, the

studies determined that the two illegal field trials resulted in contamination of surrounding areas, for which Scotts Grass was fined US$500,000.

[43] By way of reminder, Roundup Ready products have been genetically engineered by Monsanto to be resistant to its 'Roundup' herbicide (glyphosate is the active ingredient in these herbicides) – its line of glyphosate resistant seeds are marketed and known as 'Roundup Ready'.

increased weed resistance that emerges after several years of planting Roundup Ready soybeans compels agricultural producers to expand their herbicide spraying regimens by either using additional herbicides or multiple applications of Roundup Ready (Clark, 2003). Farmers who plant Roundup Ready soybeans are therefore applying approximately 0.56 kg/ha more herbicide than those growing conventional soybeans – or about 9 million kilograms of additional herbicide per year in the United States alone (Benbrook, 2001b). In the case of Bt corn,[44] Clark (2003) argues that this genetically engineered crop holds out very little promise of reducing insecticide use since relatively little insecticide is applied to control the target of Bt corn. Most of the insecticides sprayed on corn are designed to control root pests, which are not affected by current Bt corn breeds. In the case of Bt cotton, recorded reductions in insecticide use can be attributed to factors beyond the inserted genetic trait (Benbrook, 2001a; Clark, 2003). Another recent study that compared transgenic and nontransgenic cotton production systems in Georgia determined that Roundup Ready cottonseeds tend to produce lower yields than cultivars from other systems. Overall, these researchers found no significant differences in returns between the two types of production systems, although they do make room for the possibility that hidden labour savings that often inhere in transgenic crop systems could offer an important benefit (though presumably not for the agricultural workers rendered redundant!) (Jost et al., 2008). In a study published earlier this year, researchers documented field-evolved resistance among *Helicoverpa zea* (a major

[44] Again by way of reminder, biotechnology companies have also been developing virus-resistant transgenic seeds engineered to protect the resulting crops from particular blights and viruses. Most of these crops contain a gene from a naturally occurring soil bacterium known as *Bacillus thuringiensis*, which produces a crystal protein known as Bt prototoxin that destroys the digestive tract of certain Lepidopteran insects (insects that metamorphose from a caterpillar stage) when ingested and mixed with stomach acid. Seeds that contain this gene are noted by the prefix 'Bt', e.g. Bt-Cotton.

lepidopteran pest) to a Bt toxin produced by transgenic cotton (Tabashnik, Gassmann, Crowder, & Carriére, 2008).

Dr. Clark (2003) also refutes the myth propagated by the seed industry that genetically modified crops produce higher yields. As she points out, almost 99% of all genetically engineered crops are designed to be either herbicide tolerant or Bt. That is, only one active transgene is inserted. In some cases a seed will be stacked, meaning that it contains both herbicide tolerance and Bt traits. Yield, however, depends upon the interaction of multiple genetic traits. The only way that these current genetically engineered seeds augment yield is by decreasing production losses that might occur as a result of weeds, as in the case of herbicide tolerant crops, or the targets of Bt crops (e.g. the European cornborer for corn). To determine how much of any increased yield is the result of the inserted genetic trait requires a comparison to what could have been achieved using other tools (Clark, 2003). In general, studies are beginning to prove that genetically engineered seeds do not produce significantly increased yield loads. In fact, in the case of Roundup Ready soybeans it has been shown that these seeds produce fewer beans than conventional seeds (Benbrook, 1999, 2001b; Gordon, 2007). A recent study conducted in Nebraska in respect of glyphosate resistant soybeans suggests that the yield drag might be a direct result of the genetic engineering processes employed to create the seeds (Gordon, 2007). These studies have been able to show definitively that the reduced yields from Roundup Ready soybeans are the result of either the gene inserted or the insertion process (Clark, 2003; Gordon, 2007). That is, pleiotropic effects (the phenotypic expressions of gene insertion through which one gene or protein influences multiple phenotypic traits) may occur as a result of altered metabolic pathways in plants that could silence the expression of pre-existing genes in an organism. A recent Canadian study based on surveys and interviews of agricultural producers in Alberta, Saskatchewan, and Manitoba demonstrates that Canadian farmers have not experienced significant yield improvements associated with genetically engineered canola (Mauro & McLachlan, 2008).

Moreover, as hinted at previously, putatively scientific claims in support of biotechnology can be 'manufactured' easily through the use of unsound and even fraudulent methodologies, as occurred in a study conducted here in Canada.[45] The case of interest relates to the claims made in an article entitled 'Agronomic and consumer considerations for Bt and conventional sweet corn' that appeared in the *British Food Journal* in 2003.[46] According to the article, which won an award by the journal for being the most outstanding paper in 2004, consumers prefer to purchase genetically engineered (Bt) sweet corn over traditional sweet corn by a factor of three to two. However, it has since been revealed that this Ontario study was methodologically flawed. As Toronto Star reporter Stuart Laidlaw documents, the study investigators hung leading signs above the bins of corn being sold in the test-site store: above the conventional sweet corn the

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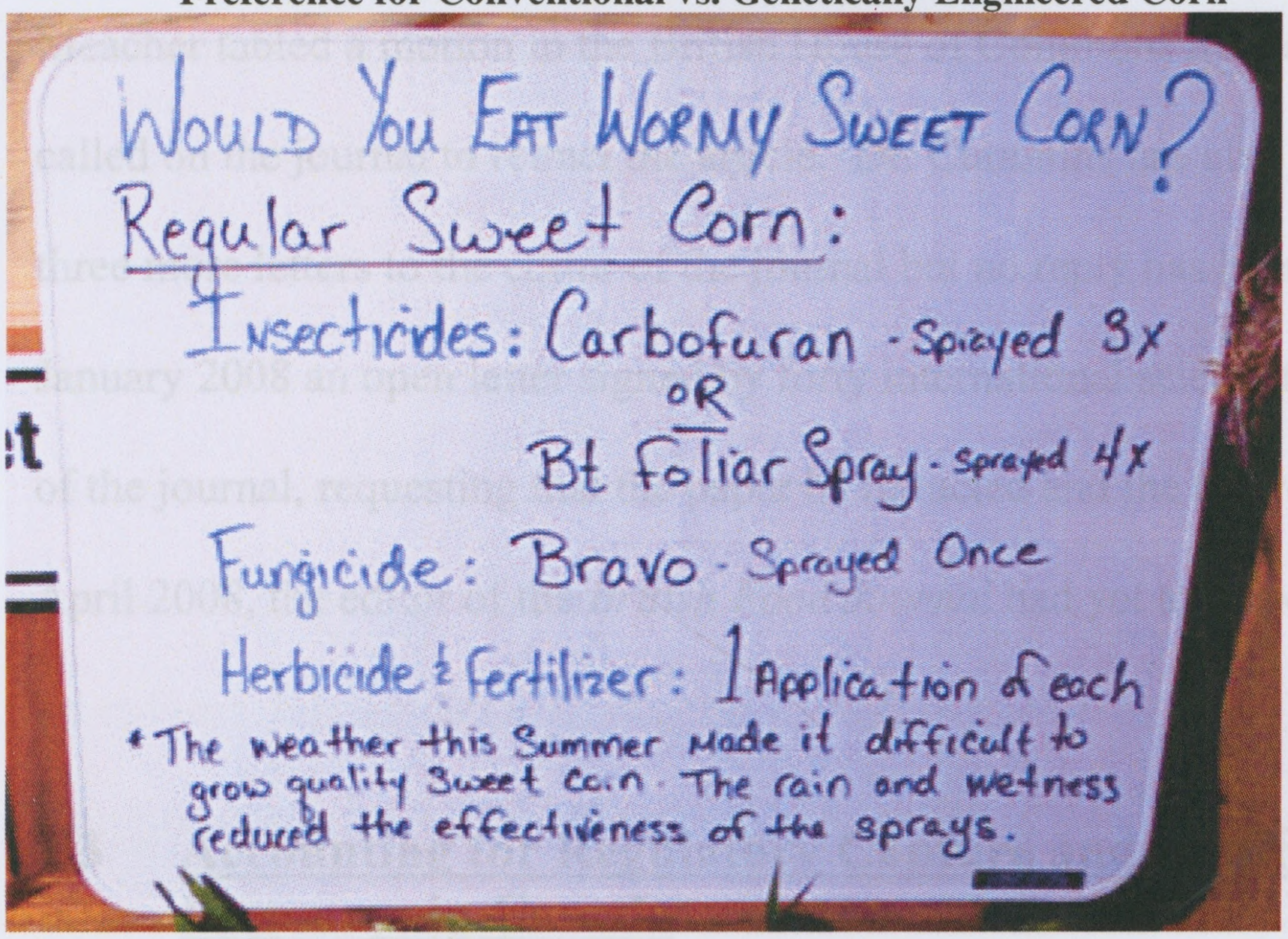
[45] An expanding number of reports are appearing on an almost weekly basis from around the world that dispute the myths being propagated by the biotechnology industry and various national governments. A recent policy paper drafted by seven environmental scientists in the United States, and which appears in the journal *Science*, contends that the data available are too vague to permit an accurate assessment of the benefits and drawbacks of genetically engineered crops. See, Marvier, M., Carrière, Y., Ellstrand, N., Gepts, P., Kareiva, P., Rosi-Marshall, E., Tabashnik, B. E., & LaReesa Wolfenbarger, L. (2008). Harvesting data from genetically engineered crops. *Science, 320*, 452-453. German federal scientists who report to the National Parliament's (Bundestag) Committee for Education, Research, and Technology Assessment maintain that there is insufficient scientific data to support the claim made by industry that genetically engineered seeds provide higher yields and therefore higher revenues for farmers, despite the fact that such genetically engineered crops have been planted for over twelve years now. The report further contends that industry claims are based on faulty methodological studies. See, for example, Maurin, J. (2008, April 29). Transgene Pflanzen in der Landwirtshaft: Gentechnik-Vorteile nicht bewiesen. *die tageszeitung*.

[46] See Powell, D. A., Blaine, K., Morris, S., & Wilson, J. (2003). Agronomic and consumer considerations for Bt and conventional sweet corn. *British Food Journal, 105*, 700-713.

sign asked, “Would You Eat Wormy Sweet Corn?”, while the sign above the genetically engineered corn read “Here’s What Went into Producing Quality Sweet Corn”. Moreover, the contrast between ‘wormy’ and ‘quality’ was further emphasised on the sign by statements about how often the conventional corn had been sprayed by insecticides and fungicides (see Image 7-1) (Laidlaw, 2003).

Image 7-1 Sign Posted Above Conventional Sweet Corn in ‘Experiment’ Testing Consumer Preference for Conventional vs. Genetically Engineered Corn



Such blatantly leading differences in the way the two types of corn were being proffered for sale to the public were not documented in either the methodology or the findings discussion sections of the article. Dr. Joe Cummins, Professor Emeritus of Plant Genetics at the University of Western Ontario, penned a letter to the Editor of the journal on May 30, 2006, asking that both the article and the subsequent award be retracted since the experiment and the controls upon which it was based were not accurately and fully disclosed. The editor of the journal refused on both accounts. What is perhaps more interesting is that Shane Morris, one of the article’s authors, claims on his website

GMOIreland (http://student.ucc.ie/blogs/GMOIreland/) not to have seen any such misleading signs. Morris is a biotechnology industry lobbyist and at the time of the controversy was a Senior Consumer Analyst in the Consumer Analysis Section of Agriculture and Agri-Food Canada.[47] Since Dr. Cummins' first letter, additional information has emerged that clearly refutes Morris' claims and seriously undermines the validity and reliability of the study. In November 2007 Member of Parliament Michael Meacher tabled a motion in the British House of Commons that, among other things, called on the journal to retract the article. Dr. Cummins has also subsequently written three more letters to the editor of the journal but no reply has been forthcoming. In January 2008 an open letter signed by forty international scientists was sent to the editor of the journal, requesting that the paper be retracted and the award withdrawn. As of April 2008, the editor of the *British Food Journal* had yet to respond.

7.3 Accounting for Regulatory Capture and Control of Biotechnology Discourse in Canada

As Karl Polanyi teaches us, an economic market is embedded in political structures of power, as demonstrated by the recourse to political and legal intervention made by capital in order to secure and expand the ambit of private property relations (Polanyi, 2001). In fact, Polanyi (2001) develops a credible argument that speaks against the possibility of free-markets, asserting instead that some form of government

[47] GM Watch, an organisation devoted to exposing the corporate and government interests behind the hype surrounding genetic engineering, has tracked and reported in detail the events surrounding this study and the subsequent controversy. Its reportage can be found at the following URL: http://www.gmwatch.org/sart.asp?paid=22. A review of the Canadian Government Electronic Directory Services indicates that Morris is no longer employed by the Federal Government. His name was also not found in the federal government lobbyist registry.

intervention, often for the benefit of capital, is usually required. Despite the rhetoric of free marketers, there is a clear relationship between economic markets and political regulation and control. The question is not *whether* the state will intervene but *how*. The same logic holds for globalisation processes, which are driven not by a reduction of political and legal control but instead by transformations in the types of control exerted (Hardt & Negri, 2004). In the contemporary context we thus recognise that neoliberalism is less a regime of unregulated capitalism and more a system of state regulation that strives to facilitate global trade and profits for capital.

While it is certainly the case that there is often an overwhelming concordance between state action and the interests of capital, it is no less the case that the state also lays claim to acting in the interests of society as a whole, a claim accepted by a large number of people. A common refrain heard from business is that the state continues to extend its reach into areas that capital considers its own domain. We suggest that an understanding of the actions of the state demands a materialist theory of the state that considers the political form to be dependent upon the form of capitalist relations of production. Rather than conceptualise the state as a captured institution that functions merely as capital's handmaiden, a more fruitful line of investigation seeks to understand the state and its relationship to capitalist accumulation and crisis (Holloway & Picciotto, 1978). A functionalist perspective considers the state to function as "the ideal collective capitalist," that promotes the interests of capital as a whole through "discriminatory management of monopolistic competition" (Therborn, 1980, p. 89). Because the state is structurally dependent upon capitalism, any interventions in the economic sphere will necessarily be developed with an eye toward ensuring the long-term viability of the capitalist system.[48] The advantage of the approach advocated by Holloway and Picciotto (1978) is that it avoids the functionalist economic reductionism inherent in some Marxist theory in which state activities are considered to emerge from the requirements of capital, while also rejecting those approaches that maintain a strict binary division between the political and the economic in which theorists concerned with the former realm of activity omit any scrutiny of capitalist accumulation processes. This conception of state development complements the overall theoretical tenor of this research, which locates the impetus for capitalist development in the struggles by universal labour that emerge from the class conflict inherent in capitalist social relations. The CBS and its emphasis on harnessing the potential of biotechnology to ensure Canada's economic growth and international competitiveness, coupled with the Canadian regulatory environment in respect of genetically engineered crops that is heavily slanted in favour of the companies being regulated, demonstrate the degree to which the economic is embedded in political structures of power as well as the reflexive nature of those political forms that depend in part on the economy for their continued existence.

More specific to the recombinant biopolitical framework we have proposed as the analytical lens through which to interpret biotechnology in this country, we note that the Canadian regulatory system functions in a manner that actually impedes the knowledge commons in respect of genetically engineered organisms. As discussed above, Canadian regulations and policies concerning genetically engineered organisms fail to ally with the principles of sustainable development that have been designed to respond to social,

[48] For a fuller explication, see, for example, Therborn, G. (1980). *What does the ruling class do when it rules?* London, GB: Verso.

economic, and environmental issues as adopted by the Government of Canada.[49] By restricting the regulatory approval system for genetically engineered products to issues of what the Canadian government and industry deem to be appropriate science, these actors are circumscribing the biological knowledge commons. Through their construction of a particular 'black box' of biotechnology, to borrow from Latour, government regulators are consciously attempting to omit from discussion a plethora of social, ethical, environmental, and economic issues that attach to the technological developments that derive from this science, and which have deep implications for species-being. While there is certainly a vocal opposition in this country that, as we will see in the following chapter, is battling to inject precisely such considerations into the debates around biotechnology, the government nonetheless occupies a potent gatekeeper function that heavily influences what knowledge is considered legitimate or not. And despite common laments about citizen apathy toward government, health and safety regulators continue to engender a substantial amount of trust among the broader population, which in turn translates into significant power to shape broader public discourses in respect of biotechnology.

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[49] Similar concerns about the efficacy of Canada's regulatory system in respect of genetically engineered organisms have been raised formally by a group that includes agricultural scientists Dr. E. Ann Clark and Dr. Bert Christie, the Council of Canadians, and the Canadian Institute for Environmental Law and Policy. This group submitted a petition on May 9, 2000 to the federal government under the *Auditor General Act* (R.S., 1985, c. A-17) that formally outlines the major concerns discussed above in respect of lax regulatory oversight of genetically engineered organisms in this country. The petitioners recommend that the Government of Canada implement a mandatory labelling scheme and overhaul the product review process to ensure comprehensive safety assessments based on independent testing and broad and inclusive safety standards (Office of the Auditor General of Canada, 2000a). In its response, which was drafted jointly by the Ministries of Agriculture and Agri-Food, Fisheries and Oceans, Industry, Environment, Health, and Natural Resources, the Government of Canada unconvincingly contends that the existing regulatory system assesses the risk of biotechnology products from a sustainable development perspective (Office of the Auditor General of Canada, 2000b).

The material offered in this part of the chapter suggests a need to probe beyond the discourse constructed by governmental and corporate actors that positions biotechnology as a panacea for problems such as hunger, disease, and low crop yield due to environmental conditions. As Negri tells us, "capital, having itself become social" is optimally positioned to obscure "the contours of the totality" in order "to disguise its hegemony over society and its interest in exploitation, and thus to pass its conquest off as being in the general interest" (Negri, 2005, p. 204). By manipulating the scope and the tenor of the discourse in respect of biotechnology in this country, capital is actively engaging in a form of biopower designed to control for its own purposes the discursive norms and institutional contexts that surround this technoscience. Recalling our discussion in chapter three, biopower organises life through capitalist command that endeavours to permeate the full range of human existence, which is facilitated by the active construction of a biotech discourse tightly controlled by industry.

We further contend that this exercise of biopower, which is reflected in the intransigence of industry and government regulators to expand the terms of the biotechnology debate, is designed to serve capitalist accumulation purposes. We previously characterised primitive accumulation as comprising those strategies designed to establish and maintain the social conditions conducive to capitalist valorisation. Any object that threatens the historically contingent balance of power between classes represents an obduracy that threatens to impede capitalist accumulation and is thus susceptible to capitalist strategies of primitive accumulation. Precisely because, according to Marx, class struggles are inherent to capitalist relations of production, capital is compelled, in order to safeguard its existence, to engage in strategies of primitive accumulation that provide the basis for accumulation proper. Viewed from this perspective, strategies of enclosure aimed at eliminating impediments to capitalist processes of accumulation legitimately can be categorised as instances of primitive accumulation. We posit that the efforts by transnational biotech companies, and to a lesser degree the regulatory system, to limit debate surrounding biotechnology to issues of safety and science only can be construed as a discursive strategy of enclosure in service of primitive accumulation. By marshalling the considerable resources at its command, capital is able to engage in active public relations campaigns, vitriolic attacks on opponents, intense lobbying, and efforts to stifle the dissemination of information not sympathetic to industry-controlled biotechnology, all of which are designed to shape and constrain the discourse around biotechnology in a manner that limits the knowledge commons in respect of this science and its applications.

Yet as is made clear in the discussion about the myths of genetically engineered seeds discussed above and the growing body of scientific evidence outlining some of the adverse impacts of genetically engineered food on human health and the environment (see Appendix II), a number of the beneficial claims attributed to biotechnologies typically advanced by industry are being called increasingly into question. Clearly genetic engineering technologies are having difficulty meeting the scientific expectations promoted by their industry developers and government cheerleaders. Since the benefits ascribed to agricultural biotechnology are susceptible to challenge precisely on scientific grounds, the one and only domain that industry and government concede as legitimate for assessing biotechnologies, it seems obvious why these actors steadfastly refuse to admit broader social, economic, and environmental issues into the debate. But as we will see in the following chapter, it is exactly these broader concerns that various strata of universal labour struggling against particular aspects of biotechnology argue must be admitted into discussions about biotechnology if we are to actualise our species potential.

The implicit message being disseminated by industry and government, which often uncritically equates technology to progress, is that biotechnology is a neutral technology that will deliver economic prosperity for the country. But as John McMurtry (2002, p. 97) resolutely states, "[s]cientific technology is not, in fact, 'neutral' in its meanings or value, but is a vast global system of moving parts that materially reproduces the transnational corporate order as a totalising mechanism to serve an absolutist value-set of turning money into more money for investors." The obvious benefit, to industry at least, of framing any discussions about biotechnology in such a manner is that it immediately forecloses admittance to broader social, environmental, ethical, and political concerns. This is not an altogether new observation; Marcuse elaborated this theme in his discussion of the infiltration of technological rationality into the social realm, which works to the oppressive detriment of humanity. As elaborated previously, political questions are rendered as technical issues to which only experts might respond, thus replacing political rationality with technological rationality in a manner that serves to denude critical opposition of its legitimacy (Marcuse, 1964).[50]

[50] Marcuse further contends that "[t]echnology, as a mode of production, as the totality of instruments, devices, and contrivances which characterise the machine age, is thus at the same time a mode of organising and perpetuating (or changing) social relationships, a manifestation of prevalent thought and behavior patterns, an instrument for control and domination" (as cited in Noble, 1977, p. xxii). See, Noble, D. F. (1977). *America by design: Science, technology, and the rise of corporate capitalism*. New York: Knopf. While this research agrees with the general premise of Marcuse's argumentation, the current project goes beyond Marcuse and others of the Frankfurt School to discern the liberatory potentials in new technologies that can be appropriated by universal labour in its struggles against capitalist control of science and technology.

In line with a number of the scholars reviewed in chapter two, we reject the notion of an autonomous technology as well as the specious teleological claims about the supposed promise of science and technology for social progress. We accept the point made by Robins and Webster (1999, p. 4, emphasis added):

> Technologies always articulate particular social values and priorities. Indeed, we may see technologies as articulating the social relations of the societies on which they are mobilised – and, of course, that must mean articulating the *power relations*....We need to be concerned with the way in which technologies mediate capitalist social relations.

A full appreciation of the opportunities for shaping the trajectory of biotechnological development presupposes a firm grasp of the social and economic conditions that prevail during its developmental stages. Science is inherently political because the concepts and theories about nature that it develops are firmly rooted in the social and political ethos prevailing at the time of their development. This should not be construed as an appeal to relativism, but rather as an admonition to bear in mind that politics do impact the way science is practiced in a particular historical epoch (Diamond, 1981). As we have documented in our discussion about the enclosure of the biological and knowledge commons in this country, capital is harnessing the power of genetic engineering to bring control over seeds – a biological artefact cultivated in common for endless generations – firmly within the logic of accumulation. An expanding application of the intellectual property regime is similarly contributing to the capitalist appropriation of seed, including both its material and informational content. This dual strategy of primitive accumulation through enclosure is being substantially facilitated through a blinkered and faulty regulatory approach that, in cooperation with an industry and government constructed discourse around biotechnology, steadfastly refuses to admit an array of broader social, political, economic, environmental, and ethical issues that attach to this technoscience.

Against such a backdrop, we, as social subjects, must employ a complementary analysis in a more reflexive manner that considers the impact social effects exercise on the trajectory of technological development, and, conversely, the effects that technology has on shaping society. By conceptualising technological development in this recursive manner, opportunities arise to alter or even resist a particular path that might otherwise appear beyond control – that is, we open pathways for resistance.

Chapter 8. Resistance is Fertile – Re-Vitalisation of the Commons

This research project is designed to elucidate the struggles that seek to counteract the forms of biopower being exercised by capital as part of its appropriation of biotechnology. To achieve this objective, interviews were conducted with fourteen key individuals involved in species-being movements that have mobilised in response to various biotechnology issues in Canada, which, as it turns out, revolve predominantly around the agricultural and food aspects of this technoscience. While we do engage in a documentary analysis of the corporate and government/regulator positions adopted in respect of biotechnology (as examined in the previous chapters), we consciously restricted our selection of interview informants to those subjects actively engaged in struggle against biotechnology. In part this decision speaks to our perhaps iconoclastic challenge to traditional norms of research 'balance' and 'neutrality'. Instead it is our belief that capital already enjoys an unbalanced advantage in terms of the resources it can assemble to deliver its message in respect of biotechnology. For example, in an effort to mitigate some of growing bad publicity associated with biotechnology issues, a number of biotechnology firms created the Council for Biotechnology Information (CBI) in April 2000 as a corporate mouthpiece that extols the virtues of biotechnology. The CBI, which has offices in the Canada, the United States, and Mexico, has developed a number of what it calls "advertorials" for television, newspapers, and a number of magazines such as *National Geographic*, *Gourmet*, and *Natural History*.[1] Those species-being

[1] The founding members of the CBI include Aventis, BASF, Dow Chemical, DuPont, Monsanto, Novartis, Zeneca, the American Crop Protection Association, and the Biotechnology Industry Organization. In the interim Bayer has also joined. A number of their current advertisements can be viewed on their website at www.whybiotech.com.

movements struggling against particular aspects of corporate-controlled biotechnology often do not possess the resources necessary to avail themselves of such extended media venues in order to inject their positions into the public domain. The present project, while certainly outlining the position of capital and government, is instead rather more interested in helping to give a voice to those subjects opposing the current trajectory of biotechnology development and implementation.

Moreover, the evidence marshalled in this chapter attests to the methodological importance we attribute to an interrogation and analysis around the points of struggle as moments revelatory of the power mechanisms at work in the broader context of capitalist society. As elaborated in chapter three, from an autonomist perspective the focus on resistance provides an analytical lens through which to view the social forces that determine a particular phenomenon, making manifest the contradictions and tensions that dynamically structure a given conjuncture of forces. As Negri (2005, p. xiii) asserts, "[s]truggles are the great teachers when it comes to our knowledge of social development, and are the engines of revolutionary theory", which include "all the struggles within a period or cycle, which are therefore rooted within a specific class composition." As Holloway (1992, p. 159) tells us:

> The more intense the social antagonisms, the less securely established will be the fetishised self-presentation of social relations. It is not theoretical reflection but anger born from the experience of oppression that provides the cutting edge to pierce the mystifications of capitalist society. The role of theory is not to lead the way but to follow, to focus on the contradictory nature of experience, to give more coherence to the vaguely perceived interconnections, to broadcast the lessons of struggle (Holloway, 1992, p. 159).

This type of 'bottom up' approach is antonymous to the traditional 'top down' analysis of capitalist power found in more classical forms of Marxism. The tension between the two was something with which we had to grapple during the course of the present research project. Ultimately we believe that the methodology employed here represents a fusion of elements from both approaches that, in tandem with our theoretical foundation, offers a novel and synthetic framework capable of apprehending the biological and knowledge issues insinuated in biotechnology and resistance to this technoscience in Canada. The concentration of this chapter on the empirical data gathered during the interview process, including its corresponding emphasis on the moments of resistance, thus functions as a balance to the substantial documentary analysis of corporate and state deployments around biotechnology that was offered in the previous three chapters.

We employed a snowball sampling approach, which, we believe, helped ensure a sample that captures all of the major resistance points being developed against biotechnology in Canada. The interviews were conducted using open-ended questions, which have the benefit of being flexible in terms of question order, and, which often succeed in eliciting fuller responses in the subject's own words than is the case with closed-ended questions. Similarly, interviews permit the researcher to clarify misunderstood questions and to employ probes that aid interviewees in elucidating and expanding their responses. Because the fourteen interviewees (see Appendix III – Organisations/People Interviewed for this Research Project for a complete list of interview informants) were geographically dispersed across the entire country from British Columbia to Prince Edward Island, the majority of interviews were conducted by telephone. On average the interviews lasted approximately 75 minutes and no noticeable difference in terms of depth of response was found between telephone versus in-person conversations. The interviews themselves were guided by an interview schedule of open-ended questions (see Appendix IV) designed to educe information about the organisation itself, the particular issue(s) around which resistance is being mobilised, and the informational and communication issues and strategies subsumed in such struggles. One of the major focal points of the discussions was an assessment on the part of the interviewees of what they perceive to be the information and knowledge concerns insinuated in the campaigns they are organising. Informants were therefore also invited to elaborate on media coverage of biotechnology topics, including their own strategies for and degree of success in attracting media attention. On the basis of these interviews we were in a position to map the various struggles that have and are emerging in response to the enclosure of biotechnology within the social factory, including, as discussed previously, the knowledge and information issues implicated in these conflicts. As the account offered below should attest, there is a vibrant landscape of active resistance that is animated by a passionate and well-informed group of activists committed to responding to and checking the capitalist-dominated developmental trajectory of biotechnology in this country.

Following an introduction of the main species-being movements responding to various aspects of biotechnology in Canada, we review an array of their resistance campaigns and strategies, ranging from opposition to Terminator technology through attempts to achieve legally mandated labelling requirements for genetically engineered foods, efforts to redress the genetic contamination of the commons, and endeavours to expand the terms of the biotechnology debate in this country. The conversation developed here also outlines the major successes achieved to date by opponents of biotechnology. We conclude the chapter with an examination of some of the ways corporate agendas that are infiltrating academia are being resisted by various immaterial workers descending from the 'ivory tower' to actively engage capitalist enclosures of biological and knowledge commons. Similar to the preceding empirical chapters, the argumentation offered here strives to provide an account informed by a reflexive interplay between theory and empirical evidence.

8.1 The Players and Their Strategies for Mobilising Resistance

8.1.1 Critical Art Ensemble

Though members of the Critical Art Ensemble were not interviewed as part of the empirical investigation of this work (an American entity not active in Canada), this group has enunciated a potential programme for resisting corporate control of biotechnology that it terms 'fuzzy biological sabotage'. Given the emphasis on active resistance that informs the current research, and particularly this chapter, it seems appropriate to outline in broad strokes the type of campaign being advocated by the Critical Art Ensemble (2002). The Critical Art Ensemble (2002) starts from the position that capital has achieved a level of control over technological development that insulates it from effective interference from institutions of democratic governance. Dismissing the possibility of employing contemporary democratic institutions as means to redress corporate control of biotechnology, the Critical Art Ensemble (2002) articulates the need to develop alternative methods of appropriating power. That having been said, the Critical Art Ensemble (2002) strikes a somewhat pessimistic chord, contending that corporate control of markets and government institutions has proceeded at a pace that renders resistance to biotechnology reactive rather than proactive. Such doubt seems warranted given the experience of Dr. Steven Kurtz, a founding member of the Critical Art Ensemble.

Following the sudden death of his wife, Hope, from heart failure in May 2004, Kurtz was detained and interrogated for 22 hours by agents from the FBI and Joint Terrorism Task Force for suspicion of bioterrorism – the police who responded to Kurtz's call to 911 were suspicious of the petri dishes containing bacteria (part of an art exhibition) that were in the couple's home and called the FBI . The FBI also seized materials from the Kurtz residence, including a number of manuscripts critical of biotechnology, which this American federal agency refuses to return. Although charges of bioterrorism were never formally brought against Dr. Kurtz, he has been charged with mail fraud and wire fraud, which hold possible jail sentences of up to 20 years. As the Critical Art Ensemble outlines on its defence fund website for Dr. Kurtz, "[t]his is a precedent-setting case with profound implications for all Americans' constitutionally guaranteed rights to freedom of speech, expression, and inquiry; and for artists, scientists, researchers, and anyone engaged in vital public discussion about the actions of their government" (Critical Art Ensemble, n.d., ¶ 23).

The Critical Art Ensemble (2002) recognises the value of more traditional resistance tactics such as electronic civil disobedience, though in developing its "model of direct biological action", the Critical Art Ensemble, in cooperation with a few sympathetic scientists, determined that the traditional civil disobedience model of resistance is not readily transferable onto the biotechnological battleground. It therefore calls for a more radical use of activities that move beyond simple denial of service attacks to include blocking internal communication systems and databases, disrupting routers, etc. More importantly, and certainly sympathetic to the resistance tack espoused by autonomist Marxism, the Critical Art Ensemble (2002) articulates the need to develop tactics of resistance that actively appropriate and subvert capitalist controlled biological materials and processes. However, because biotechnology involves living organisms, active resistance will generate some type of destructive consequence, which potentially provides capital and government with easy recourse to levy such highly charged labels as 'saboteurs' and 'eco-terrorists' in order to generate negative public opinion against resistance groups. These types of public denunciations by capital, which serve to justify swift and harsh state police responses, are to be expected particularly in the case of biotechnological products because they have been rendered private property through our contemporary intellectual property regime. Such scenarios have already played out in countries such as Germany, the United Kingdom, France, and India, where field trials for genetically engineered seeds have been uprooted and destroyed. In Europe direct actions such as uprooting the plots of experimental biotech crops have been successful. Bayer CropSciences decided in 2003 that it would no longer conduct experimental trials in Britain because of government refusal to classify the locations of trial plots as confidential. In fact, Bayer was the last agricultural biotechnology company that performed experimental trials in the United Kingdom; other companies had previously pulled out because protesters were routinely destroying their test plots. Similarly, other companies are considering whether to vacate France due to similar direct opposition actions (The Associated Press, 2003). Eager to capitalise on such resistance, as early as 1999 the Canadian government engaged in advertising campaigns that leveraged industry fears of such direct action in order to attract European companies to Canada (Mittelstaedt, 1999). Part of the attraction for corporate players is that the Canadian government, always keen to ensure an environment hospitable to industry, continues to insist that locations of test plots are proprietary information and thus exempt from disclosure requirements under section 20 (Third Party Information) of the *Access to Information Act*.[2]

While certainly laudable, these types of direct action have given capital and state authorities the pretext they need to not only harass and arrest activists but also to paint all those who resist biotechnology with one broad stroke as uninformed and dangerous saboteurs who lack respect for progress and private property.

> Whether one considers the examples of Professor Najundaswamy and his followers in India, José Bové and his followers in France, and especially the Earth Liberation Front (ELF) in the US, the destruction of assets has been of limited impact, and has functioned primarily as *counter-spectacle ripe for recuperation* (Critical Art Ensemble, 2002, pp. 106-107, emphasis added).

Perhaps more problematic is the fact that the way large agricultural biotech companies structure their field testing agreements means that in most cases it is the individual farmer who suffers the biggest loss from such campaigns – a notable response to this dilemma comes from India, where the group protesting against a genetically engineered seed field trial compensated the farmer for his work before burning the crop (Critical Art Ensemble, 2002).

In order to avoid providing capital or the state with fodder to discredit and turn public opinion against biotech resistance, the Critical Art Ensemble advocates 'fuzzy biological sabotage', an approach that seeks to exploit and resist in those areas not yet subject to complete regulation. Positioned in a sort of liminal 'no man's land' between the legal and the illegal, the fuzzy saboteur exploits legal cracks in the system that act as a catalyst for an ensuing chain of causal events that together help achieve the desired goal. The initial causal action, which should reside in the realm of the legal, is the only

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[2] R.S.C., 1985, c. A-1.

link in the causal chain with which the saboteur should be identified since subsequent links could very well proceed into the domain of the illegal. The greater the number of links in the chain the more difficult it becomes for the authorities to tie any one individual or group to the end result of the action. Conversely, as the number of links increases so too does the difficulty of controlling all the intervening variables that might influence and even derail the intended action. A significant benefit of fuzzy sabotage is that it mitigates the instances of physical confrontation with authorities and it often times eliminates the need to engage in trespass. It also opens up to saboteurs the strategy long practiced by governments around the world of 'plausible deniability' (Critical Art Ensemble, 2002).

