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**Governing the Appropriation of Life: Science, Regulatory Knowledge and Reforms
to Canada's Patent Regime (1984-1995)**

A thesis submitted to
the Faculty of Graduate Studies
in partial fulfillment of
the requirements for the degree of

Master of Arts

Carleton University
Ottawa, Ontario
April 6, 1998

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and Research acceptance of the thesis

“GOVERNING THE APPROPRIATE OF LIFE:
SCIENCE, REGULATORY KNOWLEDGE AND REFORMS TO CANADA’S
PATENT REGIME (1984-1995)”

submitted by Carlos Novas, B.A.

in partial fulfilment of the requirements for
the degree of Master of Arts

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April 6, 1998

Abstract

This thesis examines the forms of knowing, technologies of power, institutions, social practices, and strategies pursued by a range of social agents, to show how they are implicated in the processes which transform the reproductive capacities of living organisms into an object that can be legally appropriated. These processes are treated as a form of governance to capture how the legal appropriation of life is accomplished through distinctive ensembles of social relations, forms of knowledge, regulatory agents, modes of moral regulation, and a profusion of shifting alliances between humans and non-human actants. The thesis examines patents regimes as a technology of power, the discourses and practices of molecular biology, the constitution of biotechnology as an object of regulatory knowledge, and lastly, reforms to Canada's patent regime. The legal appropriation of life is demonstrated to be the result of the intersection of these diverse processes.

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Introduction

Patent Regimes, Science and Regulatory Knowledge: Governing the Appropriation of Life

The ability to act upon the reproductive capacities of living organisms represents a new modality of power that targets the body at the sub-microscopic level. Through a series of *genetic technologies* the interior spaces of life itself have become an object domesticated for economic, political and social objectives. (Shiva 1997: 5) This thesis explores the processes through which the colonization, domestication and appropriation of the reproductive capacities of living organisms is being accomplished. The central question which guides the inquiry to be sustained is: how are forms of knowing, technologies of power, institutions, social practices, and the strategies and tactics pursued by a range of social agents implicated in the processes through which the reproductive capacities of living organisms are being transformed into an object that can be legally appropriated. These processes will be studied as a form of governance as it provides a means of capturing how the legal appropriation of life is being accomplished through distinctive ensembles of social relations, and forms of knowledge, regulatory agents, modes of moral regulation, and a profusion of shifting alliances between humans and non-human actants. The argument will be made that the legal appropriation of life is a result of the intersection of governmental technologies concerned with the regulation of invention, scientific discourses and practices which target the body at the sub-microscopic level, regulatory knowledge(s), and state projects which seek to reduce the uncertainty surrounding the patentability of lifeforms.

The appropriation of life is used as a shorthand that attempts to capture how the reproductive capacities of lifeforms are being colonized for commercial, economic and political ends. The legal appropriation of life through patents represents a specific modality through which its appropriation is being achieved. Nevertheless, the patenting of life provides a means of exploring how patent regimes, scientific practices, regulatory knowledge, and legislative reforms to Canada's *Patent Act* intersect with one another to allow for the creation of property rights over new forms of life. A condition of possibility for the legal appropriation of life consists of a renegotiation of the objects that are considered patentable and legislative reforms to the patent regime. A part of these conditions of possibility is an epistemic transformation within the biological sciences which provides for a new mode of understanding, representing and intervening upon the reproductive capacities of living organisms. Lastly, the appropriation of life is accomplished through the constitution of biotechnology as an object of regulatory knowledge that seeks to promote the diffusion and commercialization of *genetic technologies*. This study will attempt to demonstrate the 'connectedness' of the legal appropriation of life with other social phenomena and how it is the result of the intersection and overlapping of a range of social relations.

As a means of studying how the legal appropriation of life is being accomplished through a combination of scientific discourses and practices, forms of regulatory knowledge and state projects, a relational approach will be developed. This approach provides a way of relating or connecting the social relations and forms of power implicated in rendering the genetic capacities of lifeforms 'docile' and domesticated for social objectives. Within a relational orientation, the processes through which social

ordering or governance is achieved are treated as a problematizing activity that seeks to bring reality into alignment with scientific, political and social objectives. A relational approach provides a means of exploring relations between humans and non-human actants, as well as how the social is heterogeneously constituted through clusters of relations that can be analytically broken down for the purpose of social analysis.

The concept of patent regimes as a governmental technology will be developed to connect the practices through which life is being legally appropriated with specific forms of scientific and regulatory knowledge. As a governmental technology, patent regimes can be thought of as distinctive regulatory configurations that mix together law, science, technology and economics in the process of creating property rights over technological inventions and technical knowledge. Patent law is constitutive of social relations by acting upon the conduct of social actors through the specification of the criteria of patentability, and more importantly, relations amongst social actors through the attribution of property rights to a patent holder. As a technology of power, the patent regime can be associated with a range of other governmental technologies and be invested by specific political rationalities.

The legal appropriation of life is made possible by the discourses and practices of molecular biologists through the creation of a rupture within the modernist episteme in which the study of life was located. Laboratory practices, techniques, skills are the technologies that are mobilized in the production of scientific knowledge and the intervention upon the reproductive capacities of living organisms. A result of these social practices have been to place humans in the demiurgic position of creator of new forms of life. An effect of these 'genetic discourses' has been to render bodies 'docile' and give

rise to a series of *genetic technologies* that mobilize reproductive capacities to suit medical, industrial, agricultural, and social objectives. The forms of power that have come to be exercised over organisms' reproductive capacities can be considered a more individualizing form of power by targeting its molecular basis. The body-power-knowledge relations that are at play in rendering bodies productive and docile can be best encompassed by the term *genetic technologies*.

Through the production of regulatory knowledge, the appropriation and domestication of life for social purposes is further effected. The domestication of biotechnology refers to a scientific, social and discursive process through which the risks associated with the genetic manipulation of life are rendered passive and *genetic technologies* are mobilized for social and economic purposes. Through a study of the production of regulatory knowledge concerning biotechnology, it becomes possible to outline the problems that political authorities have posed for themselves and delineate the institutional sites that are considered appropriate to regulate *genetic technologies*. The processes through which official publications are produced will be considered as a form of intellectual technology that translates things, events and phenomena into a format amenable to the deliberations of political authorities. Broadly conceived, the emergence of a body of knowledge on biotechnology will be considered as part of a regulatory configuration that attempts to establish and stabilize particular sets of socio-material relations.

Lastly, reforms to Canada's patent regime, will be examined as it constitutes a condition of possibility for the legal appropriation of life. In the case of genetic technologies, changes to Canada's patent regime have been guided by a strategic concern

to reduce the uncertainty surrounding the patentability of lifeforms and an attempt to harmonize Canadian law with international practices. In this light, reforms to Canada's patent regime form part of a general line of force that seek to promote the commercialization and diffusion of genetic technologies. The processes through which genetically modified organisms are being incorporated into the domain of patent law is not the result a global strategy, but rather an outcome of a series of clashes and alignments amongst a multiplicity of strategies pursued by social actors on a variety of social and spatial scales. The legal appropriation of life is being accomplished through a transformation in the political rationality invested in patent regimes, the discourses of patent agents, legal decisions handed down by the courts, state projects, and the harmonization of patent legislation through international negotiations.

Chapter 1 outlines the theoretical perspective that will be employed throughout the thesis. The main bodies of scholarship that are surveyed consist of the strategic-relational approach, actor-network theory, and the governmentality literature. Drawing mainly from the governmentality scholarship, a relational approach will be developed. It will be argued that a relational orientation allows for emphasis to be placed on the multiplicity and diversity of strategies, tactics and forms of knowing that enable the governance of the legal appropriation of life.

The focus of Chapter 2 consists of drawing out how patent regimes can be considered as a governmental technology. An effort will be made to illustrate how patent granting practices constitute a regulatory/property regime as a means of fleshing out how it is concerned with regulating 'invention' and creating property rights over new technology and technical knowledge. The forms of knowledge, regulatory agents, modes

of moral regulation, and practices that inform the issuance of patents will be drawn out as means of highlighting how it functions as a technology of government.

The issue of how the ‘genetic discourses’ of molecular biologists transformed the modernist episteme in which the study of life was located forms the concern of Chapter 3. This chapter outlines a profound transformation within the discursive formation of molecular biology which has served to define humans as the creator of new forms of life. Laboratory practices will be examined as they provide a new means of representing and intervening upon the reproductive capacities of living organisms. The concept of *genetic technologies* will be developed in this chapter as means of capturing the body-power-knowledge relations implicated in the appropriation of life through scientific practices.

Chapter 4 examines how biotechnology and *genetic technologies* have been constituted as an object of regulatory knowledge. The emergence of this body of knowledge will be studied as part of an attempt to establish and stabilize particular sets of socio-material relations. The official publications produced by the Organization for Economic Cooperation and Development, Canadian state agencies, and Quebec bureaus will be examined as they constitute an intellectual technology through which the appropriation of life is being mediated.

The study draws to an end in Chapter 5 which examines legislative reforms to Canada’s patent regime. Reforms to the *Patent Act* will be considered as a state project which seeks to reduce the uncertainty surrounding the patentability of higher lifeforms and harmonize Canadian patent law with that prevailing in other industrialized countries. This chapter will highlight the transformation of the political rationalities that are invested in patent regimes.

Chapter One

Toward a relational political economy: Agency, power and governance in the appropriation of life

This chapter is concerned with outlining the main bodies of scholarship which serve as a basis for investigating the processes through which the appropriation of life is being accomplished. Through an exploration of questions of agency, power, and governance, it is possible to relate the practices of manipulating life with reforms to Canada's patent regime. The bodies of scholarship that will be examined consist of the strategic-relational approach, sociology of science, and governmentality literature. These diverse bodies of scholarship direct attention to the question of how power is exercised relationally and the how the social is heterogeneously constituted. A common trait which these approaches share is a concern to develop non-reductionist types of analysis by placing emphasis on the contingency of social relationships and the complex of determinations through which governance and social ordering are achieved.

Through a study of these bodies of literature, a relational approach to political economy will be advocated as it provides a strategy for grasping how the appropriation of life is being accomplished through a combination scientific discourses and practices, forms of regulatory knowledge which constitute biotechnology as its object of governance, and state projects which seek to reduce the uncertainty surrounding the patentability of higher lifeforms. A relational orientation is best defined as a "concern that insists that to study any social phenomena must ensure that its general perspective is focused on its connectedness to other social phenomena." (Hunt 1993: 303) The terrain on which the appropriation of life is being achieved involves a study of the social actors,

discourses, practices, forms of knowing, technologies of power, and the political rationalities that are invested in it. Within a relational orientation, the processes through which governance is achieved are treated as a problematizing activity that seeks to bring reality into alignment with scientific, political and social objectives. Governance is understood as a process that is subject to failure and as the contingent result of the assemblage of a range of social actants. Lastly, the social is treated as being heterogeneously constituted through clusters of relations that can be analytically broken down into the scientific, textual, technological, legal, political or economic.

Strategic-Relational Approach:

The work of Nicos Poulantzas (1978) and Bob Jessop (1982, 1990) provide a mode of explanation and an approach to the analysis of the state consistent with the overall framework that will inform the thesis. In contrast to orthodox Marxist approaches, the strategic-relational approach is not concerned with explaining the social in terms of abstract, unitary laws of motion or through positing the state as an agent of class domination, but rather with developing a series of concepts by which to examine the concrete modalities of power and the institutional ensemble of the state. By placing emphasis upon the relational character of power, the social comes to be understood in terms of its contingent and conjunctural character, rather than being determined by a series of transhistorical laws. Although the state forms the predominant focus of their analysis, the strategic-relational approach insists that any state theory must form part of a broader theory of the social. Their analysis of the state can thus be supplemented by other

forms of social theory whose mode of analysis differs from the strategic-relational approach.

The strategic-relational approach maintains a non-structuralist and non-voluntarist account of agency. This approach to agency provides a means of accounting for how social agents besides individuals can develop distinctive identities, have interests, and engage in processes of strategy-formulation and implementation. This epistemological position allows for an assignation of agency to the state departments, international organizations, laboratories, corporations, business associations, and lobby groups that are involved in achieving the legal appropriation of life. Consistent with their relational orientation, social agents are seen as non-unitary subjects constituted in and through discourse, as well as by state practices. It is through processes of strategy formulation and by the articulation of their interests that the identity of social actors is shaped. The identities of social actors are understood as being defined in relation to one another and are subject to change over time. Through discursive processes, social agents define the identities of other social actors, as well as constitute the objects they seek to govern or regulate. Discursive practices thus are understood as being constitutive of the strategies which social actors formulate, the nature of the objects that are to be governed, and the spatial and temporal horizons of social action. (Hay and Jessop 1995: 6) The ability of social agents to exert an influence upon a particular social outcome is contingent upon their discourses being within the boundaries of the strategic imaginary and their ability to match the temporal and spatial scale on which an issue is being discussed. (Hay and Jessop 1995: 6) The question of how social agents exercise power is thus posed in relational terms.

In relating his concept of power to that of Foucault, Poulantzas (1978) adheres to a position “that power itself is not a quantity or object of possession, nor a quality linked to a class essence or a class subject (the dominant class).” (146-147) In a later passage, Poulantzas suggests that the “*field of power is therefore strictly relational*” (147; italics in original) Building upon this concept of power, Jessop (1982; 1990) places emphasis on how power has to be seen in conjunctural and relational terms, rather than a sum of fixed resources which can be appropriated by one social force to the exclusion of others. Through an adherence to a relational concept of power, it ceases to function as principle for the explanation of social relations, but alternatively, social analysis becomes concerned with studying the field or effects of power relations. The analysis of power thus becomes concerned with studying the modes of organization, modes of calculation, the resources, strategies, and tactics of different social agents, as well as the composition of structural constraints and conjunctural opportunities they confront which helps to determine the overall balance of forces. (Hay and Jessop 1995; Jessop 1982) This approach suggests that we do away with explaining power or social phenomena in terms of a single point of origin such as the economy, or an originating subject in the form of the state or a class. Alternatively, the focus of analysis becomes concerned with exploring the “synthesis of multiple determinations which produces actual events cannot be reduced to a single point of explanation, but must be interpreted as the result of the interaction of various causal chains.” (Jessop 1982: 252; Mahon 1991) A strategic-relational approach attempts to construct historical accounts of the combination of forces, actions, structural constraints that are necessary to produce the effects in question.

In dissolving orthodox Marxist accounts of the state as a unitary actor, the state is considered as an institutional ensemble which encompasses a broad range of actors that are not solely defined in relation to its formal political institutions. By defining the state in such a manner, the question of how it is able to give the appearance of acting as a unified political actor comes to the surface. Within the strategic-relational approach, the state is not only an institutional ensemble, but more important, a site where strategies are elaborated. As an institutional ensemble, the state possesses a range of modes of calculation, operational procedures, and a series of practices which seek to deploy these institutions and capacities for a range of highly specific ends. Posed in methodological terms, an analysis of the state requires a study of the strategies and tactics that state managers and politicians develop to impose a relative unity and coherence to the activities of the state. (Jessop 1990: 263) However, state policy should not be conceived in terms of a global strategist, but rather as the outcome of the collision of mutually opposed tactics of a multiplicity of diversified micro-policies. (Jessop 1990; Poulantzas 1978: 135-36) The concept of 'strategy without strategists' is best able to summarize an approach which stresses the contingency of social outcomes, whilst adhering to an understanding that social agents engage in processes of strategy formulation.

It is on the terrain of the state that the strategic-relational approach offers some important contributions to the analysis contained in the thesis. Consistent with the relational orientation and approach to power, the state is understood as both a social relation, and as an institutional ensemble which does not possess any power of its own. (Jessop, 1982; 1990) The question of how the state exercises power becomes one of explaining the social forces which operate in and through the state. (Jessop 1990: 256)

However, the exercise of state power is not posed in terms of an endless play of power relations in which social actors have equal access to the formation of state policy; alternatively, the state is understood as not being a neutral arbitrator amongst the diverse strategies advanced by social agents. Rianne Mahon's (1977; 1984) concept of the "unequal structure of representation" and Bob Jessop's (1982; 1990) notion of "strategic-selectivity" provide a means of addressing how the state unequally mediates amongst diverse social forces whilst maintaining a relational conception of power and an approach which stresses the contingency of social outcomes. Both of these concepts serve to suggest that the structure and mode of operation of the state is open to certain agents and political strategies at particular historical moments which is nonetheless subject to change over time. The concept of strategic-selectivity captures the notion that structural constraints are temporally, spatially, agency and strategy specific. (Hay and Jessop 1995: 8)

Added to the concept of strategic-selectivity is the notion of discursive selectivity. The discursive character of strategic-selectivity suggests that social actors perceive the world through particular frames of reference and employ certain forms of calculation that can become inscribed in the organizational practices of the state giving it a certain degree of regularity. (Hay and Jessop 1995: 8)

The character of this discursive and strategic-selectivity is the result of the crystallization and condensation of past political and social struggles thus furthering Poulantzas understanding of the state as the "material condensation of a relationship of forces". (Poulantzas 1978: 152)

Through an understanding of the state as a condensate of past political struggles, an explanation of how social relations attain a relative degree of stability or durability is elaborated. The implications of this approach suggest that an analysis of the state and the social should

pay attention to the structure of constraints and opportunities that are open to social agents at particular historical moments.

Despite the overall strengths of the strategic-relational approach, a number of criticisms can be made which provide a preliminary outline of the criteria that constitute the mode of analysis employed to study the subject matter of the thesis. A restriction of the non-voluntarist and non-structuralist account of agency put forward by the strategic-relational approach consists of confining the ascription to agency to collective actors such as corporations and state departments, whilst excluding the agency of non-human actants. The strategic-relational approach is thus subject to the speciest critique elaborated by Bruno Latour (1987) which suggests that social analysis should examine relations between humans and non-humans as part of an analytics of power and domination. By opening the door to non-human actants, it becomes possible to explore the social as a heterogeneous ensemble that mixes together and juxtaposes the scientific, technical, architectural, textual, and the economic in a format that is able to hang on to approach which places emphasis upon the contingency of social relations.

A further problem concerns the underdeveloped concept of discursivity in the strategic-relational approach. While the concept of discursive-selectivity suggests that social agents and state departments are informed by particular systems of thought, these modes of organizing thought are not explicitly related to rational deliberations over the art or practice of governing an economy or population as suggested in some of Foucault's later work on 'governmentality'. The relation between the natural sciences and human sciences, to state practices are left relatively underdeveloped within the work of Poulantzas and Jessop.

The relation between power/knowledge and the practices of the state form the basis of a final criticism. Specifically, what enables the state to act as centre or govern domains such as the population or the economy? Although the strategic-relational approach understands the state as a social relation and institutional ensemble whose form and mode of operation can be appreciated in terms of the condensation of past political struggles, it fails adequately to concern itself with how the state operationalizes its multiform strategies. Both the sociology of science and governmentality literature provide a means of relating the micro-practices through which power is exercised with its aggregation in more global sites. This does not suggest that the strategic-relational approach is incommensurable with these modes of analysis; rather it is a partial attempt to locate the state in a broader theory of the social.

Sociology of Science:

Through detailed and local studies of how science and technology enable scientists to obtain a transformed hold upon the world, sociologists of science such as Bruno Latour (1987), Michel Callon (1986a, b) and John Law (1986, 1991) provide an array of conceptual tools with which to address questions of agency, power and the precarious achievement of social ordering. By adhering to their methodological principles of following scientists and technicians in action, and by symmetrically accounting for the successes and failures of science and technology, sociologists of science have developed an actor-network approach and translation model to account for the power of science in society. The relevance of this approach to the overall argument of the thesis, is the ascription of agency to non-human actants and by illustrating how entities other than

humans can play a role in the structuring of power relationships, generating knowledge, and in processes of social ordering and domination. Through their translation model, power and agency are relationally defined, with the capacity to exercise power understood as being derived from a network of relations. Finally, through their studies, sociologists of science are able to demonstrate how the social is heterogeneously constituted through the juxtaposition of humans, non-humans, nature, texts, technical artifacts, financial resources and skills. (Callon 1991; Callon and Law 1997; Law 1991)

Sociologists of science contribute to non-voluntarist and non-structuralist accounts of agency by adding the important qualifier that agency should not solely be assigned to individuals or persons. Agency is acclaimed as not solely residing in humans and collective actors, but also in technical artifacts such as centrifuges, electric automobiles and door-closers. (Callon 1986) Similar to the strategic-relational approach, the identity and character of both humans and non-humans actants is understood as being defined in relation to one another and through social action. Through the development of a speciest critique, the sociology of science literature is able to integrate non-human actants into an analytic of power relations and social domination.

A central concern which informs the work of sociologists of science is the question of how power is exercised. Occupying a similar terrain to that of Foucault, power is understood as a substance that cannot be possessed and as an enabling phenomena. (Latour 1986a; Law 1986b; Law 1991) In contrast to the strategic-relational approach, which prefers to examine the complex of multiple and contingent determinations which produce certain social outcomes, sociologists of science privilege the study of the construction of long techno-social networks as a means of investigating

the effects of power. (Latour 1986a) Through detailed studies of how social networks are constructed it becomes possible to explore how humans and non-humans actors become associated with one another.

In addressing the question of how power is exercised in relational terms, sociologists of science have developed a translation model. Through the concept of translation, it becomes possible to account for the diffusion of knowledge and technical artifacts across space and time. Within the translation model, power is understood as a series of variegated strategies that are differentially successful in their attempt to enroll others. (Law 1986b) In summary form, translation can be thought of a series of attempts to impose versions of reality upon a range of social actors whose successful enrollment helps to facilitate the diffusion of statements and technical artifacts, alongside the network of relations. The translation model is able to hang onto a conception that social relations are contingent through an emphasis upon how processes of translation and enrollment are uncertain and ultimately reversible. The success of a particular series of translations and thus of the network itself, is contingent upon the actors enrolled not falling out of the roles that have been assigned to them. (Latour 1987, 1991) This final point is illustrated by Michel Callon's (1986b) study of a group of scientists whose efforts to promote the restoration of the scallop fishery of St. Brieuc Bay were undermined by the failure of the scallops to attach themselves to a series of nets designed to encourage their reproduction, and by the scallop fishers themselves.

One of the greatest strengths of the translation model is its notion of displacement. For the present moment, displacement will be considered in the sense of the enrollment of social actants and how technical artifacts enable for a transformed hold upon the world to

be achieved. The concept of 'obligatory points of passage' captures how one actor is able to enroll or force another along a particular path as a means of resolving a particular social or technological problem. Through the establishment of an obligatory point of passage, social actors are able to open certain possibilities while others are foreclosed. To a certain extent, obligatory points of passage can be thought of as working upon the conduct of social actors. Through the establishment of these passage points a relative imposition and stabilization of the identity and character of actors is established through reference to a particular problematization and techno-social networks. The translation model thus develops an account of how human and non-human actants are displaced in the process of constructing social networks and are made to work for particular objectives. In a strong sense, translation involves becoming a spokesperson for the entities that are being translated. Spokespersons coordinate a network of roles for the entities that are being translated and account for any possible sources of resistance that the displacement of social and technical actants may provide.

The notion of displacement is elaborated in a further sense through discussions of what accounts for the power of science within society. The sociology of science literature is concerned with explaining how scientific knowledge is produced and the practices that allow scientists to represent nature and achieve a transformed hold upon it. (Latour 1987) In dissolving the claim that scientists have privileged access to the natural world, science is demonstrated to consist of a series of highly specialized practices and forms of knowing. The production of scientific knowledge has to be understood by way of the practices that scientists use to represent nature. The diffusion and dissemination of scientific knowledge is claimed to rest on the construction of long techno-social networks

that bring together scientific knowledge, machines, skills, financial resources and persons. By advancing this claim, the distinction between pure and applied science becomes elided which is useful to the argument of this thesis. (Latour 1987) Through the sociology of science literature, the laboratory can be seen as a site that enables the pursuit of politics by other means.

In terms of accounting for how science enables the social and natural world to be refashioned according to its dictates, sociologists of science study the inscriptions, texts, and networks mobilized by scientists in the process of constructing knowledge and disseminating technical artifacts. Through a diversity of practices and the production of a range of inscriptions, scientists are able to transform local events within the laboratory into forms of knowing and ways of acting upon the world. The technical artifacts and practices that enable scientists to represent the natural world take on a profoundly political role in that they make possible a range of spatial and temporal displacements that facilitate long-distance control. The practices that provide the means to represent the natural and social realm are referred to as 'inscription devices'. Inscription devices can be produced through machines such as Richter scales, or through social practices like writing. Inscriptions can further be thought of as 'immutable mobiles' since they are easily transmittable, reproducible and combinable with a range of other inscriptions. (Latour 1986b) In an important sense, inscriptions aid the invention of a language and a range of visual tools by which to describe a domain of social activity. Through the production and distribution of a range of inscriptions, they help to translate the natural world into the domain of thought and calculation through its simplification and presentation to the eye. Inscriptions help to make possible long-distance control by

collapsing time and space by enabling the juxtaposition of unrelated and distant events. (Latour 1986b, 1987). The power of science within society is achieved through a successive series of displacements.

Through an examination of the diverse and heterogeneous processes leading to the construction of technosocial networks, a further notion of displacement is developed: that of 'action at a distance'. Through the accumulation of inscriptions in a central locale, it becomes possible for this centre to act upon distant persons and events. The capacity of this centre to act at a distance is dependent upon the strength and stability of the actors and entities enrolled in a particular techno-social network.

Despite the overall strength and theoretical coherence of the sociology of science literature, a number of problems within this approach can be highlighted to differentiate it from the analytic of power to be employed throughout the thesis. One of the most salient differences concerns the issue of how the exercise of power is conceptualized. Within the translation model, the construction of technosocial networks is contingent upon the ability of one actor to convince and enroll others into following a prescribed set of possibilities. The problem with such an approach is that it tends to privilege and highlight the activities of one social actor over the numerous others that are involved in the process of constructing stable technosocial networks. The issue is most clearly evidenced through the sociology of science literature's almost exclusive focus on the activity of scientists and engineers in their studies of how techno-social networks are constructed. By privileging particular social actors, the translation model relegates to the sidelines the multiple and contested sites through which social ordering is achieved.

Building upon this critique, the sociology of science literature tends to conceptualize the exercise of power in a rather linear and flat manner. Although the agency of social actors is conceived in strategic terms and power is seen as an effect or result of the creation of social networks, sociologists of science are ultimately unable to move away from the concept of a strategy that does not involve a global strategist. The construction of technosocial networks is primarily examined from the perspective of scientists and engineers who enroll a range of human and non-human actants in the process of generating and diffusing scientific knowledge and technical artifacts. Drawing on this approach, the exercise of power can only be understood to take place through the successful enrollment and “interreusement” of a successive chain of social actants rendering their analysis of power as flat and linear.

While sociologists of science develop the useful notion of ‘action at a distance’ the radical possibilities of this concept are not successfully explored to its full potential. The concept of ‘centres of calculation’ lacks an accompanying or corresponding account of the condensation of power relations in particular social locations. The ability of a site of act as a centre of calculation is understood in the flat sense of the accumulation of inscriptions in a particular site. Absent from this concept is any sense of permanence or regularity in the activities and practices of these locations over time. The durability of the social is solely understood in terms of the successful translation of social actants and the creation of black-boxes around technical artifacts. The issue of considered deliberations over the art and practice of governing a population, economy or any social domain, is neglected in preference for focusing on the series of translations and mechanisms that enable long-distance control. The approach to be developed prefers to stress the

contingent character of social agency, whilst maintaining that a certain element of regularity pervades social relationships through the condensation of power in particular institutional locations and ordered procedures for the production of truth.

Governmentality Literature:

The approach which informs the present inquiry is the growing body of “governmentality” literature. Through this literature, it becomes possible to address some of the critiques that I have made about the strategic-relational approach and actor-network theory. This body of scholarship builds upon Michel Foucault’s work to reflect upon questions of how power is exercised and the processes through which the governance of the social is achieved. The usefulness of this literature to the argument of the thesis lies in its ability to link the forms of power that are exercised over life itself with the governance of populations and the economy. In other words, the governmentality literature provides a means of associating the micro-physics of power with its condensation and crystallization in more global locations such as the state.

While this chapter has outlined various approaches to the exercise of power that are consistent with a Foucauldian approach, a domain that has been left unexplored is the question of the forms of power that are exercised over life. In the *Order of Things* (1970), Foucault’s reflections on natural history and the biological sciences illustrated how a profound transformation took place in the eighteenth century in which life itself became an object of knowledge. These themes are further developed in *The History of Sexuality* (1977b) to draw upon the ways that knowledge of life became associated with the governance of populations and sexuality. In this volume, Foucault makes the argument that the transition to modernity can be understood in terms of how knowledge

and techniques of power assume responsibility for life and undertake to control and modify it. Foucault uses the term bio-power to designate the processes through which life enters the domain of political calculations and power/knowledge relations become invested in it. (Foucault 1977b: 143) Through the concept of bio-power, it becomes possible to link *genetic technologies* with the appropriation of life through science, regulatory knowledge, and reforms to Canada's patent regime.

In contrast to the sociology of science literature, the governmentality scholarship is able to address the issue of the forms of knowing and the rationalities that are implicated in the governance of laboratories, enterprises, and the economy. As opposed to developing a theory of the state, the governmentality literature is concerned with exploring the operation of governmental power, the techniques and practices by which it works, and the rationalities and strategies that are invested in it. (Dean 1994: 179; Miller and Rose 1990) The question of how the state is implicated in processes of governance forms an object of inquiry. (Rose and Miller 1992)

Within this literature, government is understood as the "conduct of conduct". (Gordon 1991: 2) This understanding of government dissociates itself from a perspective that only formal political institutions govern to one that sees government as a series of activities oriented towards shaping, affecting, and guiding the conduct of persons. Through the development of this concept it becomes possible to understand governance as a process that concerns relations with the self; interpersonal relations; relations within social institutions, and political sovereignty. (Gordon 1991) Similar to the strategic-relational approach, the question of the state is posed as something that needs to be explained rather than a principle of explanation. The character and nature of the state is

understood as a result or effect of the changing practices of government. In contrast to the strategic-relational approach which tends to privilege the role of social agency, the governmentality literature is further concerned with highlighting the forms of knowing, practices and strategies that make it possible to govern particular social domains.

The forms of knowing, mentalities, problematizations and practices involved in rendering objects of governance into a language and form that render them subject to administration is encompassed by the term political rationalities. (Gordon 1991: 3) Political or governmental rationalities can be thought of as a mode of thinking about the nature and practice of government which makes that activity knowable to both its practitioners and those upon whom it is practiced. Political rationalities can be thought of as the changing discursive fields in which the exercise of power is conceptualized, the moral justifications that are put forward, the appropriate forms, objects and limits of politics and the proper distribution of tasks among political authorities. (Miller and Rose 1990; Rose and Miller 1992) A political rationality may assemble and codify different technologies of power as part of rendering the social amenable to governance. However, technologies of government form part of the conditions of possibility for particular political rationalities. (Dean 1994: 188)

Within the governmentality literature, a concept which provides a link between the human sciences and the various ways that authorities have sought to govern the 'conduct of conduct' is 'technologies of government'. (Dean 1996) Technologies of government can be defined as the complex of mundane mechanisms, programmes, calculations, techniques, apparatuses through which authorities seek to embody and give effect to governmental ambitions. (Rose and Miller 1992: 175) Technologies of government

suggest that there are patterns of association between forms of organized thought and the practical means that make it possible to act upon the conduct of persons and things. The governmental character of technologies emerges through attempts to structure the field of possible actions of those over whom authority is to be exercised so that their conduct is rendered both measurable and calculable. This concept further provides a means of relating how non-human actants can play a role in the construction of knowledge and in the practical enablement of government through the visualization, recording and inscription of particular spheres of social and natural existence into the domain of thought. This capacity of technologies of government to shape conduct is brought about through the assemblage of heterogeneous relations and mechanisms oriented towards rendering particular domains amenable to calculated deliberation and intervention. These assemblages involve a combination of forms of knowing, techniques of government, technical objects, financial resources, means of communication, professional expertise and a range of skills. Technologies of government can attain a relative degree of stability over time through the consistent application of some form of relatively systematized knowledge to the practical problems that are involved in the exercise of political authority. Through the complex assembly of a range of diverse forces and relations, technologies of government allow for the condensation of power at particular social locations. The institutionalization or institutional locations where technologies of power are situated, thus forms an important component in the analysis of power.

The governmentality literature makes use of the terms ensemble, assemblage or configuration as a means of capturing the processes of governance. As part of the analysis of governmentality, Foucault (1991) suggested that it consists of an “ensemble

formed by the institutions, procedures, analyses and reflections, the calculations and tactics that allow the exercise of this very specific albeit complex form of power,...”

(102) Through the use of the term government, an attempt is made to draw “attention to the diversity of forces and groups that have in heterogeneous ways, sought to regulate the lives of individuals and the conditions within particular national territories in pursuit of various goals. (Miller and Rose 1990: 3) Governance thus involves a combination of forces, forms of knowing and institutional practices in the process of rendering particular fields amenable to planned deliberation, intervention and regulation. Concepts such as assemblage or configuration are used to highlight how the governance of the social takes place through a series of grouping or clusters of different types of regulatory initiatives. (Hermer and Hunt 1996: 460; Hunt 1993) The term configuration is able to capture how different elements are associated, yet shift with instances of regulatory occurrences. Using the term assemblage or regulatory configuration makes it possible to address the Latourian question of how it is possible to act on distant events in a non-linear fashion. In contrast to actor-network theory, the “notion of an assemblage implies lines of continuous variation that can never be homogenized into a linear process of change and transformation. Objects of knowledge and perception, organizations, subject-forms, and other more or less durable entities, can be approached as assemblages insofar as they are analyzed as an outcome or a compound of forces and relations.” (Dean 1996: 55)

The governmentality literature provides a range of conceptual tools by which to study power relations and the practices of government. This approach is further able to link ordered procedures for the production of truth with the rationalities implicated in rendering a domain amenable to administration and intervention. Lastly, this body of

literature provides a means of reflecting upon the state as an assemblage of diverse forces and as a technological domain.