The Critical Art Ensemble (2002) outlines three concrete resistance strategies – pranks, test site disruption, and high intensity resistance and precision targeting – that employ living organisms ranging from microorganisms, plants, insects, reptiles, and mammals to genetically engineered organisms and organic chemical compounds. Pranks are designed to incite institutional paranoia and inject a degree of inertia into the developmental trajectory of capitalist controlled biotechnology. For example, a fuzzy saboteur might release mutated flies or some other mutated insect in or around research facilities. The benefit of using insects is that they are quick to reproduce and very mobile and agile in terms of infiltrating buildings. The appearance of mutant insects in a biotechnology research facility would, no doubt, stoke the company rumour mill and possibly cause fear and paranoia among personnel. Assuming that such fear and paranoia contribute to worker inefficiency, this type of prank can easily result in torpor in the system. The effects of this type of prank can be amplified if there are other businesses in proximate distance to the biotech company that can also be targeted. Assuming the owners and patrons of these secondary businesses are aware of the activities being undertaken by the biotechnology research facility, the sudden appearance of mutant insects can go a long way in creating suspicion and ill-will toward the biotech company (Critical Art Ensemble, 2002).

Test site disruption, which, as discussed above, eschews the type of direct actions designed to destroy whole test plots of genetically engineered crops, appropriates state military sabotage to its purposes. That is, it relies on minimal force and focused attacks on the weakest link. Concretely, this might entail contaminating testing sites so that companies are forced to repeat their research protocols used in support of applications for regulatory approval of their genetically engineered products. For example, Bt products require safety studies in respect of soil toxicity that results from the insertion of the Bt trait. Depending on what organisms are being measured to test the effects on soil toxicity, fuzzy saboteurs could increase the natural population of those particular organisms in sufficiently variable sizes and conditions to render the sample plot no longer scientifically viable. A new study would have to be designed and executed, thereby introducing inertia into the system. Another approach might be to release into a test plot large numbers of particular animal pests immune to the genetic trait being tested since they are immune to the laws of private property, trespass, and vandalism (Critical Art Ensemble, 2002).

Finally, high intensity and precision targeting is designed to address those genetically engineered products that have already infiltrated the market. The goal of such strategies is to subvert the genetically engineered trait of adaptability into one of susceptibility. The Critical Art Ensemble (2002) has devised two potential ways of sabotaging biotechnological processes that would either incapacitate the enzyme that renders Roundup Ready seeds impervious to glyphosate or that would turn Roundup Ready crops a particular colour. Not only would this visually distinguish such genetically engineered crops from conventional crops as a sort of stand-in labelling system that both Canadian and American governments continue to oppose, but, assuming the colour were unpalatable for large numbers of consumers, it might also destroy the market for such products (Critical Art Ensemble, 2002). The Critical Art Ensemble is not naïve; it recognises that the technical capacity required to drive this form of resistance is in low supply:

> Much like advanced electronic hacking, genetic hacking and reverse engineering are very specialized tactics. This is why corporations do not at present fear reverse engineering. The GMO revolution has been bloodless, because resistance does not have the capital to mount a counter-offensive on the molecular level. Much like fighting nomadic (virtual) power with nomadic tactics, the current molecular invasion has to be confronted in the molecular theater of operations. For the resistance to progress on any credible, effective level, rebel labs and rogue human resources in molecular biology have to be developed (Critical Art Ensemble, 2002, p. 115).

8.1.2 Council of Canadians[3]

Although the Council of Canadians made a strategic withdrawal from its genetic engineering campaign in a staggered fashion between early 2005 and June 2007, it did provide resources and other support to establish the GE Free Canada campaign that was launched in Vancouver in June 2005 as well as another independent GE Free Zone group. Similarly, as part of its transition strategy out of active campaigning against genetic

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[3] At a February 2005 meeting of its national Board of Directors the Council of Canadians made the decision to end active campaigning against biotechnology in order to concentrate on opposition to Deep Integration with the United States. The Council's phase out strategy was a staggered one, with final exit from genetically engineered issues completed in June 2007.

engineering, the Council of Canadians offered assistance to the Ban Terminator campaign by sending action alerts to its membership, distributing postcards and other information to its chapters, and posting campaign links on its website. The Council also agreed, although not acting in the capacity of spokesperson for the campaign, to circulate press releases on its newswire service on behalf of the Ban Terminator campaign. Interview informant Herb Barbolet, a biotechnology critic and founder of the British Columbia non-profit society Farm Folk /City Folk, maintains that a number of personnel and financial difficulties have essentially sapped the capacity and energy of activism around biotechnology issues in this country. Prior to its withdrawal from biotechnology activism, the Council of Canadians, according to Barbolet, was well positioned to engage in significant oppositional activities, a potential, which, unfortunately, was confounded by the extensive centralisation of the organisation and its consequent failure to provide their local committees with any significant money or aid to organise locally. Despite the tremendous potential, especially in Vancouver and Québec, nothing of any substance materialised because of lack of institutional support from the larger organisations ("Interview with Herb Barbolet, Founder of Farm Folk / City Folk," 2007).

8.1.3 CBAN

The most prominent formal species-being movement in Canada that is mobilising resistance against biotechnology is the Canadian Biotechnology Action Network (CBAN), which is comprised of various environmental, social justice, and consumer groups that had previously worked collaboratively on the campaign to stop the regulatory approval of Monsanto's Bovine Growth Hormone for dairy cows. Building on this success, which was based on sharing information and coordinating common actions on issues raised by genetic engineering, biodiversity, sustainable farming and corporate control in agriculture, these groups were also successful in their efforts to pressure Monsanto into abandoning its plans to introduce genetically engineered wheat into Canada. This informal collaboration, which stretches back to 1999, was made more permanent in 2006, when a number of the involved participants came to the conclusion that any concerted effort against genetic engineering in this country would depend upon the insertion of new momentum and resources into the struggles around biotechnology ("Interview with Lucy Sharratt, Co-ordinator of the Canadian Biotechnology Action Network," 2007). According to interviewee Cathy Holtslander, who works for Beyond Factory Farming and is also a committee member of both the Organic Agriculture Protection Fund and the Saskatchewan Organic Directorate, the decision by the Council of Canadians to remove itself from biotechnology issues provided one of the strong pushes to get CBAN established since the Council was one of the last big national organisations that was actively working on biotechnology issues and genetically engineered organisms.

Thus was born the CBAN, which is designed to function as a hub to assist information exchange, support grassroots action, and coordinate action at the national and international levels.[4] While there may be grass roots universal labourers involved in some of the mobilisation and work that the CBAN does who would tend to define

[4] Current (as of April 2008) members of CBAN include: ACT for the Earth (Toronto); Biofreedom (Edmonton); Canadian Organic Growers; Check Your Head; Coalition for Safe Food (British Columbia); Council of Canadians; Ecological Farmers Association of Ontario; G.E. Free Yukon; GeneAction (Toronto); Greenpeace; Inter Pares; National Farmers Union; P.E.I. Coalition for a GMO-Free Province; Saskatchewan Organic Directorate; Society for a G.E. Free B.C.; Union Paysanne; and, USC Canada. In addition, CBAN is supported by ETC Group and Rights & Democracy/Droits et Démocratie.

themselves as anticapitalist, this is not an explicit articulation. Some of the species-being movements aligned with CBAN have brought forth what might be perceived as an anticorporate stance, but in terms of self-identification CBAN perceives itself to be pro-democracy and pro-justice rather than anti-anything. While CBAN has taken the lead on the Ban Terminator campaign, the motivation behind its creation was to establish a species-being movement that goes beyond a single campaign with limited project definition to instead adopt an orientation based on long-term struggle around the multiple issues raised by biotechnology ("Interview with Lucy Sharratt, Co-ordinator of the Canadian Biotechnology Action Network," 2007). Ensuring a broader, enduring perspective for CBAN is something that interview participant Brewster Kneen, co-publisher of *The Ram's Horn* with his wife Kathleen and prominent food system and biotechnology activist, believes is critical to biotechnology opposition in this country. Part of that broader mandate has to include discussion and analysis of corporate control of seeds and agriculture in a very explicit manner that frames the issues in ways that speak to the general public. Resistance to biotechnology, including the work of CBAN, must, according to Kneen, become bolder in terms of the way it looks at the system and the way it communicates its message to people in order to illicit broader societal discussion about the current conjuncture of neoliberal capitalist society ("Interview with Brewster Kneen, Co-Publisher of *The Ram's Horn*," 2007).

In terms of strategies, the universal labourers involved with CBAN traditionally have sought to bring together research and information on genetic engineering that is sometimes rather difficult to locate. As Lucy Sharratt, Co-ordinator of CBAN and interview informant, points out, CBAN recognises a pressing need for organisations to do research that they can provide to the public. For example, the Canadian government does not provide a list of genetically engineered crops that is in any way accessible to the public. Seeking to fill that public information gap, CBAN would compile such a list that would also include details about which corporations own the intellectual property rights to such crops. Similarly, CBAN perceives a real need to correct misinformation and provide new information and analysis that goes beyond the often one-sided and celebratory informational content disseminated by biotechnology proponents in industry and the government. To this end, CBAN organises public lectures and other types of events that engage prominent speakers dedicated to informing the public about the range of scientific, social, economic, and political issues that attend biotechnology. Through its information collection and research activities CBAN seeks to ensure that it remains abreast of current and upcoming issues. For example, should it be discovered that a genetically engineered crop variety, such as wheat or alfalfa, is slated to receive imminent regulatory approval, CBAN will investigate and consider the possibilities and political opportunities in order to develop a potential strategy that can be brought forward to the grass roots and NGOs in order to mobilise them in different ways ("Interview with Lucy Sharratt, Co-ordinator of the Canadian Biotechnology Action Network," 2007). As it happens a type of product-by-product protest has characterised the history of such mobilisation, as was the case with opposition organised against genetically engineered wheat, genetically engineered alfalfa, and recombinant bovine growth hormone. That having been said, Sharratt contends that it is not the intention of CBAN to fight the government product by product. Rather, the intent is to maintain a rigorous and concerted critique of regulation in a very detailed way over a number of years in order to achieve systematic results. Yet in the interim CBAN also recognises the urgent obligation to address the current push to develop and commercially release genetically engineered organisms such as trees and fish.

Money, according to Sharratt, is the major obstacle currently impeding the work and information dissemination activities of CBAN. In fact, it was not until October 2007 that the CBAN, thanks to a small grant, was able to launch its own website. Prior to this the CBAN website was only a holding page, forcing the organisation to piggyback on the Ban Terminator website. Similarly, the high cost of graphic design and printing services limits the amount of informational resources CBAN is able to develop and circulate. At an even more fundamental level, lack of financial resources severely circumscribes the amount of research CBAN is able to conduct. For example, Sharratt has been attempting for a number of years to secure $2000 in funding in order to research the situation in Canada in respect of genetically engineered trees. Although field trials are currently being executed, there is a complete dearth of publicly available information on the issue. Similarly, dairy companies and farmers are concerned about the impact genetically engineered alfalfa could have on their business, but have as yet been either unwilling or unable to fund such research – CBAN has the expertise, it just needs the money ("Interview with Lucy Sharratt, Co-ordinator of the Canadian Biotechnology Action Network," 2007).

Another difficulty related to information dissemination arises from the complicated task of communicating to a broad public about a fairly complex subject that can easily come across as a technical issue. So a major challenge for CBAN, pace Sharratt, is to develop the right informational materials that not only speak to people but also serve to catalyse people into action. CBAN has therefore decided that it will only ask people to act on those issues that hold out the promise of yielding results. As Sharratt points out, "there is an abundance of things people can do but if such actions are not going to have a result or if they are not supported by other works that other people are doing and it goes nowhere, then ultimately no one, at least not those opposed to particular aspects of biotechnology, will be served" ("Interview with Lucy Sharratt, Co-ordinator of the Canadian Biotechnology Action Network," 2007).

8.1.4 Greenpeace

Greenpeace is a global organisation that maintains a presence in roughly 60 countries with approximately 45 offices throughout these different countries. Its main strategies, according to interview participant Dr. Eric Darier, Greenpeace Canada Agriculture Coordinator, are based on following large multinationals around the world to make sure that they are not engaging in detrimental practices in some, usually less developed, countries that they have been blocked from doing by civil society and organised groups in other, usually better developed, nations. For example, Greenpeace prioritises Asia, China, and India because of the rapid economic growth occurring in these countries and because multinationals, especially large chemical companies, are moving there. This global perspective applies equally to issues of genetic engineering; Greenpeace recognises that the success of its efforts against genetic engineering will be heavily influenced by its ability to coordinate an international movement against biotechnology and genetic engineering that will exert pressure on the companies and governments promoting these biotechnologies in those places where the biggest difference can be achieved. Greenpeace is cognisant of the fact that it is unable to do everything, so it instead chooses to be very strategic about what it does and where it is doing it ("Interview with Dr. Eric Darier, GE Campaigner, Greenpeace Canada," 2007).

Given that this species-being movement is mainly an environmental group, its perspective focuses on the preservation of biodiversity, which encompasses the issue of environmental release of genetically engineered organisms. In order to protect biodiversity, Greenpeace is a strong advocate of the precautionary principle. Greenpeace was, in fact, instrumental in pushing quite hard for the international community to adopt the United Nations Cartagena Protocol on Biosafety, which finally happened in Montréal on 29 January 2000. According to Darier Greenpeace realised quite quickly that faced by large transnationals like Monsanto and governments heavily influenced by these same companies, it was vital for the protection of biodiversity to achieve a multinational agreement. Greenpeace therefore lobbied forcefully for the development of some form of international agreement that would afford a degree of civil society control over genetic engineering and the biotechnology industry. Its environmental focus notwithstanding, Greenpeace is also conscious of and receptive to the various other points of entry for opposition to biotechnology. For example, corporate concentration and the resulting control of the world's food supply are a major concern, and one that, as Darier points out, is being facilitated in the biotechnology industry through the merger and acquisition activities among seed and chemical companies. Other groups of people offer ethical reservations about biotechnology, asserting that humanity should not control and patent life forms. Still others approach biotechnology from a Third World solidarity perspective, which also includes the fight against the commodification of life forms. In fact, the Greenpeace office in Germany conducts a significant amount of work in fighting and trying to revoke life patents. But as Darier laments, Greenpeace does not possess the resources to pursue similar strategies here in Canada. So in the case of Canada, with the limited resources available, Greenpeace focuses on mandatory labelling for genetically engineered foods ("Interview with Dr. Eric Darier, GE Campaigner, Greenpeace Canada," 2007).

Greenpeace is one of the few NGOs to make a choice at the very beginning of its existence to remain financially independent from corporations and governments and thus not to accept subsidies. All of its money comes from people who are willing to become a member of Greenpeace – in Canada Greenpeace has 80,000 regular members/donors. The other characteristic of Greenpeace, aside from being financially independent, is that it remains non-partisan, refusing to take an official position in support of one party or another. Greenpeace is extremely political and being independent affords it the luxury of saying what it wants to any of the political parties. If a party or the government in power does something that is a positive step for the environment Greenpeace will congratulate them for that step at that time. Conversely, Greenpeace is quick to inform governments when it disapproves of particular actions. So, for example, at election time Greenpeace asks the parties for their positions on the particular issues and then makes those positions known to the public so that citizens may decide who has the best platform and why ("Interview with Dr. Eric Darier, GE Campaigner, Greenpeace Canada," 2007).

Darier posits the existence of an informal division of labour among species-being movements. In those areas that go beyond the immediate focus of Greenpeace, but to which Greenpeace is nonetheless sympathetic, it engages in partnerships with those groups most focused on that particular issue, allowing them to take the lead on it. Similarly, Greenpeace strives to build linkages with other groups that have an interest in the issues upon which it concentrates. For example, in the case of labelling genetically engineered food, Greenpeace works with consumer groups since labelling can also be approached from a consumer perspective. This type of strategy is premised on informal and formal arrangements that exploit the synergies between different strata of universal labour such that each partner focuses on its particular area of expertise based on what is feasible given the level of available resources. In terms of general strategies, Greenpeace follows what might be called a 'weakest chain in the link' battle plan, preferring to exert pressure on the most vulnerable corporation in that particular industry sector in order to compel the others to follow suit. For example, mandatory labelling in Europe, though finally adopted by the European Commission, followed on the heels of massive pressure on some of the largest European retailers to actually withdraw genetically engineered ingredients from the food chain because they knew not only that labelling was on the legislative horizon, but more importantly that public opinion was overwhelmingly hostile toward genetically engineered food ("Interview with Dr. Eric Darier, GE Campaigner, Greenpeace Canada," 2007).

In terms of disseminating information Greenpeace makes use of multiple channels. At the first level is front-line staff, who, through the Greenpeace canvassing program, contact individuals at the door, on the street, and over the phone. Canvassers receive a briefing paper that articulates both the issues and the campaigns in which Greenpeace is actively involved. According to interviewee Josh Brandon, GE campaigner for the Greenpeace Vancouver office, Greenpeace conducts about 1400 conversations a week with Canadians through this canvassing program. Similarly, Greenpeace has a number of volunteers who collect signatures for different things and do tabling for different events so that in general Greenpeace conducts a substantial amount of one-on-one grassroots conversations. Greenpeace engages in public forums and talks at school groups etc., and it also has very extensive e-mail lists as well as a monthly magazine, in both electronic and paper format, which is sent to its 80,000 members countrywide ("Interview with Josh Brandon, GE Campaigner, Greenpeace Canada," 2007).

Some of the obstacles Greenpeace faces in disseminating information, beyond the gatekeepers in corporate media, include internal capacity on particular issues and financial constraints. That is, events and campaigns have to be coordinated nationally, which means that not all issues can receive the same attention. In terms of financial constraints Greenpeace is not able to access mass communication at the same level as industry ("Interview with Dr. Eric Darier, GE Campaigner, Greenpeace Canada," 2007; "Interview with Josh Brandon, GE Campaigner, Greenpeace Canada," 2007).

8.1.5 National Farmers Union

The National Farmers Union (NFU) is a direct membership, voluntary organisation structured according to districts that are organised on a more or less provincial basis, with the exception of Québec, which has its own distinct provincial farmers organisation. With a focus on promoting and preserving family farming as a basic food producer unit in Canada, the NFU mandate also includes an emphasis on agricultural and social policies that facilitate agriculture and community around family farming. Since its inception the NFU has undertaken efforts to avoid the patriarchalism traditionally associated with some agricultural groups by ensuring a visible and vocal place within the organisation for women and youth. For example, it has a specific women's President and Vice President, as well as a youth President and Vice President. The NFU assigns great emphasis to the democratic process. Districts all have district conventions. All members are permitted to debate and put forward resolutions from the district level to be forwarded to the national convention where they are further debated. Similarly, resolutions also can be brought forward at the national convention, where, if they are adopted at that assembly, then become NFU policy. All members of the executive board are elected from among the broader membership ("Interview with Terry Boehm, Vice President, National Farmers Union," 2007).

The NFU has conducted a number of successful campaigns around seeds, genetically modified wheat, and attempts to curb restrictive plants breeders' rights legislation, among others, according to interview respondent Terry Boehm, NFU Vice President. In the first instance the NFU generally puts out a press release, although it does have problems getting them picked up by the mainstream media given the high degree of media concentration. Relationships with other like-minded universal labourers, environmentalists, and social justice activists who are interested in food and food policy tend to be more essential to the NFU in disseminating its messages. Aside from these networks the NFU also relies on public meetings, its own membership discussions, cooperation with receptive parliamentarians and parties, and providing witness testimony at parliamentary committee meetings, etc. to advance its policy positions. The NFU also engages in some government consultation processes. For example, it participated in the national forum on seeds in an attempt to ensure a voice for its questions, ideas, and position. Unsure of how successful such consultative exercises are, Boehm is quick to add that there is always a fine line between being co-opted and spending a lot of your time in a relatively defined debate and what you are doing on the outside. For the most part he believes that it is the outside activities that are the more successful ones ("Interview with Terry Boehm, Vice President, National Farmers Union," 2007).

As Boehm outlines, the Internet is an important communication medium for the NFU in disseminating its information. In particular it relies on listservs and its website, although the organisation is finding it increasingly difficult to keep the latter current given the speed with which things seem to be happening and the number of different people working on various issues. The NFU also engages in constant activities that can help inform the broader public about some of the issues involved in biotechnology. It sends out op-ed pieces to newspapers and authors papers and briefs that articulate what are the issues around biotechnology from farmers' perspectives. These papers and briefs are distributed to members and others in order to help people understand what are the concerns involving biotechnology, to inform people about what actions are being undertaken, and to provide analysis of current and proposed legislation in terms of how it does or might affect farmers. Overall, the NFU places a great deal of emphasis on providing rigorous analysis and dissemination of the results of such analysis in order to help people understand and navigate the multiple issues encompassed by biotechnology ("Interview with Terry Boehm, Vice President, National Farmers Union," 2007).

Boehm maintains that the material the NFU produces is well respected both nationally and internationally, as made evident by the multiple requests it receives from other species-being movements to use its material. So their information and analysis is being circulated, especially within those layers of society that take a keen interest in these sorts of issues. The NFU has also been fortunate in attracting a very good staff complement that can engage in substantial analysis and effectively communicate that analysis ("Interview with Terry Boehm, Vice President, National Farmers Union," 2007).

8.1.6 ETC Group

ETC Group (formerly RAFI – Rural Advancement Foundation International) approaches biotechnology issues from social and economic perspectives, though as interviewee Pat Mooney, Executive Director and co-founder, makes clear, there is a variety of cultural, ethical, environmental, and health concerns that also attach to biotechnology. So while ETC Group does not deny that these too are aspects of the issue, it focuses on who owns and controls this technology and what the implications of such ownership patterns are for both the types of products being developed and their social implications once introduced into society. Fundamentally, the driving goal of ETC Group is ensure that those universal labourers who are most affected by biotechnology are adequately informed so that they are enabled to formulate their own approaches to this science and its technologies. Beyond disseminating the necessary information to the people who need to know about it, a second goal of ETC Group is to inject information about the issues that surround biotechnology into a broader forum for debate, such as the United Nations. Since as early as 1987 ETC Group has therefore lobbied tirelessly at the Food and Agriculture Organisation of the United Nations (FAO) to push the biotechnology issue onto the international agenda. ETC Group has been successful in convincing the FAO to agree that there should be a code of conduct in biotechnology, although the issue has not moved further than an agenda discussion point. Nonetheless, Mooney points out that there has been an ongoing debate within FAO because of ETC Group ("Interview with Pat Mooney, Executive Director and Co-Founder of ETC Group," 2007).

Mooney believes that both sides have focused the biotechnology debate too narrowly on health and environmental issues, something that continues to frustrate him and his colleagues. ETC Group does not think that is the way it should be debated. One of the failures of organised opposition to biotechnology, in Mooney's opinion, has been that many groups who instinctively, and for political reasons, are quite appropriately concerned about these technologies have struck the path of least resistance by concentrating on health and environmental risks. And while these are real and serious concerns, many of the groups that have chosen that level at which to mobilise resistance have made, according to Mooney, a tactical error. Brewster Kneen raises similar sentiments, asserting that while safety issues are important, the debate must go beyond this to consider a broader range of principled points associated with biotechnology and corporate control over agriculture and the food system. In Kneen's own words, "I wish activists would spend a little more time on their homework and learn the science better and think more about the broader context of this stuff and where it's coming from, its implications and so on" ("Interview with Brewster Kneen, Co-Publisher of *The Ram's Horn*," 2007). Unfortunately, as Kneen also readily admits, he has not been as successful as he would prefer in winning this argument.

As might be expected, the Internet is an important tool for ETC Group to disseminate information. However, unlike other opposition groups, ETC Group has existed for three decades. Over the course of these years it has worked successfully with a plethora of other universal labourers, which has helped it establish a great deal of familiarity and credibility in activist, corporate, and government circles. Moreover, according to Mooney the quality of its investigations and analysis has ensured that people, or at least its partners, tend to trust what ETC Group says. So when it distributes informational content it receives a straight, good response from media and from its partners, who, in turn, circulate the information to other interested people ("Interview with Pat Mooney, Executive Director and Co-Founder of ETC Group," 2007).

Devlin Kuyek, an interview participant and social activist who now works for GRAIN[5] and who was an early and outspoken critic of Canada's biotechnology policy, locates the root of the problem with biotechnology in the industrialisation of agriculture and food, which he believes can only be addressed by a larger social vision that promises a strong alternative. While pockets of people around the country are laying some of the groundwork for such a strategy, it, unfortunately, is not happening in a centralised place and certainly not by the Canadian government ("Interview with Devlin Kuyek," 2007). Only once this gains enough momentum will we, according to Kuyek, achieve any real and lasting success. Smaller successes include those kinds of efforts to hold things off, but in the mean time it remains imperative to broaden not only people's perspectives but

[5] GRAIN is an international non-governmental organisation that promotes the sustainable management and use of agricultural biodiversity based on people's control over genetic resources and local knowledge.

also their desire for change and their optimism that such change is possible. In the end, however, Kuyek strikes a somewhat pessimistic chord:

> I think the more you speak about it and get it into people's consciousness the more chances I think we have of success. But to be quite honest I think within activist circles I don't think we've done a lot of deeper thinking about what that means and how we're going to get there. I don't blame anyone of course because most people are doing this on their volunteer time but it does need to happen ("Interview with Devlin Kuyek," 2007).

Rather than rely on traditional media coverage, Kuyek has achieved more success in disseminating information by using alternative forms of media and by establishing networks that solicit public involvement in actions such as letter writing campaigns and similar things.

8.1.7 The United Church of Canada

At its 38th General Council in August 2003 the United Church of Canada adopted a policy statement on genetically modified[6] food based upon four guiding principles. First, the United Church asserts that the regulation of genetically modified foods should be based on the precautionary principle, arguing that it is preferable to err on the side of caution and not introduce a genetically modified food if there is the potential for serious health or environmental risk. As the Church points out, the precautionary principle is well established in international law, including the Cartagena Protocol on Biosafety, to which Canada is a signatory (and which the United Church calls on the Government of Canada to immediately ratify). Contrary to what industry and most regulators claim, the

[6] According to the policy statement developed by the United Church, it considers genetic modification technologies to encompass both recombinant DNA technology and mutagenesis. The Church employs the term 'genetic engineering' as a narrower term to refer to rDNA technology. See, The United Church of Canada. (2003). *Genetically modified food - General principles: Policy statement and report.* Available: http://www.united-church.ca/files/ecology/genetics/gmfpolicystatement.pdf [Accessed July 3, 2007].

United Church believes that lack of evidence of harm should not be conflated with proof of safety and that the burden of proof should be placed on those seeking regulatory approval rather than those who voice concerns about the potential dangers of genetically modified products. Second, the United Church contends that the regulatory review system must be independent, transparent, accountable, and participatory. The departments and agencies tasked with reviewing applications for regulatory approval must operate independently of and at arm's length from the people and organisations seeking product approval. This also means that regulatory agencies and departments must not be given dual mandates of regulator and promoter of the biotechnology industry. Industry bias and influence on the approval process must not be permitted and all the data provided in support of an application for product approval should be made available for independent peer review. The public must be provided the opportunity to inject its view into the review process in cases where the introduction of a genetically modified food might impose environmental, economic, or health impacts. The government must clarify responsibility and liability issues related to adverse events that result from the production or consumption of a genetically modified food. Consumers should be provided with clear and reliable tools to help inform their decisions about consuming genetically modified food. Third, the introduction of genetically modified foods into the food chain must not exacerbate social injustice, inequality, poverty, the reduction of biodiversity, or the erosion of the common good, either in Canada or globally. In particular, the United Church of Canada demands that genetically modified food technologies not be employed by industry as a tool to further consolidate its control over food supplies. Finally, the fourth principle outlined by the United Church of Canada speaks of protecting and sharing life, food, and our genetic heritage. Aside from opposing intellectual property protections for any living organism, the United Church supports the rights of farmers and other food producers to save seeds, breed livestock, and develop new plant varieties free of any encumbrances such as intellectual property protections, related legal instruments (e.g. technology use agreements), or GURTs. This principle also recognises the right of cultural groups and nations to engage in measures designed to protect their food supply from genetic contamination (The United Church of Canada, 2003).

In 2005 the United Church of Canada also established a social policy resolution in respect of the regulation and labelling of genetically modified foods. Specifically, the Executive of the General Council of The United Church of Canada enjoins the Government of Canada to support and promote more public agricultural research and to adopt a number of suggested changes to the current regulatory system in place to approve, monitor, and label genetically modified foods. First, an independent body should be established that would be responsible for testing and monitoring all genetically modified foods. Second, an immediate moratorium should be invoked on the approval of genetically modified foods until a more rigorous and independent regulatory system (as outlined in the following points three to ten) has been established. Third, the government should commission independent, peer-reviewed research into the multiple and as yet unanswered environmental and health concerns related to genetically modified foods. Subsequently, the current regulatory framework should be revamped on the basis of such findings to address the safety and ecological sustainability of genetically modified foods. Products that pose a significant health or environmental risk should be subject to complete prohibition. Fourth, in addition to independent and peer-reviewed testing, the approval process should admit broader social issues, including economic impacts. Fifth, antibiotic resistance markers should be prohibited in genetically modified foods, and all current foods that contain these markers should be deregistered as licenced varieties. Sixth, genetically modified food crops should not be used to produce chemical and pharmaceutical products. Seventh, genetically modified food crops used as animal feed should be subject to the same regulatory rigour as that employed to review genetically modified foods meant for human consumption. Eighth, once an overhauled and more stringent regulatory review system has been implemented all currently approved genetically modified food products should be re-tested and removed from the market if they fail to meet the newer, more stringent requirements. The moratorium outlined in point two would not be lifted until all such products have been re-tested. Ninth, a system of mandatory labelling similar to the European Union model (a product or any of its ingredients must be labelled as genetically modified if more than 0.9% of that product or any of its ingredients are produced through rDNA technology) should be implemented. In addition to mandatory labelling, an effective segregation system for genetically modified crops should be developed and implemented. Tenth, the independent body established under point one above should also be tasked with post-market monitoring activities, including the power to rescind approval for products later found to pose environmental or health risks. Eleventh, companies that market genetically modified products must be held liable for genetic contamination and gene flow that results from their products. Twelfth, refuse regulatory approval for any genetically modified wheat that could negatively impact Canada's wheat export market. Finally, withhold regulatory approval for any variety of genetically modified fish on the basis of the dangers posed to wild fish populations through the spread of transgenes from genetically engineered fish (The United Church of Canada, 2005).

8.2 Battles to Reclaim/Maintain the Commons

Making an interesting link between struggles on the biological and knowledge commons, and drawing on the lexicon of the open source movement, one commentator makes a case for developing 'biolinuxes' as a means of ensuring that genetic information and materials remain a part of the common heritage of humanity (Srinivas, 2002).[7] Other attempts at developing a commons-based system for agricultural products include the Public Intellectual Property for Agriculture (PIPRA), which is a coalition of American public universities, and the Generation Challenge Program (GCP) led by the Consultative Group on International Agricultural Research (CGIAR). The CGIAR, a collaborative effort involving more than 100 countries, holds the world's largest collection of seeds and maintains sixteen plant research centres around the world, including twelve gene banks. While the former project is based in universities and thus reliant on the traditional model of publicly funded research, the GCP seeks to establish a network of research relationships to ensure that the costs of basic agricultural research are not artificially inflated through onerous patent thickets (Benkler, 2006). A project interested in biological innovation is the Biological Innovation for an Open Society, better known as BIOS, which is an initiative of the non-profit Australian Center for the Application of Molecular Biology to International Agriculture (CAMBIA – which means 'change' in

[7] For an overview of the major open source projects devoted to biotechnology, see Deibel, E. (2006). Common genomes: Open source in biotechnology and the return of common property. *Tailoring Biotechnologies, 2*(2), 49-84. For a discussion of open source in general, see Weber, S. (2003). *The success of open source software*. Cambridge, MA: Harvard University Press.

Spanish). The BIOS project is driven by the belief that agricultural research depends upon unhindered access to a set of basic tools and enabling technologies, and that the monopoly protection provided by intellectual property instruments for such tools serves to retard research and innovation. To surmount such impediments to basic research the BIOS initiative employs a "copyleft" type of model similar to the General Public Licence (GPL) utilised by free/open-source software movements. Therefore, all the research tools of CAMBIA and the other members of the BIOS initiative are pooled together and made available on a free model that includes grant-back provisions to ensure that subsequent tools developed on the basis of existing ones also remain in the public domain. One purported advantage of BIOS is its scope, in that it seeks to include commercial and non-commercial, public and private researchers into a research network premised on openness and collaboration. CAMBIA has also developed an extensive database (its 'patent lens' project) that outlines who possesses what tools and the licencing arrangements involved with each (Benkler, 2006; Deibel, 2006). It has also erected a portal known as BioForge that provides scientific researchers access to enabling technologies that remain within a protected commons (Yancey & Stewart, 2007).[8]

8.2.1 Terminating Terminator

The recently established CBAN follows in the footsteps of Gene Allies, an informal group of 23 environmental, social justice, and consumer groups created in 1999 that were actively involved in the campaigns against Monsanto's recombinant Bovine Growth Hormone (rBGH) and Monsanto's genetically engineered wheat. Groups

[8] For an expanded outline of some of the major international 'open source' agricultural biotechnology intitiatives, see (chapter 9, pp. 336-343), Benkler, Y. (2006). *The wealth of networks: How social production transforms markets and freedoms*. New Haven: Yale University Press.

working with CBAN on this campaign include the NFU, The Council of Canadians, ETC (Action Group on Erosion, Technology and Concentration), the National Council of Women of Canada, Inter Pares, the Saskatchewan Organic Directorate, Beyond Factory Farming, Rightoncanada.ca (an Internet and public advocacy campaign of the Rideau Institute that seeks to put human rights back on Canada's political agenda), GenEthics of Australia, Oxfam, and the National Family Farm Coalition of the United States, among others. The steering committee of the Ban Terminator Campaign includes the following groups: ETC, GRAIN, Indigenous Peoples Council on Biocolonialism, Intermediate Technology Development Group, Pesticide Action Network – Asia and the Pacific, Third World Network, and La Via Campesina. There is also an international campaign to ban seed sterilisation technology in which CBAN and over 500 other species-being movements from around the world participate.

Building on the momentum generated by its success in March 2006 at the meeting of the Conference of the Parties to the Convention on Biological Diversity[9] at which CBAN helped ensure that efforts by the Canadian Government to overturn the international moratorium on Terminator seeds were unsuccessful, CBAN members decided at their first annual general meeting in October 2006 that they would take on the 'Ban Terminator' campaign in Canada as their pilot project ("Interview with Lucy Sharratt, Co-ordinator of the Canadian Biotechnology Action Network," 2007). The Ban

[9] The Conference of the Parties is the governing body of the United Nations Convention on Biological Diversity. It is responsible for the implementation of the Convention based on the decisions it makes at its periodic meetings. To date the Conference of the Parties has held 8 ordinary meetings, and one extraordinary meeting (the latter, to adopt the Biosafety Protocol, was held in two parts). Between 1994 and 1996 the Conference of the Parties held its ordinary meetings annually. Since 2000, when a change in the rules of procedure was agreed upon, these meetings have been held bi-annually. As of the end of 2007, the Conference of the Parties has taken a total of 216 procedural and substantive decisions. The ninth meeting of the Conference of the Parties to the Convention on Biological Diversity will be held in Bonn, Germany from May 19 – 30, 2008.