However, the concept of governmentality is unable to sufficiently account for the condensation of power in particular institutional locations such as the state. The strategic-relational approach to the question of state power will thus be employed as a means of interrogating how power relations condense in and around the state.

Conclusion:

To summarize briefly, the mode of analysis that will be developed throughout the thesis can be considered as relational in orientation. This approach suggests that agency should not be assigned exclusively to persons or collective actors, but also to a range of non-human actants. A relational political economy is further concerned with the study of power in a fashion that stresses the complex of contingent determinations through which it is exercised or realizes its effects. A consequence of adopting a relational approach is to place emphasis upon the multiplicity and diversity of strategies, tactics and forms of knowing that enable the governance of the social. Governance will be treated as a problematizing activity that is constituted by deliberations over the very practice of governing and oriented towards acting upon the conduct of others. The governance of the social will be considered as a process which mobilizes a diverse range of actors, institutions, forms of knowing, and technologies of government. The following chapter examines patent regimes as a technology of power as a means of drawing out how the regulation of invention is constitutive of the processes through which life is being appropriated.

Chapter Two

Patent Regimes as a Technology of Power

This chapter will study patent regimes as a technology of power to elucidate the connection between the practices through which life is being appropriated and changes to Canada's intellectual property laws. Patent regimes are distinctive configurations that mix together law, science, technology and economics in the process of creating property rights over technological inventions and technical knowledge. By examining patent regimes as a governmental technology, the combination of forms of knowing, institutions, regulatory agents, experts and practices that inform the issuance of patents and the governance of 'invention' can be successfully explored. Patent law is constitutive of social relations by acting upon the conduct of social actors through the specification of the criteria of patentability, and more importantly, relations amongst social actors through the attribution of property rights to a patent holder. The practice of granting patents will be considered as a regulatory/property regime as a means of fleshing out how it is concerned with regulating 'invention' and creating property rights over new technology and technical knowledge. As a technology of power, the patent regime can be associated with a range of other governmental technologies and be invested by specific political rationalities. The overall importance that has been accorded to the patent regime in terms of the range of economic policy tools available to the state is an issue that will be explored in Chapter 5.

As a means of highlighting the technological character of government, attention will be accorded to practices through which patents are granted. These practices are

significant since they help to render scientific and industrial research into a form of property. Through highly specialized procedures and methods of writing, patents translate the domain of invention into a calculable entity that can be deliberated upon by patent office officials, patent agents, judges and corporations. In a dual sense, these specialized practices enable these agents to work upon patents at a distance, yet the end result of these procedures allows the holders of patents to act upon the conduct of others across time and space. The dependence of these practices upon patent law provides a means of highlighting how law plays a coordinating role in technologies of power and is at the same time constitutive of certain social relations. (Hunt 1992) In an important sense, legal discourses place limits on the possibility of social action and impose certain discursive restrictions. The strategic and discursive limits of patent law can be illustrated by way of reference to its formal criteria which consist of patentable subject matter, novelty and disclosure. Through these stipulations, patent law helps to demarcate and reinforce boundaries between the forms of technology that are considered patentable, the scope of proprietary protection that should be afforded to inventors, and between the categories of 'invention' and 'discovery'. As a new form of technology, *genetic technologies* provide ample opportunity to study the social processes through which these boundaries are renegotiated as the details concerning their patentability have yet to be fully settled. (van den Belt 1989) A discussion of the processes through which patent law and its associated practices are being renegotiated forms a project that will be worked upon in subsequent chapters.

By studying patent regimes as a technology of government, it also becomes possible to disrupt the internalist narrative of patent law predominately put forward by

patent scholars and economists. These narratives exhibit a tendency to present the issuance of patents as a well oiled machine that is able rationally to distinguish amongst inventions that merit patent protection on the basis of clearly defined and time-tested criteria. An effect of these discourses is to create a black-box around patent granting practices. Raising questions about whether certain technologies should be patented leads to a confrontation over what are considered the proper ends and means of the patent system—that is, the promotion of technological innovation, industrial progress, and the widespread dissemination of technical information. The persons who are acclaimed to be authorized to tinker with the black-box on the basis of their knowledge and technical expertise are economists, patent agents, patent examiners and judges. On the basis of their expertise, these authorities are acclaimed as competent in determining the forms of technology which should receive patent protection, the criteria by which patent applications should be assessed, and the proper scope of a patent grant. The social, political and ethical questions encompassed by the patenting of certain forms of technology are proclaimed to lie outside the boundaries of patent law.¹ As with most of the ‘black-boxes’ that patents afford proprietary protection, a price tag is usually affixed to the device. In the case of the patents, the social cost of issuing them, according to patent agents and economists, consists of granting an inventor a state enforced monopoly for limited number of years. To a certain extent, this chapter aims to open the black-box that has been created around patents.

¹ A number of authors have suggested that ethical and political concerns should be excluded from questions of whether certain technologies should be granted patent protection. See Avisar (1993); Crespi (1995, 1997); Dresser (1988); Hoffmaster (1989); and Merges (1988). Within the Canadian patent literature, an exception to this view is Chong (1993).

Through the interventions of social scientists, the black-box which attempts to enclose patents has begun to give way. The controversies generated by the patenting of lifeforms and segments of the human genome, concerns expressed over the proprietary implications of new reproductive technologies, and the inclusion of intellectual property rights within the framework of international trade agreements has fostered a growing and vibrant body of literature on the subject. In contrast to the patent literature, the economic, social and ethical concerns raised by the practice of granting patents constitute a legitimate subject matter. The debates that are most useful to the present inquiry are located within the history of technology, sociology of science, and governmentality literature. The approach developed in this chapter borrows heavily from these bodies of literature in its attempt to understand patent regimes as a technology of power.

In their concern to assess the role of the patent system in processes of industrial development, technological historians have provided a complex and rich account of the emergence and evolution of patent regimes. Through their detailed historical investigations Dutton (1984), Macleod (1988) and Lubar (1991) illustrate how the early evolution of the patent system was shaped by the complex interplay of the changing state of economic and technological development, the interpretation of patent statutes by judges, and the concerns raised by users of the patent system such as professional inventors, corporations and patent agents. Their work illustrates how the evolution of patent law was shaped by changing conceptions of the economy and economic development, demarcations of the proper role of state intervention in the economy, and the use of law to promote technological progress. The materialist dimension implicit in their work illustrates how the patent system introduced an element of stability and

calculability into the ‘invention industry’ through the assurances that property rights over an invention offered. These interpretations serve to challenge the internalist narrative put forward in the intellectual property literature which assert that the British Statute of Monopolies 1624 and the United States Patent Act of 1790, established the principles which inform modern patent laws.²

Building upon actor-network theory, sociologists of science have studied patents as a means of exploring the interplay between science, technology, and the law. Within this literature, patenting is described as an activity that takes place through heterogeneous networks and involves the mobilization of a range of social actors, technical artifacts, institutions, and an array of specialized skills. (Bowker 1992; Myers 1995; Packer and Webster 1996; van den Belt 1989) By treating patents as texts or statements, they are able to show how patents form part of the strategies and tactics which social actors deploy in the processes of enrolling and translating other actors, things, and institutions into long techno-social networks. (Law 1986a; Rip 1986) The strength of a particular patent is dependent upon the successful translation of a range of actors and the ability of a patent to withstand legal challenges in the courtroom. (Bowker 1992) Through detailed case-studies of the writing of patent texts, the distinction between ‘invention’ and ‘discovery’, and the taken-for-granted criteria of patent law such as ‘novelty’, ‘obviousness’ and ‘person skilled in the art’ emerge as being socially constructed. (Myers 1995; van den Belt, 1989; Packer and Webster 1996) Patent law is demonstrated to be reliant upon the knowledge and judgments of scientists, patent agents, patent office officials and judges in the course of writing and processing a patent application.

² This type of account can be found in Fox (1947, 1969); Deller (1964); and Fisher and Smart (1914).

The socially constructed character of the categories employed in patent law is brought to the forefront through studies of courtroom battles involving new technologies. (Cambrosio 1990; Mackenzie, Keating, Cambrosio 1990; van den Belt 1989; Campbell 1989) These courtroom battles serve to illustrate how patents can come apart at any point along its network and how patents work upon the conduct of a range of social actors. A consequence of both the writing of patent texts and legal battles over the claims contained in them is to reinforce and renegotiate the scope of patent law. (Jasanoff 1995; Rip 1986) In a broader stroke, legal proceedings and court cases help to construct and normalize particular orderings of science and technology in society, often through the exclusion of competing claims. The sociology of science literature on patents successfully demonstrates how the social, the economic, and the legal are co-extensive and constitutive of the technical and the scientific.

Drawing upon the governmentality literature, Sherman (1994) examines how patents are being increasingly used in Britain to manage public sector research. Patents are seen as a governmental technology that facilitates the introduction of accounting techniques into scientific practice. Within this context, patents provide a basis on which the output of research laboratories can be assessed and made knowable to the deliberations of government. Patents further facilitate the commercialization of public sector research by providing a medium through which it can be readily translated into the language of commerce. Lastly, patents act upon the conduct of scientists through the increased need to record laboratory activities and the requirement that laboratory workers keep more detailed notes should their research become the object of a patent dispute. In contrast to the sociology of science literature, Sherman is able to provide an account

which connects the micro-practices through which patents are granted with specific political rationalities.

Regulating Invention/Creating Property Rights:

The term patent regime has been employed in a very loose and vague manner. It is now time to elaborate more precisely and fully what is meant by this term. In a broad sense, the use of the term 'patent regime' is used to connote how patents form part of and are constitutive of scientific, technical, economic and social relations. Patent regimes can be thought of as distinctive configurations or assemblages which mobilize state institutions, domestic statutes, international conventions, patent office practices, case law, technology, technical knowledge, corporations, scientists, independent inventors, patent agents, lawyers and judges. In a more precise sense, patent regimes are used as a shorthand that attempts to capture its regulatory/proprietary character. These two terms are closely associated in that patent regimes attempt to regulate 'invention' or 'innovation' by creating property rights over new technology and technical information. In its regulatory capacity the patent regime is concerned with creating market conditions for the promotion of invention and innovation. The proprietary character of patent regimes creates limited property rights over scientific and technical information that confers the right to exclude others from making, using or selling the subject matter of a particular invention for a limited period of time. The distinguishing character of patent regimes as an economic technology is that it creates proprietary rights as a means to stimulate inventive activity.

The proprietary character of patent regimes is both complementary and constitutive of their regulatory dimension. Patents attempt to shape economic conduct (in the format of increasing inventive and innovative activity) by granting the right to exclude others from making, using or selling the subject matter of an invention for a limited period of time. The proprietary character of patents realizes its effects by requiring others to purchase, license, invent around, or infringe upon the subject matter of an invention. In opposition to considering a patent grant as a form of property which confers unlimited monopoly powers over abstract and intangible objects, patents can be thought of as possessing a 'variable geometry.' (Drahos 1996: Ch. 7) Understanding patents rights in terms of a variable geometry serves to highlight how they enter into the strategies and tactics of social agents, and the forms of resistance which may render patents worthless to its possessor. Patents may be used by firms to carve out particular market niches, a form of attracting venture capital for start-up research firms, and a means through which transnational corporations consolidate holds over particular markets. (Bowker 1992) Patenting also allows scientists to publish their research findings while maintaining an enterprise's proprietary interests, or a means through which public sector scientists secure access to private sector funding. (Sherman 1994)

The variable geometry of patents suggests that they be studied in relational terms. As part of networks, the protection that patents afford is inherently unstable. The capacity of a patent to act upon the conduct of others is contingent upon the network in which it is inserted and the capacities of its possessor. Legally, the proprietary protection afforded by a patent is inherently unstable since its validity can be successfully challenged by competitors in the courts, infringements can be difficult to determine and costly to

prosecute, and lastly, the scope of intellectual property protection available in other jurisdictions may whittle away the effectiveness of a patent. A number of extra-legal conditions such as whether the patented invention will find a market and the capacity to develop it on a commercial scale further serves to render patents unstable. By highlighting the relational and unstable character of patents it serves to address how patents may serve to facilitate the condensation and reinforcement of power in particular social locations. Less attention will be drawn to the proprietary character of patent regimes throughout the thesis in order to focus attention on their regulatory aspect.

In drawing out how patent regimes constitute a form of governmental technology and compose a distinctive regulatory configuration attention needs to be accorded to the forms of knowing that are implicated in the regulation of invention. As a regulatory configuration, the object that patent regimes seek to govern is the creation of property rights over new technology and technical know-how. The range of activities associated with invention include the development of a new technology, improvements to existing technologies, the diffusion of industrial techniques, and the dissemination of technical knowledge. The proprietary character of patent regimes illustrates how the deployment of specific forms of knowledge and modes of legal intervention has consequences for the distribution of benefits of those involved in the social practices subject to regulation. (Hunt 1993: 314) The range and forms of invention and technical knowledge that the patent regime seeks to regulate vary according to the state of technological development and the delineation of whether certain forms of invention fall within what is considered to be the proper subject matter of patent law. The types of technology considered patentable are thus subject to continuous reinforcement and renegotiation that are enacted in the

actual process of making patent claims and through their contestation in the courts. The issue of whether certain forms of invention should seek protection under the scope of patent law and not another form of intellectual property law is an issue that is decided upon by the inventor, her patent agent, and political authorities.

The regulation of property rights over forms of knowledge and their practical embodiment cannot be understood exclusively in terms of the patent regime, but as part of a broader regulatory configuration that includes trade secrets, industrial designs, copyright and trademark law. The patent regime can be conceived within a broader configuration encompassed by distinctive modes of intellectual property law as a means of capturing how particular domains of social life are subject to groupings or clusters of different forms of regulation. (Hermer and Hunt 1996: 460) In a general sense, the range of activities that patent regimes attempt to govern, form part of more global regulatory strategies and governmental technologies deployed by states to promote technological innovation, industrial development and economic growth. The overall role and importance that the patent regime is accorded amongst these diverse technologies is an issue that can be addressed as part of an analysis of the problems that political authorities have posed for themselves at particular historical conjunctures.

The distinctive forms of creating and regulating property rights over technical know-how and their practical embodiment leads into a discussion of the role that law plays in coordinating and unifying particular governmental technologies. (Hunt 1992: 9) The Canadian *Patent Act* serves to delineate the types of inventions considered patentable and the conditions that need to be met in order for a patent to be granted. The *Patent Act* specifies the types of information that need to be collected, the terms and scope of

proprietary protection afforded by a patent grant, and the fees that have to be paid to maintain a patent. The *Patent Act* also serves to delineate the role of patent examiners and the persons who are authorized to prosecute patent applications before the Canadian Patent Office. The effect of these procedures is to transform 'inventions' into an immutable mobile and a calculable entity that can enter social deliberations.

The regulatory agents who form part of the configuration of patent regimes consist of patent agents and patent examiners. Through their knowledge of science, technology and patent laws, they provide a vehicle for translating the research conducted at the industrial or scientific laboratory into legal form. Patent agents and examiners act as intermediaries on the basis of their ability to negotiate between scientific texts, technical artifacts, patent statutes, patent office rules, and the relevant case law. Their skills provide a means of inscribing through texts and diagrams the characteristics of new technologies and technical know-how into a form of property. Through the translation of inventions into a format that satisfies the formal criteria of patent law, these regulatory agents tend to reinforce the dominant interpretive and representational strategies employed by the sciences.

The ability of patent agents to establish themselves as an obligatory point of passage in the processes by which technology and industrial techniques are translated into a form of property, is constituted on the basis of their formal schooling in engineering or science, knowledge of the relevant patent statutes, case law, the technical requirements for securing patents, and often the ability to defend patents in the courtroom. The expertise of patent agents rests on their ability to assist inventors in translating the details of their invention into a format that satisfies the criteria established in the patent statutes and

Patent Office Rules. The strength of any claim made in a patent rests on the ability of patent agents to define the subject matter of the invention in a manner which encompasses all of its possible applications. The skills of patent agents help to make the details of particular inventions amenable to the deliberations of patent examiners, the courts, competitors and potential users.

Similar to patent agents, the authority of examiners is constituted on the basis of their knowledge of science, technology, patent office rules and the patent statutes. Examiners provide a means of mediating between the claims established in a patent application with the criteria established in the *Patent Act* and *Patent Office Rules*. Patent examiners assess an application on the basis of whether it is capable of working in principle and satisfies the novelty requirements. Examiners play a key role in judging a 'person skilled in the art' by searching through the relevant technical and scientific literature, in addition to previous patent applications. Patent examiners mediate between the private interest of the inventor to secure the broadest scope of proprietary protection, with the public interest of ensuring that the claims of patent do not inhibit the activities of other inventors within a particular technological field.