Terminator project seeks to ensure the continued international moratorium on Genetic Use Restriction Technologies and to achieve a complete ban in Canada. As Lucy Sharratt points out, Ban Terminator is particularly important as a first campaign because it not only allows CBAN to introduce and insert itself into the debate on biotechnology in this country while developing its organisational capacity, but it also helps to establish the discourse and the work on genetic engineering within a very strong social justice framework rather than through a food security concept or individual health concern. CBAN, as a species-being movement, seeks to develop itself in a manner consistent with strong social justice and international solidarity imperatives that position farmers and agriculture at the centre of the discourse on genetic engineering. According to Sharratt, when CBAN talks about genetic engineering its members want to open a dialogue about farmers and farming in a way that will help to increase the political voice of farmers in Canada, foster urban understanding of farmers, and expand NGO connections with farmers. That having been said, CBAN also recognises that biotechnology poses environmental, health, and moral concerns, although the latter are not something CBAN seeks to actively define.

In terms of social justice for farmers and agriculture CBAN emphasises three main concerns. One is the farm income crisis that stems from the high cost of farm inputs and relatively low price for farm outputs. Aside from Canada's low-priced food policy, there is a variety of additional policies that obstruct farmers from obtaining sufficient money for their product. The second and related concern is that genetic engineering increases farmers' dependence on corporate inputs, which not only exacerbates the high cost of such inputs but also facilitates increasing corporate control of agriculture and the food supply. The third Terminator-specific concern is that this particular application of genetic engineering is explicitly designed to create dependence on the part of farmers such that corporations would exclusively control seed, as a farm input. For CBAN and its members, Terminator Technology is an obvious corporate tool of control over seed markets ("Interview with Lucy Sharratt, Co-ordinator of the Canadian Biotechnology Action Network," 2007; "Interview with Terry Boehm, Vice President, National Farmers Union," 2007).

From CBAN's perspective, debates about the developmental trajectory of biotechnology encompass issues of democracy that are not being adequately, if at all, addressed by the Canadian government. It therefore seeks to highlight what it perceives to be a major deficiency in Canada's regulatory system, namely that it offers no room for consideration of social and economic factors in its decision-making processes. One of the goals of the network is therefore to democratise the decision-making processes around genetic engineering. CBAN and its member groups advocate the need for debates in Parliament and the development of regulations that work for people, which must include consideration of economic and social factors. A corollary to this is the concern about the power that the corporations hold and are able to wield in political and economic fora ("Interview with Lucy Sharratt, Co-ordinator of the Canadian Biotechnology Action Network," 2007).

Lucy Sharratt strikes an optimistic tone when speaking about the chances of success, pointing in part to the victory achieved in March 2007 with regard to the continued international moratorium on Terminator technology. Reflecting on the national scene, she outlines the Private Member's Bill (C-448) introduced by Alex

Atamanenko, New Democratic Party Agriculture Critic and MP for British Columbia Southern Interior, in the House of Commons on May 31, 2007 to ban Terminator technology. This bill also contains a consequential amendment to the *Patent Act*[10] that would prohibit patents for Terminator technologies. So theoretically it is possible that a national ban could be enacted within a few years. Whether or not that happens remains an open question, according to Sharratt. Nonetheless, she believes that if CBAN can secure enough resources it can facilitate a general trend toward success. As an example to illustrate what she means by that, Sharratt outlines how the Canadian government is talking seriously about genetically engineered trees and genetically engineered trees and Terminator technology together, all the while knowing that the Canadian public does not want genetically engineered trees or, at least, that it would be controversial. So if CBAN can gather the resources to flag these issues publicly it can set back those plans to commercialise products that have received regulatory approval but have not yet been marketed, of which genetically engineered alfalfa is another good, and controversial, example. Sharratt contends that various species-being movements in Canada have laid such good groundwork in terms of their solid research and their engagement and interaction with Canadian government regulatory agencies that when they appear at meetings it now matters. Government regulators are gradually being convinced that they need to be concerned about the critique and the presence of mobilised strata of universal labour in this country ("Interview with Lucy Sharratt, Co-ordinator of the Canadian Biotechnology Action Network," 2007).

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[10] *Patent Act*, R.S.C. 1985, c. P-4.

8.2.2 Labelling of Genetically Modified Foods

Labelling of genetically modified foods, which, as some observers note, might be considered a type of information policy, continues to be an issue pressed by Greenpeace with the support of the Council of Canadians (Magat & Viscusi, 1992).[11] In April 2001 the NDP Government introduced a bill in the British Columbia Legislative Assembly that would have required mandatory labelling of genetically engineered food. However, the bill died on the order table when elections were called and the new government did not re-introduce it. In October 2001 a federal Liberal private member's bill (C-287) that would have legally mandated labels for genetically modified foods was defeated in Parliament, despite the support of more than 80 species-being movements and opinion polls that demonstrated overwhelming public support for such labelling requirements.[12] Part of the lobbying effort against the federal bill was mounted by Loblaws, which also operates as Zehrs, No Frills, Provigo (Quebec), Real Canadian Superstore (Western

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[11] In her informative analysis of industry influence on nutrition and health in the United States, Marion Nestle (2007) points out the intensive and usually successful lobbying pressures brought to bear on the United States Food and Drug Administration (FDA) to approve health claims for foods based on standards below the traditionally accepted standard of 'significant scientific agreement'. That is, the FDA has begun permitting qualified health claims on food packaging despite the fact that its own research concludes that consumers often assume health claims on food packaging are based on scientific study. For example, on your supermarket shelf you can find "Kellogg's Smart Start, labelled as "Healthy Heart: With oat bran, potassium, and low sodium" and as containing "ingredients that can help lower BOTH blood pressure and cholesterol," despite an ingredient list that includes sugars in 11 places" (Nestle, 2007, p. 390). See, Nestle, M. (2007). *Food politics: How the food industry influences nutrition and health* (2nd ed.). Berkeley: University of California Press. The situation is, no doubt, very similar here in Canada. Thus, on the one hand we have claims by industry that it wants to avoid consumer confusion about genetically engineered organisms and thus avoid labelling, while on the other it actively promotes consumer misinformation on other food products. In both instances industry statements about informing and protecting consumers ring completely hollow. Clearly industry is quite adept at either avoiding disclosure of information or disseminating misinformation, depending on the product and market in question, all in order to ensure the continued and expanded sales of its products.

[12] A public opinion poll of 2,022 Canadians conducted in September 2001 by Decima Research Inc. showed that over 90% (+/- 2.2% 19 times out of 20) of the Canadian public supports mandatory labelling for genetically modified foods. See, Kuyek, D. (2002). *The real board of directors: The construction of biotechnology policy in Canada, 1980-2002*. Sorrento, BC: The Ram's Horn.

Canada) and Atlantic Superstore (Atlantic Canada).[13] Moreover, within six months the Liberal Government at the time halted a promised study into the issue by the Commons Standing Committee on Health. The CBAC, in its 2002 report on the regulation of genetically modified foods, similarly voices its opposition to any mandatory labelling system. Part of the justification advanced in the report includes: possible market damage if consumers come to associate GE labels with a perception that a particular product may not be safe; the potentially onerous cost structure; the logistical difficulties associated with segregating conventional and genetically engineered crops; and, the possibility that mandatory labelling would cause Canada to contravene some of its international trade agreements, thus rendering Canadian exports subject to trade sanctions (Canadian Biotechnology Advisory Committee, 2002a). In respect of this latter argument, Nadège Adam, former Biotechnology Campaigner for the Council of Canadians, contends that

> The federal government is only trying to find a weak justification for its crawling before the U.S. Government and the Monsantos of the world. Labelling of GM food, in response to the public's wishes and with respect to the precautionary principle, can certainly be showed to be a 'legitimate objective' in the sense of NAFTA. The labelling would affect all GM food, not only from American origin. NAFTA is only a convenient excuse for the government's inaction (Adam, 2002, ¶ 7).[14]

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[13] In fact, in 2001 Loblaws sent a letter to all of its health food suppliers to remove GE free labelling from their packaging by September 1 of that year or risk losing shelf space at any stores operated by the corporation. See, Adam, N. (2001). *Loblaws removes GE-free labels this weekend: Memories of consumer choice?* The Council of Canadians. Available: http://www.canadians.org/media/food/2001/30-Aug-01.html Accessed November 7, 2006].

[14] Steven McGiffen claims that a statement issued by Agriculture Canada in 2002 contained a direct admission that the reason mandatory labelling was defeated was out of concern about annoying the United States, which is the largest importer of Canadian food exports and which does not support mandatory labels for genetically modified foods. See, McGiffen, S. P. (2005). *Biotechnology: Corporate power versus the public interest.* London, GB: Pluto Press. According to the departmental response, "[a] disjointed approach with the U.S. on voluntary versus mandatory labelling could place both trade and investment at risk" (as cited in Wilson, 2002, ¶ 6). Wilson (2002, ¶ 9) goes on to assert that "[s]ome trade officials have warned that a mandatory labelling regime in Canada likely would be challenged by the U.S. as a new trade barrier that contravenes NAFTA rules." See, Wilson, B. (2002, November 21). Canada afraid to upset U.S. with GM labels. *The Western Producer.*

In a particularly condescending fashion the CBAC report suggests, "many people do not have a clear understanding of GM foods and could be confused or misled by a label indicating GM content" (Canadian Biotechnology Advisory Committee, 2002a, p. 38). Aside from the paternalistic character of such an assertion, one wonders whether the irony was lost on drafters of this document given the mandate of the CBAC, which, in part, tasks this committee with providing Canadians with "easy-to-understand information on biotechnology issues" (Canadian Biotechnology Advisory Committee, 2005a).

The cost argument, that neoliberal shibboleth that presumably carried significant weight in the discussions against a mandatory labelling scheme, has recently been revealed to be an industry smokescreen based on extremely inflated estimates. A study commissioned by the Quebec Department of Agriculture, Fisheries and Food determined that a mandatory labelling programme would cost the Quebec food industry $28 million and the provincial government $1.7 million annually. To put those figures in perspective, the Quebec food industry is worth $30 billion annually. These cost figures are much lower than those put forth by the food industry - $950 million for the whole country and $200 million in Quebec for both industry and governments. The argument advanced by the food industry that labelling costs would have to be passed on to consumers is also disputed on the basis of experience in countries with mandatory labelling requirements such as the member states of the European Union, Japan, China, Australia, and New Zealand, where companies have changed the way they operate in order to secure operational savings that offset labelling costs (Lalonde, 2007, p. A.3). In the absence of mandatory labelling those producers who reject genetically engineered ingredients must, in order to protect their markets, label their products as being free of genetically engineered organisms. Thus, lack of a mandatory labelling requirement for genetically engineered products imposes a cost burden on non-GE producers. Perhaps most ironic is that an industry that has been quick to make appeals to 'the market' as the determining instance for introducing biotechnologies has and continues to ardently oppose labelling requirements for genetically modified foods, the only real market mechanism available to consumers to make an informed choice (Magdoff, Foster, & Buttel, 2000). As one reporter observes, "[i]t is also in the interests of farmers, and consumers, that GM products be clearly labelled – a minimal requirement that would at least offer buyers a choice. If the cabinet refuses this straightforward demand, it is fair to ask whose side they are on. And what do producers have to hide?" (Riley, 1999).

Attempts at maintaining the labelling issue on the public agenda have included the organisation of information pickets at major grocery stores by the Council of Canadians and a demonstration by 1,000 protesters in Montreal outside the UN Biosafety Protocol Meeting that took place in 2000.[15] Adopting a more direct course of action, a number of Greenpeace activists, particularly in Vancouver, went into supermarkets and placed their own labels on products that contained genetically engineered organisms, which, according to Herb Barbolet, did garner public attention for a short period ("Interview with Herb Barbolet, Founder of Farm Folk / City Folk," 2007). Some success has been

[15] This protocol, to which 143 countries have acceded as of January 2008, regulates the global trade of genetically modified organisms but does not include mandatory labelling. The protocol is similarly silent on the issue of accountability of companies in a situation where transgenic plants transmit their genes to other varieties, thus polluting and damaging the ecosystem. See, for example, de la Perrière, R. A. B., & Seuret, F. (2000). *Brave new seeds: The threat of GM crops to farmers* (M. Sovani & V. Rao, Trans.). London, GB: Zed Books. Nonetheless, proponents of the biotechnology industry were quick to slam the protocol as a sell-out and source of needless regulation. See, for example, Miller, H. I., & Conko, G. (2000, February 29). The great biotech sell-out: Capitulation on UN's Biosafety Protocol leads to needless regulation. *National Post*, pp. C7.

had – McCain and Seagrams discontinued purchasing genetically engineered potatoes and grains for use in their respective products.

The main group struggling for the institution of a mandatory labelling regime for genetically engineered products in this country is Greenpeace. According to Darier, labelling is an important tactical strategy because Greenpeace found that in Europe and Australia once labelling or mandatory labelling was instituted consumers avoided genetically engineered foods, which ultimately resulted in such products being removed from the food system. In turn, because there is no incentive to grow them such crops are then also removed from the environment. Greenpeace believes that introducing some kind of transparency in consumer labelling is usually enough to push industry, or at least a segment of industry, to begin removing genetically engineered ingredients from its products. Given such positive experience in other countries, Greenpeace Canada has made the strategic decision to exert pressure on Canadian governments to implement mandatory labelling as the main form of leverage in the struggle to remove genetically engineered organisms from our food supply chain ("Interview with Dr. Eric Darier, GE Campaigner, Greenpeace Canada," 2007; "Interview with Josh Brandon, GE Campaigner, Greenpeace Canada," 2007).

Although the Private Member's Bill (C-287) that would have implemented a mandatory labelling system for genetically engineered food in this country was defeated in October 2001, Darier argues that this was an interesting battle because the bill came very close to being adopted. In fact, half of the cabinet at the time made sure to be present in the House of Commons to vote against the proposed bill, which, as Darier suggests, demonstrates both the high level of concern among the government of the day and the degree to which the Liberal party was split on the issue. Subsequent to this parliamentary defeat, the debate on mandatory labelling took two different directions. The federal government moved slowly on a voluntary labelling scheme, which is precisely what industry advocated since ultimately it would be unenforceable. A Canadian standard for voluntary labelling of genetically engineered foods was released in 2003. But as Sharon Labchuk of the P.E.I. Coalition for a GMO-Free Province adds, "[o]f course no companies have ever voluntarily labelled their foods as containing GE ingredients. It is only mandatory labelling that will give consumers choice in the grocery store" (n.a., 2008a). In response, Greenpeace decided to refocus its efforts and concentrate on those places where it believed it could get some traction on the issue. Based on its own analysis of support levels for mandatory labelling and thus prognosis for success, Greenpeace has elected to focus on Québec and British Columbia as the two likeliest provinces where provincial legislation has a chance of being promulgated. This strategy is designed to capitalise on one of the peculiarities of a federal state: if one level of government refuses to act it is quite possible to convince another level to do so (a tactic, Darier points out, that industry is quite adept at employing). Some initial success has been made – in 2007 NDP MLA for Vancouver-Fairview, Gregor Robertson, introduced a Private Member's Bill (Bill M 226 – 2007, *Right to Know Act*) in the British Columbia legislature that would make labelling mandatory for genetically engineered foods ("Interview with Dr. Eric Darier, GE Campaigner, Greenpeace Canada," 2007; "Interview with Josh Brandon, GE Campaigner, Greenpeace Canada," 2007).

The Québec Liberals have promised mandatory labelling and, in fact, in 2004 an all-party Agriculture Committee of the Québec National Assembly unanimously recommended that Québec implement a mandatory labelling regime based on the European system. That having been said, the recommendation has yet to be operationalised, although Greenpeace continues to exert pressure for action on this policy file. The situation is similar in British Columbia, where, although the campaign is younger, the objective is to get that province to move on mandatory labelling for genetically engineered food before the next provincial election in 2009. The campaign in British Columbia relies on traditional petition action to mobilise public opinion around the issue ("Interview with Josh Brandon, GE Campaigner, Greenpeace Canada," 2007).

Despite the limited focus on these two provinces, Greenpeace Canada continues to exert pressure on other provincial governments and the federal government. For example, Greenpeace demanded that labelling and Monsanto 863 (the genetically engineered corn that is controversial in Europe because of some of its health impacts and which has been banned by a number of European countries) be placed on the agenda of the June 2007 meeting of Canadian agricultural ministers in Whistler, British Columbia. Greenpeace also sent a letter to all the federal, provincial, and territorial agriculture ministers that outlined the following requests: a reassessment of all other authorised genetically engineered products currently on the market based on complete scientific, social, environmental, and health risk evaluations of each; an immediate suspension of the current authorisation process for genetically engineered organisms, pending a serious review of the risk assessment and management measures based on recommendations in the 2001 Royal Society report and the 2004 Auditor General's report on the CFIA; an immediate and complete recall of Monsanto's genetically engineered corn (MON863) from the market based on recent scientific evidence of its toxicity and health risks (see

Appendix II – Evidence of Adverse Environmental and Health Effects from Genetically Engineered Crops); and, mandatory labelling of all genetically engineered food and feed, not only to give consumers the fundamental right to know, but also to put in place a traceability system to track the source of any GE contamination. Greenpeace also organised a protest at the Telus Conference Centre in Whistler on June 27 to which it invited the input and participation of other agricultural and environmental species-being movements ("Interview with Josh Brandon, GE Campaigner, Greenpeace Canada," 2007).

Although the demands remain unheeded, Darier points out that maintaining pressure on governments about the issues is itself an important oppositional tactic. In fact, Darier contends that although there has not yet been 'success' on the labelling issue, it should be considered relative to the broader struggle. For example, in 2000, the President of the CFIA articulated plans to have 500 new genetically engineered products in Canada within five years. Yet even now in 2008 the numbers of approved products remain more or less the same, and certainly far removed from the prognostications made by government and industry proponents of biotechnology ("Interview with Dr. Eric Darier, GE Campaigner, Greenpeace Canada," 2007). Darier credits the various campaigns organised against genetic engineering with the success in slowing down the rates of approval for these products. He also points to the successes opposition struggles have had in convincing industry to withdraw from various biotechnology projects, the most recent success being the decision by Monsanto, under enormous international pressure and market rejection, to scrap its plans to introduce genetically engineered wheat into Canada. Overall then, more than 12 years after the first authorisation of a genetically engineered product, the main products being commercialised continue to be corn, soy, and canola. So for Greenpeace there has been success in terms of retarding the progression and introduction of biotechnology in Canada ("Interview with Dr. Eric Darier, GE Campaigner, Greenpeace Canada," 2007).

As a result of winning a random Parliamentary draw, Gilles-André Perron, Bloc Québécois MP for Rivière-des-Mille-Îles was permitted in April 2008 to introduce his Private Member's Bill (C-517) in the House of Commons that would legislate the mandatory labelling of genetically engineered foods. The bill was debated during a second reading on April 3, 2008, with a second hour of debate possible as early as mid April (as of May 12, 2008 second reading had yet to occur). If adopted in its second reading, Bill C-517 will be referred to a parliamentary committee for further study and then returned to Parliament for a third reading. In a press release from CBAN, Tony Beck of the grassroots coalition GE Free BC proclaims that "[w]e have a fundamental right to know what foods are genetically engineered." The Federal government has refused to establish mandatory labelling despite years of polls that show 79% to 90% of Canadians and Québécois want these labels. "Our government has tried everything to keep Canadian consumers from having the ability to chose non-GE foods," said Beck. Josh Brandon maintains that "[t]his Private Members Bill is an outstanding chance for our Members of Parliament to listen to consumers and support democracy and choice for consumers" (n.a., 2008a). As Lucy Sharratt points out,

> Without mandatory labelling, Canadians have no tools to track potential health effects from consuming GE foods. Canada hosted an international conference on post-market surveillance which would have set up a system to track GE foods and their health impacts, but the government abandoned this project when it became clear that mandatory labelling would also be required (n.a., 2008a).

Accordingly, both CBAN and Greenpeace actively engaged their membership to write to Members of Parliament to express support for the bill once it comes up for a final vote in the House.

8.2.3 GE-Free Zones

Coalitions for GE-Free zones are developing throughout the country, particularly in British Columbia. The group spearheading efforts in British Columbia, the Coalition for a Genetically Engineered Free BC, is a coalition established in June 2005 of universal labourers committed to social justice who strive to unshackle food production from control by large corporations in order to achieve local food security and environmental sustainability. The vision statement of this organisation foresees a Canada in which no genetically engineered life forms are created, approved, patented, bought, sold, or traded. GE Free BC mobilises resistance to genetically engineered food in a number of ways: it participates in the Ban Terminator campaign, undertakes fundraising projects, has hosted a forum with Percy Schmeiser and other activists opposed to genetically engineered food, advocates at the CBAC, attends global meetings and participates in national movements against genetic engineering, and hosts a number of community events.

The Council of Canadians is campaigning for a GE-Free Canada. The strategy is to pursue local movements designed to get municipal governments to declare themselves GE-free zones. Launched in June 2005, this campaign is a grassroots effort that is attempting to mobilise support across the country among farmers, environmentalists, and any other Canadian concerned by food safety and food sovereignty issues. The initial goal of the campaign was to convince 50 communities in Canada to declare themselves

GE-Free by the end of 2007. Two jurisdictions have done so in British Columbia and a legislative committee in the province of Prince Edward Island began hearings on the issue in 2005. However, the final report tabled in December 2005 by the Legislative Assembly's Standing Committee on Agriculture, Environment and Forestry ultimately caved in to the rhetoric of economic development as demonstrated by its fourth recommendation that the government of Prince Edward Island continue to support the life sciences sector as a source of provincial economic growth. The Committee thus issued a recommendation in support of co-existence between conventional, organic, and genetically engineered agricultural practices. The report does, however, call on the Prince Edward Island Government to support the development of a labelling regime to ensure consumers can be properly informed about the inclusion of genetically engineered organisms in their food (Standing Committee on Agriculture Forestry and Environment, 2005). On November 27, 2007 a petition signed by around 1700 people was delivered to the Yukon legislature that calls on the territorial government to implement a ten-year moratorium on the planting of genetically engineered seeds. However, the response from the government was that it would study the matter and gather additional information before making a decision about a possible moratorium.

8.2.4 Recombinant Bovine Growth Hormone

In her chapter, *No to bovine growth hormone: Ten years of resistance in Canada*, Lucy Sharratt (2001b) outlines one of the most protracted battles to date in Canada over one particular aspect of biotechnology.[16] In 1986 Health Canada scientists claimed that

[16] The book in which Sharratt's work appears, *Redesigning life?: The worldwide challenge to genetic engineering*, is, as the title suggests, a compendium of struggles organised in opposition to this new

recombinant Bovine Growth Hormone (rBGH), which was developed by Monsanto,[17] did not pose demonstrable risks to human health, although the assertion was not supported by scientific evidence. By 1988 rBGH was tested on dairy cows in four provinces and the resulting milk was introduced into the commercial supply. It was not until dairy processors informed the media of the situation that the public became aware in November 1988 that parts of the Canadian milk supply had been infiltrated by milk 'contaminated' with rBGH. The result was immediate and negative. Moreover, it signalled the beginning of substantial public opposition that would continue for ten years until rBGH was finally denied regulatory approval by Health Canada (Sharratt, 2001b).

In British Columbia unease at the prospect of consuming milk containing the growth hormone caused more than 600 people to call one processing plant in one morning, jamming 17 trunk lines (Sharratt, 2001b). In Ontario, processors wrote letters to the Ontario Milk Marketing Board until it acquiesced and instructed researchers not to allow milk from their experiments into the commercial supply. The NFU was also quite vocal in its opposition to rBGH out of fear for both animal safety and the farm industry. Position papers and letters from a diverse constituency of individuals and organisations opposing rBGH streamed into the federal Agriculture and Health Departments. Brewster Kneen and Lorraine Lapointe, who had been instrumental in the struggle in Ontario, organised the "Pure Milk Campaign", which was the first systematic effort to inform the public and encourage opposition to rBGH. The issue also received wide coverage in *The*

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technology. This is a rich work that touches on a wide range of issues surrounding biotechnology, including the promise of genetically engineered rice to solve the problem of starvation in the world, the ecological effects of biotechnology, xenotransplantation, enclosure of the commons, biopiracy, and patenting.

[17] According to Sharratt (2001b), Eli Lilly submitted its own application to Health Canada for approval of its rBGH product but subsequently withdrew it, pending the outcome of Monsanto's application.

Ram's Horn,[18] which helped link it with wider trends in genetic engineering and the growing control that agribusinesses were exerting over agriculture. According to Kneen, the ultimate success of the opposition movement to rBGH in Canada can be attributed to three main factors. First, the emerging countermovement ensured that the name Bovine Growth Hormone dominated public consciousness, rather than the sanitized predicate preferred by Monsanto and its champions, recombinant bovine somatotropin or rBST. Second, attention was focussed on ensuring that farmers' concerns remained central to the overall issue so that apprehension over rBGH did not degenerate into a concern 'merely' over food safety.[19] Finally, opponents of rBGH articulated a contingency demand that rBGH milk be labelled should Health Canada issue regulatory approval. This latter factor was a particularly strategic one because of the Canadian milk supply system. In this country milk is pooled in a single system so labelling requirements would have required segregation and the development of a second marketing system, which would have been costly for both dairy producers and consumers (Macdonald, 2000; Sharratt, 2001b).

By 1994, shortly before Health Canada was poised to approve rBGH, opposition had grown even further, with hundreds of thousands of signatures having been collected by the Council of Canadians and sent to Parliament. The Minister of Agriculture issued a moratorium that included a one-year delay on the use and sale of rBGH in August 1994. Although the moratorium was not renewed, Health Canada did request additional data from Monsanto, which had the same effect of delaying approval. Senate hearings in 1998

[18] *The Ram's Horn* is the monthly journal put out by Brewster Kneen and his wife, Cathleen, that treats food and agricultural issues.

[19] The Critical Art Ensemble (2002) similarly advocates the need for opposition movements organised around biotechnology issues to engage in consciousness raising activities that will aid people in recognising the exploitive structures and processes of capitalist controlled biotechnology.

would later discover that pressure had been exerted by executives at Monsanto and bureaucrats within Health Canada[20] on fellow scientists at Health Canada to rush approval for rBGH and disregard negative findings. In response to some of the internal conflicts between scientists and managers at Health Canada, the department requested two independent bodies to review the available data: the Royal Society of Physicians and Surgeons and the Canadian Veterinary Medical Association. Internal Health Canada documents show Monsanto tried to inject itself in this process by suggesting agenda items for meetings in which the work of the independent panels was being considered and specific scientific studies that it wanted the panels to consider in their review (Sharratt, 2001b). While the report written by the Royal Society of Physicians and Surgeons merely made the point that the Bureau of Veterinary Drugs (the directorate within Health Canada responsible for the rBGH review – now reorganised in the department as the Veterinary Drugs Directorate) had sufficient data to reach a decision, the Canadian Veterinary Medical Association confirmed the findings of Health Canada scientists that rBGH poses risks for bovine health. This panel's findings provided Health Canada with the scientific justification it needed to refuse Monsanto regulatory approval for its drug. Finally, on January 15, 1999 Health Canada announced that Monsanto's application for regulatory approval of rBGH would not be approved "at this time" (Sharratt, 2001b, p. 394; Smith, 2003).[21]

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[20] According to the Council of Canadians, in 2002 Health Canada was found once again to be exerting pressure on its scientists to approve the drugs Baytril and Tylosin, which are used to enhance chicken and bovine growth respectively. Baytril is an antibiotic that some scientists believe could cause antibiotic resistant bacteria in animals that could be transmitted to humans. Tylosin is a growth hormone that has been banned by the European Union after research revealed a link to cancer. The World Health Organisation has also requested its member countries to ban the hormone. See the website of the Council of Canadians (http://www.canadians.org/).

[21] At least one commentator claims that Monsanto did not engage in tactics designed to pressure Canadian regulators: Macdonald, M. R. (2000). Socioeconomic versus science-based regulation: Informal influences

The lesson learned from ten years of opposition to rBGH was that a diverse movement of universal labourers with support from across the country made it almost impossible for Monsanto to single out and discredit specific individuals or groups. The diversity of the species-being movement was sustained by the Council of Canadians, which also provided structure at key moments and helped catapult local resistance strategies onto the national scene (Sharratt, 2001b).

8.2.5 Genetically Engineered Wheat

In the interim, Monsanto, in collaboration with Agriculture and Agri-Food Canada, has developed a genetically engineered wheat strain designed to tolerate Roundup pesticide. This collaboration includes a royalty sharing arrangement that would net the federal government between one and ten percent of Monsanto's total sales if its genetically engineered wheat is commercialised.[22] The NFU, Greenpeace, the Canadian Wheat Board, the Council of Canadians, and the Saskatchewan Association of Rural Municipalities, among others, mobilised widespread opposition against genetically

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on the formal regulation of rbST in Canada. In G. B. Doern & T. Reed (Eds.), *Risky business: Canada's changing science-based policy ad regulatory regime* (pp. 156-181). Toronto: University of Toronto Press. Moreover, his treatment of the rBGH debate tends to discount the efforts expended by the opponents of Monsanto's application for regulatory approval. According to Macdonald's account, it was concern about the scientific authority of the Bureau of Veterinary Drugs (the organisational unit within Health Canada responsible for reviewing the scientific data accompanying Monsanto's application) that opened the door to other groups with concerns beyond the science of rBGH, but which, nonetheless, could attack the issue on a scientific basis that couched their underlying socio-economic concerns. Ultimately he claims that these types of latter concerns, alongside science, will come to assume importance in the regulatory process. It remains unclear whether he perceives this as a good thing or not.

[22] In a typically imprecise government fashion, John Culley, director of intellectual property for Agriculture and Agri-Food Canada refused to divulge an exact figure of the profit sharing agreement reached with Monsanto. See, Bueckert, D. (2004, January 10). Agriculture Canada puts brakes on Roundup Ready wheat project. *The Globe and Mail,* pp. A7. While the terms of the contract between Monsanto and the department are confidential, and thus hidden from public scrutiny, Jim Bole, Director of Cereal Research at Agriculture and Agri-Food Canada at the time, informed a reporter that Monsanto had invested $1.3 million in the project and the department contributed $500,000. The department also provided Monsanto with access to the genetic material it had developed over the preceding years. See, Warick, J. (2003, August 9). Lining up against GM wheat. *Star Phoenix,* pp. E1.

engineered wheat ("Interview with Ian Mauro, Doctoral Candidate and Co-Producer of *Seeds of Change*," 2007; "Interview with Terry Boehm, Vice President, National Farmers Union," 2007). Early in 2004 Agriculture and Agri-Food Canada formally stopped contributing funds toward research for Monsanto's Roundup Ready wheat (Bueckert, 2004). As Glen Neufeld, president of Saskatoon's Sunrise Foods International, which exports $10 million annually of Saskatchewan-grown organic grain, succinctly states: "It [introduction of genetically engineered wheat] would be devastating. Once it comes, it's all over. I don't hear farmers or anybody asking for this. We are going to be screwed. Somebody needs to shut Monsanto down. Monsanto doesn't really care about the industry. They care about making the next big buck" (Warick, 2003). Survey data collected by interview informant Ian Mauro helped in the fight against the introduction of Monsanto's genetically engineered wheat. Monsanto said it would withdraw its regulatory application if farmers indicated they did not want genetically engineered wheat, all the while believing that such data were not available. Normally a relatively safe assumption, what Monsanto did not know was that researchers at the University of Manitoba were finishing up a major survey of Canadian Prairie farmers that asked about precisely this issue. The findings demonstrated an overwhelming majority of respondents strongly opposed to genetically engineered wheat. Aside from catching Monsanto off-guard, this episode indicates the vital importance of disseminating this type of information into the public domain ("Interview with Ian Mauro, Doctoral Candidate and Co-Producer of *Seeds of Change*," 2007).

In June of 2004 Monsanto formally withdrew its application for regulatory approval of its Roundup Ready wheat. The company also withdrew its submissions for regulatory review in Australia, New Zealand, Russia, South Africa, Colombia, and the United States (Department of Agriculture and Environmental Protection Agency. It did, however, leave its application before the United States Food and Drug Administration) (Hall, 2004). Although Monsanto eventually backed down from seeking permission to market this product, expectations remain that Monsanto will attempt to obtain regulatory approval in the future. In fact, in announcing its decision in May 2004 to halt the introduction of genetically engineered wheat in Canada, Monsanto spokespeople stated clearly that the decision was a question of timing rather than a complete end to attempts to market their product (MacAfee, 2004).

According to Josh Brandon the regulatory system is completely loaded in favour of corporate interests, as demonstrated by the fact that the safety studies used by the government for product approval rely on data produced and designed by industry. In Brandon's assessment the CFIA is aware of environmental contamination concerns associated with genetically engineered crops, but whether or not such voices are heard within the CFIA remains dubious. In general, the CFIA completely avoids social and economic issues in its regulatory decision-making processes. Brandon recounts the story about Monsanto wheat; the CFIA had no mechanism that it could use to not allow genetically engineered wheat because the safety issue of that crop was not really that different from other genetically engineered products that had already been approved, such as canola and corn. The overwhelming logic for not allowing approval of Monsanto's genetically engineered wheat was the fear of destroying the Canadian wheat export market because major importers of Canadian wheat, such as Europe, refuse to accept genetically engineered crops. In the end Monsanto was pressured to withdraw its application rather than the CFIA not granting approval. Brandon believes that the pressure came from government, which itself had received a lot of pressure from Greenpeace and other species-being movements.

8.2.6 Genetically Engineered Alfalfa

In the United States District Court Judge Charles R. Breyer of the Northern District of California ruled on February 13, 2007 that the United States Department of Agriculture violated the law when it did not properly assess the environmental impact of genetically engineered alfalfa before approving Monsanto's Roundup-Ready alfalfa. The lawsuit against the federal agency was brought by a coalition of groups led by the Washington, D.C. based Center for Food Safety. In his decision, Judge Breyer cited concerns about gene transfer through pollen to organic or non-genetically engineered alfalfa, which could impinge on export markets given the refusal of a number of foreign countries to accept genetically engineered crops. Breyer also censured the Agriculture Department for failing to consider the possibility that the use of Roundup-Ready alfalfa could result in increased application of the Monsanto herbicide, which, in turn, could lead to weed resistance to glyphosate (Pollack, 2007). In response to Breyer's ruling, a Monsanto spokesperson stated that "[w]e're going to do everything we think is appropriate to defend growers' right to choose this technology. Our goal is to restore that choice for farmers" (Jenkins, 2007, ¶ 38). The disingenuity of this statement is not lost on a number of commentators who point out that gene flow from genetically engineered plants is contaminating traditional crops to such an extent that farmers are loosing the ability to choose to grow non-genetically engineered crops ("Interview with Arnold

Taylor, Chairperson of the Organic Agriculture Protection Fund and President of the Canadian Organic Growers Association," 2007). Others also note the various efforts made by Monsanto over the last decade to compel agricultural producers to purchase bundled packages of its genetically engineered seeds and herbicides, as well as efforts to expand and consolidate its dominant market position through mergers and acquisitions, restrictive licencing agreements, and alleged price fixing. In fact, Monsanto is named in at least 20 antitrust cases in the United States (Jenkins, 2007). In a later decision on March 12, 2007 Judge Breyer vacated the U.S. Department of Agriculture's 2005 approval of genetically engineered alfalfa and ordered an immediate injunction on sales of such seed. That injunction was made permanent in a decision on May 3, 2007 by Judge Breyer that bans any further planting of genetically engineered alfalfa until the United States Department of Agriculture completes an Environmental Impact Statement (Pollack, 2007). In Canada the CBAN has begun investigating the status of genetically engineered alfalfa in this country.