A further dimension of the regulatory/proprietary character of patents regimes that needs to be expanded is how they involve an element of moral regulation. (Hermer and Hunt 1996; Hunt 1993: 314) Within patent law, moral regulation operates by the suppression and marginalization of certain forms of invention and legal forms. Within Canadian patent law, methods for the medical treatment of humans and animals are not considered patentable due to the possible restrictions that it may impose on the conduct of medical science. To reinforce this point, within U.S patent practice, contraceptives,

gambling devices, and illicit objects used to defraud were considered unpatentable as they were believed to encourage immoral behavior. (Wells 1994: 113) The granting of patents is further seen as a means of facilitating the dissemination of technical know-how in opposition to inventors seeking recourse to trade secrecy law to protect their inventions. Lastly, patents are constructed as part of an individual's fundamental right to property.

Considering patent regimes as a regulatory/proprietary regime and a governmental technology, opens a space in which to consider law as constitutive of social relations. Examining patent law in such a manner provides a means of exploring how law participates in the constitution of a terrain or field in which social relations are generated, reproduced, disputed and struggled over. (Hunt 1992: 31) The proprietary character of patent law has a variable geometry which constitutes relations amongst social actors. Consistent with a relational orientation, law is not considered to have a distinctive unity or essence, but is rather expressed in a plurality of forms which need to be tied to its specific instances. (Hunt 1993: 303) The task becomes one of exploring how patent law is implicated and intersects with a range of other social relations. The practices through which patents are granted entail the deployment of specific knowledge(s) and regulatory agents in the process of creating property rights over technical know-how and their practical embodiment in technological artifacts. The practice of granting patents involves an element of moral regulation which operates by the suppression and marginalization of certain forms of invention and modes of intellectual property protection. Lastly, legal discourses can be understood to impose certain discursive and structural constraints on the tactics and strategies of social agents as Chapter 5 will demonstrate.

Patent Regimes as a Governmental Technology:

This section examines the forms of knowing and institutional practices that are implicated in the process of granting a practice. The development of these practices is the result of changing patent statutes, international conventions, patent office rules, and case law which serve to specify the forms of invention considered patentable and the procedures for acquiring a patent. These practices are aimed at transforming an invention into a property right and an immutable mobile through the description of the details of the invention. In contrast to the proprietary character of the patents which acts upon relations between social actors, patent granting practices work upon the conduct of an inventor through the requirement of the translation of the invention into a format that is amenable to the deliberations of patent examiners and compliant with the terms of the *Patent Act*. The varied techniques through which patents are granted constitute an inscription device and intellectual technology that allow the Canadian Patent Office to regulate the creation of property rights over technology and technical know-how. Through an examination of the practices through which patents are granted, I wish to highlight a profound transformation of the way in which life itself is understood that ultimately allows for the reproductive capacities of living organisms to be considered as a form of industrial property.

The role that law plays in coordinating and unifying this technology of power can be illustrated by way of reference to the practices through which patents are granted. A key determinant of patentability is whether the invention falls within the ambit of statutory subject matter. Within the *Patent Act*, an 'invention' is defined as "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."

(McKay-Carey 1992) Traditionally, patents have not been granted for theories, scientific discoveries, processes for medical treatment, plants, and animals since they are perceived as being incapable of industrial application or involving a sufficient inventive step. The distinction between a 'discovery' or 'scientific principle' in opposition to an 'invention' is claimed to rest on the forms of knowing and practices which transform discoveries or scientific principles into an object capable of industrial application. Patent laws have traditionally excluded lifeforms on the principle that lifeforms are a 'product of nature' and not a human creation. The patenting of lifeforms thus implies a drastic redefinition of how nature is understood which will be explored in Chapter 3.

The novelty and non-obviousness requirements of patent law serve as a further means by which the regulation of the creation of property rights over technology and technical know-how is effected. Legally, an invention is considered novel so long as it has not been publicly disclosed anywhere in the world prior to the application for a patent. In the case of genetic technologies which involve the manipulation of life, the novelty issue becomes more complex as it involves the modification of organisms whose characteristics are well known and publicized. The ability of genetically modified organisms to satisfy the novelty requirement is suggestive of a profound discursive transformation and newly acquired capacity to act upon reproductive processes which serves to place scientists in the demiurgic position of the creator of new forms of life. For inventors seeking to patent genetically modified organisms, the novelty requirement constitutes an item of significant contestation and renegotiation—an issue that will be taken up in Chapter 5 through an examination of changes to Canada's patent regime.

The non-obviousness requirement of patent law is closely related to the issue of novelty. The grant of a patent is conditional upon an invention being constructed as possessing a genius that could not have been predicted by a person of average skill within the relevant field of technology. (Fox 1969; Hayhurst 1993) Both the inventive genius and skill of an average person within the art is assessed by searching through prior patent literature and a review of the relevant technical or scientific literature. The person skilled in the art does not have to refer to a single individual, but can consist of the range of technicians required to produce the invention in question. (Rudolph 1996) The knowledge and skills of patent examiners is crucial in constructing the 'person skilled in art'. It is through this construction that the dominant forms of knowing and representational practices employed by the sciences are drawn into the realm of patent law.

A final condition that needs to be satisfied in order for a patent to be granted consists of the disclosure requirements. In this capacity, the writing of a patent specification can be thought of as a process of enrollment which attempts to configure the subject matter of the invention, patent agents, patent examiners, and the potential users or infringers of the patent. (Myers 1993; Packer and Webster 1996) The patent disclosure serves to make the invention both thinkable and knowable across time and space by rendering it susceptible to description through texts, diagrams, and increasingly through the deposit of a biological sample. The disclosure has to establish the distinctness of the invention from the prior art and must be written in a format that would enable a person skilled in the art to replicate the invention. (Hayhurst 1993; Cherniawsky and Lown, 1993) Patent disclosures predominately draw upon established scientific principles and

forms of representation as a means strengthening the claims of patent so that it can withstand legal challenges.

The final and one of the most important elements of a patent application are its claims. Patent claims serve to stake out the legal boundaries of the monopoly being claimed against which others should not trespass. (Myers 1995; Bowker 1995) To serve their purpose, patent claims have to be drafted in a format that withstands challenges in the courtroom. Claims are used to elaborate an inventor's contribution to the art, not only in terms of the invention itself, but the possible range of uses and embodiments of the invention. (Hayhurst 1993) Patent claims are a negotiated process that takes place between the applicant, the patent agent, and the patent examiner. (Heller 1995) Claims fall into two categories which offer varying degrees of legal protection. The first is the product *per se* claim which affords the greatest scope of coverage for an invention. This type of claim extends to the product itself, independent of any process of preparation. (Bousfield 1988) The other type of claim is the product-by-process claim which serves to define a product or substance by its process of preparation or method of production. This type of claim offers a more limited degree of protection than the *per se* claim, as it only covers the process and not the product itself. Patent *per se* claims have traditionally not been allowed over lifeforms as an element of 'inventive genius' was thought to preclude the creation of novel forms of life. A condition of possibility for the appropriation of life through patents is thus predicated on a redefinition of human capacities to represent and intervene upon the reproductive capacities of living organisms.

Conclusion:

This chapter has attempted to provide a broad overview of the development of the patent regime in Canada and the practices associated with granting patents. The concept of patenting as a regulatory/property regime was developed as a means of drawing out how patents attempt to regulate the creation of property rights over new forms of technology and technical know-how. The practices through which patents are granted were examined since they provide a means of translating scientific research into legal form. The ability to describe genetically modified organisms in a format that complies with the requirements of patent law suggests a profound redefinition of the meaning of life that will be explored in the next chapter.

Chapter Three

Redefining the Meaning of Life: Molecular Biology and the Constitution of Bio-technologies

On June 10, 1980 the United States Supreme Court in *Diamond v. Chakrabarty* (447 U.S. 303) determined that a genetically altered strain of bacteria could be considered a patentable subject matter under the terms of U.S. patent law. The case concerned a patent application filed by Ananda Chakrabarty³ in 1972 for a genetically altered strain of bacterium from the genus *Pseudomonas* that contained stable energy-generating plasmids engineered to break down multiple components of crude oil. This 'novel' strain of bacteria provided an enhanced biological method for the treatment of oil spills. The patent made 36 claims in total which can be divided into three types: process claims relating to the method for producing the bacteria; claims for a floating inoculum to carry the bacteria; and lastly, product claims for the bacteria. The patent examiner allowed the first two types of claims and rejected the claims for the bacteria. The basis for this decision was that micro-organisms are products of nature, and that as living things, they are not patentable subject matter.

Chakrabarty subsequently appealed this decision to the Patent Office Board of Appeals which affirmed the examiner on the second ground.⁴ The basis for the Board's reasoning was that Congress, through the 1930 U.S. Plant Patent Act, which extended patent-like protection to asexually reproduced plants, had intended laboratory-created

³ The patent was assigned to General Electric as Chakrabarty was an employee of this corporation and developed this strain of bacteria while in their employ.

⁴ The Board concluded that Chakrabarty's strain of bacterium could not be considered a 'product of nature' since the microorganisms contained plasmids that were not naturally occurring.

microorganisms such as Chakrabarty's to be excluded from the terms of reference of the Utility Patent Act. The case was then appealed to the Court of Customs and Patent Appeals which affirmed the Board's earlier ruling and recommended that the case be taken up for review by the Supreme Court.

In making its ruling, the U.S Supreme Court chose to focus on the narrow issue of whether the "micro-organism constitutes a 'manufacture' or 'composition of matter' within the meaning of the statute." (149) The term 'manufacture' was defined as "the production of articles for use from raw or prepared materials by giving to these materials new forms, qualities, properties, or combinations, whether by hand-labor or by machinery." (149) The term 'composition of matter' was also defined by common usage to include "all compositions of two or more substances and ... all composite articles, whether they be the results of chemical union, or of mechanical mixture, or whether they be gases, fluids, powders or solids." (149) The Court suggested that Congress, by using the terms 'manufacture' and 'composition of matter' in its definition of statutory subject matter, had intended these terms be given broad application so that they could accommodate the development of unforeseen technologies. Recognition was made that patent laws do not embrace every discovery such as "laws of nature, physical phenomena, and abstract ideas", yet concluded that Chakrabarty had produced a "new bacterium with markedly different characteristics from any found in nature and one having the potential for significant utility. His discovery is not nature's handiwork, but his own; accordingly it is patentable subject matter..." (151)

The Court then proceeded to dismiss the petitioner's claims that the Plant Patent Act and the 1970 Plant Variety Protection Act excluded the consideration of living things

as ‘manufactures’ or ‘compositions of matter’. In building its argument, the Court reasoned that these legislative acts had been developed to accommodate the specific needs of plant breeders. These acts were informed by the notion that artificially bred plants were a ‘product of nature’ and were not amenable to written description which served to preclude their inclusion within the terms and conditions of the Utility Patent Act. The Court made the claim that the legislative intent of Congress suggested that the “relevant distinction was not between living and inanimate things, but between products of nature, whether living or not, and human-made inventions.” (152) The microorganism in question thus could be considered a result of human ingenuity.

The event described above marks an important transformation in the relationship between law and nature. Although the Supreme Court was ruling on whether a particular form of ‘invention’ falls within the scope of patentable subject matter, entangled within this complex web of legal terminology, previous court decisions, and statutory intentions, is a recognition of a new way of understanding and representing organisms. For the Supreme Court, the long-standing mode of classification based on distinctions between natural entities and the technical artifacts created by humans had lost its relevance. In its ruling, the Supreme Court confirmed that life had come to acquire a new meaning that enabled it to conform to the mechanistic and causal logic of patent laws. The Court further recognized that a new technology had come into existence that was qualitatively different from the techniques of natural selection and selective breeding previously used for centuries to introduce genetic changes—a difference reflected in the fact that organisms were now considered patentable. The presentist concern of how we have arrived at a moment in history where it has become possible to consider issuing exclusive

property rights over living organisms forms a central concern of this chapter. The question of how life came to acquire a new meaning guides the mode of inquiry that will be sustained.

In addressing these concerns, I wish to illustrate how the discourse(s) and practices of molecular biology have become the hegemonic mode of representing and reasoning about life. The significance of these discourses consists in that they are taken up and employed by scientists, patent agents, patent examiners, judges, patent offices, lobby groups, and state agencies in the process of adjudicating and expanding the scope of patent law to accommodate genetically modified organisms. The argument will be made that molecular biology has given life a new meaning by disrupting the modernist episteme in which the study of life was located. This transformation has been achieved through the constitution of genes as an object of knowledge, the techniques through which the minute characteristics of organisms have been forced to reveal themselves, the institutionalization of molecular biology, the standardization and diffusion of technologies that make it possible to manipulate life, and the language, metaphors and representations employed by molecular biologists. The discipline of molecular biology has given life a new meaning by translating the genetic structures and reproductive processes of living organisms into a domain that is knowable and calculable in physical and chemical terms. Through a combination of forms of knowing and highly specialized practices, scientists have been able to gain mastery and control over DNA. This mastery over nature is reflected in the technologies of genetic engineering and the metaphors commonly employed to describe organisms' reproductive processes. The laboratory practices, techniques, and skills are technologies that are mobilized in the production of

scientific knowledge acquire added significance in the case of molecular biology since they place humans in a demiurgic position of the creator of new forms of life. The multiform tactics, techniques and strategies through which life has come to acquire a new meaning form part of the modalities of power that operate throughout society. An effect of these genetic discourses has been to render bodies 'docile' and give rise to a series of *genetic technologies* that mobilize reproductive capacities to suit medical, industrial, agricultural, and social objectives.

Science and Power:

Until the present moment, the analysis of both government and power has taken the form of how the conduct of individuals and groups may be directed; while power has been understood as a mode of action upon the actions of others. I now wish to draw upon this form of analysis to study the forms of power that are exercised over things. In the *Order of Things* (1970) Michel Foucault's reflections on political economy, biology and philology focus upon the conditions of possibility for the emergence and transformation of discourses. His genealogical studies directed attention towards how particular ways of organizing thought came into being and the role that discourse plays in constituting social subjects, shaping their identities, their relations, and the field in which they exist. By focusing on molecular biology, what is of relevance from Foucault are the rules of formation governing the production and circulation of statements; the exclusion, prohibition and marginalization of competing truth claims; and lastly, the relationship between power and knowledge.

In this chapter, the issue of the capacities exercised over things forms an important dimension of the analysis undertaken. Foucault suggests that the study of this form of power requires an investigation of how power is predicated upon the properties directly inherent in the body and/or by a reliance upon a series of external instruments. (Foucault 1982) However, this line of inquiry remained underdeveloped within the corpus of Foucault's work. In addressing the question of how power is exercised, the sociology of science literature has developed this theme in a novel way by focusing on the relationships between humans and non-human actants. The work of Bruno Latour (1987), Michel Callon (1986), John Law (1991) and Joseph Rouse (1987) illustrates how power relations operate by weaving together forms of knowing, scientific practices, technical artifacts and non-human actants. Their work draws attention to how the production of scientific knowledge and the dissemination of technology involves the construction of heterogeneous networks that mobilize scientists, organisms, texts, diagrams, laboratories, technologies, skill, and capital. Through their studies, laboratories emerge as important institutional locations for the production of knowledge and practices which enable a transformed hold upon organisms and the natural world to be achieved. The laboratory emerges as intensely political by providing a transformed hold upon nature and by remodeling it to meet laboratory-like conditions. In addressing the issue of how life acquired a new meaning, laboratories are considered as a technology of power since they provide a transformed hold upon the reproductive capacities of organisms and are responsible for the production and dissemination of knowledge about life itself. Laboratory practices realize their effects through a series of displacements in spatial scale which serve to subject the entities under study to a hierarchical gaze that enables scientists

to shape their conduct and make statements about these entities. In the broader context of the thesis, an analysis of laboratories provides a means of addressing how two or more technologies of power interact to facilitate the appropriation of life.

A final element appropriated from the corpus of Foucault's genealogical studies is how power/knowledge relations become invested in the body. (Foucault 1977a, b) In the case of molecular biology, knowledge is directed at the microscopic structures of life, and 'genes' are constituted an object of scientific investigation. These 'genetic discourses' are directed at the body through a series of highly specialized practices concerned with conquering and gaining mastery over the reproductive processes of organisms. Molecular biology allows power relations to operate at the level of the body in new ways, rendering it productive, subjected, and suitable for medical, agricultural, and industrial purposes. The displacements accomplished through laboratory practices thus enable the deliberate and controlled manipulation of the reproductive capacities of living organisms.

Constituting Genes as an Object of Knowledge:

In the *Order of Things* (1970), Foucault's reflections on the decline of the representational order of the Classical Age and the emergence of biology suggest that a condition of possibility for this new science was that life itself came to define the object of biological inquiry. (Cooper 1982; Gutting 1989) The main elements of this new mode of representation and classification were: organisms could be understood as complex sets of organs that performed functions related to their survival; the distinctiveness of species was related to their environments; and lastly, organisms evolved over time through the pressure of environmental forces. (Gutting 1989) The concern with discovering the

physical and chemical properties of genes from the 1920s onwards forms part of this modern episteme.