In a position paper from March 23, 2006, the Saskatchewan Organic Directorate recommends that the Government of Canada, in order to ensure food and feed safety, as well as support organic farming, rescind approval for the environmental release of genetically engineered alfalfa, ban imports into Canada of genetically engineered alfalfa or alfalfa contaminated by genetically engineered alfalfa, and prohibit the testing or any other introduction of genetically engineered alfalfa into Canada. Given the loss of canola as an organic crop in this country due to genetic contamination,[23] the Saskatchewan Organic Directorate is particularly concerned about the detrimental impact that

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[23] Not only has canola been lost as a market crop but also as one of the crops available to organic farmers as a rotational tool to control weeds and sustain soil fertility.

commercial release of genetically engineered alfalfa would have on organic farmers ("Interview with Arnold Taylor, Chairperson of the Organic Agriculture Protection Fund and President of the Canadian Organic Growers Association," 2007; "Interview with Cathy Holtslander, Committee Member of the Organic Agriculture Protection Fund," 2007). As the position brief states:

> All organic farmers use legumes as a soil-building component in their crop rotations. Alfalfa is a perfect legume for nitrogen fixation in the crop rotation for the majority of organic farms. To lose alfalfa in organic farm crop rotation would severely hamper our ability to maintain soil fertility and prevent soil erosion, which would harm the future of our soils [sic] health and sustainability (Saskatchewan Organic Directorate, 2006, ¶ 3).

Arnold Taylor, Chairperson of the Organic Agriculture Protection Fund, points to the success farmers and other universal labourers achieved when, after widespread opposition and public pressure, Monsanto withdrew its application for regulatory approval of its genetically engineered wheat in June 2004. However, the current and growing fear is that Monsanto and other companies will renew their efforts to expand their control over agricultural markets through genetically engineered alfalfa. Organic farmers consider genetically engineered alfalfa to be as much of a threat to organic agriculture as was genetically engineered wheat, particularly given the tremendous organic soil building capacity of alfalfa. The Saskatchewan Organic Directorate was therefore quite pleased with the United States injunction on the sale of alfalfa that has happened in recent months in California. As part of their efforts to oppose the commercialisation of genetically engineered crops that threaten the sustainability of organic farming, the Organic Agriculture Protection Fund has written to Monsanto and Syngenta in order to put them on notice that if they do try to introduce genetically engineered wheat or genetically engineered alfalfa in Canada, organic farmers will respond with all legal mechanisms at their disposal, including attempts to obtain an injunction until the liability issue has been settled ("Interview with Arnold Taylor, Chairperson of the Organic Agriculture Protection Fund and President of the Canadian Organic Growers Association," 2007). As Taylor puts it, these companies need to understand "we are here and we are not going away", important words that industry would do well to heed given that Saskatchewan is home to 1200 organic farmers who till 1.2 million acres of organic land.

8.3 Attempts at Judicial Redress to Commons Contamination

In response to the contamination of organic canola by genetically engineered varieties of canola seed, a committee of the Saskatchewan Organic Directorate[24] passed three motions to investigate the viability of instigating legal action against Monsanto and Aventis (which was subsequently acquired by Bayer CropScience) in respect of genetic drift into organic canola from genetically engineered canola. As part of the legal strategy, the motions called for the establishment of a self-sustaining committee known as the Organic Agriculture Protection Fund. It is this body, and not the Saskatchewan Organic Directorate, that is attempting to sue Monsanto and Bayer CropScience. Although this committee ultimately reports to and remains under the umbrella of the Saskatchewan Organic Directorate, it has been accorded a substantial degree of independence, which includes the responsibility for acquiring the funds necessary to

[24] The Saskatchewan Organic Directorate is the umbrella organisation that unites the province's producers, processors, buyers, traders, certifiers, and consumers of certified organic food and fibre. It is incorporated as a non-profit membership organisation.

support its legal actions ("Interview with Cathy Holtslander, Committee Member of the Organic Agriculture Protection Fund," 2007).

The Organic Agriculture Protection Fund attempted to become certified as a class action under the Saskatchewan *Class Actions Act*[25](Larry Hoffman and Dale Beaudoin are the named plaintiffs).[26] The Organic Agriculture Protection Fund, which submitted its statement of claim[27] on January 10, 2002, is the first group in Saskatchewan that has tried to make use of this relatively new legislation, which was proclaimed on January 1, 2002. The statement of claim is for damages caused by the introduction of genetically engineered canola and for an injunction to stop genetically engineered wheat. The plaintiffs allege that "[a]s a result of widespread contamination by GM canola few, if any, certified organic grain farmers are now growing canola. The crop, as an important tool in the crop rotations of organic farmers, and as an organic grain commodity, has been lost to certified organic farmers in Saskatchewan" (*Statement of claim in the Court of Queen's Bench judicial centre of Saskatoon*, 2002, para. 27). On February 2, 2004 the statement of claim was amended to include compensation for costs incurred by organic farmers to remove genetically engineered canola from their fields and seed supplies. After Monsanto withdrew its application for regulatory approval of its Roundup Ready wheat on June 19, 2004, a further amendment was made to the statement of claim to remove the request for an injunction against genetically engineered wheat.

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[25] S.S. 2001, c. C-12.01.

[26] The increasing importance of the issues raised by this case is reflected in the fact that two issues (3 and 4 of volume 27) of the *Bulletin of Science, Technology & Society* are devoted to examining the ability of the courts and intellectual property law to address disputes over genetically engineered plants.

[27] *Hoffman and Beaudoin v. Monsanto Canada*, Sask. Q.B., No. 67 of 2002.

The statement of claim alleges that Monsanto and Bayer CropScience are liable in negligence, strict liability, nuisance,[28] and trespass.[29] The claim of *negligence* is based on the defendants' failure to ensure that their genetically engineered canola would not infiltrate or contaminate farmland, to warn farmers about cross-pollination, and to advise growers of farming practices that would limit the spread of genetically engineered canola.[30] The defendants' are alleged to be liable on the basis of *strict liability* for engaging in a non-natural use of land and permitting the escape of something likely to do mischief or harm. *Nuisance* is alleged because of the interference genetically engineered canola has caused organic farmers in trying to use and enjoy their land. Liability based on *trespass* is purported to arise from the defendants' introduction and unconfined release of genetically engineered canola in Saskatchewan, which has subsequently trespassed on lands owned by organic farmers.[31] The plaintiffs also allege that genetic modifications

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[28] For discussions of liability under nuisance in the context of genetically engineered organisms, see Lee, M. (2003). What is nuisance? *Law Quarterly Review, 119*, 298-325. For other discussions about liability issues related to the release of genetically engineered organisms, albeit from a mainly British and European perspective, see also, Lee, M., & Burrell, R. (2002). Liability for the escape of GM seeds: Pursuing the 'victim'? *The Modern Law Review, 65*, 517-537.; and Rodgers, C. P. (2003). Liability for the release of GMOs into the environment: Exploring the boundaries of nuisance. *The Cambridge Law Journal, 62*, 371-402.

[29] For a well-researched article that provides a legal analysis of the chances of success of these statements of claim based on existing case law against neighbouring farmers, against the government, and against biotechnology companies, see Matthews Glenn, J. (2004). Footloose: Civil responsibility for GMO gene wandering in Canada. *Washburn Law Journal, 43*, 547-573.

[30] The plaintiffs appear to be pursuing the negligence charge from the well-established 'products liability' line of argumentation, stating that "between 1995 and 2001, with respect to Aventis Canada [now Bayer CropScience] and Liberty Link, and between 1996 and 2001, with respect to Monsanto Canada and Roundup Ready, farmers purchasing either variety were not warned about the potential harm to neighbouring crops caused by GM volunteer canola. In particular, no warnings were given to farmers to keep a buffer zone to minimize the flow of pollen to surrounding crops, to ensure that all farm trucks transporting the seed were properly and securely tarped, to thoroughly clean all farm machinery before leaving a field where the GM crop was being grown, or to warn neighbours that GM volunteers might emanate from the GM crop" (*Statement of claim in the Court of Queen's Bench judicial centre of Saskatoon*, 2002, para. 25).

[31] Elizabeth Judge tries to develop the argument that such actions, rather than availing themselves of tort remedies, might be better pursued through intellectual property law itself. She considers the role of the exhaustion doctrine in copyright as providing a possible parallel in patent law in respect of genetically engineered seed and the case at bar, ultimately arguing for a Hohfeldian framework that would attach duties to the rights granted under patent legislation. See, Judge, E. F. (2007). Intellectual property law as an

are "pollutants" within the meaning of *The Environmental Management Protection Act* (Saskatchewan)[32] and that such pollutants have caused harm to organic farmers as a result of their discharge into the environment.[33] The plaintiffs therefore seek to hold the defendants (as "owners or persons in control")[34] liable to organic farmers pursuant to subsection 13(3) of the Act for the damages they have incurred as a result of the introduction of genetically engineered canola ("pollutant") into the Saskatchewan environment.[35] Finally, the plaintiffs contend that the testing and unconfined release of genetically engineered canola in Saskatchewan was a "development" under *The Environmental Assessment Act*[36], which requires an environmental impact assessment and ministerial approval prior to environmental release.[37] Having failed to either conduct such an assessment or obtain ministerial approval, the statement of claim alleges that

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internal limit on intellectual property rights and autonomous source of liability for intellectual property owners. *Bulletin of Science, Technology & Society, 27*, 301-313.

[32] S.S. 1983-84, c. E-10.2. This statute was replaced on October 1, 2002 by the similarly sounding *Environmental Management and Protection Act*, S.S. 2002, c. E-10.21.

[33] Jodi McNaughton provides a detailed legal analysis of how this Act might serve as a statutory mechanism to hold producers of genetically engineered seed liable for genetic contamination of the environment. See, McNaughton, J. (2003). GMO contamination: Are GMOs pollutants under *The Environmental Management and Protection Act*? *Saskatchewan Law Review, 66*, 183-216.

[34] Ownership would presumably arise from the patent rights owned by the defendants and control would inhere in the reach and effect of the technology use agreements that companies like Monsanto force farmers to agree to before being able to purchase genetically engineered seed. For a discussion of "owners or persons in control" under the original Act, see *Busse Farms Ltd. v. Federal Business Development Bank*, (1998) 168 D.L.R. (4th) 27 (Sask. Ct. App.).

[35] The original Act sets out in subsection 23(1) that the person alleging loss, damage, or injury "is not required to prove negligence or intention" to inflict it. Subsection 23(2) of this Act stipulates further that the burden of proving that the loss, damage, or injury "was not caused by a development is on the person who proceeds with the development". The statement of claim filed with the Saskatchewan Court of Queen's Bench includes discussion of the reversed burden of proof set out in *The Environmental Management Protection Act.*

[36] S.S. 1979-80, c. E-10.1.

[37] The Supreme Court of Canada has recognised that "stewardship of the environment" is a "fundamental value in Canadian society" that the courts can protect (*Ontario v. Canadian Pacific Ltd.*, [1995] 2 S.C.R. 1031). In fact, the Supreme Court has established the precedent that polluters must pay to repair environmental damage for which they are responsible (*Imperial Oil Ltd. v. Quebec (Minister of the Environment)*, [2003] S.C.J. No. 59). Moreover, the Court has suggested that class action suits involving environmental cases can be useful given "[t]he rise of mass production,...the advent of the mega-corporation, and the recognition of environmental wrongs" (*Hollick v. Toronto (City)*, [2001] S.C.J. No. 67). See, for example, de Beer, J., & McLeod-Kilmurray, H. (2007). Commentary: The SCC should step up to the environmental plate. *The Lawyers Weekly, 27*, 7.

under section 23 of the Act the defendants are liable for any loss or damage sustained by organic farmers from the 'development' without proof of negligence or intention (*Statement of claim in the Court of Queen's Bench judicial centre of Saskatoon*, 2002).

The Organic Agriculture Protection Fund pursued class action because no single member of the Saskatchewan Organic Directorate has the financial ability to single-handedly litigate against a transnational corporation. Aside from lack of resources, if an individual were to lose a court battle, the defendants (i.e. Monsanto and Bayer CropScience) could be awarded costs, meaning that the plaintiff would be forced to reimburse Monsanto and Bayer CropScience for all the legal costs they incurred defending themselves in the lawsuit, which is an absolute barrier to undertaking legal action against large corporations ("Interview with Cathy Holtslander, Committee Member of the Organic Agriculture Protection Fund," 2007). The Saskatchewan *Class Actions Act*[38] was designed to remedy this obstacle by shielding plaintiffs from awards of cost unless there is a fraudulent misuse of the courts. Section six of this Act sets out the following five criteria that must be met for an action to be certified as a class action:

> The court shall certify an action as a class action on an application pursuant to section 4 or 5 if the court is satisfied that:
> (a) the pleadings disclose a cause of action;
> (b) there is an identifiable class;
> (c) the claims of the class members raise common issues, whether or not the common issues predominate over other issues affecting individual members;
> (d) a class action would be the preferable procedure for the resolution of the common issues; and
> (e) there is a person willing to be appointed as a representative plaintiff who:
> i. would fairly and adequately represent the interests of the class;
> ii. has produced a plan for the class action that sets out a workable method of advancing the action on behalf of the class and of notifying class members of the action; and

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[38] *Supra*, note 25.

> iii. does not have, on the common issues, an interest that is in conflict with the interests of other class members.

According to interview informant Cathy Holtslander, who works for the Beyond Factory Farming Coalition and was one of the Organic Agriculture Protection Fund committee members pursuing the lawsuit, the new Act provides access to justice by assisting a large group of people who individually might have only a small or modest amount of damage that normally would not warrant suing a corporation, but when you aggregate all these various amounts of damage it becomes significant enough to merit class action.

The initial hearing on class certification occurred in November 2004 before Judge Gene Ann Smith of the Saskatchewan Court of Queen's Bench. In her ruling from May 11, 2005, Justice Smith denied the plaintiffs' claims, stating that they had failed to meet the criteria for class certification as set out in *The Class Actions Act*,[39] including a failure to demonstrate either an identifiable class or a cause of action in negligence, nuisance, strict liability, and trespass. In respect of negligence, Justice Smith argued that the plaintiffs failed to sufficiently demonstrate proximity and foreseeability:

> What is missing from the plaintiffs' claim, however, is any specific allegation that the loss and damage to organic farmers in particular which is claimed (*viz.*, loss of the use of canola as a marketable organic commodity and loss of canola for use in crop rotation, plus the clean-up costs and loss of use of fields as a result of GM canola volunteers) was foreseeable.[40]

In respect of proximity, Justice Smith's judgement maintains that the plaintiffs "have not alleged any relationship at all, either in the pleadings or in the argument before me, that would give rise to an argument for sufficient relational proximity to support a *prima facie*

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[39] *Ibid.*
[40] 2005 SKQB 225, para. 64.

duty of care."[41] In her analysis of the nuisance claim alleged by the plaintiffs, Justice Smith wrote that

> No harm can be said to have been caused by the *mere* sale or marketing of GM canola. The adventitious presence of canola in the crops and on the land of organic farmers required the intervention of neighbouring farmers who cultivated GM canola. While the "release" of the GM varieties of canola by the defendants may have been a necessary condition for the occurrence of the harm alleged, it was far from sufficient, in itself.[42]

This conclusion is particularly problematic for the plaintiffs since Saskatchewan, like most other jurisdictions in Canada, has so-called 'right to farm' legislation,[43] which prohibits nuisance suits being brought against farmers who operate within the parameters of "normally accepted agricultural practices".[44] Thus, through a combination of statute and common law, a claim of nuisance cannot be brought against either the user or the manufacturer of substantially harmful genetically engineered organisms (Phillipson, 2005). Justice Smith relied on the precedent established in *Rylands v. Fletcher* to disallow the plaintiffs' claim alleging strict liability:

> Regardless of whether one considers GM canola a "dangerous substance", or the field trials for GM canola an "unnatural" or "non-natural" use of land, it is not reasonably arguable that the commercial release and sale of Roundup Ready canola seed and Liberty Link canola seed constituted an "escape" of a substance, dangerous or otherwise, from property owned or controlled by the defendants in the sense of "escape" required by the rule in *Rylands v Fletcher*. It is my conclusion that the pleadings do not disclose a reasonable cause of action based on the rule in *Rylands v Fletcher*.[45]

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[41] *Ibid.*, para. 67.
[42] *Ibid.*, para. 113.
[43] *Agricultural Operations Act*, S.S. 1995, c. A-12. A deeper discussion of 'right to farm' legislation can be found in Phillipson, M., & Bowden, M.-A. (1999). Environmental assessment and agriculture: An ounce of prevention is worth a pound of manure. *Saskatchewan Law Review, 62*, 415-435.
[44] *Agricultural Operations Act*, S.S. 1995, c. A-12, ss. 3(1).
[45] *Supra* note 40, para. 97.

Finally, Justice Smith refused the plaintiffs' claim of trespass, arguing that they were unsuccessful in meeting the directness requirement articulated by Lord Denning in *Southport Corporation v. Esso Petroleum Inc.*:

> It is my conclusion that action in trespass does not lie against the defendants as the inventors and marketers of GM canola for the adventitious presence of GM canola in the crops and on the lands of organic farmers, for even a liberalised requirement...for direct interference cannot be met in the circumstances of this case.[46]

One element of the claims that Justice Smith did decide in favour of the plaintiffs, albeit reluctantly, was for a cause of action under the amended *Environmental Management and Protection Act,* 2002[47]:

> Given the literal wording of section 15 I am unable to say that it is plain and obvious that the plaintiffs' claim under this statute cannot succeed. This provision, so interpreted, would not require the plaintiffs to allege and prove that the "substance" at issue is inherently harmful or unsafe.[48]

Overall, this judgement, which rejects almost all the causes of action claimed by the plaintiffs, seriously calls into question the capacity for common law to provide a judicial remedy to the current asymmetry between rights and obligations in respect of genetically engineered organisms in this country.

> Perhaps more troubling, however, is the *combined* effect of *Schmeiser* and *Hoffman.* Monsanto can exert unprecedented levels of control over things it could not patent, whilst simultaneously being able to deny that it has any control *over the same product* in the context of the common law or statute. This is an unacceptable incongruity (Phillipson, 2005, p. 372).

It is precisely because of this seeming inability of common law to adapt to the new realities posed by biotechnology that a number of observers are beginning to advocate a *sui generis* legislative framework designed to respond to the challenges of genetic

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[46] *Ibid*, para. 133.
[47] S.S. 2002, c. E-10.21.
[48] *Supra* note 40, para. 168.

technologies (Phillipson, 2005). Yet as discussed previously, and not completely unexpectedly given its industry bias, the CBAC opposes such a solution, arguing instead that:

> In our view, Canadian law already adequately addresses issues of liability and compensation for damages through the common law of negligence and the civil law of obligations, which are based on principles of accountability and responsibility. Specific provisions for damages caused by products of biotechnology, patented or not, are not required (Canadian Biotechnology Advisory Committee, 2002b, p. 17).

As Terry Zakreski maintains in his memorandum of argument seeking leave to appeal the case at the Supreme Court of Canada, "[g]iven the ease at which the courts below swept aside the Applicants' claims, the CBAC's confidence in the ability of Canadian law to adequately address issues of liability and compensation appears to be misplaced. This legal state of affairs ought to be reviewed by this Court" (Zakreski, 2007, ¶ 28).

The Organic Agriculture Protection Fund sought leave to appeal Justice Smith's decision on May 25, 2005, believing that she not only engaged too closely with the factual controversy of the case when deciding whether to certify as a class action but that she also applied an overly strict interpretation of the requirements of the Act that would make it inordinately difficult for any group of people to ever be defined as a class ("Interview with Cathy Holtslander, Committee Member of the Organic Agriculture Protection Fund," 2007). As one legal observer points out:

> Refusing to certify a case as a class action has very serious consequences. The certification decision is not purely procedural, as the motions judge said it was; in fact, it has significant substantive effect. It prevents the attainment of the three goals of class actions: access to justice, judicial economy, and behavior modification in cases of widespread harm. Although technically the case can still go forward as an individual claim, the complexity and cost of arguing the scientific and economic issues mean access to justice would be out of reach of the individual farmer. In terms of behavior modification, even if each of the class members could successfully sue individually, the award would not be an aggregate one, and the message would not have the power of a collected action.

> If environmental cases are repeatedly refused certification, the potential threat of group action is reduced, leaving those who might inflict widespread harm undeterred (McLeod-Kilmurray, 2007, p. 197).

According to Cathy Holtslander, organic farmers are very clear that genetically engineered organisms and organic agriculture cannot coexist. She is very quick to reject the coexistence arguments advanced by the corporate gene giants, which include the notion of adventitious presence, a term coined by the biotechnology industry and one that was employed in the lower court's judgement. Holtslander interprets the use of such language in Justice Smith's decision as particularly offensive because it indicates the judge was using the language of the companies. Taking this rejection of the possibility of co-existence and adventitious presence to its logical conclusion, the ultimate goal is to compel the biotechnology companies to stop developing and marketing genetically engineered seeds and other agricultural products ("Interview with Cathy Holtslander, Committee Member of the Organic Agriculture Protection Fund," 2007).

Leave to appeal the lower court decision was granted on August 30, 2005 and the actual appeal hearing took place on December 11, 2006 before Mr. Justice S. J. Cameron, Madam Justice M. A. Gerwing, and Mr. Justice N. W. Sherstobitoff of the Saskatchewan Court of Appeal. In its decision from May 2, 2007, the Saskatchewan Court of Appeal dismissed the appeal, thus upholding the lower court's ruling that denied class certification. Cathy Holtslander considers this disappointing outcome to have been the result of the Court of Appeal's failure to consider any of the arguments presented by counsel for the Organic Agriculture Protection Fund. Instead, in its ruling the Court of Appeal, according to Holtslander, essentially re-itereates the lower court's ruling and sets an even worse precedent. Justice Cameron, who wrote the appeal court's majority decision, contends that the preclusion of awards of cost in *The Class Actions Act*[49] warrants a very high standard for establishing class certification in order to prevent unscrupulous plaintiffs from seeking class action certification as a pressure tactic to compel a company or an institution into a settlement,

> a settlement induced not by fear of being found to have engaged in any wrongdoing but by concern over the enormous cost associated with class action litigation. There is an obvious need to guard against such mischief in the interests of furthering, not distorting, the purposes of the *Act*, and of maintaining respect for, and confidence in, the class action regime.[50]

Holtslander believes this decision to be "a real affront to justice, because it is saying that we have to protect these poor corporations from all these uppity people who think that maybe corporations should be responsible. Those are my words, that's not our official position" ("Interview with Cathy Holtslander, Committee Member of the Organic Agriculture Protection Fund," 2007).

On August 1, 2007 the Organic Agriculture Protection Fund filed papers with the Supreme Court of Canada, seeking leave to appeal the May 2, 2007 decision of the Saskatchewan Court of Appeal. In his Memorandum of Argument, Organic Agriculture Protection Fund Counsel Terry Zakreski states:

> This case seeks to ask whether biotechnology companies incur responsibility when their patented genetically modified seed, pollen and plants infiltrate farmland, causing harm. While *Monsanto Canada Inc. v. Schmeiser* confirmed that these companies have significant exclusive rights to GMO seed and plants, the question remains whether they have any corresponding duties (Zakreski, 2007, ¶ 1).[51]

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[49] *Supra*, note 25.
[50] 2007 SKCA 47, para. 46.
[51] There is a growing literature among legal scholars contending that with the rights of private property come corresponding responsibilities and obligations. For example, see Singer, J. W. (2000). *Entitlement : The paradoxes of property.* New Haven, CT: Yale University Press.; and, Underkuffler, L. S. (2003). *The idea of property : Its meaning and power.* Oxford: Oxford University Press.

Unfortunately, on December 13, 2007 the Supreme Court of Canada dismissed without costs the application for leave to appeal. On April 16, 2008 Larry Hoffman and Dale Beaudoin announced their intention not to proceed with their individual claims against Monsanto and Bayer, while also noting that they and other organic farmers would continue fighting for the rights to farm free of genetically engineered organisms and to eat non-genetically engineered food. According to Beaudoin: "We are closing a chapter, but not the book. We will challenge Monsanto and Bayer for the liberty, freedom and right to grow GMO free crops. We want to be able to save and use our own seed" (n.a., 2008c, ¶ 6).

So while there are certainly environmental aspects to the fight being waged by Saskatchewan organic farmers against Monsanto, Bayer, and any other corporation that seeks to introduce genetically engineered crops into the province, the main thrust of their battle focuses on economic issues, asserting that even with regulatory approval these large transnationals must accept responsibility for the liability issues that attend genetically engineered crops. The NFU has similarly waded into the liability debate, arguing that the "federal government must compel companies which own patents on GM seeds or livestock to set up contingency funds to compensate for product liability and [must] legislate efficient and accessible mechanisms to enable liability claims to be effectively pursued" (National Farmers Union, n.d., art. 9). Organic farmers, having already suffered the loss of canola given that even the seed stocks are now contaminated, refuse to lose the right to grow any further major crops. For example, because it is now impossible to grow canola and still comply with organic standards, some major processors, such as Nature's Path, have had to take canola out of their process. They no longer use canola oil because they are unable to guarantee that it is free of genetically engineered organisms. This is also an aspect of criticism of Canada's regulatory system, which fails to address the potential economic impact of genetically engineered products on current producers. According to Arnold Taylor, the lawsuit has helped expand the clout of organic farmers by impressing upon agribusiness that until the liability issue is adequately resolved it will be almost impractical to introduce new genetically engineered products into the Canadian market, a fact lost on neither shareholders nor insurers ("Interview with Arnold Taylor, Chairperson of the Organic Agriculture Protection Fund and President of the Canadian Organic Growers Association," 2007).[52]

Percy Schmeiser also recently entered the GE contamination debate. In 2005, while preparing his fields for a mustard crop, Schmeiser found a number of Monsanto's Roundup Ready canola plants. After informing the company of these volunteer plants in September 2005, Monsanto dispatched a team of investigators to the Schmeiser farm where they confirmed that Roundup Ready canola was growing in his fields. Schmeiser, who had the plants professionally removed, demanded that Monsanto re-imburse him for the removal costs, contending that stray plants are pollution and that responsibility for remedying the situation remains with the polluter. Monsanto indicated its willingness to cover the costs ($660) of what it referred to as a "specific and local" event on condition that Schmeiser and his wife sign a document that forever releases Monsanto from any

[52] At the international level negotiations by the Working Group established under the United Nations Cartagena Protocol on Biosafety failed in March 2008 to reach an agreement to establish an international regime for liability and redress for damage caused by genetically engineered organisms. The Biosafety Protocol stipulates that such an international liability system should be agreed upon and concluded by 2008. The Working Group therefore took the decision to meet again in Bonn in early May 2008. The outcome of this meeting will be reported to Fourth Meeting of the Parties (MOP 4) to the Cartagena Protocol, which will also be meeting in Bonn from 12-16 May, 2008. Ultimately, however, it is unclear what, if any, implications an agreement on liability would have in this country since Canada, an opponent of the Biosafety Protocol since its original negotiation, is not a Party to the Protocol.

lawsuits associated with its products and forbids the grower from disclosing the terms of the settlement – which Schmeiser promptly refused. In his own words,

> No corporation should have the right to introduce GM seeds or plants into the environment and not be responsible for it. It doesn't matter if it was $600, or $600,000. It has now become a very important case, even though it is small, because if we win then it could cost Monsanto millions and millions of dollars across the world. It was almost unbelievable that Monsanto didn't pay, because it came out and admitted it was their GMO [genetically modified organism] on our property. But they said they would refuse to pay unless we signed a non-disclosure statement. No way would we ever give that away to a corporation (as cited in Adam, 2008).

Given Monsanto's intransigence Schmeiser initiated proceedings in small claims court to recover the removal costs. However, the lawsuit was settled out of court on March 19, 2008. Monsanto has agreed to pay all the clean-up costs of the Roundup Ready canola that contaminated Schmeiser's fields and it has dropped its demands that Schmeiser not disclose the settlement and that Monsanto cannot be sued again if further contamination occurs. Schmeiser, according to his website, believes this precedent-setting agreement ensures that farmers will be entitled to reimbursement when their fields become contaminated with volunteer Roundup Ready canola or any other unwanted genetically engineered plants. It will be interesting to determine what, if any, effects this admission by Monsanto will have for the legal struggles being waged by the Organic Agriculture Protection Fund.

8.4 The Struggle to Expand the Biotechnology Debate beyond the Confines of Science

Having examined some of the immediate points of conflict ignited by biotechnological development in Canada, we now turn to examine wider issues about the discursive framing of these controversies. We begin by contemplating the demands being articulated by critics involved in the biotechnology debate about the need to broaden its terms, and finish by outlining why a number of universal labourers refuse to participate in government consultation processes in respect of biotechnology issues.

As discussed in the previous chapter, the restriction of debate around biotechnology to issues of science only is a function of Canada's regulatory process, which simply does not permit the injection of ethical, political, or socio-economic considerations into the discussion. The only exceptions to this have come in the last few years, when farmers and commodity groups – newly informed by the personal financial implications of increasing global rejection of genetically engineered crops over the previous years - have objected to Monsanto's Roundup Ready wheat in Canada and genetically engineered rice in the United States. The NFU has long recognised that the control issues that stem from legal constructs around genetics and biotechnology such as gene patents, plant breeders' rights, and regulatory and legislative initiatives have really been detrimental to the economy of ordinary farmers and they are likely to be so in the future. The NFU is convinced that there has not been adequate research in terms of human health and broader environmental concerns, nor have the issues surrounding biotechnology been debated in the public forum, in part due to a lack of a reasonable supply of knowledge and research on either side of the debate. Instead, the biotechnology agenda, which has been greatly facilitated by the Canadian federal government, continues to be largely industrially promoted and dominated. Thus, although the debates about, for example, market harm, social concerns, and health concerns have yet to be sufficiently dealt with, Canadians are forced to live with the results of this technology. That having been said, the NFU does have members who use biotech crops; as an organisation it does not seek to control what its membership does. The important point for the NFU is that people be afforded the opportunity to participate in informed debate about whether or not to utilise these new biotechnologies. While such deliberation is certainly occurring within the NFU, it has yet to really emerge at a broader societal level ("Interview with Terry Boehm, Vice President, National Farmers Union," 2007).

Terry Boehm opines that a new ‘religion’ has developed around science, which has marginalised people to such an extent that where they might have been comfortable debating ethical and moral issues in the past without having a particular education in that field, that is no longer the case because the scientific community is now presenting itself as the “high priest of the truths who should be almost blindly trusted” ("Interview with Terry Boehm, Vice President, National Farmers Union," 2007). As Boehm points out, people have witnessed and experienced enough examples in the past of the detrimental results that can flow from science that “we should no longer be prepared to adhere to blind faith.” We need to overcome what Humphrey Jennings, a British documentary filmmaker and cultural critic, refers to as the “fatalism among the mass about present and possible future effects of science, and…[the] tendency to leave them alone as beyond the scope of the intervention of the common man” (as cited in Robins & Webster, 1999, p. 36). According to Boehm, the promoters of biotechnology have assiduously attempted to create a private good out of what was a once public good through legislative and other legal and technical constructs. The Canadian government has been actively promoting the development of biotechnology as an industrial sector for the last twenty years so it too has a vested interest in this project. The transnational corporations that dominate the biotechnology sector are interested in marketing and pushing this technoscience as fast as possible. Boehm believes that if court decisions would have been decided differently both in Canada and the United States, for example, in terms of gene patents and by extension control of the seed and the plant that results from that seed, there would be much less interest in advancing and marketing biotechnology as fast as possible. Boehm similarly believes that if liability issues, in terms of health and environmental concerns, were dealt with in a manner that protected agricultural producers and the environment, the development and promotion of biotechnology would no doubt slow significantly ("Interview with Terry Boehm, Vice President, National Farmers Union," 2007).

In its encounters with government regulators the NFU finds that the various departments and agencies myopically focus on regulatory definitions, which has the effect of containing the debate there and only there in terms of approval decisions. Any attempts to insert broader contextual questions are met with obdurate resistance on the part of government bureaucrats who, according to Boehm, quite frankly admit that they will not base any of their decisions on such concerns because their focus is on their regulatory definition. Even when regulators acknowledge that more extensive social and economic concerns might be quite valid, they still refuse to consider them ("Interview with Terry Boehm, Vice President, National Farmers Union," 2007). As Lucy Sharratt argues, the government and industry have worked together closely in constructing the regulatory process, which, in turn, has implications for what type of information about genetic engineering is required by the public regulatory review system. Both industry and government regulators remain steadfast in their attempts to ensure that the discourse around biotechnology is limited either to the science of these new technological innovations or to the claims that biotechnology and genetic engineering will contribute to economic growth ("Interview with Lucy Sharratt, Co-ordinator of the Canadian Biotechnology Action Network," 2007). Interview informant Dr. Eric Darier, like others, suggests that the Canadian government and its regulators deliberately focus on the issue of safety in order to silence debate on all the other concerns that emerge in respect of biotechnology. Darier is suspicious of institutions that concentrate inordinately on one aspect of an issue, arguing that such tactics are usually to compensate for something being neglected in another important area. So, according to Darier, when government and industry talk about safety or science-based regulation, when one scratches the surface it quickly becomes apparent that the discussion is, in fact, not science-based and that the issue often has relatively little to do with science ("Interview with Dr. Eric Darier, GE Campaigner, Greenpeace Canada," 2007). Darier's suspicion seems accurate when one considers the 2001 Royal Society of Canada Report on elements of precaution, as discussed previously, in which 14 top Canadian experts, many of whom work in biotechnology, all agreed that the current regulatory approach of 'substantial equivalence' is not science-based, and who also went on to bemoan the lack of independent review of data since any findings provided to government regulators in support of applications for product approval remain confidential. As the Royal Society Report pointedly remarks, there is nothing more anti-scientific than this (The Royal Society of Canada, 2001).