By focusing on molecular biology, I wish to illustrate how this discipline has constituted genes as an object of knowledge. Molecular biology draws upon the forms of knowing, practices and projects derived from other discursive formations such as Medelian genetics, biochemistry, embryology, immunology, protein chemistry, cytology, physiology, and physics. The distinctiveness of this discipline, compared to the other biological sciences which it competed against and encountered resistance from, lies in that it seeks to explain the physicochemical laws and processes governing the structure and function of genes. Molecular biology further seeks to investigate how genes govern vital life processes such as development, growth and reproduction. The heterogeneous practices through which genes and cellular processes have been forced to reveal themselves can be considered part of the multiform tactics, techniques and strategies of power.

Molecular biology distinguished itself from the traditional field of biology in that it located the basis of life at the sub-microscopic level and sought to explain the physicochemical laws governing vital phenomena. (Kay 1993) In locating life at the sub-microscopic level, a drastic reorientation of the conditions for the generation of truth claims within the biological sciences and the ordered procedures for its production was effected. This movement initiated a profound epistemological and cognitive shift in the form, content, and practice of biological science. A programmatic element was present in this discursive shift in the form of a preoccupation to create a 'better' biology founded on the model and techniques employed by the physical and chemical sciences. A

consequence of this new orientation was that the production of truth in the biological sciences became increasingly dependent upon technical intervention and specialized techniques that rendered observable and amenable to description the minute characteristics and behavior of genes. The language of physics and chemistry provided a new way of explaining the actions of genes, now reduced to the causal and linear logic of chemical interactions. The laws of physics and chemistry could be used to develop theories and models of the structure and function of genes without having complete knowledge of the objects under study. Lastly, and most important, the physicochemical laws governing gene and cellular activity could be used to highlight the commonality of all organisms by underscoring how they are governed through a series of chemical interactions. Within the biological sciences, the classification of organisms in terms of the structure and functions of their organs was supplanted and displaced by a new representational order which accentuated the commonality of all species in terms of the microscopic mechanisms governing vital life processes. The logic of molecular biology thus established a rupture within the modern episteme in which biology was located.

The epistemological and cognitive shift entailed by the emergence of molecular biology established a new style of reasoning that delineated certain possibilities for truth and falsehood within the biological sciences. The rules of formation governing the production of statements within molecular biology embraced an ontology which established genes as the basis of life. A consequence of this ontological shift was to displace the cell as the primary unit of analysis. The activity of genes became the focal point for understanding the reproductive and developmental processes of organisms. The gene became the privileged space within the cell, commanding the critical gaze of

molecular biologists. Positing the gene as the central entity to be studied occluded other spaces and processes going on within the cell and organisms. The study of genes became located in a discursive formation which established the questions that scientists posed for themselves, the boundaries of acceptable explanations, the experiments which made sense, and the organisms that were studied. (Keller 1995) The claims of molecular biologists were nonetheless challenged and encountered resistance from practitioners in the field of classical genetics and embryology which placed greater emphasis upon the role that environmental factors played in guiding the development of organisms.

The 'discourse of gene action'⁵ which gradually began to emerge rests on a series of technical interventions and theoretical models constructed by molecular biologists and protein chemists throughout the 1930s until the early 1950s. With the successful development of a model of DNA (deoxyribonucleic acid) in 1953 by James Watson and Francis Crick, molecular biology took a decisive turn. Life increasingly came to be defined and understood as a series of instructions or bits of information encoded in the molecular structure of DNA. The central dogma which came to inform molecular biology was a unidirectional model which posited the movement from DNA to RNA to Protein. The distinctiveness of species, previously accounted for in terms of environmental and evolutionary forces, became elided by a self-referential model that posited the development of organisms in terms of the structure of their DNA. A further movement away from the epistemic foundations of modern biology can thus be noted.

The discursive formation which serves to guide the production of statements about the molecular basis of life and genes cannot be considered a unity, but rather as

enshrining a dispersal. (Foucault 1972: Ch. 2) The constitution of genes as an object of knowledge prior to the discovery of the structure of DNA took place through a diverse number of seemingly unrelated projects. These efforts consisted of the study of *Drosophila* (fruit flies), *Neurospora* (yeast), bacteriophages (small viruses that infect bacteria) and protein chemistry which examined large organic molecules. From the mid-1950s onwards, the breakthroughs accomplished in the field of molecular biology led to the expansion of this type of research into medicine, cancer research, pharmacology, and agricultural science. Molecular biology reoriented the concerns of these fields to focus increasingly on the genetic causes of disease or on ways of improving organisms through genetic manipulation.

A number of institutions played an important role in funding and contributing to the expansion of the research programme of molecular biology. These institutions constitute an important link between research directed at the fundamental properties of life with the human sciences of eugenics, medicine, and psychology. In the 1930s, the Rockefeller Foundation, and the Carnegie Foundation to a lesser extent, played an important role in funding the development and expansion of biology laboratories, assisting scientists and graduate students interested in conducting molecular biology type of research, and creating a heterogeneous network of scientists and institutions. (Kay 1993) The institutionalization of molecular biology was informed by a concern to avoid it having to play a service role to medicine and agriculture—a role that had been traditionally assigned to the biological sciences. This movement was also paralleled in Britain and France as funding for molecular biology increased during the post-war years.

⁵ I borrow this term from Keller (1995).

(Gaudillière 1996) The prominent research laboratories in which molecular biological research was performed consisted of the California Institute of Technology, Cold Spring Harbor-Harvard University, the Institut Pasteur in France, and Cambridge University in Britain. Through the institutional networks created by the Rockefeller Foundation, scientists combined an interest in gaining knowledge of the molecular basis of life with concerns such as improving both human and animal populations, understanding the individual and group behavior of humans, and improving the ability to administer society rationally. (Kay 1993) The discipline of molecular biology cannot be considered as a series of isolated discourses and social practices, but rather as being thoroughly integrated with the human sciences which target 'man' and 'bodies' as part of their objects of knowledge.

Throughout the post-war era the number of research laboratories conducting molecular biology increased dramatically in both the United States and Europe. The funding of this type of research often took place under the auspices of the Ford Foundation, respective institutes of health, and a variety of state programs aimed at funding basic research in the biological, physical and chemical sciences. The dramatic breakthroughs accomplished in the field of molecular biology gradually served to reorient the focus of the traditional medical and agricultural sciences towards finding the genetic causes of disease and the physicochemical interactions governing cellular and organismic processes. From the 1970s onwards, the increased capacities that humans were able to exercise over genes through a series of technologies which permit the genetic modification of organisms expanded the field of application and funding for molecular biology research. Institutional support for molecular biology was reflected in the growing

number of academic research laboratories and the creation of molecular biology laboratories within the confines of transnational corporations. (Kenney 1986; Kloppenburg 1988; Yoxen 1983) The expanded scope of molecular biology since the 1970s is reflected in the emergence of international collaborative research efforts such as the Human Genome Project which seeks to map and sequence all the genes contained on human DNA.

A further reflection of growing institutionalization and recognition of the status of the discipline of molecular biology is reflected in the creation of the *Journal of Molecular Biology* in 1959. This process was further complemented by a number of well established journals appending their titles to include some reference to molecular biology and by revising their 'guidelines for submissions' to accommodate this growing field of research. (Zallen 1993) The development of a growing number of research journals specifically concerned with molecular biology lent a greater aura of legitimacy to this science and provided a broader forum for the dissemination and circulation of their statements.

The 'genetic discourses' of molecular biology introduced several important ruptures in the modern episteme in which biology was located. The diversity of the structures and functions of organ systems became dissolved by a commonality premised on the physical and chemical laws governing cellular and organismic activity. The evolution of organisms came to be defined less in terms of evolutionary pressures caused over time through environmental forces, but rather by a self-referential model which posited the development of organisms in terms of their DNA structure. The development and expansion of this program was accomplished through a network of institutions, scientists, and research journals which combined an interest in basic science with

attempts to increase 'man's' ability to administer nature and society rationally. The achievement of hegemony by molecular biology cannot be accounted for solely in terms of its ability to redefine the field of biological inquiry; rather reference needs to be made to the practices of representing and intervening through which a transformed hold upon nature is achieved. It is through laboratory practices and a series of technologies which permit the controlled manipulation of genetic structures, that a final and decisive rupture occurred with the modern episteme of biology. With this disjuncture, life acquired a new meaning and the possibility of its legal appropriation became thinkable.

Laboratory Practices: Representing and Intervening

The analysis has thus far concentrated on how the discourses of scientists have constituted genes as an object of knowledge. A further element needs to be introduced in order to avoid presenting scientific knowledge as being a series of free-floating discourses which mysteriously realize their effects. To obviate this claim, the production of scientific knowledge will be understood as being bound to the material practices that serve to generate and support it. (Carroll 1996) In drawing out the implications of this statement, attention will be directed towards laboratories. Laboratories constitute an important social location for the condensation of power relations by facilitating the production and support of the truth claims generated by scientists. Laboratories are further implicated in relations of power by providing a transformed hold upon the world and by refashioning it to meet laboratory-like conditions. The varied technical apparatuses and practices deployed in laboratories serve to isolate and make visible the objects of scientific knowledge against a background of other objects and events.

(Hacking 1983; Rouse 1987: Ch. 7) Through successive experimentation, most often characterized by failure, laboratory practices gradually force the objects of scientific knowledge to emit signs that can then be subjected to detailed observation and measurement. The ability to successfully repeat experiments suggests mastery of the phenomena in question and provides a basis on which scientific claims can be founded. The technical apparatus of laboratories provides a means through which we come to know the objects under study, in addition to providing a range of inscriptions that can be inserted into scientific texts. (Latour 1987) In the case of molecular biology, its practices allow for a transformed hold upon organisms and their mobilization into particular social-material configurations.

The dependence of science upon technical apparatuses in the process of representing nature can be illustrated by reference to one of the best known and celebrated diagrams employed by molecular biologists: James Watson's and Francis Crick's double helix. The production of this inscription relied upon the previous work of others and techniques such as ultracentrifugation, electrophoresis, spectroscopy, x-ray crystallography, and electron diffraction designed to separate, isolate and make visual the chemical components and properties of organic molecules such as DNA. Watson and Crick relied upon the x-ray images generated by Rosalind Wilkins and her colleagues to develop their model of DNA. With reference to these images, they constructed and proposed models on the basis of the known bonding properties of the chemical constituents of nucleic acids. Crucial to their success was the mobilization of 'Chagaff laws' which state that nucleic acids are composed of equal amounts of adenine (A) and thymine (T), and as much guanine (G) as cytosine (C). (Latour 1987:1-13) Based on this

knowledge, they were able to build a model which suggested that these pairs bonded with one another in a complementary fashion which accounted for the double helical structure of DNA and how it is able to split apart to create an exact copy of itself. The end result of these techniques and modeling efforts is a powerful inscription that stands to represent the structure of DNA. These inscriptions are combinable and superimposable with one another which allows the structure of DNA to be represented in terms of its structure, molecular composition, and its role in the production of proteins. By transforming DNA into an immutable mobile it allows these diagrams to be integrated into scientific texts and patent applications. These techniques ultimately allow what is acclaimed as being the basis of life to be presented on a two-dimensional surface.

Despite the elegance of Watson's and Crick's model, the force of this diagram is dependent upon the context into which it is inserted. Diagrams must discipline the observer in order to travel along scientific-technical-social networks. (Latour 1986b; Latour 1987; Law 1991) The molecules which form the structure of DNA gradually came to be understood in terms of 'codes', 'instructions', 'information' and 'programs' which serve to guide cellular processes, growth, and reproduction. (Kay 1995) The arrangement of base pairs came to be seen as short three chemical sequences called codons which contain 'information' which serves to direct cellular and organismic functions. Through a series of further technical interventions in the 1960s, the processes through which DNA is transcribed to create working copies of itself known as 'messenger RNA' illustrated how DNA was responsible for guiding the production of amino acids and proteins. (Gaudillière 1996) By posing life in terms of a series of instructions and

information it suggests knowledge of these 'cellular programs' and the possibility to obtain mastery over life through its reprogramming.

Accompanying practices of representation and intervention are techniques which provide us with a transformed hold upon nature. In the case of molecular biology, these techniques mobilize the inherent capacities of organisms to transfer segments of DNA across species without killing the host organism. Using the well known technology of 'recombinant DNA' most often associated with 'genetic engineering', an illustration of the techniques employed in transferring genes will be developed. This technology was developed as part of attempts to discover the regulation of gene activity and bacterial resistance to antibiotics thus blurring the distinction between pure and applied science. (Wright 1986)

This technology uses a series of enzymes, known as restriction enzymes, that are understood to form part of bacterial resistance to viruses by cutting up the invading DNA into a series of fragments. It was discovered that these restriction enzymes cut DNA at particular locations. Through the use of a further series of enzymes known as ligases, the cut portions of DNA could be rejoined. (Wright 1986; Yoxen 1983) The first gene splicing experiments used plasmids which are small, circular rings of DNA separate from the main bacterial chromosomal DNA which could be separated from the cell through a treatment of calcium chloride. These plasmids were then cut using restriction enzymes and successively joined together with fragments from other bacteria, and later, a species of toad. Recognition of the successful transfer of these genes was expressed in terms of resistance to particular antibiotics. The 'incommensurability' of species had thus been overcome and in the process DNA was transformed in a biological 'universal equivalent'.

Molecular biology moved from representing and intervening, to a science that could claim the ability to genetically modify organisms to create lifeforms distinct from those found in nature. The essence of life henceforth became defined in terms of its constructability rather than it being shaped over time through the pressure of environmental forces thus establishing a final, decisive break with the modern episteme of biology.

Another process that was developed to transfer the genetic material amongst two organisms is cell fusion. Although these techniques are not as precise as recombinant DNA technology, they allow for the successful transfer of genetic material amongst distinct species. The technique involves breaking down the walls of the cell nucleus by passing an electrical current through it. The two nuclei are then fused, introducing novel characteristics into the cell.

A further laboratory phenomena which enables scientists to produce reliable claims about the organisms they study is cloning. By manipulating organisms to produce 'copies' of themselves over an endless succession of generations, these varied techniques enable scientists to transform organisms into homogeneous entities whose behavior can be more readily observed by introducing an element of stability. Cloning thus enables scientists to render immobile the random capacity of organisms to transform themselves. These techniques domesticate the reproductive capacities of organisms and facilitate the commodification of genetically modified organisms by allowing for their faithful reproduction. The ability to uniformly recreate and transmit the results of genetic modification helps to make possible the legal appropriation of life. More important, the capacity to clone organisms reinforces the break within the modern episteme of biology

by allowing for the reproduction of the cloned individual across time and space thus shattering conceptions of gradual evolutionary change.

The widespread dissemination and diffusion of these techniques was made possible through the standardization of the technologies employed to make DNA knowable and 'visible'. Standardization serves to make a technique more robust and enables it to circulate outside its original context. (Rouse 1987: 114-5) The growing availability of restriction enzymes, plasmids, cell cultures, and laboratory manuals explaining how to move genes around facilitated the uptake of these techniques and molecular biology type of research projects. (Fujimura 1988) Creating black-boxes around many of the initial practices and processes required to isolate, decipher, and represent the elements employed in molecular biology research advanced the transmission of these techniques and skills into other branches of research. The ability to modify genes became a means through which further knowledge could be generated about the physical and chemical interactions governing cellular processes and organisms could be rendered useful for pharmaceutical, medical, agricultural and industrial purposes.

The ability to manipulate life reoriented the modern episteme of biology by introducing a new mode of classifying organisms—a category that consists of the 'man-made'. In contrast to the modernist mode of classification premised on temporal and evolutionary development, recombinant DNA technologies allow for an understanding of organisms dissociated from any reference to time or place. Genetic engineering thus can be considered a profoundly post-modern technology. (Wheale and McNally 1994)⁶ The

⁶ Wheale and McNally (1994) reach a similar conclusion, although they do not draw out the epistemic foundations by which this transformation was accomplished.

laboratory constitutes the primary social location through which we have come to know the reproductive structures of living organisms and have obtained the capacity to modify lifeforms. The discipline of molecular biology has effectively transformed the 'gene' into an entity that is knowable and calculable. The 'genetic discourses' of molecular biologists have primarily been directed at the body and have rendered the reproductive capacities of organisms suitable for economic and legal appropriation. The standardization of the techniques employed to represent genes and permit their modification has contributed to their diffusion and increased their robustness. Nevertheless, the processes described above relate primarily to the diffusion of forms of knowing and practices along particular scientific-technical paths. The issue of how this new mode of classification and techniques becomes inserted into the vocabulary of lawyers and lay persons requires attention to a further phenomena of language: metaphors.

Drawing Associations: The Metaphorical Representation of Life

In the process of representing and providing interpretations for the objects of scientific knowledge, scientists employ a range of metaphors that attach specific bits of information to the objects that are being described. A range of feminist authors (Bleier 1986; Harding 1986; Keller 1985; Keller 1995; Merchant 1980; Rosner and Johnson 1995) demonstrate how metaphors are both social and political by serving to reinforce patriarchal representations of nature and orienting the practice of science in a masculinist direction. Reflecting upon the history of psychological discourse, Kurt Danziger (1990) makes the argument that when a range of authors working within a particular discipline

employ the same metaphors, they serve to reveal underlying and recurrent patterns of thought about the objects that are being described. Metaphors occupy an important place within a discursive formation since they act as a shorthand that serves to relate and simplify a complex series of events. (Danziger 1990; Rosner and Johnson 1995) Metaphors help to reinforce particular constructions of the natural and social world by sustaining that the objects of scientific knowledge and the practices through which that knowledge is achieved, are in accordance with established social practices. The predominant metaphors employed in molecular biology draw upon the analogies of writing, machines and computer software. (Kay 1995; Keller 1995: Ch. 3) A result of these metaphors is to place humans and organisms within particular physical and social locations. The significance of these metaphors becomes all the greater when they act as a series of unquestioned assumptions as they are translated within and across social domains.

A metaphor that is widely employed in describing the structure and function of DNA is the analogy of writing. (Kay 1995; Rosner and Johnson 1995) These textual analogies can be combined with diagrams of the molecular structure of DNA to further discipline readers and confine the range of possible meanings that can be imputed to any inscription. The structure of DNA is compared to a four letter alphabet whose grammatical rules only allow for the pairing of certain letters. This four letter alphabet allows for the formation of three letter nucleotide words which form sequences or sentences specifying the assembly of amino acids. The language of amino acids is confined to twenty words that can be combined in particular ways to allow for the construction of complex sentences or paragraphs which form proteins. The various

internal structures and processes of the cell are acclaimed as being able to read the information contained within the strands of DNA which ultimately allow organisms to sustain themselves, evolve, and replicate. These textual analogies imply a mastery over DNA and the ultimate constructability of life. These linguistic references further suggest that DNA is a text that can be read by those who know the 'code of life' and edited through the use of a series of highly specialized techniques. Through the analogy of the common technology of writing, the manipulation of life and the establishment of proprietary rights over the 'prose' or 'art' of manipulating genes appears natural.

A predominant metaphor employed within the discipline of molecular biology relates the functioning of genes and cellular processes to that of machines and industrial factories. (Krimsky 1991) These mechanistic metaphors relate cells to machines by referring to them as self-assembling, self-maintaining, and self-reproducing machines that convert elements from their environment and transform them into useful products. (Yoxen 1983) Within this mechanistic and industrial construct, DNA is understood as being the 'chief executive officer' responsible for directing cellular processes and giving orders as to which goods are to be produced. Similar to machines, DNA acts as a template which consistently stamps out particular products according to cellular and organismic demands. By comparing DNA to an industrial template suggests that DNA can be remodeled in order to produce a range of products that are considered desirable by humans. The broader significance of these metaphors consists in relating the microscopic domain of cells with the more global sites industrial production and the accumulation of capital. The cell thus becomes another location of production whose machinery can be appropriated to manufacture valuable goods according to the vagaries of commercial markets. (Krimsky

1991) This metaphor is ultimately one of imposition since it indicates that through the intervention of technology, 'man' is able to harness the power of nature and put it to serve 'his' ends.

The most pervasive metaphor that is used in molecular biology to describe the action of DNA draws upon information theory, cybernetics, and control and communications systems. The understanding of DNA as encoded bits of information arose in the post-war era as these technological systems began to establish themselves. (Kay 1993; Keller 1995) These metaphors suggests that DNA can be understood as information that provides instructions which direct cellular processes, guide organisms' development, and facilitate the faithful transmission of particular characteristics onto subsequent generations. In a more basic sense, the metaphor of DNA being a program that operates the hardware of the cell is also employed. In both cases, the assumption is that information flows unidirectionally from DNA and guides all cellular processes thus maintaining the privileged position of DNA. Far more important, this metaphor suggests that life can be reprogrammed to serve social and political objectives. Scientists and technicians can attach specific bits of information to cells thus altering the goods which cells produce. Information theory metaphors help to sustain notions that cells and organisms can be understood as machines, that life is ultimately constructable, and lastly, that its reprogramming forms part of everyday industrial practices.

The metaphorical representation of life provides a means through which the specialist discourses and vocabulary of scientists can be circulated within and across social domains. Metaphors help to simplify and draw associations between complex series of events, thus expediting their uptake by other social actors. In so doing,

metaphors tend to reinforce particular ways of understanding and make the objects to which they refer seem natural and part of everyday social practices. As a phenomena of both thought and language, metaphors form part of the micro-strategies and networks of power relations that have rendered bodies 'docile'.

'Docile Bodies' and *Genetic Technologies*:

The constitution of genes as an object of knowledge and the practical capacities that have come to be exercised over the reproductive processes of *all* organisms have rendered the body productive and subjected in new ways. The forms of knowing and practices through which the body has been rendered 'docile' cannot be considered the result of a global strategy, but rather as an overlapping and selective reinforcement of techniques and practices that have their own local rationales of adoption. (Rouse 1987: Ch 7) Bodies, which can be understood as embracing humans and non-humans, constitute a site where micro-strategies of power converge and can be observed. (McNay 1994) Foucault's (1977a) notion of 'docile bodies' highlights the relationship between bodies that are knowable to ones that are usable. By employing the concept of *genetic technologies* an attempt will be made to illustrate how power/knowledge relations intersect at the body.

In drawing attention to bodies, the issue of how power relations target and affect the body in different ways needs to be addressed. Molecular biology posits a new relationship to bodies, distinct from classical genetics and techniques of selective breeding, by seeking to gain knowledge and control of the sub-microscopic and physicochemical processes of organisms. The distinctiveness of the genetic discourse(s)

and recombinant DNA techniques consists in that it is a more individualizing form of power directed at the internal mechanisms governing reproduction, rather than treating the body *en masse*. Power relations not only produce knowledge of the genetic structures of organisms but also transform objects by drafting the targets as productive. The bodies of organisms are rendered 'docile' through the material arrangements and practices of laboratories, the homogenization of their physical being and activity, their isolation and classification, and lastly, through a series of normalizing judgments which serve to specify qualities and capacities that are considered desirable. Within the context of molecular biology, the body becomes merely a vehicle for the replication of genes and the production of 'useful' substances. (The Biology and Gender Study Group 1989)

The power/knowledge relations that target and affect the body rendering it both productive and subjected can be captured by employing the term *genetic technologies*. The use of this term forms part of an attempt to encompass and stress the body-power-knowledge relations that are at play in giving life a new meaning. *Genetic technologies* refers to the complex ensemble of the forms of knowing, statements, texts, projects, laboratory practices and techniques through which the reproductive capacities of living organisms are rendered amenable to the purposes of industrial production and the accumulation of capital. An attempt is further made to dissociate *genetic technologies* from the common usage of biotechnology which primarily refers to the practical techniques and practices that make it possible to manipulate organisms. Throughout the remainder of the thesis, biotechnology will be confined to the more narrow usage of the forms of industry which make use of *genetic technologies* as part of their production practices. The constitution of a body of knowledge on the potential commercial,

industrial, and agricultural application of *genetic technologies* will be form the basis of the following chapter.

Conclusion:

The United States Supreme Court decision in *Diamond v. Chakrabarty* was made possible through the emergence of a new mode of classifying and understanding life. This change was not the result of a global strategy or an underlying teleology imputed in the logic of science, but rather through a selective overlapping and mutual reinforcement of forms of knowing and techniques through which genes have been constituted as an object of knowledge. The patenting of life can be considered an effect or outcome of tactics, techniques and strategies of power that have rendered genes amenable to description in physicochemical terms, and that also make possible the controlled manipulation of genetic structures.

Life has acquired a new meaning through the 'genetic discourses' and practices of molecular biology. Molecular biologists have been able to give life a new meaning by shifting the epistemic foundations of modern biology. The grid of perception through which organisms can now be classified posits a fundamental similarity amongst all organisms based on the physicochemical interactions governing cellular functions; the development of organisms can be understood by reference to the structure of their DNA; and lastly, life is no longer constrained by the temporal pressures of evolution, but understood as being ultimately constructable. Molecular biology introduced a new mode

of classifying organisms—a category that consists of the ‘man-made’. On June 10, 1980 the U.S. Supreme Court decided that this mode of classification was relevant in determining the patentability of organisms.

The networks and micro-strategies of power that allow us to mobilize the reproductive capacities of organisms primarily target the body, rendering it ‘docile’. The forms of power that have come to be exercised over organisms’ reproductive capacities can be considered a more individualizing form of power by targeting its molecular basis. Unlike techniques of natural selection and selective breeding that treat the body *en masse*, genetic engineering allows for the deliberate and controlled manipulation of genes. Bodies are rendered docile through a complex array of laboratory practices, the homogenization of their physical being, through new modes of classification and a series of normalizing judgments. A recognition that the bodies of organisms have been made amenable to the purposes of industrial production and the accumulation of capital is reflected in the U.S. Supreme Court’s decision to grant Ananda Chakrabarty a patent for ‘microorganisms having multiple compatible degradative energy-generating plasmids’. The body-power-knowledge relations that are at play in rendering bodies productive and subjected can be best encompassed by the term *genetic technologies*.

The language, representations and metaphors employed by molecular biologists are profoundly political since they are taken up by patent agents, patent examiners, judges, lobby groups, business associations, international organizations, and state agencies. By translating genes into the domain of thought, it becomes possible to integrate them into political, economic and social deliberations. The technologies that make it possible to manipulate life become the objects of knowledge of a range of human

sciences. The constitution of *genetic technologies* and biotechnology as an object of knowledge forms the concern of the next chapter.

Chapter Four

The Domestication of *Genetic Technologies*: Constituting Biotechnology as an Object of Knowledge

This chapter exploits the propensity of texts to map out the social relations and the networks that they help to constitute in order to examine the construction of biotechnology as an object of knowledge and regulation. The primary texts that will be examined consist of official publications produced by the Organization for Economic Cooperation and Development (OECD), Canadian state agencies, and the Quebec bureaucracy. Two strategies of textual analysis will be deployed as a means of drawing out how the human sciences contribute to intergovernmental and state projects concerned with the regulation, diffusion and commercialization of *genetic technologies*. One strategy examines these texts in terms of their capacity simultaneously to translate the heterogeneous objects to which they refer into a format that is highly mobile, reproducible, and accessible to the eyes of a potential reader. The writing of these texts can be considered as an 'inscription device' or 'intellectual technology' which serves to record the deliberations of government, map the networks of which these texts form part, and attempt to enroll an implied reader into adopting a course of action recommended by the text. The other tactic consists in delineating how they form part of a discursive formation concerned with rendering biotechnology into an entity that is knowable and amenable to the interventions of government. This form of examining texts provides a means of highlighting the problems that authorities have posed for themselves with regard to the diffusion and commercialization of *genetic technologies*. The issue of *how* biotechnology has been constructed as an object of regulation, the institutional sites that

have been considered the proper forum to regulate it, and the modes of intervention proposed to facilitate its industrial and commercial application form an important dimension of the analysis to be undertaken. The diverse and multiform publications produced by these organizations are constitutive of the strategies and tactics that attempt to put to work the 'docile' bodies of genetically modified organisms for the purposes of capital accumulation, economic growth and industrial development. The related issue of how the constitution of a body of knowledge on biotechnology was translated into regulatory or legislative form constitutes the basis of the subsequent chapter which examines changes to Canada's patent regime.

The domestication of biotechnology is used to refer to a scientific, social and discursive process through which the risks associated with the genetic manipulation of life have been rendered passive and *genetic technologies* are mobilized for social and economic purposes. This chapter outlines changes in the discursive formation of *genetic technologies*, first in terms of the scientific and environmental risks they posed, then towards a concern with promoting their diffusion and commercialization. The mandates of the organizations under study will be examined as they reveal the problems that political authorities have posed for themselves, delineate the institutional sites that are considered appropriate to regulate *genetic technologies*, lay claim to certain knowledge and awareness of the problems that the commercialization of biotechnology poses, and lastly, they are concerned with transforming this knowledge into a format that can be translated into regulatory or legislative form. The processes through which official publications are produced will be considered as a form of intellectual technology that translates things, events and phenomena into a format amenable to the deliberations of

political authorities. The processes through which biotechnology is defined, discursively associated with a range of social and economic processes, and the practice of making comparisons will be considered as a form of intellectual technology that attempts to domesticate *genetic technologies* for the purposes of its governance. The capacity of these documents to act upon the world is contingent upon their ability to create a policy space in which actors and things are distributed and made calculable. The policy recommendations contained in these documents will be considered as a mode of positioning subjects such as microorganisms, scientists, corporations, universities, and the institutional apparatus of the state. Lastly, the failures and sources of resistance to the state projects outlined in these documents will be highlighted. Broadly conceived, the emergence of a body of knowledge on biotechnology constitutes part of a regulatory configuration that attempts to establish and stabilize particular sets of socio-material relations.

Bureaucracies, the Human Sciences, and Official Publications:

The previous chapter examined the role that laboratories and the biological sciences played in translating genes into the domain of thought and providing scientists with a transformed hold upon the world. A present concern is to direct attention toward the human sciences and bureaucracies as sites for the production and dissemination of regulatory knowledge. Through ordered procedures for the production of truth and the mobilization of a range of 'intellectual technologies', the combination of bureaucracies and the human sciences represent a powerful array of forces which help to render the world amenable to description and intervention. To borrow from Latour (1987),

bureaucracies can be thought of as 'centres of calculation' that make it possible to act upon the social world and shape economic and social conduct 'at a distance'. It needs to be pointed out that the constitution of a particular bureaucratic site as a 'centre' is issue and strategy specific, discursively selective, and contingent upon the ability to mobilize and enroll social actors.

Similar to laboratories, bureaucracies represent an important site for the condensation of power. The distinctive capacity of bureaucracies to act as a centre emerges in part through a combination of practical techniques, intellectual technologies, technologies of power and the human sciences that may be condensed in particular institutional locations. In other words, bureaucracies can be thought of as a variable social configuration that mobilizes texts, knowledge, skills, financial resources, social actors, files, and machines oriented towards transforming aspects of social existence into a format that can be deliberated over and acted upon by authorities. Through the mobilization of *intellectual technologies* such as writing, comparing, defining, and the maintenance of files, aspects of social relations become selectively recorded, compared, juxtaposed, and problematized within official publications. Bureaucracies do not govern the social in isolation, rather they make use of independent academic initiatives, experts, professionals, lobby groups, other bureaucratic institutions, public consultations, and committees as part of the process of transforming the world into an entity that is programmable and amenable to governmental interventions. The human sciences are deeply implicated in this process; they transform the inscriptions produced by these technologies into something that is intelligible, render problematic specific domains of social activity, and put forward solutions and proposals for the positive reform of reality

consistent with social, economic and political objectives. Through the mobilization of these distinct resources, bureaucracies attempt to establish themselves as a centre that differentially enable them to govern at a distance.

Attempts by bureaucracies to act upon the world can be studied by examining the texts they produce and circulate. In the case of the agencies under study, the production of official publications can be thought of as a set of social practices concerned with transforming events and phenomena into information to be utilized by authorities. (Rose and Miller 1992: 185) Reports help to isolate and make visual the objects to which they refer against a background of other social relations and events. Processes of textual production are implicated in governance since they allow for the juxtaposition of heterogeneous elements, enabling events to be aggregated across time and space. They help to construct associations, establish relations, elaborate norms, determine processes, and they constitute the basis on which interventions are made. (Rose and Miller 1992: 182-189) Governmental reports aim to make reality stable, predictable, and mobile, as well as to transform aspects of social existence into a format that is debatable, diagnosable, and amenable to intervention. Through the production and dissemination of texts, social actors develop shared vocabularies, definitions, theories, and explanations that help to form associations within and across state departments, lobby groups and independent academic initiatives. By transforming aspects of the social and natural world into the domain of thought and into a format that is capable of being strategically deployed, official publications are constitutive of social relations. The production and circulation of official publications that take biotechnology as its object of knowledge form part of a social configuration and series of strategies that attempt to naturalize the

appropriation of life and integrate *genetic technologies* into the logic of capitalist production.

As a genre, official publications serve to define the problems that authorities have posed for themselves, illustrate the proposals put forward to tackle a particular concern, and they help to specify the institutional sites or regulatory agents that should properly address an issue. Government reports serve to record the problematizations of government and outline the proposals and actions taken by political authorities as they attempt to stabilize particular socio-material relations. (Cambrosio, Limoges, and Pronovost 1990) Official publications attempt to enroll readers, build consensus around a particular social or economic concern, distribute information about the object of regulation, and lastly, highlight the attempts that are being made to govern it. The production and circulation of official publications attempts to stabilize and make durable a network of social relations.