As a consequence of the emphasis on this type of informational content that tends not to be particularly relevant to citizens, farmers, and consumers, the public is left largely uninformed. In order to extend the terms of the debate in respect of biotechnology in this country, CBAN is trying to construct a type of dialogue about farming that makes sense to urban people, a discourse that gives people some sense of empowerment, not just as consumers but as citizens, as participants in democracy. CBAN views the urban rural connection as an important issue, but one that is not facilitated by government given the lack of political power enjoyed by farmers and the relatively low priority accorded the agricultural sector by the government. According to Sharratt, although federal agricultural policy in this country is weak, policy and investment in biotechnology is quite strong because it is perceived as a new form of high technology that will secure Canada's future economic prosperity. This inherent conflict is also part of the message that the CBAN seeks to disseminate among the public. Darier similarly believes that Canadian society must expand the discourse around biotechnology in order to avoid technological determinism and the technological imperative, which, as discussed in the preceding chapter, provides capital and government a convenient strategy for circumscribing social debate about the way biotechnology should be developed and deployed. Technology is not neutral. The perception of science and technology as asocial catalysts for progress independent of purposive human agency serves to obscure the social sphere from the design and development stages of technological innovation. Such an ostensibly objective ideal of scientific and technological development not only relegates the social implications of new technologies to the instances of their application, but also casts the social effects of such science and technology on society as secondary and contingent. Moreover, this type of discursive framing easily explains away negative social effects as unavoidable by-products of history's teleological march of progress that can be mitigated through the perspicacious application of the new technologies. Overall, this perspective, while admitting the presence of social priorities at the application stage, elides such concerns at the developmental stage, thus refusing alternative visions of science and technological development informed by broader social imperatives. Such a conception of scientific and technological development conceives of scientists and technologists as the discoverers of laws and processes immanent within an external and autonomous natural realm such that the social is subsumed under the natural. Progress putatively rooted in the natural order of a world that triumphs over historical and social particularities thus comes to be viewed as unassailable (Robins & Webster, 1999).

Canadians need to make collective decisions about what kinds of technology they want, at what cost, and for what purposes. Darier believes, however, there is no political space to conduct such debate within the existing political structure, aside from the formal ones such as the House of Commons. But even there this broader type of debate rarely happens, and certainly not in any depth, according to Darier. In part, this democratic deficit is one of the reasons that Greenpeace does not follow everything in Canada, and nothing in Ottawa because even in those few instances in which the public is consulted, such events are dismissed as insubstantial and insincere staged public relations exercises designed to ratify what has long since been agreed upon behind closed doors ("Interview with Dr. Eric Darier, GE Campaigner, Greenpeace Canada," 2007). Greenpeace is therefore very selective, choosing to participate only when it sees an opportunity to expose the issue and the consultation process in mainstream media and to the wider public. That, as Darier comments, is the sad reality in Canada today.

Although Greenpeace initially focussed its debate in terms of biodiversity and genetic engineering, it very quickly realised that it is not by accident that Monsanto, which controls the overwhelming majority of all genetically engineered products in the world, is a chemical company. Monsanto sells pesticides, herbicides, and genetically engineered seeds. In a way this recognition forced Greenpeace to enlarge the debate to admit issues about what kind of agriculture we want, what kind of food we want, who should control it, and so forth. So in Canada genetic engineering has become an issue that has permitted Greenpeace to open up a dialogical terrain to such wider agricultural concerns, particularly in Québec and British Columbia where there are strong organic sectors, which, has helped promote a greater awareness of biotechnology and genetic engineering over the last five years ("Interview with Dr. Eric Darier, GE Campaigner, Greenpeace Canada," 2007).

In order to expand the terms of public debate about biotechnology, Sharratt believes an essential first step is to legitimise people's instincts as to why they oppose a particular technology based on socio-economic factors that go beyond science-based discourse. By providing multi-faceted information, opposition movements can empower people to decide for themselves their positions on biotechnology and genetic engineering.

> It is vitally important not to underestimate the manipulation and misrepresentation that is taking place in a frantic, not to say hysterical, campaign to convince the public that we really love GE and will starve in a polluted environment without biotech. We ignore the deceitful, highly centralized and extremely well-funded character of the campaign at our peril (Kneen, 2000, ¶ 7).

By providing critical information, CBAN and other groups can help validate lay knowledge and legitimate the particular stance toward biotechnology adopted by the average person. While CBAN readily accepts the responsibility of equipping the public with sufficient and credible information, it also recognises the substantial challenge posed by such a task. This is so because genetic engineering affects differently people's lives and touches many diverse sectors of society. There thus emerges the very interesting and strategic question of how to communicate with such an assorted array of people. In part, this desideratum contributed to the choice made by CBAN to position 'Terminator Technology' as the focus for its first major campaign. CBAN also believes that this issue will help explain the impacts of genetic engineering on farming, as well as furnish a conduit that facilitates international solidarity among a variety of social groups and movements. Sharratt contends that CBAN's discourse on 'Terminator' is far stronger than that of the government, arguing that the current Canadian regulatory system, based almost exclusively on science, is obviously not adequate to deal with the full ambit of challenges posed by this new technology. The regulatory regime was not adequate to deal either with rBGH or genetically engineered wheat, which compelled the federal government to develop exit strategies in respect of these particular biotechnologies. According to Sharratt, to the extent that opposition movements such as CBAN succeed in injecting broader social, economic, political, health, and environmental dimensions into the biotechnology debate, this type of conflict will continue to confront and potentially stymy industry and government. Specific to the issue of 'Terminator Technology', CBAN believes that if it can sufficiently expand the discourse around this genetic technology among the general public to admit clear and strongly articulated economic and social justice concerns, then regulators' assertions about the safety of this technology will be unmasked as a wholly inadequate response to the concerns of Canadians. In part, the intransigence within the government against expanding the terms of the biotechnology debate beyond safety issues explains the unwillingness of a number of groups to engage in public consultations ("Interview with Devlin Kuyek," 2007; "Interview with Lucy Sharratt, Co-ordinator of the Canadian Biotechnology Action Network," 2007).

8.5 Critical Dismissal of CBAC Consultations

The Council of Canadians and other groups boycotted the public consultations organised by the CBAC on food biotechnology issues, accusing this governmental advisory body of not being interested in a true public consultation process.[53] As one observer charges, CBAC "consultations are designed to control public input and legitimate government decisions" (Sharratt, 2002, p. 41). In general, the CBAC project on the regulation of genetically engineered food is criticised for the way it framed the issue; *how to regulate* genetically engineered foods rather than a more fundamental discussion and debate about whether such food should be grown in the first place (Magnan, 2006). In a petition sent to the Government of Canada, 50 species-being movements justified their decision not to actively participate in public consultations in the following manner:

> We believe the [CBAC process] is fundamentally and importantly flawed and that NGO participation in the consultation could legitimate CBAC's wholly inadequate mandate and process and undermine demands for true democratic processes and widespread public consultation (as cited in Tansey, 2003, p. 62).

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[53] For a discussion about how exercises in public participation in public policy issues tend to be co-opted by powerful interests and that participation without decision power is meaningless, see Nelkin, D., & Pollak, M. (1979). Public participation in technological decisions: Reality or grand illusion? *Technology Review, 81*(August/September), 55-64. See also, Dickson, D. (1984). *The new politics of science*. New York: Pantheon. "The promise of technology assessment was that it would ensure a better balance of the costs and benefits of scientific and technological progress by allowing for more democratic participation in the selection of technical choices. Genuinely opening up the channels for such participation, however, would have required a substantial shift in control over decision-making away from private into public channels. This...was a step that neither the scientific, the corporate, nor the political establishment was willing to take" (Dickson, 1984, p. 259).

The case study of the CBAC carried out by André Magnan (2006) reinforces this major criticism.[54] Drawing on the work of Habermas, Magnan (2006) argues that debates about genetically engineered foods have been captured by 'manipulated publicity',[55] which, in turn, has resulted in a general lack of critical attention among the public in respect of biotechnology. Situating the context of public debate within the latest structural changes in capitalist society, Magnan (2006) demonstrates how the dual and contradictory role of regulator and promoter of biotechnology (an issue that the CBAC did problematise in its 2002 report) has rendered the Canadian state unable to assure the type of rational and critical debate Habermas envisions as necessary for the vitality of the public sphere.[56] Canada's commitment to global competitiveness is stymieing an open

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[54] Les Levidow (1999), in his study of agricultural biotechnology in Europe, articulates similar scepticism about public participation in biotechnology debates. Similar to arguments he has advanced in at least one other work (1981), he contends that public participation is usually left to a late stage in the development process when effective change based on social concerns is rendered exceedingly difficult. Instead, "[p]articipatory exercises help legitimize the neoliberal 'risk-benefit' framework, which offers a free consumer choice to buy 'safe' genetic fixes" (Levidow, 1999, p. 65). See, for example, Levidow, L. (1999). Democratizing technology - or technologizing democracy? Regulating agricultural biotechnology in Europe. In R. von Schomberg (Ed.), *Democratising technology: Theory and practice of deliberative technology policy* (pp. 51-69). Hengelo, Netherlands: International Centre for Human and Public Affairs.; and, Levidow, L., & Young, B. (1981). Introduction. In L. Levidow & B. Young (Eds.), *Science, technology and the labour process: Marxist studies* (Vol. I, pp. 1-7). Atlantic Highlands, NJ: Humanities Press.

[55] 'Manipulated publicity' is Habermas's term to indicate a type of public discourse whose purpose is less to promote reasoned debate than to garner uncritical support for a position developed by powerful interests from above.

[56] William Leiss (2001) suggests that this dual role represents a conflict of interest that erodes public confidence in government and regulatory systems. He argues that it is important to distinguish between risk management and risk issue management. The former is a science driven process while the latter is a social process. See, Leiss, W. (2001). *In the chamber of risks: Understanding risk controversies.* Montreal: McGill-Queen's University Press. For a critical appraisal of these two conflicting mandates, see also, Clark, E. A. (2002). *Government and GM.....for whom.....by whom?* Paper presented at the Association Canadienne Francaise pour l'Avancement des Sciences, Laval, QC. James Tansey (2003), following the suggestion of Macdonald, contends that the issue is rather one of conflicting obligations in that the federal government is tasked with promoting economic growth as well as safeguarding public health. See, for example, Tansey, J. (2003). *The prospects for governing biotechnology in Canada* (Electronic Working Papers Series Paper No. DEG 001). Vancouver: W. Maurice Young Centre for Applied Ethics, University of British Columbia. Similarly, the Institute on Governance opines that government credibility, which it sees as a major criterion in effectively dealing with biotechnology in Canada, is undermined by the government's dual role as promoter and regulator of this new technology. See, Boucher, L. J., Cashaback, D., Plumptre, T., & Simpson, A. (2002). *Linking in, linking out, linking up: Exploring the governance challenges of biotechnology.* Ottawa: Institute on Governance.

and critical public debate about biotechnology in this country as successive governments concentrate on promoting this industrial sector while paying only nominal lip service to demands for public enquiry into and oversight of these new technologies (Magnan, 2006). According to the Royal Society of Canada:

> Such concern with industry development, though understandable, highlights another aspect of the regulatory conflict. The conflict of interest involved in both promoting and regulating an industry or technology…is also a factor in the issue of maintaining the transparency, and therefore the scientific integrity, of the regulatory process. In effect, the public interest in a regulatory system that is "science based" – that meets scientific standards of objectivity, a major aspect of which is full openness to scientific peer review – is significantly compromised when that openness is negotiated away by regulators in exchange for cordial and supportive relationships with the industries being regulated (The Royal Society of Canada, 2001, pp. 213-214).[57]

As Magnan (2006, p. 48) contends, "[h]aving made biotechnology central to its development strategy, the state is limited in its ability to effectively respond to legitimate public concerns about the long-term implications of the technology." Herb Barbolet, an interview informant who also participated in early CBAC meetings, contends that in its initial constellation the CBAC contained a group of open-minded industry members who indicated that they would be quite willing to accept constraints on the biotechnology sector so long as they were clear and reasonable. Interestingly, it was government representatives who, according to Barbolet, dug in and asserted that industry constraints were infeasible ("Interview with Herb Barbolet, Founder of Farm Folk / City Folk," 2007). Very soon thereafter new staunchly pro-industry representatives were brought to the table, as well as a new chair, whose impartiality was suspect given her work as a

[57] The report by the Royal Society of Canada is also critical of the media campaign initiated by the Canadian Food Inspection Agency (a supplement it paid for in a 2000 edition of *Canadian Living*) to promote agricultural biotechnology and reduce public concerns about genetically engineered foods. "The more the regulatory agencies are, or are perceived to be, promoters of the technology the more they undermine public trust in their ability to regulate the technology in the public interest" (The Royal Society of Canada, 2001, p. 212).

business consultant. Additional personnel changes resulted in the inflow of a number of people who clearly recognised that their career interests would be ill served if they adopted a stance too critical of industry. A new and somewhat confrontational chair, Arnold Nymark, also exacerbated the increasingly poor working environment within the CBAC. The upshot of such changes was a membership iteration through which, as a number of other commentators point out, CBAC became an unabashed promoter of the biotechnology industry on behalf of the government that is no longer interested in balanced dialogue and debate ("Interview with Herb Barbolet, Founder of Farm Folk / City Folk," 2007). Another observer is even more critical in his assessment of the advisory functions of the CBAC in Canada:

> It is understood from the outset that the government and the advisory bodies share a common agenda. The advisory bodies, and the government itself, are only there to act out the roles of and make a few adjustment [sic] to a script that, in many ways, has already been decided upon behind closed doors (Kuyek, 2002, p. 75).

All groups organising against particular aspects of Canada's Biotechnology Strategy tend to dismiss public consultations with the CBAC. Lucy Sharratt, who also participated in some of the initial consultations held by CBAC, points out that this body committed some major errors in judgement from the outset of its consultation process. Sharratt accuses the CBAC of showing a "real ignorance and a real arrogance in its attempts to exclude certain critical perspectives from becoming members", instead preferring for membership those people who had previously proven to be vehement biotechnology industry proponents ("Interview with Lucy Sharratt, Co-ordinator of the Canadian Biotechnology Action Network," 2007).

The NFU, following the strategic decision amongst many other groups, similarly chose not to participate in CBAC consultations. At the time of the consultations the NFU actually lacked a well-developed policy on biotechnology. With regard to possible participation in future CBAC consultations, Terry Boehm articulates the concern that this is always a very difficult internal debate with two different schools of thought – one that you have to be at the table and the other that you are being co-opted when you are there. For the NFU the decision depends on the specific instance and analytically where it thinks it can do the best work to advance its fundamental goal of creating social and economic justice for family farmers. Though not the official position of the NFU, Boehm, hazarding a relatively educated guess, believes that the NFU would probably decline to participate given the behaviour of CBAC in the past and the kinds of positions that the NFU understands the CBAC will adopt. According to Boehm, not only have the terms of the debate been completely confined to what is called 'sound science', but the government and industry committee members in such fora tend to lay absolute claim to being the only ones to possess this 'sound science'. So from the perspective of the NFU, CBAC would not be a very successful place to participate ("Interview with Terry Boehm, Vice President, National Farmers Union," 2007).

When asked about CBAC and possible participation in future consultations, Cathy Holtslander is unequivocal in her response: "CBAC is a completely illegitimate organisation. It's set up as an apologist for the industry, so we wouldn't participate in that." She goes on to add that "even participating in CFIA is a bit problematic because you know, are they sincere? Is this just a matter of going through the motions so they can say they did consultations before they bring in their plans anyways? And it's always a problem. It's something NGOs are always struggling with. Inside versus outside strategy" ("Interview with Cathy Holtslander, Committee Member of the Organic Agriculture Protection Fund," 2007).

Given Devlin Kuyek's overall dismissal of the CBAC, it is not surprising that he rejects participation in any of its consultations. He does not, however, completely dismiss consultation processes in general, and has, in fact, encouraged involvement in the recent seed variety registration public consultations conducted by the CFIA. Nonetheless, he points out that engaging with government processes can be very difficult and time-consuming. Involvement in these processes demands a lot of energy and resources and oftentimes in the end so little of what an organisation actually said is ultimately included in the policy. As Kuyek states, the government offers no resources to support people's participation and because organisations have limited time and resources available, what a group can effect is usually pretty narrow, especially since things often are decided elsewhere, irrespective of the opinions put forward during the consultation process ("Interview with Devlin Kuyek," 2007).

GE Alert, including Dr. E. Ann Clark, submitted position papers to the first few CBAC calls for public consultation, and Clark was nominated to be on the CBAC. Eventually Clark and others from GE Alert realised that the CBAC was paying no attention at all to what they were writing, and that membership on CBAC was for the handpicked few, after which they declined to respond to further CBAC calls for proposals ("Interview with Dr. E. Ann Clark, Associate Professor in the Department of Plant Agriculture at the University of Guelph," 2007).

8.6 Media Coverage Around Biotechnology

> The biotech stuff, the real biotech stuff appears on the business pages as stock promotion so it's quite clear that the corporate concentration includes interlocking directorships between the banks, the media, the pharmaceuticals, the petrochemical companies, the food companies. So it's not a surprise that the media are not covering it or if they are covering it they are covering it as page one news that there may possibly be a breakthrough that in the future could possibly help .1% of the population with a hangnail, but the side effects might be death and then the stock price goes up so everybody's happy ("Interview with Herb Barbolet, Founder of Farm Folk / City Folk," 2007).

As Barbolet unequivocally articulates, part of the difficulty in expanding the debate around biotechnology is that the media tend to take their cues from industry and government, framing their reportage about this science and its attendant technologies almost solely in terms of food safety implications, which contributes to an individualised consumption discourse. Devlin Kuyek contends that one of the major informational challenges confronting species-being movements is the need to rigorously analyse the information being circulated by government and industry in order to reveal its unsophisticated and often misleading content. Thus, one of the issues critics of biotechnology encountered from the beginning, and continue to do so, is the need to put into perspective some of the propaganda disseminated by the biotech industry. As Kuyek points out, much of this industry hype is based on upcoming innovations that are yet to appear, so a lot of activist work early on was trying to shatter such myths. This task is complicated by weak media coverage that fails to engage in any real analysis or investigative work, which Kuyek finds particularly shocking given the emphasis the Canadian government places on positioning this country at the forefront of biotechnology and genetic engineering. According to Kuyek, the media fail to question the dominant economic model and instead have uncritically bought into the idea about the dominance and importance of the 'knowledge economy', including Canada's need to become a leader in technological innovation. The superficial incantations of the dominant mantra about progress through innovation invoked by the media and government have circumvented any critical, public dialogue and debate about what all of this means and the broader implications that this science and these technologies pose for society and humanity. As Kuyek laments, it is easier to stick to the current catchphrases without engaging in deeper analysis, a trend that seems to be quite prevalent in the media. Kuyek believes it is not lack of popular interest that is motivating media silence. Journalists who want to take up this issue can draw on a wide pool of knowledgeable people working on biotechnology issues, so it is not difficult to put together a balanced story. The few journalists who have done this have produced good reportage but it is very sparse. Instead, pace Kuyek, the Canadian media, or at least most of it, blindly accept and repeat the message that the biotech industry puts out. This type of 'sound bite' reporting completely fails to enhance people's perspectives ("Interview with Devlin Kuyek," 2007).

Some of the very minimal critical reportage of biotechnology issues in this country has tried to alert the public to the oblique links between the biotechnology industry, government, and a number of ostensibly independent non-governmental organisations (Stewart, 2002). Particularly with respect to the latter groups, Stewart (2002) shows that a number of them that are dependent upon government funding tend to adopt positions that mirror and conform to the communication strategies pursued by the government-industry nexus. For example, the Dieticians of Canada, which describes itself as "the nationwide voice of over 5,000 dieticians, bringing trusted information on food and nutrition to Canadians", published a pamphlet in May 2002 entitled "Modern

Food Biotechnology: Principles and Perspectives" (Stewart, 2002). Although the Dieticians of Canada claims that the information brochure is a neutral educational resource to help its members comprehend the issues involved with genetically engineered foods, the project was funded by the Council for Biotechnology Information, an industry group dedicated to persuading the public about the benefits of biotechnology. The Dieticians of Canada chose not to disclose this funding source when announcing the release of the pamphlet, which was written by Dr. Milly Ryan-Harshman, who was previously employed by Monsanto. Dr. Ryan-Harshman has also been involved in the promotion of genetically engineered foods, including efforts to lobby the Chilean government (on a CIDA-funded initiative) to loosen its regulation of genetically engineered foods (Stewart, 2002).

8.6.1 CBAN

Given the relative youth of CBAN as an organisation, it has not yet actively developed a media strategy. However, Sharratt does recount her experience with the media while she was employed as the coordinator for the Sierra Club of Canada's Safe Food, Sustainable Agriculture Campaign, which launched the first movement against genetic engineering in Canada. According to Sharratt, at that time the success of media attention was more a function of the novelty of the issue and the kind of inherent controversy that the media could envision developing around biotechnology. Today, however, the media has largely lost interest in biotechnology issues. For example, there were two incidents of experimental genetically engineered pigs that had not been approved for human consumption but nonetheless accidentally infiltrated the animal food chain and subsequently the human food system. This occurred on two separate occasions, by two companies conducting two different experimental procedures, yet the mainstream media never picked up the information ("Interview with Lucy Sharratt, Co-ordinator of the Canadian Biotechnology Action Network," 2007). Sharratt goes on to bemoan the fact that when media coverage is forthcoming, it is heavily biased in favour of industry. For example, the 2002 counter conference to the industry Biotech conference in Toronto that year organised a picnic that fed 2000 people an organic lunch. Yet the reporter from the *Globe and Mail* who covered the event, and with whom the organisers of the counter conference spoke, elected to pick up only on the press releases posted by industry participants at the industry conference. In one small article, the accompanying picture was of people at the industry conference with their industry filled bags and a caption along the lines of, 'people pick up swag at industry conference'. Meanwhile, David Suzuki, Vandana Shiva and other prominent activists were speaking at a nearby local park to some 2000 people in a festival-like atmosphere, of which the paper made no mention, let alone offer a picture. For Sharratt this represented a blatant example of the almost total blind eye the media turn toward the issues being brought forward by critics of biotechnology ("Interview with Lucy Sharratt, Co-ordinator of the Canadian Biotechnology Action Network," 2007).

Perhaps more importantly, even when there is wider media attention to biotechnology issues, coverage tends to assume an alarmist tone that distorts the critical message opposition movements are attempting to publicise. In a conversation with David Suzuki, Sharratt asked him why we have this problem with critical media coverage in Canada and his response was that the climate for science in Canada is not such that we can really effectively look for allies, and if we should happen to find them they usually tend to be marginalised. It is only those scientists who support innovation that have a voice while those groups and individuals who articulate an anti-GM message are chastised as being anti-science and therefore relegated to the periphery. In terms of moving forward, Sharratt is unsure how relevant media strategies will be to the work of CBAN. It depends on the strategy: if the goal is to attempt to move an issue politically so that Members of Parliament pay attention, CBAN will be compelled to try and attract media attention. If the objective is to communicate to people about the benefits of purchasing local food in support of farmers and to convince them to write letters to their Member of Parliament, CBAN can accomplish such things by employing a variety of public channels outside of the media, who, in any event, are normally not particularly interested in taking up such stories ("Interview with Lucy Sharratt, Co-ordinator of the Canadian Biotechnology Action Network," 2007).

One of the major dynamics of CBAN is that it functions as a coalition designed to take up campaigns in a very active manner. The diversity of its membership gives rise to a variety of information needs that CBAN provides to its members who can then employ that information in mobilising their networks. Contingent upon funding, CBAN is planning to develop a fact sheet on genetic engineering that is framed inside a fact sheet on farming for urban consumers. CBAN will also produce a genetic engineering fact sheet for farmers. Thus CBAN strives to provide a variety of informational materials suited to the needs of its particular members. The plan is to disseminate the information to urban consumers via farmers markets and events in urban communities and to bring the information about genetic engineering to farmers via rural fairs and farm shows. At the moment, and again given the relative youth and resource constraints of CBAN, the strategy developed for connecting with various publics in respect of Terminator technology is not yet very diverse ("Interview with Lucy Sharratt, Co-ordinator of the Canadian Biotechnology Action Network," 2007).

Brewster Kneen contends that it is extremely arduous to entice the media into covering stories about the loss of biodiversity or the expansion of corporate control over agriculture and the food system given the ownership structure and resulting bias of the media. In fact, Kneen believes that it has been an unwritten policy among both the corporate and government sectors to restrict public discussion of biotechnology issues to their very minimum, a policy facilitated by a media environment that devotes little critical coverage to the topic. Nonetheless, Kneen also observes a much broader and quiet discussion about biotechnology, one that the corporations continually try to counter with all their hype about feeding the world because they know that public opinion is becoming more and more suspect about the confluence of corporate control and pesticides, agrotoxins, genetic engineering, etc.. People, according to Kneen, are becoming more and more suspicious, reading the labels much more, and genetic engineering is one of the things that elicits growing mistrust. People are also beginning to ask whether genetically engineered products are even necessary. Yet the corporations keep talking; a Monsanto press release about its acquisition of Delta and Pine Land Company states that part of motivation behind the purchase is to improve food quality. Kneen sums up the feelings of many critics of the biotechnology sector:

> Well I'd like to see an example and so would a lot of other people. What is it you're talking about? What have you delivered? Because people know there hasn't been any quality and this is where it gets interesting because people's realisation about fresh foods and nutrition and long distance travel and then you

> get the energy equation put into it, I think the public now, and that's reflected in Loblaws and other stores in terms of their organics and their refusal to push GE. You know what they're doing is responding to the public.... I think the challenge is and it's difficult with this stupid government we have now that doesn't care about what the public thinks, what possibilities are there to affect policy. It may well be that the courts are one way of doing this, particularly given some of the interesting decisions they're making. But that's a long and expensive way to go. Myself I wish we had the population of India and we did do some direct action. Put 5000 people in the field ("Interview with Brewster Kneen, Co-Publisher of *The Ram's Horn*," 2007).

8.6.2 Greenpeace

From its creation in 1971, Greenpeace has tasked itself with trying to be effective in terms of communicating to the wider public. According to Josh Brandon, media coverage is not at all balanced – industry proponents receive ten times the coverage that Greenpeace manages to get in the papers. The only way that Greenpeace succeeds in getting its message out is to develop clever ways of framing the issues or being creative in the way that it provides visuals. Brandon recounts an incident with a journalist from the *Vancouver Sun*, who told him that the newspaper would not cover protests against genetic engineering and that if Greenpeace wanted to get any information or its message published it would only happen if Greenpeace had scientific data. Some time later Greenpeace did come out with a scientific report that was peer-reviewed and that appeared in a scientific journal about the toxicity of GE corn. Greenpeace sent out a press release and Brandon also contacted that same reporter from the *Vancouver Sun*, only to be told that while the article might be peer-reviewed the newspaper wants information from B.C. scientists. According to Brandon, Greenpeace does get coverage in the national press but the B.C. press tends to be very regional in its coverage ("Interview with Josh Brandon, GE Campaigner, Greenpeace Canada," 2007).[58]

Given the nature of the commercial media and the way they operate, Greenpeace has long recognised what it considers the strategic necessity of engaging in very visible tactics that will help ensure its underlying message is carried through those media that are being widely viewed by the public. As Darier points out, it is not by accident that Greenpeace undertakes spectacular actions; it is not just because Greenpeace likes doing them but rather that they actually fulfill a purpose. Such actions, which are outlined in detail on its website, help ensure that Greenpeace and its message make their way into the news in order to inform the general public and to move the issue politically. Thus, unlike some other groups that discount the value of the media, Greenpeace uses the media and the existing means of communication as a major component of its strategy to reach people on a large scale. Greenpeace is well aware of the fact that once a species-being movement does something it loses control of the message. For this reason Greenpeace ensures that it develops and implements a very clear communication strategy to try to prevent side issues from emerging. It is impossible to communicate everything so Greenpeace must be clear, it must have one message, it must have one target, it must adhere to the basic rules of communication that apply in the context of the current media environment that is dominated and very often constrained by heavy corporate control. As Darier readily admits, it is not an exact science and it changes over time, but for the most

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[58] Observers of media coverage of biotechnology issues in the United States similarly note that news accounts tend to be local rather than national. They propose this is the case because most controversies surrounding biotechnology emerge at the local level. See, Hornig Priest, S., & Ten Eyck, T. (2004). Transborder information, local resistance and the spiral of silence: Biotechnology and public opinion in the United States. In S. Braman (Ed.), *Biotechnology and communication: The meta-technologies of information* (pp. 175-196). Mahwah, NJ: Lawrence Erlbaum Associates.

part he believes that their message is reflected fairly accurately in the media ("Interview with Dr. Eric Darier, GE Campaigner, Greenpeace Canada," 2007).

8.6.3 National Farmers Union

Although the messages the NFU tries to communicate through the media appear relatively intact, the weight given to its positions versus others such as industry or science is often quite small, particularly in the mainstream media, when they do pick something up on an NFU issue. Aside from very sparse coverage, the national papers, according to Boehm, tend to lack thoroughness and depth in their reporting. The NFU has more success in convincing media at the local level, such as little community weeklies, to take its press releases and print them verbatim. More pernicious is the latest trend in the media environment of press release services, which Boehm likens to marketing food products in the supermarket where you pay for shelf space. Now organisations can pay a not insignificant fee to ensure that the media will pick up their releases before other random releases that come in. This practice really limits the media coverage the NFU can achieve. As Boehm states, "whether media is going to admit it or not that this is taking place, these fee for dissemination services are there. Freedom of the press for a price. I guess it wouldn't really be freedom of the press, it's probably more freedom of public access to the press for a price" ("Interview with Terry Boehm, Vice President, National Farmers Union," 2007). Overall, Boehm believes that the pressures in the media are creating a situation that impinges on the level and quality of journalistic research being conducted for stories.

8.6.4 Organic Agriculture Protection Fund

Arnold Taylor believes that the media, for the most part, fail to understand the mindset around organic farmers. Moreover, he recognises that companies like Monsanto and Bayer are the largest advertisers for small newspapers like the *Western Producer*, which has implications for the amount and depth of coverage that organic farming issues will receive. For example, at the initial certification court case in Saskatoon, a *Western Producer* reporter, despite statements to the contrary, failed to attend. When Taylor called the editor of the paper about this he was told that because it was 'merely' a procedural motion the newspaper decided not to attend; instead it would wait until the trial, though Taylor remains sceptical of coverage even then. As he says, "You know, I'm not naïve enough to think that Monsanto doesn't say to the owner of the *Western Producer* that, you know you're advertising is at stake here. Let's just kind of downplay this. That's all they have to do and you know it's millions or thousands or whatever" ("Interview with Arnold Taylor, Chairperson of the Organic Agriculture Protection Fund and President of the Canadian Organic Growers Association," 2007). Cathy Holtslander, who has been working on issues of agriculture and genetic engineering for over ten years, believes that the media in Saskatchewan, which is considered to be big biotech country, tend to avoid stories that might have a negative connotation for the biotechnology sector and instead focus on the more glamorous breakthrough-type stories ("Interview with Cathy Holtslander, Committee Member of the Organic Agriculture Protection Fund," 2007).

8.7 Accounting for Resistance to Biotechnology

As the material presented in this chapter attests, biotechnology continues to elicit a range of resistance in this country around issues of control by transnational corporations over seeds, the lack of rigorous scientific study of some of the claims being made by industry and other biotechnology proponents, uncritical media championing of biotechnology, the heavy industry slant of government consultation bodies, particularly the now defunct CBAC, the lack of funding for public good agricultural research, and the enclosing effect that high levels of patentability are having on biological resources and information. Most contestation tends to revolve around the genetic engineering of agricultural crops and food and has involved a number of prominent organisations, including: the Council of Canadians[59], the National Farmers Union, the Action Group on Erosion, Technology and Concentration (ETC - formerly Rural Advancement Foundation International), Greenpeace, and the Canadian Biotechnology Action Network.

Capital speaks of the radical and putative beneficial transformations that biotechnology will have for humanity yet it continues to lobby hard for keeping the regulatory *status quo*, arguing in this context that nothing has changed and that such new products are substantially equivalent to what has come before. The inherent paradoxical nature of such corporate promotion appears lost on both industry and Canadian regulators. Moreover, the way regulators define genetic technology as a science issue restricts debate by excluding a range of other points of view and interests. It also affects the way science (at least corporate science) itself is defined and practiced – veils of secrecy invoked by capital through trade secrets and proprietary information place

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[59] As discussed above the Council is no longer actively involved in biotechnology issues, although it continues to lend support to various specific campaigns being organised by Greenpeace and CBAN.

important data needed by government reviewers beyond their purview and certainly beyond the reach of the public and other scientists, thus violating the basic tenet of openness in the scientific enterprise. All of this similarly has decisive implications for stakeholder consultations given that such bodies are struck based on an underlying framework that uncritically accepts the purported benefits of biotechnology and promotes industry development as a powerful economic goal. The result is a consultation process that limits the type of information it solicits and thus the scope of ideas it develops, which ultimately serves to limit policy options. This was particularly the case with the CBAC, which all groups critical of biotechnology development in this country reject as a body stacked with industry proponents that functioned according to a pre-ordained mandate designed to champion this technoscience as one of the new motors for Canadian economic growth. As one Canadian expert advises, "[t]he regulator who follows a strategy of co-management is unlikely to be sensitive to non-industry interests and constituencies, and unlikely to find its interpretation of the public interest supported among the wider public" (Salter, 1993).

While all these species-being movements are mobilising against particular biotechnologies that are embodied in physical, organic artefacts, most are struggling simultaneously to broaden the deliberately circumscribed public discourse being constructed by transnational corporations, the government, and the media that endeavour to frame this technoscience strictly in terms of safety in order to avoid challenge on broader social, economic, environmental, political, and ethical grounds. There is a recognition among these oppositional groups that resistance against the capital inspired enclosure of the biological commons needs to be strategically linked to the information issues implicated in biotechnology and its attendant enclosure of both the biological and knowledge commons. These species-being movements realise that biological knowledge long cultivated in common is being appropriated by capital through such mechanisms as intellectual property rights, which facilitate the creation of biotechnologies that impinge upon the terrestrial commons. Efforts by capital to assert control over seeds through a combination of genetic engineering and intellectual property rights demonstrate the degree to which these natural endowments cultivated over millennia through the common efforts of universal labour need to be recognised as physical artefacts that simultaneously contain an abundance of biological information. We need to recall the distinction between the intangible nature of the information content and the physical container that holds and delivers that content. The public good nature of the information contained in seeds that is non-exclusive and non-rivalrous in consumption is being appropriated by capital through patents on their material form, which transforms them and the knowledge they embody into private goods subject to exclusive ownership and use.[60] Biotechnology provides capital a new means by which to extend and consolidate its control over the social factory.

In order to respond to such enclosure, many of the species-being movements contesting capitalist-controlled biotechnology realise that the success of their actions hinges upon the ability to inject broader knowledge issues into the public debate surrounding this science and its attendant technologies. Contemporary biotech activists are seeking to actively address what they perceive to be a corporate constructed public information gap in respect of biotechnology. Many of these species-being movements

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[60] Stanley Besen was one of the first commentators to articulate the distinction between the physical container and its information content. See, for example, Besen, S. (1987). *New technologies and intellectual property: An economic analysis.* Santa Monica, CA: Rand Corporation.

are engaging in information dissemination campaigns designed to correct misinformation and to offer more balanced and rigorous analysis of biotech issues that advance beyond the typical one-sided, celebratory content propagated by biotechnology proponents in industry and government. Adhering to the admonition of one critical observer, Canadian activists agree that we should "... not buy into living in a world of narrow choices and debates that are framed by corporations and constrained by the images projected by well-paid public relations firms" (Teitel, 2000, p. 162).

A fundamental element of the information production and dissemination efforts these groups have tasked themselves with is an analysis of the corporate control of biotechnology and agriculture more broadly. Many Canadian activists ardently believe that science, technology, society, and humans interact and co-evolve in a holistic social context, meaning that science and technology are not neutral but instead are influenced in their development and application by particular social interests and biases. In concrete, historical terms universal labour, in a manner congruent with attempts to actualise our species-being, proposes that biotechnology, a technoscience that has far-reaching implications for a range of complex organic life forms, including humanity and the environment, is being successively appropriated by capital in its efforts to expand accumulation and profit; what we referred to in the previous chapter as a contemporary form of biopower designed to facilitate new processes of primitive accumulation at the molecular level of existence. Capital, with the aid of the state, is co-opting the emancipatory capacity of science and technology, which is one of the reasons why it is so important to reconstruct science in a manner that admits the interaction between it and technology, capital, and society. Accepting such co-construction legitimises attempts to inject social values and justice, democracy, and ecology into debates about the development and application of science and technology. Situating science and technology in a socio-political context conditioned by both power interests and struggle opens up science to external and political readings that firmly reject the myth that science develops according to its own internal dynamics based on objective truth and reason. That is, it leads the way to an epistemology of science that construes science as a politically contested social construct that can be emancipated from capitalist control and domination to be diverted in service of fulfilling the ethical, social, political, and ecological demands of humanity (Best & Kellner, 2001). "This is not a protest against technology, in other words, but against the political powers that decide without the representation of those primarily affected to privatize the common, enriching the few and exacerbating the misery of the many" (Hardt & Negri, 2004, p. 283).

If these issues represent in broad strokes the nature of resistance to biotechnology in this country, the following elements of our proposed theoretical model would appear to offer the most promise in conceptually situating the current contested developmental trajectory of this technoscience.

8.7.1 Assessing Resistance to Biotechnology through the Lens of our 'Recombinant' Neo-Marxist Biopolitical Framework

We begin by recalling the correlation we discussed above between biopower and real subsumption, through which the object of capitalist appropriation has metamorphosed from 'labour power' to 'life itself'. As Hardt and Negri (2000, pp. 364-365) inform us

> The powers of production are in fact today entirely biopolitical; in other words, they run throughout and constitute directly not only production but also the entire realm of reproduction. Biopower becomes an agent of production when the entire context of reproduction is subsumed under capitalist rule, that is, when reproduction and the vital relationships that constitute it themselves become directly productive. Biopower is another name for the real subsumption of society under capital, and both are synonymous with the globalized productive order.

Wealth creation in the global economy, pace Hardt and Negri (2000), increasingly relies on biopolitical production, on the production of social life itself, in which the economic, the political, and the cultural increasingly overlap and intertwine with one another. Biopolitical production, aside from yielding physical goods, produces information, cooperation, and communication that can be appropriated by the multitude in order to transform socially destructive forms of biopower.

> In the context of immaterial and biopolitical production, however, this traditional demand [reappropriation of the means of production] takes on a new guise. The multitude not only uses machines to produce, but also becomes increasingly machinic itself, as the means of production are increasingly integrated into the minds and bodies of the multitude. In this context reappropriation means having free access to and control over knowledge, information, communication, and affects – because these are some of the primary means of biopolitical production (Hardt & Negri, 2000, pp. 406-407).

Moreover, because biopolitical production has moved beyond the immediate point of production to appropriate increasing areas of social existence, there simultaneously emerge myriad points of resistance at which the multitude can re-appropriate the positive aspects of production and communication in autonomous struggle against capital.

Specific to resistance, we remind the reader that unlike the critical theorists of the Frankfurt School, who concentrated almost exclusively on the negative implications of capital's attempts to commodify increasing areas of social existence, autonomist theorists recognise that each push by capital to expand the social factory simultaneously exposes new potential sites of struggle against this inexorable drive by capital. Capital's efforts at decomposing labour actually render labour more abstract and social, which, in turn, opens the possibility of the independence of universal labour that capital cannot completely recuperate. From this newly emerging constitution of labour springs a new subject and active agent of social change (Surin, 1996). Nonetheless, *autonomia* is also cognisant of the fact that these struggles involve a variety of different agents (e.g. factory workers, students, housewives), many of whom articulate demands specific to their own interests and who are organised along different lines. Autonomists recognise that the industrial proletariat – Marx's traditional 'mole' – can no longer be privileged as the sole force to subvert capitalist social relations. As Bologna points out, the 'changing class composition' means that this task now falls to a collection of different subjects, to a new "tribe of moles" – a loose and highly mobile tribe of students, part-time workers, members of the underground economy, and other social subjects who have erected fleeting and continuously changing autonomous zones of social life that have thrown the mass-worker organisation of the social factory into disarray (Bologna, 1979). Thus, while autonomists maintain the traditional Marxist distinction that emphasises the fundamental dissimilarity between labour and capital, they also realise that labour is not a monolithic class – which provides further compelling evidence in support of the concept of 'universal labour' and its comprehension of different strata of labour that avoids the overdetermination contained in the concepts of the 'multitude' and 'immaterial labour'.

Instead, universal labour allows us to comprehend the struggle being waged against biotechnology by farmers and other agricultural workers, who, as a class category often receive short shrift in Marxist and autonomist analysis (with, as discussed previously, the notable exception of Harry Cleaver (1982)). Though Hardt and Negri

(2004) contend that agricultural production processes will come to resemble those found in other industrial sectors such that separate categories of labour will disappear as production becomes biopolitical, the emphasis they place on the informational and affective aspects of immaterial labour tends to privilege the high-skilled, cybertariat in a way that provokes a degree of internal tension in their theory, thus serving to mitigate its usefulness in comprehending resistance to biotechnology in this country. It was in order to avoid this problem that we adopted the alternative formulation of anti-biotechnological struggles as waged by a 'universal labour' force that includes a wide variety of types and sites of work—'material,' 'immaterial' and 'immiserated.' This dual recognition about the nature of labour (antagonistic to capital and mutable) enables autonomist Marxism to abandon vanguardist versions of struggle in place of anticapitalist collaboration among an array of universal labourers committed to a circulation of struggles.

Similarly, as discussed in chapter three, *autonomia* posits that the conflict between labour and capital represents a fundamental asymmetry that holds the promise of true autonomy for the former. Because capital relies on expanding commodification and wage labour for its growth, it needs labour. The same does not hold for labour, which can potentially renounce its wage contract with capital in favour of alternative means of organising its creative energies (Cleaver, 1979; Holloway, 1995; Negri, 1984, 2005; Tronti, 1979b). The autonomist perspective thus posits that unilateral domination by capital is structurally impossible given capital's dependence on universal labour. Subversion and revolution are considered to be viable and permanent possibilities that reside at the very centre of the system, as opposed to the cultural fringes, as Marcuse asserts, or with those actors forced outside of the wage-labour nexus by the effects of crisis (Moulier, 2005). The same emphasis on liberatory potential also informs autonomist analysis of technology. To be sure, autonomist Marxism does recognise and assess the capitalist appropriation of technology and science as mechanisms in service of its agenda of social control.

> The raw material on which the very high level of productivity of the socialized worker is based – the only raw material we know of which is suitable for an intellectual and inventive labour force – *is science, communication and the communication of knowledge*. Capital must, therefore, appropriate communication. It must expropriate the community and superimpose itself on the autonomous capability of managing knowledge, reducing such knowledge to a mere means of every undertaking of the socialized worker. This is *the form which expropriation takes in advanced capitalism* – or rather, in the world economy of the socialized worker (Negri, 2005, p. 116).

However, autonomist analysis goes beyond this perspective to consider the effects that class struggle exercises on vitiating capital's attempted stranglehold on technology. Both waged and unwaged labour are exhorted to actively engage with capital over the latter's attempt to dominate technological innovation. One strategy is to simply refuse such control, even by sabotage if necessary.[61] A more active tactic recommends that universal labour harness its own skills and abilities to usurp capital's control over technology. This approach is made possible because, as discussed previously, capital's attempts to exert technological control over universal labour necessarily require that at least part of the

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[61] Perhaps the most infamous example of such an exhortation came from Negri in his writing about industrial struggles in Italy in the 1970s that took place in a number of factories, especially in the huge Fiat plants. See, for example, Negri, A. (1979). Domination and sabotage. In Red Notes Collective (Ed.), *Working class autonomy and the crisis* (pp. 93-138). London, GB: Red Notes. Kevin Robins and Frank Webster (1985) discuss sabotage in terms of it being a means to destructure the totality of capital. It implies the development of the productive forces of the proletariat in the fervent belief that the subordination of society to the logic of capital can be transcended. See, for example, Robins, K., & Webster, F. (1985). Luddism: New technology and the critique of political economy. In L. Levidow & B. Young (Eds.), *Science, technology and the labour process: Marxist studies* (Vol. II, pp. 9-48). Atlantic Highlands, NJ: Humanities Press. This rendering of sabotage resonates more closely with Negri's later use of the term, in which he asserts that sabotage, in the era of the socialized worker and its attendant emphasis on new ways of thinking and collective action, includes a creative and innovative function. Destruction becomes as important as innovation, in both productive and political terms. "*Sabotage is innovation*" (Negri, 2005, p. 79, emphasis in original). See, in particular, Negri, A. (2005). *The politics of subversion: A manifesto for the twenty-first century* (J. Newell, Trans. 2nd ed.). Cambridge, UK: Polity Press.

workforce is reskilled and equipped with the necessary levels of scientific and technological literacy to manipulate the new technological innovations implemented by capital. Viewed from this perspective, technology need not be rejected out of hand for embodying the dominative logic of capital.[62] Instead, the autonomist recognition that technological innovation is, in part, a response to active universal labour resistance against capital opens the analysis to the role that this conflictual logic exercises on the development of technology. As Panzieri (1980, p. 61) contends,

> the subversive strength of the working class, its revolutionary capacity, appears (potentially) strongest precisely at capitalism's 'development points', where the crushing preponderance of constant capital over living labour, together with the rationality embodied in the former, immediately faces the working class with the question of its political enslavement.

Dyer-Witheford (1999, p. 72) aptly sums up the benefit of this perspective:

> Instead of understanding Marx's "negative" and "positive" visions of machine use in a linear, before-and-after progression – with the same machines that were repressive before communism becoming magically emancipatory afterward – autonomist analysis allows us to reconceive the process of deconstructing and reconstructing technologies as itself part of the movement of the struggle against capitalism.

Autonomist analysis was certainly on the mark in respect of information and communication technologies, as demonstrated by the multiple sites of resistance to capital that have been opened up over the last two decades or so through the active efforts by universal labour to subvert these new means of communication in support of their own autonomous projects. For example, digitalisation, which provides part of the technical infrastructure necessary for capital to expand its commodification drive, also furnishes

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[62] Robins and Webster (*op. cit.*) also discuss the role of technology in expanding the social factory and bringing workers further under the control of capital. In this context they outline the need to rehabilitate the concept of Luddism as part of a broader strategy by which the working class can appropriate and reconstitute technology toward alternative social relations and values. "Rather than accept the social factory geared to labour discipline, social struggles need to contest and inform what counts as 'technological progress'" (Robins & Webster, 1985, p. 38).

the channels within which different sectors of universal labour can come together and develop strategic alliances. Dyer-Witheford (1999, p. 131) speaks of "the other globalization" in recognition of the ability of countermovements around the world to co-opt global capital's means of communication to reconstruct themselves and help in their resistance struggles. The *Constituent imagination* anthology similarly offers a variety of works that elucidate the importance of information and communication technologies for social movements in their struggles against capital (Shukaitis & Graeber, 2007). Harry Cleaver (1994, 1999), in his discussions of the creation of an "electronic fabric of struggle", also provides us with an analysis of the subversive potential afforded social movements through the active use of digital communication technologies. For example, the Chiapas uprising was facilitated by the ability of those involved to alert the world to their plight and to build alliances with other movements around the globe through the use of information and communication technologies (Cleaver, 1994, 1999). Indeed, the reappropriation of digital media by various activists has today become a theme and topic of discussion that goes well beyond autonomist Marxism. As noted above, Benkler (2006) outlines in explicit detail the multiple alternative and 'Indymedia' projects that have blossomed in direct response to the increased proprietary control over social information being exerted by capital.

But as appealing as is the potential for liberation through cycles of struggle and the subversion of capitalist-controlled technology by universal labour, the empirical evidence in Canada thus far provides a somewhat mixed picture in that capitalist appropriation has yet to engender any significant technological reappropriation by universal labour. Recombinant DNA technology certainly became one of the vehicles developed by capital in its restructuring efforts of the 1980s that responded to worker mobilisation and the remnants of the broader economic downturn that began in the mid-1970s. The rapid development of biotechnology that began in the 1980s coincided with the rise of neoliberalism[63] and its attendant agenda of deregulation and privatisation. Moreover, biotechnology, particularly in the United States (and in Canada by the 1990s, as demonstrated by the CBS), assumed the mantle of industrial revitaliser. Biotechnology came to be viewed as the new industrial sector that would provide export opportunities to compensate for the growing foreign penetration of domestic markets (Krimsky, 1991; Wright, 1998). But as a number of observers note, biotechnology research after World War II was driven predominantly by public sector investment. Its current appropriation by private interests is, therefore in fact, a misappropriation (read enclosure) of the broad societal cooperation (read commons) responsible for initiating and expanding this branch of scientific research and development; an enclosure that is substantially mystified by the anaemic and largely corporate dominated discourse constructed around biotechnology (Dickson, 1984; King, 1997; Kloppenburg, 1988a). Canadian critics of capitalist controlled biotechnology realise that neoliberal governance ultimately strives to restrict the social space in which we can question and effectively debate those norms and value practices accepted by capital. Instead, neoliberalism functions to normalise the universality of market norms and values such that commons as

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[63] Neoliberalism traces its conceptual roots to the late 1930s when it emerged as a relatively obscure school of thought opposed to communism, socialism, and all forms of government intervention in the economy that went beyond providing protection for private property and market institutions. By the 1940s a number of influential scholars, including Friedrich von Hayek, Ludwig von Mises, and Milton Friedman, began actively engaging with this theory, although it remained beyond conventional economics until the financial crises of the 1970s discredited then mainstream Keynesianism and demand-side economics. For deeper discussions of neoliberalism, see, for example, De Angelis, M. (2007). *The beginning of history: Value struggles and global capital*. London: Pluto.; and, Harvey, D. (2003). *The new imperialism*. Oxford: Oxford University Press.

the foundation for the reproduction of livelihoods and communities are discounted in favour of markets in which the only common basis is the disciplinary competition that governs individual interaction. Once internalised the disciplinary market functions as a baseline against which actions, including those that oppose market values, are judged, and in the case of the latter, brought to heel by the discipline and control of the market. Thus, biotechnology, as an increasingly important form of production, corresponds to what Heller (2001, p. 406) terms the *organic*[64] phase of capitalism: "a phase in which capital targets the reproductive mechanisms of cultural and biological life as loci for intensified production and commodification." Clearly capital's efforts to appropriate biotechnology have achieved a not insignificant amount of success.

What has yet to occur is a radical reappropriation of biotechnology by universal labour similar to that seen in respect of digital communication technologies. We submit that the still fairly complicated nature of biotechnology has rendered it impervious to subversion by species-being movements in their opposition to capital. That having been said, if we consider the historical development of information and communication technologies, including that of the Internet, we realise that the widespread reappropriation by universal labour of these technologies occurred only once they had matured technically. That is, it was only once these digital communication technologies became easier to use and relatively ubiquitous in society that they could be deployed by universal labour in its struggle against capital. While we have yet to reach the point where biotechnologies for the masses are realistic, the biotech industry is certainly intent on developing economies of scale that would make things like genetic testing kits affordable

[64] This differs from Marx's application of the term that considers the organic composition of capital to be the ratio of living labour (workers) to dead labour (machinery).

to the average person. Perhaps in a decade or two we will be at a point where biotechnologies have become so user friendly and omnipresent that a reappropriation by universal labour will be possible.

Our own position on such a prospect is, however, rather equivocal. Given the prodigious implications genetic engineering poses for human health and the environment, that is for our species-being, we remain uncertain whether it would be prudent for biotechnology to become a weapon in our arsenal against capital. In any event, the majority of current species-being movements in this country have adopted a tack that refuses biotechnology. We qualify our statement because not all those interviewed reject biotechnology out of hand. What does, however, unify all is their opposition to capitalist control of biotechnology and its practical applications. This is also consonant with the underlying source of contention found among those species-being movements seeking to recuperate control over information and communication technologies in a bottom-up approach. Whether in the realm of the communicational or biological, universal labour shares a common goal of demanding that these emerging technologies, with their potential to impact and transform our species-being, be subject to democratic control from below in a manner that might yield a more equitable distribution of their attendant benefits and disadvantages than is currently the case under capitalist control.

Given our own position in academia we propose to conclude the chapter with an interrogation of some of the struggles around biotechnology being waged in the context of the burgeoning linkages between capital and institutions of higher education.

8.8 Biotechnology and the Academy

According to Industry Canada, from the beginning of this century most of the core Canadian biotechnology companies (defined as companies for which biotechnology is the principal activity and that conduct biotechnology R&D) have been spin-offs based on discoveries made in Canadian universities, research hospitals, and government laboratories (Industry Canada, 2005). One critical observer of this situation aptly sums up this trend and some of the arguments presented previously in the literature review chapter:

> [T]he appearance of a new academic type: the professor-entrepreneur who uses his academic affiliation as a launching pad for lucrative ventures...[with a] tendency to privatise revenues and socialise expenses (through the use of university administrative resources as well as "free" student labour) (Warde, 2001, ¶ 11).

Some of the literature attributes the growth in spin-off companies to a growing perception that equity ownership, though requiring greater administrative burden, is a more efficient vehicle for securing long-term income streams for universities than is the case with royalty payments from patents and licencing arrangements (Etzkowitz et al., 1998a; Loeppky, 2005). Between 1997 and 2000 the National Research Council Canada (NRC), a tax-funded federal research agency, had spun off more than 20 biotechnology companies from its five biotechnology laboratories,[65] and a 1998 Statistics Canada survey indicated that Canadian universities established 90 biotechnology companies (Industry Canada, 2000). Between 1998 and 2003 the NRC applied for 340 patents, of which 123 had issued by 2004. Over this same period the NRC signed 43 licence agreements with

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[65] This group includes the NRC Plant Biotechnology Institute in Saskatoon, the NRC Institute for Marine Biosciences in Halifax, the NRC Institute for Biological Sciences in Ottawa (biopharmaceutical research), the NRC Biotechnology Research Institute in Montreal (biopharmaceutical research), and the NRC Institute for Biodiagnostics in Winnipeg.

various companies to transfer its research and consequent technologies to the marketplace (Government of Canada, 2004). The Canadian Institutes of Health Research (CIHR) is also active in moving research from universities and research hospitals to the marketplace through such programmes as its Proof of Principle. Similarly, the Natural Sciences and Engineering Research Council (NSERC), the federal granting agency that funds research in the natural sciences and engineering, has recently developed I2I (Idea to Innovation). This programme helps speed up technology transfer from universities, or what is tellingly referred to as the pre-competitive stage, to Canadian companies. Finally, the Intellectual Property Management programme, which is jointly administered by CIHR, NSERC, and the Social Sciences and Humanities Research Council (SSHRC), aids universities and hospitals in developing and exploiting their intellectual property portfolios (Government of Canada, 2004). Such strategies are bearing fruit for governments and universities; according to a report by the Association of University Technology Managers commercialisation at Canadian universities and hospitals in fiscal year 2005 (latest available data) was at the highest level ever seen: 1,423 inventions were disclosed to technology transfer offices as compared to 1,307 in fiscal year 2004, which represents an 8.9% increase and 685 new patent applications were filed by 36 institutions, as compared to 572 by 34 institutions in 2004 (an increase of almost 20%). The report goes on to predict steady growth in the number of new patent applications over the next five years (Bostrom, Bruce, & Flanigan, 2007). As one commentator on the contemporary position of the university in society stated before his untimely death, "…the University is becoming a transnational bureaucratic corporation, either tied to transnational instances of government such as the European Union or functioning independently, by analogy with a transnational corporation" (Readings, 1996, p. 3). Leah Lievrouw (2004, p. 146) is even more direct in her assessment of the situation in respect of biotechnological research: "If, as Nelkin, Zuckerman, and others claim, the gaps between science and the market were narrowing in the 1980s, it can be argued that in biotechnology today they have effectively disappeared."

It is in this context that scientific researchers critical of biotechnology are finding it increasingly difficult to secure grant money, a concern that has also been raised by the Royal Society of Canada: "In relation to food biotechnology, it is arguable that such a refocusing of the public research agenda makes it more difficult to find funds for research aimed at the critique or evaluation of GMO technology or scientific researchers with the independence and objectivity to carry it out" (The Royal Society of Canada, 2001, p. 217). According to Lucy Sharratt university scientists are finding it increasingly difficult to offer critiques of biotechnology without attracting the pejorative label of being non-scientific. The long established consensus among industry and government regulators that it is not legitimate to talk about non-scientific issues in respect of biotechnology is achieving a similarly strong foothold in the academy ("Interview with Lucy Sharratt, Co-ordinator of the Canadian Biotechnology Action Network," 2007). This section of the chapter examines the treatment that two prominent academic critics (one of whom we have already introduced, Dr. E. Ann Clark, and the second, Ian Mauro, a doctoral candidate at the University of Manitoba and co-producer of the film *Seeds of change*) of agricultural biotechnology have experienced in the hallowed halls of academe.

One well-known person who has experience with the repercussions for voicing critical concern in respect of biotechnology is Dr. E. Ann Clark, Associate Professor in the Department of Plant Agriculture at the University of Guelph. Over the last decade her financing has been curtailed significantly and she has been relocated from her original laboratory to make room for biotechnology researchers. Dr. Clark speaks of her dismay at the constant refrain heard from regulators and defenders of biotechnology about 'science-based' decision making, when, in fact, there is very little science in the decision making process. When technology (not science) leads, the driving motivation is commercial success, which results in an array of predictable and adverse potential outcomes. As she point out, Monsanto and others have made a concerted effort to buy up all of the seed companies on the planet, which affords such companies the freedom to decide which varieties to carry, which ones to fit with their patented genes (or not), and how much seed of each variety to produce and make available to farmers. But as Clark reminds us, the only thing that is genetically engineered in such seed varieties is that single trait (or two or more in the case of stacked varieties), while all of the remaining tens of thousands of genes in a given variety are the result of conventional plant breeding. So, in order to access the latest and greatest plant breeding innovation in yield, maturity, disease resistance, quality etc., agricultural producers are compelled to purchase a genetically engineered variety if a company chooses to produce that variety only when fitted with its genetically engineered gene. This, according to Clark, is just one example of what happens when technology leads. Another is the near absence of interest in funding research that considers the possible adverse effects of genetic engineering. “After all, why would someone who benefits from the sale of the technology allow or encourage scientific risk assessment? They would not” ("Interview with Dr. E. Ann Clark, Associate Professor in the Department of Plant Agriculture at the University of

Guelph," 2007). This sentiment is echoed by interview respondent Dr. Rene Van Acker, Professor and Departmental Chair of the Department of Plant Agriculture at the University of Guelph, who maintains that rigorous, long-term research studies into the effects of genetic engineering are not being conducted due to a lack of sufficient funding. Moreover, the technology developers are not bound to cooperate in such studies and those who do want to cooperate might not have access to the necessary technology because it is proprietary ("Interview with Dr. Rene Van Acker, Professor and Departmental Chair of the Department of Plant Agriculture at the University of Guelph," 2007). Conversely, according to Clark, if science led technology, then at least some of these potential risks would be identified and studied, giving regulators a more balanced information portfolio if they actually wanted to safeguard the public interest ("Interview with Dr. E. Ann Clark, Associate Professor in the Department of Plant Agriculture at the University of Guelph," 2007).

Following from the technological imperative that is fuelling biotechnology in this country, Clark believes that genetically engineered products have been released prematurely, with inadequate to negligible risk assessment research. This, according to her, is not to say that there is anything intrinsically harmful about genetic engineering. There is simply not sufficient evidence to say that, but then neither is there sufficient evidence to claim the converse. Absence of evidence is not evidence of absence. As Clark contends, "the Canadian government is gambling that nothing will go wrong, and is covering their ass by denying mandatory labelling. This makes for a nation-wide experiment with one treatment and no control, and all the evidence on safety coming from those seeking regulatory approval for their products" ("Interview with Dr. E. Ann

Clark, Associate Professor in the Department of Plant Agriculture at the University of Guelph," 2007). Genetically engineered solutions are being promoted without due regard to the 'precautionary principle'. Very little is known about risks, which should in itself urge caution. No consideration is given to alternative means of achieving the same end through such things as weed management substitutes for glyphosate resistance. Consumers are being obliged to absorb the potential risks without the option of saying no. This, according to Clark, is achieved in Canada by denying mandatory labelling, and is done internationally by forcing nations to buy the products we want to sell them (e.g. doing an end-run around the restrictions of the Biosafety Protocol and using the WTO to override the European Union moratorium on the approval of genetically engineered food crops). Clark laments that, in effect, risk is being externalised involuntarily in a shameless and heedless fashion in a process facilitated by our own government ("Interview with Dr. E. Ann Clark, Associate Professor in the Department of Plant Agriculture at the University of Guelph," 2007).

Clark goes on to add that an academic who writes an article critical of some aspect of genetic engineering runs the very real risk of being subjected to personal attack, innuendo, and defamation – but those leading the charge seldom attempt to respond in any way to the critical substantive arguments. "Or they dredge up some specious results from an industry-funded lobby group or a hack-for-hire to rebut the points" ("Interview with Dr. E. Ann Clark, Associate Professor in the Department of Plant Agriculture at the University of Guelph," 2007). That having been said, critical analyses are being published now, rather than just rejected out of hand. One of Clark's recent papers on environmental risks of GM Crops in *Euphytica* (which was vigorously challenged by reviewers but ultimately published) has resulted in more reprint requests than any of her other papers. Whether it has any impact at all on industry or institutional thinking remains dubious. "As Guy Cook argues in his book, *Genetically modified language*, the values driving biotechnology proponents are not going to change, no matter how compelling the scientific arguments. It is a faith-based argument that receives the same response as asserting that the Pope is not Catholic" ("Interview with Dr. E. Ann Clark, Associate Professor in the Department of Plant Agriculture at the University of Guelph," 2007).

Dr. Clark hosts a confidential listserv (GE Alert[66]) that connects Canadian scientists concerned with biotechnology issues. The group is unfunded, wholly volunteer, and mobilises primarily by writing papers, position papers, and popular press articles. Dr. Clark also helps the Council of Canadians, Greenpeace, and similar groups when asked for information, a conference talk, or other form of support. When Clark presented her first GE Alert paper at a press conference in Ottawa, the then Dean of the Ontario Agricultural College at the University of Guelph, Rob MacLaughlin, stated publicly in a *Toronto Star* interview that Clark had acted unethically in speaking out on something other than her area of expertise, which is pasture and grazing management. As a result, Clark was branded as being unethical in the national press for a few weeks. The Dean's comments, which were at variance with academic freedom, created a rather large uproar within the academy. On sabbatical at the time, Clark received a substantial outpouring of academic support for her right to say things as she saw them – even by those who disagreed with what she was saying. In the end Dean MacLaughlin was

[66] GE Alert is an independent group of scientists, academics and agricultural professionals committed to informing Canadians about the implications of agricultural genetic engineering. Members have no ties to the life science industry and are therefore free of potential conflicts of interest.

sanctioned by Senate and Clark let the matter drop. MacLaughlin, however, did not. He subsequently tried to close down her confidential listserv, but again she was firmly within her rights as an academic so the Dean was forced to back down. However, her laboratory was expropriated while she was away on sabbatical, with her technician slated to move into a former seed storage room that had been heavily fumigated with toxic chemicals for 20 years. Clark strenuously objected and her lab assistant was moved into another, much smaller lab after her return from sabbatical. Aside from being verbally insulted by department chairs and faculty colleagues in public debates and in Internet postings, her research funding has dried up almost entirely, though, as she points out, she is not alone in that regard. Today it is exceedingly difficult to secure access to research funding, including public funds, unless the proposed research has the potential to deliver results that are easily commercialised. Clark also contends that when one is perceived as a loose cannon, one is excluded from key committees, plumb appointments, and research collaborations. Given such a contentious environment Clark has chosen to take early retirement within about three years ("Interview with Dr. E. Ann Clark, Associate Professor in the Department of Plant Agriculture at the University of Guelph," 2007).

According to Clark, she has more media attention than she wants or needs, mostly because she is one of the few people who will speak openly on some issues. She does not depend on corporations for funding since she would rather do without than do what they want, so she runs no risk of withdrawal of funding if she criticises them. Conversely, most of her colleagues are hostage to their funding sources. People who help her with her talks or who review her papers will not speak publicly. Even in GE Alert, most members are wholly anonymous in order to avoid retribution. Clark adds that there are only about ten academics willing to be known publicly and most of them are retired, which leaves her and a very few people like her, such as Dr. Elisabeth Abergel at York University and Dr. Ralph Martin at the Nova Scotia Agricultural College, who are sufficiently knowledgeable about the issue and willing to speak publicly ("Interview with Dr. E. Ann Clark, Associate Professor in the Department of Plant Agriculture at the University of Guelph," 2007).

Another prominent battle over academic freedom in respect of research critical of biotechnology was waged recently at the University of Manitoba. In 2000 the university concluded a $7 million deal with Monsanto to lease the company a building on campus that would be transformed into a Crop Technology Centre. The ten-year lease was negotiated at the request of the federal Department of Agriculture and was concluded without debate or input from members of the university community. More dramatically, the university, which clearly has strong ties with Monsanto, stalled the release of the documentary film, *Seeds of change*, for over three years. This film, which is part of doctoral work conducted by Ian Mauro and his dissertation supervisor, Dr. Stéphane McLachlan, examines the impact of and controversies surrounding the introduction of genetically engineered seeds on the Canadian Prairies. As Mauro makes clear, his research adopts an interdisciplinary approach rooted in the experiential knowledge of farmers that strives to elucidate the ecological, cultural, and socio-economic impact of genetically engineered crops, as experienced from farmers' perspectives ("Interview with Ian Mauro, Doctoral Candidate and Co-Producer of *Seeds of Change*," 2007).

As Mauro explains, he received funding from both the Social Sciences and Humanities Research Council and Agriculture Canada Manitoba Rural Adaptation

Council to complete the film. In both funding proposals, Mauro and McLachlan stated explicitly that they planned to use any grants from these agencies to create farmer-focused documentaries designed to communicate the issues they were exploring around genetically engineered agriculture. Because Mauro is committed to participant action research, he and McLachlan worked actively with farmers to construct the film in a manner that would be relevant to farmers and that would help facilitate community agency and community capacity building. The project was thus developed to research and learn about what was happening in respect of genetic engineering on the Canadian Prairies in a manner that not only built these communities into the project, but also immediately contributed back to them as a way to create goodwill. Mauro and LcLachlan started the project in 2002. Specifically, the film deals with genetically engineered canola and genetically engineered wheat in a way that addresses all of the prominent issues surrounding genetically engineered crops, with particular emphasis on all of the implications these biotechnologies pose for farmers ("Interview with Ian Mauro, Doctoral Candidate and Co-Producer of *Seeds of Change*," 2007).

Immediately upon commencing the project, Dr. MacLachlan, in his capacity as dissertation supervisor, began engaging with the university administration in order to ascertain the procedures surrounding video production, including a discussion of intellectual property rights with respect to video and how they might differ from other academic work products. According to Mauro, the University of Manitoba was initially equivocal, unable to offer any definitive pronouncements since the production of a film or a research video was a first at the university. Despite some of these open questions, Mauro began collecting his data and had completed the majority of his interviews by the end of summer 2002, including with such prominent personalities as Percy Schmeiser, Vandana Shiva, and David Suzuki. Final production and scoring of the film was nearing completion toward early January 2003. During the autumn of 2002 discussions with the university around intellectual property continued, although things began to become more complicated. A private company had been located that was prepared to invest $35,000 to finance the distribution of the film. According to Mauro, the success in attracting private investment generated excitement for the project among university administrators, given their emphasis on securing corporate funding. This, coupled with the currency of the film at a time when opposition to the introduction of Monsanto's genetically engineered wheat into Canadian fields was growing, resulted in a very supportive stance toward the research from the University of Manitoba, at least initially. As Mauro explains, the university could not believe that this project about biotechnology and farmers was attracting this kind of money and attention ("Interview with Ian Mauro, Doctoral Candidate and Co-Producer of *Seeds of Change*," 2007).

As part of his action research methodology, Mauro returned to the farmers he had interviewed to screen the film with them in their homes to guarantee that all respondents were satisfied with the way the film had been constructed. That is, Mauro took pains to ensure that the film was participatory, that it was created with the farmers, and that the farmers signed off on the final message. By late 2002 the Director of Research Services at the University of Manitoba entered into dialogue with the distribution company executive and eventually a distribution deal was signed between the university and this company. As the project neared completion, Mauro and McLachlan screened the film for the university administration, including the university lawyer and the Director of

Research Services. According to Mauro, it was at that moment that the discourse between him and McLachlan, as researchers, and the University of Manitoba changed. As mentioned previously, the film deals with the benefits of biotechnology and it also deals with the risks. The farmers that Mauro interviewed voiced significant concerns about Roundup Ready Wheat. They indicated substantial apprehension about the trajectory of biotechnology as a project being executed on the Canadian prairies. Moreover, many interviewees expressed their discontent and, at some level, their explicit dissatisfaction with the aggressive tactics Monsanto was employing around Roundup Ready Wheat, as well as the company's enforcement of its intellectual property rights and corresponding treatment of Percy Schmeiser ("Interview with Ian Mauro, Doctoral Candidate and Co-Producer of *Seeds of Change*," 2007).

The university administrators saw the film and, according to Mauro, they were afraid of it and the anti-corporate message that came out of it; a message that, of course, emanated from the respondents and not from Mauro and McLachlan. At this point university administrators articulated their concern about being sued by the biotechnology industry and thus began erecting roadblocks to stymie the release of the film. Mauro and McLachlan pointed out that the film is a research product and that because the tenets of academic freedom dictate that research is supposed to be unhindered, the film should be released. The University of Manitoba refused. What ensued was a series of prolonged negotiations with university administrators and university lawyers. Realising that the university lawyer was not negotiating on their behalf, Mauro and McLachlan demanded that the university retain a separate lawyer on their behalf, which it did. Over the course of the next year and a half Mauro and McLachlan, with the aid of their lawyer, tried to secure the release of the film. In the face of the university's fears about insurance and an apparent incapacity to insure itself against a lawsuit, Mauro's and McLachlan's lawyer, who is an entertainment lawyer, recommended that a way around the intransigence of the university would be to purchase errors and omissions (E&O) insurance – something that is common practice among documentary film-making. Mauro and McLachlan thus found themselves compelled by the university to steer the project along the route of intellectual property rights and into control, whereby every person in the film had to sign off and release their image to the University of Manitoba. Mauro therefore went back to the film participants and asked each interviewee to sign a specific waiver that included the film's title, the amount of minutes that person appeared in the film, and the details about the potential liabilities surrounding the film. With the exception of Vandana Shiva, who refused to sign off on it because she believes neither in intellectual property rights nor in the need to sign a piece of paper in the Western colonial tradition that exchanges intellectual property rights,[67] all participants signed the insurance waiver ("Interview with Ian Mauro, Doctoral Candidate and Co-Producer of *Seeds of Change*," 2007).