A further property of official publications is that they lay claim to some form of privileged knowledge of the problem(s) to be addressed. Official publications can be thought of as a set of social practices that attempt to communicate, inform, and enroll a specified reader through the mobilization of writings, concepts, charts, tables, diagrams, statistics, as well as, a range of linguistic and rhetorical devices. As a discursive process, the production of official publications may involve the active construction of an object of regulation. The production of regulatory knowledge involves an interplay between government officials, professionals, academics, lobby groups, opinion polls, and public consultations. The capacity of regulatory knowledge to act upon the world is contingent upon it being produced in a format that allows it to be expressed in regulatory or

legislative form. (Hunt 1993: Ch. 13) A strategic element thus is present within the contents of official publications.

Through the production of official knowledge, the character or identity of biotechnology and genetically modified organisms is constructed. The commercialization and diffusion of biotechnology is premised on a particular social construction of genetically modified organisms. This identity emerges from a range of competing and contradictory discourses which constitute the discursive formation of biotechnology. The identity and capacities ascribed to genetically modified organisms are partly scientific, technical, economic, and social. In constructing *genetic technologies* as an object of regulation, these technologies emerge as environmentally safe, and thought to possess the revolutionary potential to restructure existing industries and create new ones. This construction serves to enshrine particular interpretations of biotechnology and delegitimize others. An effect of this discursive formation has been to render 'neutral' or 'domesticate' biotechnology into the logic capital accumulation and national economic growth.

The Domestication of *genetic technologies*:

The publication of a report commissioned by the OECD entitled *Biotechnology: International Trends and Perspectives* (Bull, Holt, and Lilly 1982) is an event which marks an important transformation in the discursive formation concerned with the practices of genetic manipulation. The OECD report is indicative of a shift in how biotechnology was problematized and constituted as an object of knowledge by political authorities. The report is further representative of an expansion of the persons authorized

to speak in the name of *genetic technologies* and an enlargement of the forums in which the social implications of genetic technologies could be discussed. Throughout the 1970s, the persons authorized to speak in the name of biotechnology predominately consisted of molecular biologists and institutions such as the U.S. National Institute of Health (NIH) which funded this type of research. The official forums in which biotechnology policy was debated consisted of prominent scientific journals and state science committees. Throughout the 1970s, the dominant problematization that informed the discourse on biotechnology was concern over the safety hazards posed by the experimental manipulation of the genetic structures of living organisms. The OECD report denotes a transformation in this discursive formation, indicative of a growing governmental preoccupation that began to concern itself with the question of *how* to promote the widespread diffusion and commercialization of biotechnology. A condition of possibility for the emergence of these discourses consisted in the containment of the safety anxieties raised by the novel capacity to manipulate genetic structures at the molecular level.

The enhanced ability to manipulate genes raised a number of concerns within the scientific community over the possible environmental and social hazards that could result from novel combinations of bacterial DNA. Concerns over the hazards posed by this novel technology were not exclusive to the scientific community; they received expression within the peace and environmental movements, as well as the media. However, the resolution of these concerns was primarily mediated through the intervention of a select group of molecular biologists. (Krimsky 1982; Wright 1994) The discourses surrounding the safety hazards posed by this new technology were contained through the restriction of the arenas in which this issue could be deliberated, the selective definition of policy

agendas, and the limitation of persons authorized to speak on behalf of recombinant DNA. (Wright 1994)

The hazards posed by this novel technology were raised at the Gordon Conference (1973) where the results from some of the first genetic engineering experiments were presented. The conference convenor, Maxine Singer (NIH) and Dieter Soll (Yale University) expressed their concerns at the conference and subsequently published them through a letter which appeared in *Science*. The concerns expressed in the letter suggested that “such hybrid molecules might prove hazardous to laboratory workers and the public.” (Wright 1994) The letter proposed the establishment of a committee to examine the problem and establish a series of guidelines. Subsequently, the National Academy of Science recommended Paul Berg, a leading molecular biologist, to form a committee to examine the issue. The Berg Committee was composed of leading molecular biologists who focused exclusively on the laboratory hazards posed by the genetic engineering of viral and bacterial DNA. The concerns and recommendations raised by this committee were aired in the scientific journals *Science*, *Nature*, and the *Proceedings of the National Academy of Science* in a text dubbed the ‘Berg letter’. This highly publicized letter restricted the hazard issue to concerns over laboratory safety and proposed that scientists impose a temporary moratorium on certain forms of genetic experimentation; namely, experiments that would confer bacterial resistance to antibiotics, the capacity to produce toxins, and the genetic experimentation with animal viruses. In parallel, the NIH established the Recombinant DNA Molecule Program Advisory Committee to investigate the environmental hazards posed by these novel organisms. Concerns over the safety hazards posed by genetic technologies were not

exclusively confined to the United States. In Britain, the Advisory Board of Research Councils established a committee under the chairmanship of Lord Ashby which collaborated with the Berg Committee.

Both the Berg and Ashby Committees heard evidence from scientists over the best ways to contain the hazards associated with genetic engineering. The consensus which emerged in these committees was that the hazards posed by genetic experimentation could effectively be contained through biological and physical means. The committees proposed that the safety hazards could be contained through the use of organisms that were considered to have little prospect of surviving outside the laboratory. The physical containment of the hazards could be accomplished through the construction of specialized laboratories and the implementation of certain practices dependent upon the type of risk. The Berg and Ashby Committees effectively introduced a method of risk assessment for genetically modified organisms as a means of containing the safety hazards posed by genetic experimentation. (Krimsky 1982; Wright 1994) Many of the recommendations of these committees were subsequently implemented in the United States and Great Britain.⁷ However, towards the 1980s, these guidelines were not as closely followed due to diminished scientific concern over the hazards posed by genetic manipulation. (Wright 1994)

The successful bracketing of the hazards posed by genetic manipulation created a space in which the discourses concerning the commercialization of biotechnology could flourish. The dominant question which began to preoccupy authorities was how to

⁷ In the United States, adherence to the Berg Committee guidelines was a condition for receiving NIH funding. (Wright 1986)

promote the widespread commercialization and diffusion of this technology. Henceforth, concerns over the safety and regulation of biotechnology would be subsumed within this broader governmental objective. The number of persons authorized to speak in the name of these powerful new entities was expanded to include a range of experts such as economists, political scientists, and patent lawyers. The constitution of biotechnology as an object of knowledge beyond the immediate concerns of the laboratory is reflected in the mandates of governmental departments. These mandates authorized the collection of information on biotechnology with the aim of educating authorities of the policies that needed to be put in place in order to exploit the economic potential of *genetic technologies*.

The Authorization of Statements: Governmental Mandates

The publication of *Biotechnology: International Trends and Perspectives* (1982) does more than simply make biotechnology into a concern of the OECD. Rather, it serves to denote a growing governmental preoccupation with the commercialization of biotechnology and the forms by which political authorities began to address this issue. The production of a diverse range of official publications by the OECD, the Canadian state and Quebec bureaus whose object of knowledge consists of biotechnology can be associated with each other as they form part of a discursive formation concerned with the ordered generation of knowledge about *genetic technologies*, and their commercialization. The discursive formation which guides the production of statements about biotechnology cannot be considered a unity, but as enshrining a dispersal. (Foucault 1972: Ch. 2)

The constitution of biotechnology as an object of regulatory knowledge officially took place through the elaboration of mandates which authorize particular state agencies and intergovernmental bureaus to collect information and make statements about domains of social existence. Through the elaboration of mandates, introduced either by legislative or departmental fiat, regulatory objects become legitimate domains to be acted upon, contested, supported or modified by social actors. Mandates help to stipulate the types of information that are collected, guide the modes of inquiry that are employed, and orient the ends to which that information is put. The incorporation of a particular regulatory domain within the mandate of a particular bureau can be understood as a complex process oriented around the representation of the external world in a form that allows it to be acted upon by regulatory agents. Both the elaboration and institutional settings in which a particular governmental mandate becomes located are indicative of the problems and priorities with which government has concerned itself at particular historical moments. Mandates are strategic in character through the proposition of particular courses of governmental action. Finally, the elaboration and execution of governmental mandates can be understood to form part of attempts to make reality stable and predictable. It is important to note that mandates undergo a process of change through the transformation of objects of regulation and shifts in the social conditions which led to the elaboration of the mandate.

The incorporation of biotechnology into the mandate of a particular intergovernmental organization can be illustrated with reference to the OECD Committee for Scientific and Technological Policy (CSTP). In *Biotechnology: International Trends and Perspectives* (Bull, Holt, and Lilly 1982), the first statement that readers encounter is

an outline of the objectives of the CSTP. A major task of the CSTP is defined as "...to follow the emergence of major fields of technology, to debate the various policy issues arising from it, and to help solve those which fall within its Mandate." (3) Readers are further informed that the following report on biotechnology is in accordance with the objectives of the CSTP which are to foster increased multi-disciplinary research, promote greater integration between fundamental and applied research, assess future opportunities in science and technology, and lastly, promote the integration of science, economic and other policies. Lastly, readers are informed that the CSTP plans to undertake further work on biotechnology through the commissioning of studies that will relate biotechnology to such issues as patent protection, safety regulations, government policies and the economic implications of this technology. The CSTP has thus made biotechnology an essential part of its mandate and constituted it as an object of regulatory knowledge.

The incorporation of a particular technosocial concern within the state apparatus is not always as clear cut as the example referred to above. Rather, it can be complicated by the overlapping jurisdictions of departments. Whilst a number of Canadian federal and provincial agencies were informally monitoring developments in biotechnology within their field, it did not exist as an exclusive object of government policy or as the mandate of a particular state agency. (Cambrosio, Limoges, and Pronovost 1990: 206-209) The establishment of biotechnology as an explicit target of government policy officially took place on June 10, 1980 with the announcement by John Roberts, Minister of State for Science and Technology (MOSST) of the creation of a task force that was to report to MOSST regarding Canada's industrial opportunities in biotechnology. (Science

Council of Canada and Institute for Research on Public Policy 1980: 8) The concern with examining the commercial opportunities offered by biotechnology was also undertaken by the Quebec Secretariat for Scientific Development (SSD) in March 1981 through an analysis of the literature, interviews with scientists, and consultations with university administrators, industry spokespersons and civil servants. (Cambrosio, Limoges, and Pronovost 1990: 199) The Canadian concern to investigate the economic potential of biotechnology was not an isolated phenomena; rather it was both reinforced by and supported a number of other studies commissioned by state agencies within other advanced capitalist countries.⁸ Both the Task Force on Biotechnology⁹ and the SSD¹⁰ produced documents which described biotechnology, highlighted its potential impact on selected industries, problematized dimensions of existing public policy, outlined some form of biotechnology strategy, and proposed a series of institutional sites that were considered appropriate to both regulate and facilitate the commercialization of biotechnology.

The location of a biotechnology mandate within particular institutional sites is indicative of governmental priorities at particular historical conjunctures. The report of the Task Force on Biotechnology (1981) recommended the creation of a National Biotechnology Advisory Committee (NBAC) to be located within MOSST so that it could be incorporated in a more global strategy to promote the development of a science and

⁸ The growing importance of understanding the relationship between biotechnology and industrial opportunities can be noted in the growth of official publications. For an example of this literature see Advisory Council for Applied Research and Development, Advisory Board for the Research Councils, and Society (1980); Office of Technology Assessment (1981; 1984)

⁹ Government of Canada (1981).

¹⁰ Gouvernement du Quebec (1982).

high technology strategy in Canada. A similar process can be noted in Quebec which located biotechnology within a newly formed ministry responsible for the development of Quebec science policy. Both of these departments created specialized agencies to deal with biotechnology whose structure and aim was to facilitate the coordination of various state departmental attempts to promote and regulate biotechnology, in conjunction with the private sector. The structure of these organizations were purposely designed so that they could play a coordinating role due to the heterogeneous character of biotechnology. Mandates are not simply discursive, but possess a material dimension through the creation of institutions, the allocation of resources, and the mobilization of social actors around a project or set of projects. The recommendations of the Task Force on Biotechnology eventually led to the creation of the NBAC and the allocation of \$23 million to help foster the development of biotechnology in Canada. (National Biotechnology Advisory Committee 1984: 1)

It is important to point out that once a mandate is issued it can either be ignored, be taken up and modified by social actors, or be subject to a series of challenges. The biotechnology mandate has served as a focal point for different Canadian state agencies which have attempted both to modify and to place their distinctive stamp on the issue. The process through which mandates are espoused and modified by social actors can be illustrated with reference to the Science Council of Canada and MOSST which had overlapping jurisdictions in terms of the objects to which their departmental mandates refer: science and technology. The Science Council produced its report *Biotechnology in Canada* (September 1980) shortly after the announcement of the creation of the Task Force on Biotechnology (June 1980). The report acknowledges the importance of

establishing biotechnology as a specific target of government policy and then proceeds to authorize its own voice by reference to its mandate which consists of advising the government on science policy issues. The report further mentions how John Roberts acknowledged a role for both the Science Council and Institute for Research on Public Policy (IRPP) in terms of their potential contributions to the discussion on biotechnology. The report then goes on to claim that the IRRP initiated public policy debate on biotechnology through the publication of a report by Pierre Sormany entitled *Les Micro-esclaves vers un bio-industrie Canadienne* (1979). (Science Council of Canada and Institute for Research on Public Policy 1980: 8) The distinctive stamp that the Science Council was attempting to place on the discursive formation on biotechnology was the need to promote the development of biotechnology that took into consideration the ethical and safety concerns raised by this novel technology before its commercialization. These concerns were ignored in the report produced by the Task Force on Biotechnology in 1981.

Governmental mandates constitute an important element in the social processes through which domains of social existence become translated into an object of regulatory knowledge. Mandates are indicative of the problems that governments have concerned themselves with at particular historical moments. Once a mandate becomes well established, social actors make fewer references to the conditions which led to the establishment of the mandate, and become increasingly concerned with how biotechnology fits in with more global political programmes. The transformation of a mandate into something that is capable of projecting itself onto the social and natural

world requires the mobilization of a range of intellectual technologies and the human sciences.

Defining Biotechnology: Old Wine in New Bottles?

The practice of defining an object constitutes an intellectual technology through which particular aspects of social existence are transformed into the domain of thought. Through the process of defining, the character or identity of biotechnology and genetically modified organisms becomes established. The task of providing a definition for biotechnology assumes particular importance as regulatory agents attempt to represent and act upon the world. At stake in defining an object is laying boundaries as to what should and should not count as biotechnology. Consequently, definitions tend to emphasize or de-emphasize certain features or properties of the object being defined. (Cambrosio, Limoges, and Pronovost 1990) Definitions thus tend to reinforce particular representations and socio-material relations through the standardization of a mode of reference to a particular social object. The widespread diffusion and acceptance of a definition increases the speed at which statements can circulate within particular regulatory configurations, in addition to facilitating the ability to make comparisons, develop assessments and draw conclusions. The use of a common definition helps to reinforce particular representations of social objects, alongside a series of governmental decisions. A further property of definitions is that they act as intellectual shorthands that attempt to encompass a broad range of social relations in their sweep. While definitions usually take into account the aggregate properties of an object, they also attempt to take into consideration their manifestation in individual instances. (Hermer and Hunt 1996: 461)

The attention dedicated to providing a definition for biotechnology can best be illustrated with reference to the authors' attempt to do so in *Biotechnology: International Trends and Perspectives* (1982). The need for a common definition and comparable statistics by which to study biotechnology on an international scale is first on the list of conclusions and recommendations issued by the CSTP Committee of Experts. (Bull, Holt, and Lilly 1982: 21) In the introduction, the authors state that "Without a common definition, governments risk speaking at cross-purposes when they discuss biotechnology in international contexts,... and international statistical comparisons of biotechnological research and production, which are among the prerequisites of rational policy-making, will remain difficult and unreliable." (1982: 21) Biotechnology is subsequently defined as the "application of scientific and engineering principles to the processing of materials by biological agents to provide goods and services." (21) The effort that is dedicated to providing a broad, yet precise definition of biotechnology forms part of an attempt to have it accepted by a broad range of countries. The lack of a commonly employed definition is cited throughout these reports as being a factor that hinders the development of reliable international comparative assessments and statistics concerning biotechnology.¹¹

The problem of stabilizing and imposing a definition of biotechnology can be highlighted with reference to Canadian government documents related to biotechnology. The definition of biotechnology employed in Canadian official publications is the "application of biological organisms, systems, or processes to manufacturing or service industries." (Government of Canada 1981; Science Council of Canada and Institute for

¹¹ Beier, Crespi, and Straus (1985) and OECD (1986, 1988, OECD 1989).