Having obtained all the waivers and completed the necessary application, Mauro and McLachlan submitted the package to an E&O insurance company. The company offered to provide insurance, explaining that although not a high risk, there did exist nonetheless the potential that people could be sued. Based on the calculated risk, the insurance company committed to underwriting a policy for a premium of approximately $3000 per year over three years. In the case of a lawsuit, the policy outlined a $10,000 rider, which would increase to $50,000 if Monsanto initiated the lawsuit. While this may

[67] Shiva argued that her verbal guarantee that she wanted to participate in the project should be sufficient – a guarantee that she made on film.

appear to be a large sum of money, it should be kept in mind that the film cost about $120,000 in total to make. For about $10,000 the film could be insured but the negotiations with the university remained deadlocked ("Interview with Ian Mauro, Doctoral Candidate and Co-Producer of *Seeds of Change*;" 2007).

The university, continuing to articulate its fear of being sued, then developed the position, after almost two years of negotiations, that it was no longer interested in purchasing E&O insurance. As Mauro explains, this period was an extremely stressful time for both him as a graduate student and his supervisor, McLachlan, who did not have tenure at this point in his career. Both felt very vulnerable. Adding to this was a claim made by some within the university administration that Mauro and McLachlan had not properly adhered to the guidelines for ethics approval. This was a completely spurious claim that was readily refuted, but it does indicate the degree of harassment to which these researchers were subjected. Refusing insurance, the University of Manitoba then proceeded to claim that the film was not research and that it had been created independently of the university. As a result, so argued the university, it could not support the film. Given this new university position, Mauro and McLachlan found themselves entering into negotiations with the Vice President of Research for the university about whether or not their film was research ("Interview with Ian Mauro, Doctoral Candidate and Co-Producer of *Seeds of Change*," 2007).

As might be imagined, this changed the whole dynamic of negotiations, with Mauro and McLachlan having to justify what they were doing. First the university was completely supportive, then obstructionist, and then suddenly revisionist, completely rewriting the history of the film's development, claiming it was no longer a university project. The university attempted to justify this latest claim through reference to the private investor, arguing that such outside involvement meant the project was independent. Yet as outlined above, it was actually the University of Manitoba that signed the deal with the distribution company, a fact clearly evident from the documentation surrounding the distribution agreement. At the same time, the Director of Research Services, with whom Mauro and McLachlan had been working, and the only person from the university that understood the history of the project, disappeared. Mauro and McLachlan were thus forced to negotiate with various vice presidents of the university, most of whom had very little knowledge about either the project or the state of negotiations up to that point. In fact, the main points made explicit to these people were that the research project is accompanied by a potentially huge liability and that the film is actually not even university research ("Interview with Ian Mauro, Doctoral Candidate and Co-Producer of *Seeds of Change*," 2007).

The University of Manitoba then proceeded to reverse its position about the film not being a university project and invoked an outdated and little-used clause in the collective agreement that provides the university with a 50% ownership stake in teaching videos. As Mauro argues, this film is a research project, a creative piece; it is the equivalent of a book in video form. In no way is it a teaching video. Yet the university claimed 50% ownership and refused to release it unless Mauro and McLachlan would do exactly as it said. There were three main things the university wanted: the first, and most egregious, according to Mauro, was that he and McLachlan would have to personally indemnify the University of Manitoba against any lawsuits. Second, Mauro and McLachlan would not be permitted to use their university affiliations when disseminating the film. Third, they would only be allowed to distribute and use the film for educational purposes. The University of Manitoba did not want the film screened in movie theatres. As might be expected, both Mauro and McLachlan were extremely upset when they heard the university's terms for release of the film. For both, the situation smacked of extortion ("Interview with Ian Mauro, Doctoral Candidate and Co-Producer of *Seeds of Change*," 2007).

At this point in early 2005, Mauro and McLachlan approached the Canadian Association of University Teachers (CAUT). Jim Turk, the Executive Director of the CAUT at the time, after having examined all of the material surrounding the film, pointed out that Mauro and McLachlan were engaged in one of the biggest fights over intellectual freedom in the country at the time. Turk encouraged them to build a campaign against the University of Manitoba, which they began in the spring of 2005. In complete parallel to all of this, Mauro, while browsing the Monsanto Canada website to see if it contained any information about one of the recent decisions in the Organic Agriculture Protection Fund case, read about a new corporate partnership between the University of Manitoba and Monsanto, through which Monsanto relocated its Canadian corporate headquarters to the University of Manitoba Smart Park. Moreover, the public relations director who signed the announcement on the Monsanto webpage was the person once in charge of research services at the University of Manitoba; the same person Mauro and McLachlan had been dealing with from the beginning and who had disappeared halfway through the negotiations. It turns out that this person had been promoted to being an Associate Vice President and President of Smart Park. It was during his tenure in these positions that he then landed a position with Monsanto. According to Mauro, he played both sides of the fence, actively suppressing what Mauro and McLachlan were doing, and as soon as the time became ripe he courted Monsanto and landed its Canadian corporate headquarters at the University of Manitoba. It was at this point that Mauro realised he and McLachlan had been sold out by their university in a violation of every tenet of academic freedom that also betrayed the prairie history on which the university had been built ("Interview with Ian Mauro, Doctoral Candidate and Co-Producer of *Seeds of Change*," 2007).

Consequently, Mauro and McLachlan made the decision to take their fight public and see it through right to the end. Mauro went back out into the farm community to communicate to its members what was happening, and, according to him, all of these farmers said "let's do this, let's get this thing out" ("Interview with Ian Mauro, Doctoral Candidate and Co-Producer of *Seeds of Change*," 2007). A number of them actually helped to develop the campaign. With the help of the CAUT Mauro and McLachlan launched their 'free the film' campaign. The issue also attracted media coverage and commentary that portrayed the fight in 'David versus Goliath' terms, i.e. powerless graduate student versus the giant university apparatus. With the help of the CAUT, a number of student organisations, and a variety of farmer organisations, the film was toured across Canada over the following year. In the interim, Mauro has distributed thousands of DVD copies of the film all over the country, and he makes it available for free download over the Internet. As of late summer 2007, the associated website (http://www.seedsofchangefilm.org/) has received over 300,000 unique web hits and the video had been downloaded over a thousand times from the site ("Interview with Ian Mauro, Doctoral Candidate and Co-Producer of *Seeds of Change*," 2007).

Although the University of Manitoba has never admitted it, one is left to wonder to what degree the critical nature of the film, particularly its treatment of Monsanto, played a role in the decision taken by the university administration to try and suppress the film through actions that blatantly trounced the tenets of academic freedom.

8.8.1 Accounting for Academia/Industry Relationships

> As was the factory, so now is the university. Where once the factory was a paradigmatic site of struggle between workers and capitalists, so now the university is a key space of conflict, where the ownership of knowledge, the reproduction of the labour force, and the creation of social and cultural stratifications are all at stake. This is to say the university is not just another institution subject to sovereign and governmental controls, but a crucial site in which wider social struggles are won and lost (Federici & Caffentzis, 2007, p. 63).

Recalling our previous discussion about cycles of struggle, capital sought to actively decompose the labour and social militancy of the 1960s and 1970s by developing new technologies (especially computer and information technologies) and becoming peripatetic (for example, through free trade agreements, free-trade zones in developing countries, and capital mobility, among other things), both of which have helped capital insinuate itself both spatially and temporally into ever-increasing areas of social existence. Capital achieved substantial victory in spreading its gospel of neoliberalism throughout not only the developed world but also among an increasing number of developing countries. Neoliberalism, like Keynesianism before it, should therefore be understood as the form of governance that emerged as a response to the increasing number of societal struggles that threatened to upset the existing 'social stability' and make manifest capital's intrinsic tendency toward crisis and rupture of accumulation processes. The massive revolts that occurred in the factories, universities, and in broader segments of society in the late 1960s and early 1970s slowed down, and in some cases interrupted, the nodes in the circuit of capital within the M-C-M′ cycle. Capital responded to the growing social conflict and mounting crises of accumulation by developing and implementing a set of neoliberal policies beginning in the late 1970s that were designed not only to re-affirm the disciplinary powers of the market, but moreover to normalise market values as universal values throughout society. State intervention from the 1980s onwards thus limited itself to the imperatives of political domination and capitalist accumulation, away from its previous preoccupation with political legitimation and redistributive policies (Castells, 1989). By privileging value practices premised on the discourse of the market, neoliberalism provides the policy face for capitalist biopower that strives to colonise all areas of human existence on the basis of market normalisation.

Within this broader context, reduced funding to institutions of higher learning as a direct result of the neoliberal restructuring of government agendas over the previous two and a half decades has caused universities to seek out alternative financial sources. As the OECD has outlined,

> "although the flows of R&D funds from industry to universities may appear extremely modest at the macro level, it is quite clear that at the micro level, such cooperation may be extremely important for the individual contracting partners…in countries where public funding for university research is becoming increasingly scarce, cooperation with industry may even in the worst cases, become a condition for survival for some university institutions" (as cited in Etzkowitz et al., 1998a, p. 28).

Coupled with this is the now well-established 'truth' among many governments (including Canada, as evidenced by the ninth pillar of the CBS; see section 1.6) that economic growth and development depends upon the ability of private enterprise to commercially apply and exploit the knowledge and innovation developed in educational institutions (Etzkowitz & Webster, 1998).[68] Aside from CBAC admonitions to commercialise university research, the Association of Universities and Colleges of Canada in 2002 signed a framework of agreed principles with the Government of Canada that commits Canadian universities to double the amount of research they conduct and to triple the amount of commercialisation they undertake of such research (Association of Universities and Colleges of Canada, 2002). Further evidence of this trend can be seen in the well-staffed technology transfer offices found at universities throughout Canada, which continue to increase their staff complements in response to expanded commercialisation activities on Canadian campuses (Bostrom et al., 2007). At the risk of pointing out the obvious, the contemporary academic environment offers a paradigmatic example of the enclosure of the knowledge commons.

In terms of the informational focus of the present work, studies in the United States foreshadow the implications of these changing institutional arrangements and partnerships. One piece of research determined that American corporations funding academic research increasingly require universities to maintain the confidentiality of information for periods longer than necessary to acquire patent rights (Blumenthal, Causino et al., 1996). Another study found similar evidence that industry linkages tend to result in deferral of publication and other information withholding practices, although industry sponsorship alone was not sufficient; instead such practices occurred when the investigators were also involved in marketing the research results (Bekelman et al.,

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[68] These same authors muse about whether we are witnessing the beginnings of a new 'social contract' between academia and society, in which academic institutions will continue to be funded only to the extent that the resulting research developed within them can be harnessed to stimulate economic growth. See, Etzkowitz, H., & Webster, A. (1998). Entrepreneurial science: The second academic revolution. In H. Etzkowitz & A. Webster & P. Healey (Eds.), *Capitalizing knowledge: New intersections of industry and academia* (pp. 21-46). Albany: State University of New York Press.

2003). Put another way, the imposition of capitalist social relations into the university environment is effecting a betrayal of Mertonian principles of scientific development that has direct and detrimental implications for the free flow of information from institutions of higher education to society.[69] Universities are plagued by a number of concerns related to funding alliances with corporate partners, including: restrictions on internal collaboration within the university; loss of academic freedom; loss of objectivity; emphasis on applied research at the expense of basic research; student exploitation; pressure on faculty to concentrate disproportionately on commercial activities instead of other duties such as teaching; and, abuse of the researcher/physician-patient relationship in the case of clinical trials (Caulfield & Feasby, 1998; Lievrouw, 2004; Washburn, 2005). Overall, as neoliberal government agendas lead to reduced funding for education institutions yet simultaneously emphasise the role research and technological development will play in leading future economic growth, it should really not come as any surprise that commercial imperatives increasingly infiltrate university campuses.

The contemporary university might thus be viewed as providing part of an enabling infrastructure that contributes to capitalist growth and development, which, in the contemporary context, relies on knowledge creation (Florida & Cohen, 1999). Scientific knowledge, which has traditionally been considered an input necessary to expand the field, is, under expanding commercial pressure, being increasingly evaluated as a research outcome that can drive industrial utility and economic efficiency (Freeland Judson, 1994; Sigurdson, 1993). To be fair, it might be objected that scientific ideas have

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[69] Given the possibility of sustaining critique for invoking a set of norms that were perhaps more imagined than actual, we hasten to add our intent here is merely to emphasise some very real and documented changes to free and robust dissemination of information and knowledge out of universities that are occurring with increasing frequency at our contemporary neoliberal conjuncture.

long been translated into industrial applications as evidenced by the historical importance of the chemical and electrical industries to the Industrial Revolution.[70] What does appear both quantitatively and qualitatively novel is the intensification of this process in terms of the reduced temporal period between discovery and application, the strategic importance of the knowledge developed in academic institutions to industry, and the expanded push by governments to encourage (coerce?) universities into becoming incubators for economic growth and development through partnerships with business (Etzkowitz et al., 1998a, 1998b). It is precisely the prominence of knowledge in fuelling production and economic growth that has made universities such an attractive site for appropriation by capital in service of its expansionist agenda.

In the terms of our theoretical framework, institutions of higher education have joined the ranks of casualties infiltrated by capital's practices of primitive accumulation. "The triad of government, industry, and academia constitutes a mutually reinforcing system of self-interest that brings to a close an important period of independence for basic research in the biomedical sciences" (Krimsky, 1991, p. 78).[71] "The consequences are that secrecy has replaced openness; privatisation of knowledge has replaced communitarian values; and commodification of discovery has replaced the idea that university-generated knowledge is a free good, *a part of the social commons*" (Krimsky, 2003, p. 7). If we truly want to resist contemporary enclosures of the university by championing the commons, we need to problematise the imposition of capitalist social

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[70] Other observers point to an even earlier historical period, discussing Francis Bacon's ideas of science as technology; see, for example, Hindmarsh, R., & Lawrence, G. (2004). Recoding nature: Deciphering the script. In R. Hindmarsh & G. Lawrence (Eds.), *Recoding nature: Critical perspectives on genetic engineering* (pp. 23-40). Sydney: University of New South Wales Press.

[71] For an empirical study that provides direct evidence of the widespread links between American biologists and corporate entities, see Krimsky, S., Ennis, J. G., & Weissman, R. (1991). Academic-corporate ties in biotechnology: A quantitative study. *Science, Technology, & Human Values, 16*, 275-287.

relations in the university setting without invoking some sense of nostalgia for a romanticised past (keeping in mind that any notion of a romantic past would need to admit some of the 'nasty' gender, race, and socio-economic cleavages that have long plagued higher education). By recognising that the commodification of higher education is a process made possible by social and conflictual power relations, we open up the possibility of glimpsing lines of flight and terrains of resistance.

This expanding infiltration of academia by capital yields a battery of questions that we can only hope to pose and perhaps respond to provisionally rather than definitively answer in the context of the current work: are we witnessing a change in the value-form of knowledge in the academy – or at least a change occurring more broadly in society but being taken up increasingly within academia? Given the heightened emphasis on commercialisable research agendas within both universities and funding agencies, the general intellect developed within the academy is being appropriated with alarming frequency by capital. If so, what are the implications for funding, spin-offs, intellectual property, etc.? As we have seen in this section of the chapter, knowledge that fails to fit the corporate paradigm increasingly runs the risk of going unfunded while the push to patent and spin off firms has evolved into a major preoccupation across university campuses in this country. Has the capital value-form of knowledge reduced knowledge in the context of universities to something prized more for its capacity to position people in the labour market than for its inherent quality? Is the contemporary university thus being transformed into a node increasingly important to capitalist regulation and control of labour power? Although we have not directly addressed these two questions through this research, our tentative responses to the previous queries indicate that positive retorts, with all their negative implications for the knowledge commons, are here too in order. Finally, has neoliberal discourse become so normalised within the university that we no longer challenge capital's increasing control over the way knowledge is valued? Our hope is that the empirical evidence marshalled in this chapter provides compelling evidence of the range of universal labourers both within and beyond the university who are engaging in moments of struggle in what we contend are efforts that hold the potential to actualise our species-being.

Chapter 9. Conclusion

Reflecting on the research questions driving this project and the evidence presented in preceding chapters, we contend that biotechnology and biotechnological information are subject to increasing commodification pressures by capital as a direct result of the Canadian Biotechnology Strategy. The assimilation of ever-greater aspects of social existence by capitalist imperatives continues unabated today, and has perhaps reached its apotheosis in its control over biotechnology and thus the molecular existence of living organisms. The extensive reach of capital is evidenced by the globalisation juggernaut that seems to permeate almost all the territories around the globe. The intensity of its grasp is demonstrated by the increasing swaths of once private and sacrosanct areas of life now being regulated by commercial imperatives based on the criteria of profitability, private property, and metred access according to ability to pay. Talk of the 'biotechnology revolution' masks the fact that the development and application of this technology is being driven largely by capitalist imperatives to expand its reach into deeper areas of social existence, thus making such talk unhelpful and misleading. Such discourse, as we have endeavoured to demonstrate throughout this research, must be subjected to systematic critique. As Foucault admonishes, we need to "isolat[e] the form of rationality presented as dominant, and endowed with the status of the one-and-only reason, in order to show that it is only *one* possible form among others" (Foucault, 1988, p. 27, emphasis in original). Behind the apparent revolution is a more fundamental issue about access to and control over biological information resources. Aside from admitting broader issues of social change, such an approach to analysing the place of biotechnology in contemporary society politicises its development by conceptualising it as a science and technology that has implications for access to and control over information.

Responding to research questions two and three about the counter struggles engaging capitalist enclosures of the biological and the knowledge commons, and the information issues implicated in such struggles, we agree with Hardt and Negri (2004) that mapping such resistance is a useful exercise in promoting the autonomy of universal labour:

> There is no longer an outside to capital, nor is there an outside to the logics of biopower…and that correspondence is no coincidence, since capital and biopower function intimately together. The places of exploitation, by contrast, are always determinate and concrete, and therefore we need to understand exploitation on the basis of the specific sites where it is located and specific forms in which it is organized. This will allow us to articulate both a *typology* of the different figures of exploited labor [sic] and a *topography* of their spatial distribution across the globe. Such an analysis is useful because the place of exploitation is one important site where acts of refusal and exodus, resistance and struggle arise (Hardt & Negri, 2004, p. 102, emphasis in original).

Along these lines we thus offer the following schematic overview of the dominant issues articulated by universal labourers in their struggles against biotechnology in this country.

1. A predominant concern voiced by all interview informants resisting biotechnology in Canada revolves around corporate control of seeds and agriculture, as well as the power such corporations are able to wield in political and economic fora. Most of the interview respondents articulated a strong desire to establish civil society control over genetic engineering and the biotechnology industry. There is a belief among those struggling against biotechnology that the commodification of life following in the wake of this technoscience is altering our relationship to life at the expense of people and community.

2. Terminator technology, an example of how capitalist production and reproduction processes are beginning to depend on regulating and controlling natural reproduction, is one of the major issues on the organised activist front in Canada right now. Terminator technology represents a repeat of the failed Green Revolution; the genetic treadmill has been substituted for the chemical treadmill. Aside from squeezing farmers at another end in the production chain, such technology provides transnational biotech companies a technological mechanism to expand control over farmers, agriculture, and the food supply. Capital is interrupting the traditional plant-to-seed-to-plant-to-seed cycle to bring it more securely within the capitalist circuit of production and value creation. Terminator technology is basically the biological form of digital rights management systems; one regulates genetic code and the other digital code. The dilemma is that 'hacking' genetic code is exponentially more difficult.

3. Participants in oppositional movements are engaging in deliberate efforts to expand the terms of the debates around biotechnology to insert economic, political, ecological, and social justice issues. All are critical of our regulatory system for failing to consider issues beyond science and health. Lack of transparency in the regulatory review process is a similar source of criticism, including from the Royal Society of Canada. Demands being articulated by interview informants that the scientific data provided by companies seeking regulatory approval be made public for independent testing and review continue to be rejected by government and industry.

4. A variety of respondents recognise that the legal constructs around genetics and biotechnology have been detrimental to the economy of ordinary farmers, such that previously common biological resources and information are being privatised and commodified. There is a perceived need to determine and make public who owns and controls what, and what are the implications of such ownership patterns for the types of products being developed, as well as their social implications once they are introduced into society.

5. Part of the rationale offered by a number of oppositional movements for the lack of public debate around biotechnology is the inadequate supply of knowledge on either side of the issue – instead the biotechnology agenda is largely industry promoted and dominated. A predominant goal is to ensure that those most affected by this technoscience are properly informed, which is viewed as dependent upon strategies that entail adequate research, rigorous analysis, and the dissemination of results. That is, almost all interview informants perceive the need to respond to a substantial information gap in this country in respect of biotechnology.

6. Respondents are also struggling for a mandatory labelling regime for genetically engineered products, which is viewed as a means of helping to remove genetically engineered organisms from the food chain. At a fundamental level this is an information issue that from a purely market perspective creates information asymmetry and thus violates the assumptions of classical economics. The irony,

however, remains lost on industry and government, both of whom continue to oppose mandatory standards.

7. All interview informants articulate the need to engage in deliberate attempts to subvert the 'sanitized' scientific discourse being constructed and employed by industry and government in respect of biotechnology. Participants in oppositional movements recognise that biotechnology is a complex topic and that the science that surrounds it has been purposely mystified to discourage average citizens from debating the political, economic, environmental, ethical and moral issues surrounding this science and its technologies. Similarly, most interview participants perceive the need to correct and respond to the misinformation being disseminated by industry. Some sense a requirement of rendering biotechnology issues relevant to the urban population. Among all there is an acknowledgement that communicating to an assorted array of people who are affected by biotechnology in different ways is complex and difficult.

8. People struggling against biotechnology value network forms based on practices of cooperation on issues of mutual interest, information sharing, and coordination of grass roots activism. Members of oppositional groups attribute much of the power of resistance to communication and the ability to disseminate information. While one informant makes the case that if you know how to plot your message into the media some success can be had, most other informants are very sceptical about media coverage around biotechnology issues – reasons include superficial and/or

biased reportage, the concentrated structure of the media industry, and fees for newswire service that most groups are unable to afford. There is also a perception among biotech activists that the media have uncritically bought into the idea about the dominance and importance of the 'knowledge economy', in which biotechnology figures. The 'progress through innovation' message being circulated by the media is seen to be short-circuiting critical public dialogue and debate.

9. Information dissemination instead relies very much on relationships with like-minded organisations, public meetings, membership discussions, witness testimony at parliamentary committees (only National Farmers Union seems to have enough clout to appear before committees), public fora, email and listservs, websites (although there are difficulties associated with keeping websites current given the speed of developments and resource constraints), one-on-one grassroots conversations (in this case mainly Greenpeace), op-ed pieces, research papers and briefs, and letter writing campaigns. An idea repeated over and over by a number of interview informants is the importance of rigorous analysis and dissemination of results so people have enough information to make their own reasoned decisions.

10. There is unanimous agreement among those involved in oppositional movements that public consultations in respect of biotechnology in this country have been staged public relations exercises designed to ratify decisions previously reached behind closed doors. Those more sanguine about possible future consultation

processes nonetheless express concern about the difficulty of manoeuvring a fine line between participation and co-optation.

11. Industry and academia linkages are replete with examples of universities directly interfering with academic freedom, with direct implications for research topics, direction, and dissemination. That is, a changing university environment is impacting the types of research being conducted in institutions of higher education. Researchers run a risk of being labelled anti-science and subsequently marginalised professionally and academically if they voice critique of biotechnology.

In contemplating our fourth research question, we believe that the neo-Marxist biopolitical framework developed in this research succeeds in providing a conceptual construct sufficient to interrogating the issues inherent in biotechnology and the species-being movements it engenders. Science has become integral to capitalist development but there is an inherent contradiction between capital's distortion of science to its own valorising ends and the immanent nature of science that seeks to improve the lot of humanity. As Kloppenburg (1988, p. 3) contends, "[b]iotechnology promises to enhance significantly our power to create and reproduce the material conditions of our existence." Expressed in terms of the theoretical framework informing this research, genetic technologies lend humanity the potential, for the first time in history, to alter what Marx referred to as "species-being". Yet capital has been adept at appropriating the 'general intellect' developed through the labour of past generations, particularly in its scientific manifestations, to produce technological innovation in service of accumulation imperatives. The result has been an unprecedented enclosure of both the knowledge and biological commons at the molecular level of existence. These enclosures, which represent contemporary instances of primitive accumulation, are particularly insidious because the collective knowledge and material resources being appropriated hold the potential to facilitate a transformation of human development in a manner that actualises our species-being. Instead, the potential that biotechnology and genetic technologies portend for humanity's capacity to actively navigate its collective development are being alienated through private ownership, thus rendering this technoscience susceptible to the exigencies of atomised market exchange relationships, from which an inequitable distribution of the social wealth generated by species activity obtains. The private ownership of the so-called 'code of life' by 'life science' transnationals should be recognised for what it is, an affront to the public character of our species-being (Barber, 2001). Biotechnology is impacting what it means to be human, privileging some aspects and denying others. In order to exert some control over our own humanity it is thus vital that we reclaim political and economic control over the developmental trajectory of such technologies in a manner that opens up a space for informed and reflexive debate (Feenberg, 2002).

Capital responds to opposition movements mobilised against biotechnology through a number of strategies, including infiltration of the regulatory system and deliberate misinformation campaigns that emphasise only the purported benefits of such technologies, in order to obtain public acceptance and curtail the development of other more sustainable approaches to the problems industry claims biotechnology can solve. Capital champions the effectiveness of immaterial property (such as intellectual property protection) as an effective corporate instrument to exploit the products that derive from and promote the common. But given the nature of their development, intellectual property claims over genes and other forms of life represent private property claims over social and historical processes of knowledge creation. Enclosing knowledge by limiting access through intellectual property and bundling technological packages have all helped secure enormous profits for the biogiants, not to mention consolidate their control over the biotechnology industry.

Though beyond the scope of the present work, the difference in the way universal labourers have been able to re-appropriate communicational and biotechnological innovation does raise interesting questions about the continued accuracy of the dialectic posited by autonomist thinkers between the category of 'cycle of struggles' and capitalist development. This research suggests that this dialectic may breakdown in respect of biotechnological innovation, a topic that merits its own future consideration.

We would like to conclude both this chapter and the dissertation in a perhaps unconventional manner that again references an admonition articulated by Hardt and Negri (2004, pp. 284-285):

> This series of biopolitical grievances allows us to recognize and engage the ontological conditions on which they are all established, something like what Michel Foucault calls the critical interrogation of the present and ourselves. "The critical ontology of ourselves," Foucault writes, "must be considered not, certainly, as a theory, a doctrine, nor even as a permanent body of knowledge" but rather as "the historical analysis of the limits imposed on us and an experiment with the possibility of going beyond them." The legal, economic, and political protests that we have considered are all posed on this ontological foundation, which is crisscrossed by powerful and bitter conflicts over goals that invest the entire realm of life.

We ardently hope that this research, by illuminating the multiple points of struggle being opened up by an assorted collection of universal labourers around the contested nature of biotechnology in this country, contributes to a broadening of the terms of the debate that surround this technoscience in order to admit deeper perspectives that not only reflect technological and scientific concerns about biotechnology, but that also question and challenge more fundamental issues about the capitalist control that has captured the developmental trajectory of this science and its technological applications.

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Appendix I – Summary of the Recommendations Made by the Expert Panel of the Royal Society of Canada

Recommendations Concerning Underlying Policies and Principles Guiding the Regulation of Agricultural Biotechnology

7.1 The Panel recommends that approval of new transgenic organisms for environmental release, and for use as food or feed, should be based on rigorous scientific assessment of their potential for causing harm to the environment or to human health. Such testing should replace the current regulatory reliance on "substantial equivalence" as a decision threshold.

7.2 The Panel recommends that the design and execution of all testing regimes of new transgenic organisms should be conducted in open consultation with the expert scientific community.

7.3 The Panel recommends that analysis of the outcomes of all tests on new transgenic organisms should be monitored by an appropriately configured panel of "arms-length" experts from all sectors, who report their decisions and rationale in a public forum.

8.1 The Panel recommends the precautionary regulatory assumption that, in general, new technologies should not be presumed safe unless there is a reliable scientific basis for considering them safe. The Panel rejects the use of "substantial equivalence" as a decision threshold to exempt new GM products from rigorous safety assessments on the basis of superficial similarities because such a regulatory procedure is not a precautionary assignment of the burden of proof.

8.2 The Panel recommends that the primary burden of proof be upon those who would deploy food biotechnology products to carry out the full range of tests necessary to demonstrate reliably that they do not pose unacceptable risks.

8.3 The Panel recommends that, where there are scientifically reasonable theoretical or empirical grounds establishing a prima facie case for the possibility of serious harms to human health, animal health or the environment, the fact that the best available test data are unable to establish with high confidence the existence or level of the risk should not be taken as a reason for withholding regulatory restraint on the product.

8.4 As a precautionary measure, the Panel recommends that the prospect of serious risks to human health, of extensive, irremediable disruptions to the natural ecosystems, or of serious diminution of biodiversity, demand that the best scientific methods be employed to reduce the uncertainties with respect to these risks. Approval of products with these potentially serious risks should await the reduction of scientific uncertainty to minimum levels.

8.5 The Panel recommends a precautionary use of "conservative" safety standards with respect to certain kinds of risks (e.g. potentially catastrophic). When "substantial equivalence" is invoked as an unambiguous safety standard (and not as a decision threshold for risk assessment), it stipulates a reasonably conservative standard of safety consistent with a precautionary approach to the regulation of risks associated with GM foods.

9.1 The Panel recommends that Canadian regulatory agencies and officials exercise great care to maintain an objective and neutral stance with respect to the public debate about the risks and benefits of biotechnology in their public statements and interpretations of the regulatory process.

9.2 The Panel recommends that the Canadian regulatory agencies seek ways to increase the public transparency of the scientific data and the scientific rationales upon which their regulatory decisions are based.

9.3 The Panel recommends that the Canadian regulatory agencies implement a system of regular peer review of the risk assessments upon which the approvals of genetically engineered products are based. This peer review should be conducted by an external (non-governmental) and independent panel of experts. The data and the rationales upon which the risk assessment and the regulatory decision are based should be available to public review.

9.4 The Panel recommends that the Canadian Biotechnology Advisory Commission (CBAC) undertake a review of the problems related to the increasing domination of the public research agenda by private, commercial interests, and make recommendations for public policies that promote and protect fully independent research on the health and environmental risks of agricultural biotechnology.

Recommendations Concerning Regulations and Guidelines

4.1 The Panel recommends that federal regulatory officials in Canada establish clear criteria regarding when and what types of toxicological studies are required to support the safety of novel constituents derived from transgenic plants.

4.3 The Panel recommends that, in view of the availability of suitable alternative markers, antibiotic resistance markers should not be used in transgenic plants intended for human consumption.

4.8 The Panel recommends that approvals should not be given for GM products with human food counterparts that carry restrictions on their use for non-food purposes (e.g. crops approved for animal feed but not for human food). Unless there are reliable ways to guarantee the segregation and recall if necessary of these products, they should be approved only if acceptable for human consumption.

5.1 The Panel recommends that the Canadian Food Inspection Agency (CFIA) develop detailed guidelines describing the approval process for transgenic animals intended for (a) food production or (b) other non-food uses, including appropriate scientific criteria for assessment of behavioural or physiological changes in animals resulting from genetic modification.

6.10 The Panel recommends that companies applying for permission to release a GM organism into the environment should be required to provide experimental data (using ecologically meaningful experimental protocols) on all aspects of potential environmental impact.

6.11 The Panel recommends that an independent committee should evaluate both the experimental protocols and the data sets obtained before approvals of new plants with novel traits are granted.

6.12 The Panel recommends that standard guidelines should be drawn up for the longterm monitoring of development of insect resistance when GM organisms containing "insecticidal" products are used, with particular attention to pest species known to migrate over significant distances.

6.13 The Panel recommends that a moratorium be placed on the rearing of GM fish in aquatic netpens.

6.14 The Panel recommends that approval for commercial production of transgenic fish be conditional on the rearing of fish in land-based facilities only.

Recommendations Concerning the Regulatory Process

4.2 The Panel recommends that regulatory authorities establish a scientific rationale that will allow the safety evaluation of whole foods derived from transgenic plants. In view of the international interest in this area, the Panel further recommends that Canadian regulatory officials collaborate with colleagues internationally to establish such a rationale and/or to sponsor the research necessary to support its development.

4.6 The Panel recommends development of mechanisms for after-market surveillance of GM foods incorporating any novel protein.

4.7 The Panel recommends that the appropriate government regulatory agencies have in place a specific, scientifically sound and comprehensive approach for ensuring that adequate allergenicity assessment will be performed on GM foods.

4.9 The Panel recommends that all assessments of GM foods, which compare the test material with an appropriate control, should meet the standards necessary for publication in a peer-reviewed journal, and all information relative to the assessment should be available for public scrutiny. The data should include the full nutrient composition (Health Canada, 1994), an analysis of any anti-nutrient and, where applicable, a protein evaluation such as that approved by the United Nations Food and Agriculture Organization (FAO).

4.10 The Panel recommends that protocols should be developed for the testing of future genetically engineered foods in experimental diets.

4.11 The Panel recommends that the Canadian Nutrient File should be updated to include the composition of genetically engineered foods and be readily available to the public.

5.2 The Panel recommends that the approval process for transgenic animals include a rigorous assessment of potential impacts on three main areas:

1) the impact of the genetic modifications on animal health and welfare;
2) an environmental assessment that incorporates impacts on genetic diversity and sustainability; and
3) the human health implications of producing disease-resistant animals or those with altered metabolism (e.g. immune function).

5.3 The Panel recommends that the tracking of transgenic animals be done in a manner similar to that already in place for pedigree animals, and that their registration be compulsory.

5.4 The Panel recommends that transgenic animals and products from those animals that have been produced for non-food purposes (e.g. the production of pharmaceuticals) not be allowed to enter the food chain unless it has been demonstrated scientifically that they are safe for human consumption.

5.6 The Panel recommends that the use of biotechnology to select superior animals be balanced with appropriate programs to maintain genetic diversity, which could be threatened as a result of intensive selection pressure.

5.8 The Panel recommends that changes in susceptibility of genetically engineered plants to toxin-producing microbes, and the potential transfer of these to the animal and the food supply, be evaluated as part of the approval process.

5.9 The Panel recommends that a data bank listing nutrient profiles of all GM plants that potentially can be used as animal feeds be established and maintained by the federal government.

5.10 The Panel recommends that university laboratories be involved in the validation of the safety and efficacy of GM plants and animals.

5.11 The Panel recommends that Environment Canada and the Canadian Food Inspection Agency establish an assessment process and monitoring system to ensure safe introductions of GM organisms into Canada, according to the intent of the *Canadian Environmental Protection Act.*

6.1 The Panel recommends that all ecological information on the fate and effects of transgenic biotechnology products on ecosystems required under existing regulations should be generated and made available for peer review.

6.2 The Panel recommends the carrying out of exhaustive, long-term testing for ecological effects of biotechnology products that pose environmental risks, especially with respect to persistence of the organism or a product of the organism, persistent effects on biogeochemical cycles, or harmful effects resulting from horizontal gene transfer and selection.

6.3 The Panel recommends that, in evaluating environmental risks, scientific emphasis should be placed on the potential effects of selection operating on an introduced organism or on genes transferred to natural recipients from that organism.

6.5 The Panel recommends that the history of domestication, and particularly the time period and intensity of artificial selection, of GM plants should be taken into account when assessing potential environmental impacts. Species with a short history of domestication should receive particularly close scrutiny because they are more likely to pose environmental risks.

6.6 The Panel recommends that environmental assessments of GM plants should pay particular attention to reproductive biology, including consideration of mating systems, pollen flow distances, fecundity, seed dispersal and dormancy mechanisms. Information on these life history traits should be obtained from specific experiments on the particular GM cultivar to be assessed, not solely from literature reports for the species in general.

6.7 The Panel recommends that environmental assessments of GM plants should not be restricted to their impacts on agroecosystems but should include an explicit consideration of their potential impacts on natural and disturbed ecosystems in the areas in which they are to be grown.

6.8 The Panel recommends that research data from experiments conducted by industry on the potential environmental impacts of GM plants used in Canadian Environmental Protection Agency assessments should be made available for public scrutiny.

6.16 The Panel recommends that potential risks to the environment posed by transgenic fish be assessed not just case-by-case, but also on a population-by-population basis.

Recommendations Concerning Scientific Capacity for the Regulation of Food Biotechnology

4.4 The Panel recommends that the Canadian government support research initiatives to increase the reliability, accuracy and sensitivity of current methodology to assess allergenicity of a food protein, as well as efforts to develop new technologies to assist in these assessments.

4.5 The Panel recommends the strengthening and development of infrastructures to facilitate evaluation of the allergenicity of GM proteins. This could include development of a central bank of serum from properly screened individuals allergic to proteins which might be used for genetic engineering, a pool of standardized food allergens and the novel GM food proteins or the GM food extracts, maintenance and updating of allergen sequence databases, and a registry of food-allergic volunteers.

5.5 The Panel recommends that federal and provincial governments ensure adequate public investment in university-based genomic research and education so that Canada has the capacity for independent evaluation and development of transgenic technologies.

5.7 The Panel recommends that a national research program be established to monitor the long-term effects of GM organisms on the environment, human health, and animal health and welfare.

6.4 The Panel recommends that a detailed analysis be undertaken of the expertise needed in Canada to evaluate environmental effects of new biotechnology products and, if the appropriate expertise is found to be lacking, resources be allocated to improving this situation.

6.9 The Panel recommends that a federally funded multidisciplinary research initiative be undertaken on the environmental impacts of GM plants. Funds should be made available to scientists from all sectors (industry, government and university) with grant proposals subject to rigorous peer review.

6.15 The Panel recommends the establishment of comprehensive research programs devoted to the study of interactions between wild and cultured fish. Reliable assessment of the potential environmental risks posed by transgenic fish can be undertaken only after extensive research in this area.

6.17 The Panel recommends that identification of pleiotropic, or secondary, effects on the phenotype resulting from the insertion of single gene constructs into GM organisms be a research priority.

7.4 The Panel recommends that Canada develop and maintain comprehensive public baseline data resources that address the biology of both its major agroecosystems and adjacent biosystems.

7.5 The Panel recommends that Canada develop state-of-the-art genomics resources for each of its major crops, farm animals and aquacultured fish, and use these to implement effective methodologies for supporting regulatory decision making.

Appendix II – Evidence of Adverse Environmental and Health Effects from Genetically Engineered Crops

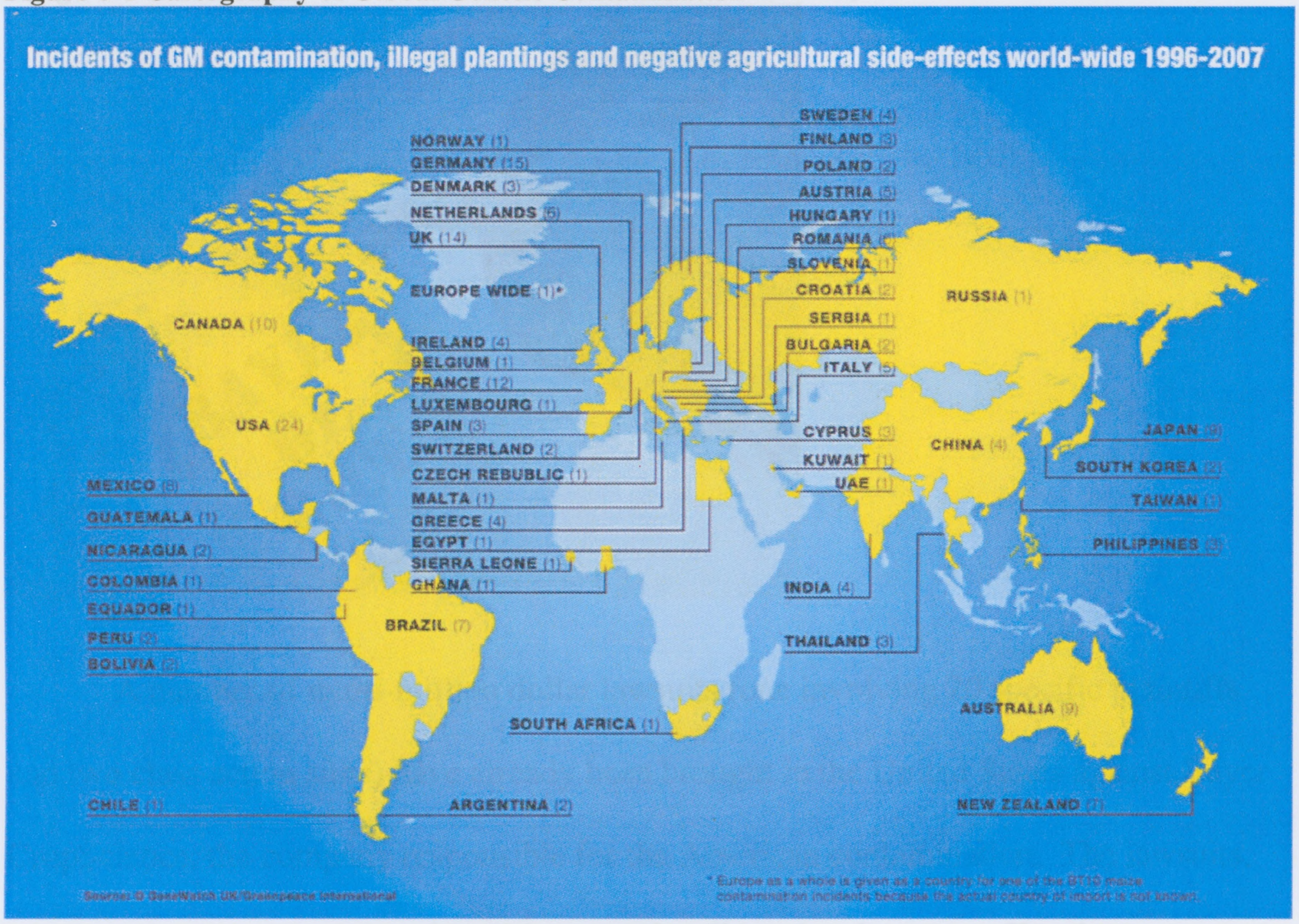
In a discussion about the dangers of gene flow from genetically engineered crops to non-genetically engineered crops, Philip Davies (2004) outlines the following hypotheses: genetically engineered crops have the potential to pollinate and thus contaminate non-genetically engineered crops; genetically engineered crops will pollinate weed species to produce genetically engineered weeds; genetically engineered crops contain genes that have the potential to be detrimental to human health, either directly through ingestion of genetically engineered crops or even foods that have not been genetically engineered but through cross-pollination are nonetheless contaminated; genetically engineered crops can have adverse effects on soil organisms, about which relatively little is known; engineered genes released into the environment are impossible to contain; and, horizontal gene transfer (the movement of genes between species outside of normal reproductive processes) has the potential to wreak havoc on the environment through gene escape and the inability to accurately predict the behaviour of a modified gene that has entered another organism. While proponents of genetic technologies, particularly those from the corporate sector, are quick to argue that decisions about the release of genetically engineered organisms should be based on a risk-benefit analysis, the science behind the risk assessment is too imprecise. Moreover, the risk-benefit calculus is unfairly calibrated in favour of the corporate interests that have developed these technologies, while the risk burden is shouldered by the entire human population and the environment (Davies, 2004).[1] According to the GM Contamination Register,[2] between 1996 and 2007 there were 216 publicly documented cases of genetic contamination in 57 countries across the globe, eleven of which involved the illegal release of genetically engineered organisms (see Figure 0-1).[3]

[1] There is a growing body of scientific literature that outlines the dangers inherent in the release of genetically engineered organisms into the environment; dangers that are increasingly coming to light as more and more hectares of farmland are planted with genetically engineered crops. See, for example, Faure, N., Serieys, H., & Berville, A. (2002). Potential gene flow from cultivated sunflower to volunteer, wild *Helianthus* species in Europe. *Agriculture Ecosystems and Environment, 89*, 183-190.; Hall, L., Topinka, K., Huffman, J., Davis, L., & Good, A. (2000). Pollen flow between herbicide-resistant *Brassica napus* is the cause of multiple-resistant *B. napus* volunteers. *Weed Science, 48*, 688-694.; Lavigne, C., Klein, E., & Couvet, D. (2002). Using seed purity data to estimate an average pollen mediated gene flow from crops to wild relatives. *Theoretical and Applied Genetics, 104*, 139-145.; Mikkelsen, T., Anderson, B., & Jørgensen, R. (1996). The risk of crop transgene spread. *Nature, 380*, 31.; and, Nottingham, S. (2002). *Genescapes: The ecology of genetic engineering*. London, GB: Zed Books. For a compelling discussion about the dangers that stem from the structural instability of transgenic lines, see Ho, M.-W. (1999). *Genetic engineering: Dream or nightmare? Turning the tide on the brave new world of bad science and big business* (2nd ed.). Dublin: Gateway.

[2] As stated on the GM Contamination Report website: "This GM contamination register is the first of its kind in the world. Although GM crops were grown on over 100 million hectares in 2007, there is no global monitoring system. Because of this failure of national and international agencies, GeneWatch UK and Greenpeace International have launched this joint initiative to record all incidents of contamination arising from the intentional or accidental release of genetically modified (GM) organisms (which are also known as genetically engineered (GE) organisms). It also includes illegal plantings of GM crops and the negative agricultural side-effects that have been reported. Only those incidents which have been publically documented are recorded here. There may be others that are, as yet, undetected." http://www.gmcontaminationregister.org/

[3] For a detailed report of GE contamination according to type and country, see Greenpeace International. (2008). *GM contamination register report 2007: Annual review of cases of contamination, illegal planting and negative side effects of genetically modified organisms*. Amsterdam: Greenpeace International.

Figure 0-1 Cartography of Global Genetic Contamination



In 2006 two genetically modified strains of rice, one from the United States (LLRice 601, which contains Bayer's Liberty Link protein and is designed for herbicide tolerance, was found in southern long grain rice) and one from China (rice designed to resist bacterial blight and insect resistant rice), neither of which had received regulatory approval, infiltrated and contaminated their own domestic and the global rice supply, including Canada's (though it was Greenpeace rather than the Canadian government that made this determination).[4] According to Bayer, the infiltration of the rice supply by its genetically engineered variety was the result of an 'act of God'.

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[4] The two major types of herbicide tolerant rice have been developed by Monsanto (its Roundup Ready rice is tolerant of Monsanto's pesticide glyphosate) and Bayer (its Liberty Link rice is resistant to Bayer's herbicide glufosinate). Bayer's LLRice62 has been approved for cultivation and food use in the United States and for food use in Canada (June 7, 2006).

Image 0-1 GE Rice Contamination is God's Fault According to Bayer

A number of multi-million dollar lawsuits (one involving 20 specific plaintiffs and two class action suits) have already been brought in the United States against Bayer CropScience, the company responsible for the American contamination. The lawsuits, which seek compensatory and punitive awards, allege that farmers suffered monetary damages because of the contamination, which caused foreign countries to limit imports of American rice, subsequently resulting in a decline in the price of rice. According to the USA Rice Federation, the national advocate for all segments of the American rice industry, 63% of American global exports of rice in 2006 were negatively affected by the contamination (USA Rice Federation, 2006). Interestingly, on November 24, 2006 the United States Department of Agriculture deregulated genetically engineered LLRice601, claiming that it is as safe as conventionally bred rice strains. Yet other scientific studies in respect of Bt rice indicate that it poses serious health and environmental concerns.[5] For example, the Bt toxin Cry1Ac has been found to be a potent immunogen, raising questions about its allergen properties when genetically engineered into rice and other

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[5] To be fair it should be re-iterated that LLRice601 is engineered to be tolerant of Bayer's glufosinate herbicide. It is not a Bt variety.

food crops. Amazingly, in May 2007 the United States Department of Agriculture approved field trials of genetically engineered rice that contains human proteins, despite past experiences with Liberty Link and adamant American rice industry opposition to the trial. Dubbed 'cannibal rice', this genetically engineered rice variety is intended to produce drugs that alleviate diarrhoea. What such examples make abundantly clear is the fatuousness of the 'coexistence' claim voiced by the biotech industry and government regulators.

Environmental dangers increasingly being determined include the ill effects of herbicide tolerant crops on the surrounding bird, mammal, and fish populations. Studies in the United Kingdom have tracked significant declines in bird and insect populations around farmlands planted to genetically engineered canola and sugar beet as compared to conventional farm plots (Borromeo & Deb, 2006). A recent laboratory and field study conducted by environmental scientists at Indiana University indicates that the toxin contained in genetically engineered Bt corn increases mortality and reduces growth in caddisflies – aquatic insects related to the pest targets of the Bt toxin. This raises a concern because caddisflies are a source of nourishment for fish and amphibians and the pollen and other plant remnants from fields planted with Bt corn are being washed into neighbouring streams and other waterways (Rosi-Marshall et al., 2007). Another study published in late March 2008 in the *Archives of Environmental Contamination and Toxicology* demonstrates that genetically engineered maize containing the Bt-toxin Cry1Ab increases mortality and reduces female sexual maturation and overall egg production levels among the water flea *Daphnia magna*, a crustacean anthropod typically used as a model organism in ecotoxicological studies (Bøhn, Primicerio, Hessen, &

Traavik, 2008). A study published in *Biology Letters* (online version) in March 2008 indicates that genetically engineered canola volunteers can survive and produce progeny as long as a decade after first sown, thus providing further compelling evidence about the dangers of genetic pollution and contamination (D'Hertefeldt, Jørgensen, & Pettersson, 2008). A recent Canadian study determined that herbicide tolerant volunteer canola, which was found on the farms of 38 percent of those involved in the research, is a major concern that influences prairie farmers' risk assessment of this biotechnology (Mauro & McLachlan, 2008). The findings being documented by these various studies belie the claims articulated by industry and government regulators that genetically engineered organisms receive marketing approval only after being subject to comprehensive and stringent safety assessments. Instead, such new research underlines the logic of applying the precautionary principle to biotechnological products in the absence of a clear understanding of the effects of runoff material from fields planted with transgenic seeds on waterways and the aquatic organisms living within or around them.

Bt cotton, which has been planted for a number of years already, is also beginning to demonstrate problems. Not only have pest and natural enemy populations been affected by the toxins genetically engineered into the cotton, but so too have beneficial parasites and populations of secondary pests (Hisano, 2005). Other studies have documented the persistence of Bt toxins in soils, which could threaten the long-term health of the soil (Desser, 2000; McAfee, 2003). Similarly, and most damaging for the agricultural biotechnology industry, a study conducted by researchers at Cornell University on Bt cotton in China has documented that after seven years of cultivation of this crop, populations of other insects have increased so much that farmers now have to spray their fields up to 20 times a season. Rather than reduce pesticide applications, one of the vaunted benefits publicised so widely by proponents of agricultural biotechnology, these genetically modified plants require increased herbicide use. Similarly, another study conducted using nine years of United States Department of Agriculture data concludes that Monsanto's Roundup Ready soybeans not only require more chemicals at higher doses but also produce lower yields than conventional soybeans. The same study notes further that weed resistance to glyphosate (the active ingredient in Monsanto's Roundup herbicide) is now a major problem in the United States (Borromeo & Deb, 2006). Aside from damaging the environment, the ultimate effect is to further consolidate the grip of transnational agrochemical companies on the food production cycle in efforts to squeeze additional profits from farmers.

Some of the major health and safety concerns specific to humans that are associated with genetically engineered foods include: an increase in antibiotic resistance; higher levels of food toxicity; masked allergens[6]; a nutritional decline in food as a result of an increasingly genetically homogenous food supply; potential food shortages due to reduced biodiversity; and ecological upheaval that could flow from the release of genetically engineered organisms into the environment (Ferrara & Dorsey, 2001; Ho, 1999). A risk of employing viruses as vectors in genetic manipulation is that they could enter their infectious phase, replicate, and escape from the target cell to introduce the gene insert into other cells or organisms (Wheale & McNally, 1998). In fact, the mosaic

[6] The first study to confirm the dangers of hidden toxicity because of genetic engineering involved attempts by Pioneer Hi-Bred International (now wholly owned by DuPont) to augment protein levels in soybeans by injecting a gene from the brazil nut. The University of Nebraska determined that the gene produced proteins that elicited strong, and potentially lethal, allergic reactions in samples from people allergic to the brazil nut. Pioneer eventually discontinued its efforts to market the enhanced soybeans. See, Ferrara, J., & Dorsey, M. K. (2001). Genetically engineered foods: A minefield of safety hazards. In B. Tokar (Ed.), *Redesigning life?: The worldwide challenge to genetic engineering* (pp. 51-66). Montreal: McGill-Queens's University Press.

character of most vector constructs renders them structurally unstable and disposes them to recombination (Ho, 1999). For these reasons a number of researchers make a plea for the discontinuation of the use of the cauliflower mosaic viral promoter, which is employed in a substantial majority of all transgenic crops already released commercially or at the field trial stage (Ho et al., 1999). Similarly, the British Medical Association (1999) and American Medical Association (2000) have issued appeals to stop using antibiotic resistance marker genes in genetic engineering out of concern that these genes, and antibiotic resistance, could be transmitted to bacteria in the environment, including the bacteria that reside in human and animal intestines. This has the potential to become a human health concern because as bacteria become more resistant to antibiotics, these drugs lose their effectiveness in treating human viral infections (Ferrara & Dorsey, 2001; Kloppenburg, 2004).

In March 2003 Monsanto received regulatory approval for unconfined release of its MON 863, an insect resistant corn variety that produces the Cry3Bb1 protein. Two weeks subsequent to the approval from CFIA, Health Canada approved MON863 for human consumption. This transgenic corn, which is engineered to produce an insecticide that renders the plant resistant to Western corn rootworm (*Diabrotica virgifera virgifera*) and Northern corn rootworms (*Diabrotica barberi*), has been the subject of health concerns since at least 2002, when experts at the French Genetic Engineering Commission began articulating critical concerns about the test data provided by Monsanto in support of its application for European regulatory approval of MON863. Simultaneous studies were emerging in Germany that linked the Cry3Bb1 protein to other comparable proteins that exhibit high relevance for human health. After three years of lobbying by Greenpeace and other activists in Europe, and despite intensive pressure by Monsanto to maintain the confidentiality of the results it included in its application for regulatory approval, an order from a German Court of Appeal (Münster) compelled authorities in 2005 to release the original data provided by Monsanto for independent testing (Brandon, 2007). The ensuing study conducted by the Committee for Independent Research and Information on Genetic Engineering (Comité de Recherche et d'Information Indépendantes sur le Génie Génétique – Crii-Gen), the results of which appear in a 2007 peer-reviewed article in the *Archives of Environmental Contamination and Toxicology*, disputes the claim made by Monsanto that this genetically engineered variety exhibits no significant biological differences as compared to conventional corn. Aside from being critical of the methodology of the study conducted by Monsanto researchers, these independent scientists determined that

> the two main organs of detoxification, liver and kidney, have been disturbed [by MON863] in this study. It appears that the statistical methods used by Monsanto were not detailed enough to see disruptions in biochemical parameters...we strongly recommend a new assessment and longer exposure of mammals to these diets, with cautious clinical observations, before concluding that MON863 is safe to eat (Séralini, Cellier, & Spiroux de Vendomois, 2007a, p. 601).

Also problematic, according to these scientists, is the particle bombardment method used by Monsanto to inject engineered genes into the seed, through which shards of metal covered with the gene plasmid are injected into the cell nucleus of the target organism. Aside from the inherent imprecision of this process, it also "may cause insertional mutagenesis effects, which may not be directly visible by compositional analysis..." (Séralini et al., 2007a, p. 597). Given the growing consensus among the scientific community that placement within the genome has important implications for genotype, this method of genetic engineering alone should be enough to warrant review of the scientific data being produced by the corporations seeking approval for their genetically engineered products.

Greenpeace has provided the results of this independent testing to the CFIA and to all Canadian federal, provincial, and territorial Ministers of Agriculture. As of April 2008, the CFIA has issued no response and made no indication as to whether it will revoke approval of MON863 in this country. It has also yet to state whether the data provided by Monsanto in support of its application in Canada will be made publicly available, data that, no doubt, are very similar to those provided to European regulators (Brandon, 2007). Given the track record of the Government of Canada in protecting the confidentiality of what it broadly considers proprietary information, it seems very unlikely that this information will be forthcoming without some form of judicial compulsion.[7]

In the course of further study, the French Crii-Gen research group, in a preliminary report issued in June 2007, voices deep concerns about the methodological design and resulting interpretation of test data for the studies conducted by Monsanto and provided in support of its application for approval in Europe of NK 603 (NK 603 was approved in Canada in 2001), another 'Roundup' tolerant corn variety (Séralini, Cellier,

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[7] It should be noted that the location of field trials is categorised as proprietary information by the CFIA and therefore kept secret from the public by virtue of an exemption in the federal *Access to Information Act* (R.S.C., 1985, c. A-1). This compares unfavourably to Article 9 ("Consultation of and Information to the Public") of *Directive 2001/18/EC of the European Parliament and of the Council on the Deliberate Release into the Environment of Genetically Modified Organisms*, which sets out requirements for public disclosure of specific and identifying information in respect of arable land sown with genetically engineered seeds. In 2003 the Saskatchewan Association of Rural Municipalities passed almost unanimously a resolution demanding that the locations of test plots for genetically engineered crops be made public and that farmers and municipalities be notified before test plots are established. In a letter from then Minister of Agriculture and Agri-Food Canada Lyle Vanclief, the Association was apprised of the federal government's position that "it is in the public interest that the exact location of the trials remains confidential." See, Warick, J. (2003, August 9). Lining up against GM wheat. *Star Phoenix*, pp. E1. This same position was affirmed to the researcher, whose access to information request for details outlining specific geographical co-ordinates of all past and present genetically engineered field trials was refused in early 2008.

& Spiroux de Vendomois, 2007b). In a study of the effects of genetically engineered corn on Atlantic salmon, a Norwegian research group has determined that Monsanto's Bt maize MON810 (it contains the transgenic protein Cry1A(b) that provides resistance against the European corn borer (*Ostrinia nubilalis*)) affects white blood cell populations, which has implications for immune response. The study's authors further point out that the insertion of transgenic DNA could also result in the production of unknown proteins during the engineering process, which is particularly problematic given that transgenic DNA sequences of varying sizes have proved to survive feed processing and remain in the digestive tract of Atlantic salmon. Finally, the study demonstrates that MON810 has effects on liver and intestinal activity, which are indicative of a mild stress response (Sagstad et al., 2007). Despite the WTO ruling that requires the European Union to lift its moratorium on approvals for genetically engineered crops, France implemented a ban[8] in January 2008 on MON810, the only genetically engineered crop currently approved for cultivation in that country. On March 19, 2008 France's top legal authority, the State Council, upheld the ban against an emergency injunction filed by proponents of biotechnology, including Monsanto and the Biotechnology Industry Organization, that sought to overturn the government decree (de La Hamaide, 2008; Parent, 2008). Overall, these studies provide independent evidence that Monsanto not only conducts methodologically weak scientific assessments of its products but that, in fact, genetically engineered crops pose health risks when consumed by higher organisms. There is similarly mounting data that genetic engineering results in unpredictable biological

[8] Although MON810 is one of the few genetically engineered seed varieties approved for sale in the European Union, France was able to implement the ban by invoking an EU level legal mechanism known as the 'safeguard clause'. France will, however, have to produce new, scientific proof of the risks posed by MON810 seeds at the Union level.

events within the organisms being modified. On the basis of such evidence, Greenpeace Canada calls on the Government of British Columbia to implement a mandatory labelling regime for all food products that contain genetically engineered ingredients, to begin developing a strategy that would remove all genetically engineered food from the province's food supply, and to exert pressure on the federal government to implement the recommendations made by the Royal Society of Canada in its report, *Elements of precaution: Recommendations for the regulation of food biotechnology in Canada* (Brandon, 2007).

Appendix III – Organisations/People Interviewed for this Research Project

Lucy Sharratt, Coordinator **Canadian Biotechnology Action Network (CBAN)** Collaborative Campaigning for Food Sovereignty and Environmental Justice 431 Gilmour Street, Second Floor Ottawa, ON, K2P 0R5 Phone: 613-241-2267 Fax: 613-241-2506 coordinator@cban.ca www.cban.ca	**Brewster Kneen, Founder** **The Ram's Horn** 2746 Cassels Street Ottawa, ON, K2B 6N7 Phone: 613-828-6047 http://www.ramshorn.ca/
Pat Mooney, Executive Director **ETC Headquarters** 431 Gilmour St, Second Floor Ottawa, ON, K2P 0R5 Phone: 613-241-2267 Fax: 613-241-2506 http://www.etcgroup.org/en/contact_us.html	**National Farmers Union (Head Office)** **Contact: Terry Boehm, Vice President** 2717 Wentz Avenue Saskatoon, SK, S7K 4B6 Phone: 306-652-9465 Fax: 306-664-6226 Email: nfu@nfu.ca http://www.nfu.ca/contact.html
Greenpeace Canada, Montreal Office **Contact: Dr. Eric Darier** 454 Laurier Est, 3me. etage Montréal, Québec H2J 1E7 Phone: (514) 933-0021 Fax: (514) 933-1017 http://www.greenpeace.org/canada/en/about-greenpeace/contact-us	**Greenpeace Canada, Vancouver Office** **Contact: Josh Brandon** 1726 Commercial Drive Vancouver, British Columbia V5N 4A3 Phone: (604) 253-7701 Fax: (604) 253-0114 http://www.greenpeace.org/canada/en/about-greenpeace/contact-us
Dr. E. Ann Clark, Associate Professor **University of Guelph** Department of Plant Agriculture, Crop Science Building Guelph, Ontario, N1G 2W1 Phone: 519-824-4120 ext. 52508 Fax: 519-763-8933 Email: eaclark@uoguelph.ca http://www.plant.uoguelph.ca/faculty/eclark/	**Dr. Rene van Acker, Professor and Chair** **University of Guelph** Department of Plant Agriculture University of Guelph Guelph, Ontario, N1G 2W1 Phone: (519) 824-4120 ext. 53386 Fax: (519) 821-8660 Email: vanacker@uoguelph.ca http://www.plant.uoguelph.ca/faculty/vanacker/index.html

Dr. Bert Christie, Professor Emeritus University of Guelph Phone: (902) 569-2171 Email: shocolglen@islandtelecom.com	**Cathy Holtslander, Beyond Factory Farming and Committee Member of Organic Agriculture Protection Fund** #501 - 230 22nd Street East Saskatoon, SK S7K 0E9 Phone: (306) 955-6454 Fax: (306) 955-6455 Email: cathyh@beyondfactoryfarming.org
Arnold Taylor, Chair of OAPF Committee and President of Saskatchewan Organic Directorate Box 224 Spalding, SK S0K 4C0 Phone: (306) 252-2783 Email: taylor.organic.farms@sasktel.net	**Ian Mauro, Doctoral Candidate Co-director and Co-producer, Seeds of Change University of Manitoba** Department of Environment and Geography 303 Wallace Bldg. Winnipeg, MB, R3T 2N2 mclachla@umanitoba.ca Phone: 204-474-9316 Email: ianmauro@gmail.com
Herb Barbolet, Founder of Farm Folk / City Folk; Associate at the Food Security and Sustainable Community Development, Centre for Sustainable Community Development, Simon Fraser University 1937 West 2nd Avenue Vancouver, BC V6J 1J2 Phone: (604) 833-1742 Email: herb@ffcf.bc.ca	**Devlin Kuyek, Researcher at GRAIN** Montréal, Québec Phone: (514) 273-7314 Email: devlin@grain.org http://www.grain.org/staff/?id=10

Appendix IV – List of Questions for Open-Ended Interviews

(Not all questions will be applicable to all respondents.)

1. Would you please outline the issue(s) around which you are mobilising resistance?
2. Is the issue/s considered political, economic, social or a combination of all?
3. What are the strategies your group employs to mobilise resistance?
4. Is part of the goal to achieve an alternative social organisation?
5. Would you characterise the movement as anti-corporate or anti-capitalist?
6. Does your group find itself labelled as anti-progressive etc. by capital and if so what do you do to respond? (i.e. counteroffensives by opponents?)
7. Have you found that biotechnology proponents, and particularly industry, attempt to restrict debate to issues of safety, to which they can respond with science (even if it is one-sided)? If so, how have you responded? Has safety become a type of surrogate issue for broader social issues? (See Nestle)
8. What do you consider the informational issues involved in the struggle?
9. What has been your success in attracting media attention? Has your group and the issue been portrayed accurately?
10. Why do you think you have been un/successful in attracting media attention?
11. Have you been confronted by other obstacles to disseminating information, for example, as a result of intellectual property rights?
12. In general, what types of difficulties and opportunities have you encountered when trying to present information to the public and various media venues?
13. What are your external communication strategies (including types of media employed)?
14. How do you manage internal communications?
15. How is your group/movement structured organisationally?
16. What type of decision-making structure does your organisation have (within and without if involved in alliances)?
17. Has your group participated in public consultations with the CBAC (the secretariat responsible for, among other things, coordinating public consultations with interested stakeholders)? If not, was your group not invited or was it a conscious choice? If the latter, why?
18. Does your group collaborate with other movements/social actors? If so, which ones and what is the organisational structure of such cooperation (e.g. unified under central authority or network structure)?
19. What is the prognosis for success?
20. Is there intent to move beyond Canada (to extent issue extends beyond our borders)?
21. How is your group funded?
22. What types of people fill the ranks of your supporters?

Appendix V – Ethics Approval Form

Western
Faculty of Information and Media Studies
Office of the Dean

Ethical Review of Research Involving Human Subjects

All non-medical research involving human subjects at the University of Western Ontario is carried out in compliance with the Social Sciences and Humanities Research Council Guidelines (2002). The Faculty of Information Media Studies (FIMS) Research Committee has the mandate to review FIMS student research proposals for adherence to these guidelines.

2006 – 2007 FIMS Research Committee Membership

1. C. Ross, Dean and Chair*
2. T. Craven*
3. G. Leckie, Associate Dean*
4. A. Quan-Haase*
5. A. Hearn*
6. J. Martin*
7. S. Burdett (alternate)
8. L. Vaughan (alternate)
9. V. Rubin (alternate)

Research Committee members marked with * have examined the research project entitled:

Canada's Biotechnology Strategy: The New Enclosure of Biotechnology within the Social Framework

as submitted by: Wilhelm Peekhaus (Co-investigator/Student)
Nick Dyer-Witheford (Principal Investigator/Supervisor)

and consider it to be acceptable on ethical grounds for research involving human subjects under the conditions of the University's Policy on Research Involving Human Subjects.

Approval Date: June 5, 2007

Catherine Ross, Dean and Chair

The **University** *of* **Western Ontario**
Faculty of Information and Media Studies
North Campus Building, Room 240 • London, Ontario • CANADA - N6A 5B7
Phone: 519-661-3542 • Fax: 519-661-3506 • www.fims.uwo.ca

Appendix VI – Information Letter and Consent Form Used for Interviews as Approved by Faculty of Information and Media Studies Ethics Committee

Canada's Biotechnology Strategy: The New Enclosure of Biotechnology within the Social Factory

Letter of Information

Dear :

Thank you for your interest in participating in the research project that I am conducting for my doctoral dissertation at the University of Western Ontario's Faculty of Information and Media Studies in the Graduate Programme in Library and Information Science.

The purpose of this letter is to inform you about the project and to obtain formal consent to interview you. For this research I am interviewing key informants involved in oppositional movements and organisations mobilised around biotechnology issues in Canada. The interviews are designed to elucidate the contemporary struggles organized against particular areas of biotechnology in this country, including the informational issues involved in such struggles.

The interview with you will last approximately sixty to ninety minutes. Your participation in this research is voluntary. There are no known risks or benefits to you associated with your participation in this research. If you agree to be interviewed you may refuse to answer any questions and you may end the interview at any time. Should you wish, your name will not be used in any report, document, or publication that is generated from this research, nor, in such case, will any other information be used that could identify you.

With your permission I would like to record the interview using an audio device in order to verify the accuracy of my written notes. You may elect not to have any of the session tape-recorded or, at any time during the interview, you may direct that the audio recorder be switched off. The notes and audiotapes recorded during your interview, and any records made from them, will be kept secure in a locked file cabinet and/or in a password protected computer file at my university office. All this material will be destroyed once the dissertation, and any subsequent publication emanating from it, is fully complete. At maximum this material will be retained for up to five years.

Enclosed with this letter you will find a Consent Form that confirms you have been informed about this research project and that you agree to participate in the interview. I will contact you by telephone in the next few days to confirm your willingness to participate. If you do agree to participate, please read and sign the Consent Form, which I will then collect from you at the time of the interview.

Should you wish to know more about the study please feel free to contact me at the Faculty of Information and Media Studies, University of Western Ontario: telephone (519) 661-2111, ext. 88013; fax (519) 661-3506; or email wpeekhau@uwo.ca. The faculty supervisor for this project is Dr. Nick Dyer-Witheford, who can be reached at the Faculty of Information and Media Studies: telephone (519) 661-2111, ext. 88502; fax (519) 661-3506, or email ncdyerwi@uwo.ca.

Sincerely,

Wilhelm Peekhaus

Encl.: Consent Form

Canada's Biotechnology Strategy: The New Enclosure of Biotechnology within the Social Factory

Consent Form

I, ________________________________, have read the accompanying letter of information, have had my questions answered to my satisfaction, and agree to participate in the study.

________________________________ ________________________________

(Name – Person Obtaining Informed Consent) (Signature – Research Participant)

________________________________ ________________________________

(Signature – Person Obtaining Informed Consent) (Date)

(Please fax signed copy to the attention of Wil Peekhaus, Faculty of Information & Media Studies, (519) 661-3506).