Research on Public Policy 1980) This definition tends to be employed throughout all government publications related to biotechnology. However, this should not suggest that definitions are accepted uncritically; rather they are subject to contestation by social actors. The Science Council (1985: 13) challenges the definition developed by Bull, Holt and Lily (1982) by suggesting that is too vague and does not adequately represent the novelty of biotechnology. The preferred definition of biotechnology attempts to draw greater attention to the techniques associated with 'new biotechnology'—a category that will be addressed later in this text. One author goes so far as to suggest that the term biotechnology should be abandoned altogether in preference for referring to specific genetic technologies in order to avoid confusion and prevent negative public perceptions of genetic engineering from tainting an appreciation of biotechnology as a whole. (OECD 1989: 62) Lastly, the issue of defining biotechnology assumes less importance as the body of knowledge on biotechnology becomes stabilized and the concerns of government become increasingly oriented around the issue of how biotechnology is being commercialized within their borders. In more recent official publications, greater attention is dedicated to defining and mapping the networks that help to support and sustain biotechnological industries.¹²

A property of definitions that was alluded to earlier made reference to how definitions attempt to act as intellectual shorthands by aggregating a range of elements within their sweep. In Canada, the specific technologies that are encompassed by the term biotechnology include recombinant DNA, cell fusion, fermentation technology, enzymes, and process and systems engineering. This definition of biotechnology is not

¹² See OECD (1989), National Biotechnology Advisory Committee (1991) and Heller (1995).

simply a linguistic device; rather it serves to confine biotechnology to a discreet series of technologies which can be applied in specific forms and to particular industrial processes in Canada. The definition of biotechnology in Canada was strongly associated with its applicability to the resource sector, and has more recently become focused on its ability to improve the capacity for innovation and competitiveness of the Canadian economy.

Definitions further serve to lay boundaries as to what should and should not count as biotechnology. The definitions of biotechnology employed in official publications tend to make a distinction between 'old' and 'new' biotechnology.¹³ 'Old' or 'classical' biotechnology is used to refer to techniques such as bread making, brewing, animal husbandry, and techniques of natural selection which either use organisms or introduce genetic changes at the somatic level. By way of contrast, 'new' biotechnology is used in reference to the technologies which make it possible to introduce genetic changes at the molecular level and grow these organisms on an industrial scale. The key distinction between old and new biotechnology is claimed to rest on the degree of control over biological processes. (Science Council of Canada 1985: 13) This mode of classifying biotechnology attempts to stress the continuity of genetic technologies with practices that have been employed for centuries. This mode of classification tends to promote a linear conception of scientific progress which gradually and successively improves humanity's material conditions of existence. Lastly, these representations of biotechnology help to sustain and reinforce particular social and material practices such as capital-intensive

¹³ This distinction is sustained in Canadian and OECD official publications and is employed in the Advisory Council for Applied Research and Development, Advisory Board for the Research Councils, and Society (1980) and Office of Technology Assessment (1984). This distinction is also sustained in the secondary literature on biotechnology.

agriculture or pharmacologically-oriented medicine. The definitions and representations of biotechnology employed in official publications thus seek to naturalize and domesticate biotechnology by stressing its congruity with existing social practices. This point can be reinforced with reference to an OECD document which stresses that information distributed to the public should "...not emphasize increasingly complex scientific details, but rather the achievements, the breadth, continuity, and antiquity of biotechnology (a technology with which mankind has been familiar for thousands of years, and from which it has derived substantial benefits)." (OECD 1989: 61)

A final issue that needs to be addressed is the problematic character of laying boundaries. The diverse nature of genetic technologies makes it difficult to account for in modes of classification such as the Statistics Canada Standard Industrial Classification. (Cambrosio, Limoges, and Pronovost 1990; Heller 1995). This issue is highlighted in Cambrosio, Limoges, and Pronovost (1990) account of the development of Quebec science policy. In *A l'heure des biotechnologies*, Quebec science policy officials drew up an inventory of scientists in Quebec who were conducting biotechnological research. As a result of their investigation, 120 scientists were "discovered" in Quebec who were engaged in this type of research. This figure represented a substantial improvement upon the 90 scientists discovered throughout all of Canada a year earlier by the Task Force on Biotechnology. (Cambrosio, Limoges, and Pronovost 1990: 210) Representations thus are incomplete and tend to emphasize or de-emphasize certain qualities of the objects to which they refer.

The practice of defining social objects emerges as part of attempts to render it into the domain of thought and establish particular socio-material relations. Through

definitions, the character or identity of genetically modified organisms and biotechnology is constructed. These representations of biotechnology attempts to enroll readers along particular technosocial paths. The capacity of definitions to accomplish this end is greatly aided by the social and economic goods with which biotechnology is associated.

Drawing Associations:

A means by which biotechnology is discursively domesticated to the logic of capitalist social relations is through a series of discursive associations. The social relations with which biotechnology are discursively associated help to construct the character or identity of this technology. Similar to metaphors, discursive associations serve to establish the compatibility or congruity of biotechnology with established social practices in an attempt to render it natural. These discursive associations can be thought of as sub-discourses within a discursive formation that help to construct the identity of a regulatory object by associating it with a series of well known objects or social practices. Discursive associations thus can be conceived as an intellectual technology. In the case of biotechnology, discursive associations help to illustrate the potential uses of genetic technologies and demonstrate their commercial applicability. These discursive associations are highly selective and are strategic in character by providing indications of how a regulatory object may be governed.

The objects and social relations discursively associated with biotechnology are not chosen randomly: rather they build upon a range of well established assumptions. The mechanistic and computer software metaphors employed to describe genetically modified organisms by scientists underscore how they may be employed in industrial processes.

The computer software metaphors that suggest the ultimate programmability of life are used to promote the view that genetically modified organisms are environmentally safe, since humans have mastery over the code of life. An OECD publication on safety makes the argument that “genetic changes from rDNA techniques will often have inherently greater predictability than compared with traditional techniques, because of the greater precision that the rDNA techniques affords to particular modifications.” (OECD 1986: 31) The mechanistic metaphors used to describe cellular processes are transcribed onto an industrial scale through references to how biotechnology can improve productive processes and how organisms such as sheep and cows can be used as ‘bioreactors’ for the production of useful substances.

A powerful discursive association invoked in the process of describing biotechnology consists of referring to it as a ‘high technology’. Biotechnology is associated with a range of high technologies such as microelectronics, semiconductors, new materials, and information technology. Through its association with high technology, biotechnology becomes identified with the capacity to strengthen and maintain the competitive position of advanced capitalist states. Throughout official publications and the academic literature, biotechnology is referred to as an enabling technology that will facilitate the renewal of declining industrial sectors and lead to the creation of new ones. (Science Council of Canada 1985; Heller 1995; National Biotechnology Advisory Committee 1991) Through the construction of biotechnology as a ‘revolutionary’ and ‘enabling’ technology, these discursive associations suggest that the ability to compete in the global economy is contingent upon the development and application of *genetic technologies* throughout all sectors of the economy.

The capacities that are associated with biotechnology are discursively selective and tend to be oriented or organized around a particular mentality of government. Throughout the early 1980s, the predominant capacity with which biotechnology was associated in Canada consisted of the reduction of the use of fossil fuels through the development of alternative sources of energy, and the ability to increase the use of renewable resources. As a high technology, biotechnology is discursively associated with the capacity to solve pressing economic problems and provide an attractive solution to environmental pollution. More recently, biotechnology has become increasingly associated with improving the innovative capacities of states and their competitive position in the global economy.

Discursive associations also play a legitimating role by placing emphasis on how biotechnology can provide a range of social goods such as feeding the world's hungry by increasing agricultural yields and enabling the cultivation of marginal lands. The enhanced ability to manipulate genes is promoted as a means of introducing greater genetic diversity, reducing the amount of fertilizers and pesticides used in agriculture, and improving the quality of food. (OECD 1989; Science Council of Canada 1985) Biotechnology is also associated with the capacity to provide solutions to a number of previously incurable diseases. The ability to manipulate genes is seen as a vehicle that can be used to acquire a greater understanding of cellular and organismic processes, thus expanding the capacity to develop new treatments. Biotechnology is further constructed as a means through which new treatments can be developed through the manipulation of genes or modifying organisms to produce highly specific drugs. The advantages associated with gene therapies are the reduction in the price of drugs and hospital costs

through the mobilization of the genetic capacities of organisms. (Government of Canada 1981; Science Council of Canada and Institute for Research on Public Policy 1980)

Technosocial Accounting: Making Comparisons and Assessments

A final intellectual technology that is deployed in official publications which will be studied consists of the practice of making comparisons. Comparisons are a form of passing judgment, a means of testing resources, a way of bringing things into relation, and lastly, a mode of measuring the strengths and weaknesses of social objects to determine which parts will crumble when they encounter resistance. (Law 1986a) The practice of making comparisons is a problematizing activity concerned with constraining reality by putting objects in relation to one another so that they can be deliberated upon. Within official publications, comparisons are often used to espouse a programme for the reform of reality through the elaboration of a series of norms against which to judge the object under scrutiny.

A common comparison that is used to highlight the significance of biotechnology is its juxtaposition to the microelectronics revolution. Comparing biotechnology with the microelectronics revolution serves to stress the importance of the acquisition of a comparative advantage in the development of this technology in order to remain competitive within the global economy. This form of comparison attempts to highlight the magnitude of the potential economic and social impacts of biotechnology thus alerting authorities to the need to prepare for it, as well as harness its potential. The comparison of biotechnology with previous technological revolutions serves to highlight the problems that need to be overcome in order to facilitate the commercialization of genetic

technologies. One OECD (1989) report uses the example of nuclear technology in order to stress the problems which public resistance posed to the development of this technology and negated its widespread commercial diffusion.

Comparisons also serve to inform political authorities of the diversity and range of policies implemented by other states as they attempt to establish similar sets of socio-material relations. Through comparisons, policy makers are presented with a range of possibilities and can attempt to adopt these policies to local circumstances. However, comparisons can play a more strategic role within official publications by attempting to convince political authorities of the necessity and political opportunities of embarking on the particular course of action delineated in the report. In the case of biotechnology, Canadian reports often illustrate the efforts being undertaken in other countries and the necessity to keep up in order to remain competitive within the world economy. (Government of Canada 1981; Heller 1995; Science Council of Canada 1985) Comparisons can thus be used to support and reinforce the arguments that are being made by indicating the policies undertaken in other states. In this sense, comparisons construct a norm against which particular state policies are to be judged.

Throughout the Canadian and OECD biotechnology publications, the United States is constructed as the world leader in this field of technology. The policies and practices developed in the United States have become the norm against which to evaluate the success of domestic policies in terms of promoting the commercialization of biotechnology. The elevation of United State policy to the status of the norm acts as a powerful vehicle for the standardization and normalization of social practices related to the commercialization of biotechnology on a global scale. This norm is used to stress the

importance of developing strong industry-university links, funding basic research in molecular biotechnology, the patenting of multicellular lifeforms, strong intellectual property rights, and a 'flexible' approach to the regulation of biotechnology risks. Failure to comply with these norms is associated with the loss of potential investment and competitive advantage to the United States. (Heller 1995; National Biotechnology Advisory Committee 1991; Science Council of Canada 1985)

Making Recommendations, Positioning Subjects:

An effect of the discursive formation on biotechnology is the construction of a range of subject positions for a range of human and non-human actants. The prominent subject positions that will be discussed consist of genetically modified organisms, scientists, corporations, universities, the public, and state agencies. These subject positions are mobilized and incited within the policy recommendations of official publications as part of attempts to govern social objects and establish particular socio-material relations. Policy recommendations are explicitly concerned with the creation of a policy space in which actors and things are distributed in a format that allows for the interventions of government. Recommendations are indicative of particular mentalities of government and tend to reveal the proposals put forward by political authorities to shape economic and social conduct in a format consistent with governmental objectives. Policy recommendations tend to be expressed in a form that is amenable to their expression in regulatory or legislative form.

Within the discursive formation on biotechnology, genetically modified organisms are constructed as subjects which possess the capacity to improve the competitive position

of national economies, breathe new life into declining industrial sectors, create new industries, increase agricultural productivity, augment the state of medical knowledge, develop treatments for previously incurable diseases, and provide solutions to pressing environmental problems. Through the construction of this subject position, genetically modified organisms are made indispensable to economic and social progress. The potential for these organisms to act upon the world requires the intervention of government. Some of the recommendations regarding genetically modified organisms include the expansion of the range of microorganisms used for genetic experimentation, mechanizing certain aspects of the isolation and selection of microorganisms, the maintenance of culture collections, the introduction of new modes of classifying organisms, and the improvement of fermentation technology. (Bull, Holt, and Lilly 1982) They also suggest that microorganisms and animals should receive patent protection so long as they meet the requirements for patentability. In Canada, successive reports made the recommendation that Canada become a signatory to the Budapest Treaty, to ensure that microorganisms could satisfy the disclosure requirements of patent law. (Consumer and Corporate Affairs Canada 1986, 1988; National Biotechnology Advisory Committee 1991)

A further subject position that is constructed within the discourses of biotechnology consist of scientists. Within the Canadian and OECD literature, concerns about the number of scientists capable of engaging in biotechnological research is considered central to the commercialization of this technology. The 'manpower' question can be reduced to a series of questions of how to encourage academic scientists to find industrial applications for their research and how to increase the number of persons

capable of conducting this form of research. The proposals encourage academic scientists to find commercial application for their work, the creation of intellectual property departments within universities, increasing the grace period within patent law so that scientists can maintain their academic publications and also pursue patent applications, and legally require scientists employed by state laboratories to patent any research which may manifest commercial applicability. (Bull, Holt, and Lilly 1982; Government of Canada 1981; OECD 1989) In terms of increasing the persons capable of performing this type of research, emphasis is placed on multidisciplinary science programs, increasing the funding for science, and encouraging young people to pursue science. These recommendations are in accordance with existing state strategies that place emphasis upon science as a means of increasing the capacity to compete in a global economy. A distinctive element of Canadian policy recommendations consists of proposals to amend Canada's immigration laws as a means of encouraging skilled scientists from abroad to conduct research in Canada. (Government of Canada 1981; National Biotechnology Advisory Committee 1991)

Another social actor that is rendered subject by the discursive formation on biotechnology consists of universities. The university laboratory is constructed as the prominent site where the extension of knowledge of biological organisms and the development of new capacities to manipulate life will emerge. The laboratory is not simply mobilized as an entity that will increase knowledge and develop new practices. Rather, the university is seen as playing a prominent role in the commercialization of biotechnology through close ties with industry. The association between universities and

industry is seen as a means of increasing the speed at which this technology is commercialized, thereby helping to improve the competitive position of a particular state.

A number of policy recommendations are specifically targeted towards enlisting corporations as part of the effort to promote the commercialization of biotechnology. The prominent distinction that is introduced in terms of the types of firms that are mobilized consists of small research firms and multinational corporations. As a means of soliciting the support of these entities, a number of policy recommendations suggest strengthening the terms of patent protection as a means to encourage these firms to innovate and market their products. Throughout a number of reports, the NBAC suggests the provision of tax credits, loans and research grants as a means of facilitating the cooperation of these social actors. More recently, a social actor that has been both problematized and rendered subjected consists of venture capital.

A subject that is further positioned through the discursive formation on biotechnology is the public. Public acceptance is seen as a factor that will affect the rate of the commercialization of biotechnology. The public constitutes an important element that needs to be enrolled in order to promote the commercialization and diffusion of biotechnology. Through the technology of public opinion polls, the public is broken down into distinct groups that either oppose or are in favour of certain forms of genetic technologies and the uses to which *genetic technologies* are put. The policy recommendations that have been issued with regard to public acceptance concern themselves with the type of information that is distributed to the public, the amount of information, and the groups to which it should be targeted. An OECD report suggests that the production of regular, and internationally comparable public surveys of

professional quality would be helpful to policy makers and industry (OECD 1989: 60) As a means of increasing public acceptance of biotechnology, one report suggests that the involvement of lay people, alongside scientists and policy-makers can help improve public acceptance of biotechnology.

Lastly, the state positions itself through the issuance of policy recommendations. The construction of a role for the state in the regulation and governance of biotechnology helps to sustain its position as a centre and as a means by which to reform of reality. By making policy recommendations, official publications position specific state agencies in particular social locations. The process of positioning is not random, rather institutions which are considered appropriate to further the objectives of the report are assigned particular roles. The Task Force on Biotechnology recommended the creation of a national biotechnology advisory board to coordinate the activities of different state agencies. This recommendation eventually led to the establishment of the NBAC. In the process of carrying out its mandate, the NBAC has allocated particular roles to the National Research Council, Agriculture Canada, Consumer and Corporate Affairs, Forestry Canada, Health and Welfare, and Industry Canada. Through the positioning of particular state agencies, the state is constituted as an agency central to commercialization and diffusion of biotechnology. The reports produced by the OECD help to reaffirm the central position of the state in being able to govern and help promote the commercialization of biotechnology. The discourses on biotechnology become integrated and form part of more global discourses and state projects such as improving the competitiveness of the Canadian economy in light of the forces of economic globalization.

Resistance and the Incompleteness of the process of domesticating biotechnology:

The domestication of biotechnology has encountered resistance along a number of points or elements in the configuration that seeks to govern biotechnology. The success of stabilizing particular socio-material relations is dependent upon minimizing the anodes along which resistance may be encountered, thus diverting or slowing down the process at which the commercialization of biotechnology takes place. Both the failures and sources of resistance to which political programmes are subject, provide for further projects of governmental and regulatory intervention.

In Canada, there have been a number of sources of resistance and failure as part of the attempt to facilitate the commercialization biotechnology. Organisms have resisted their domestication into the logic of economic relations through the manifestation of physical deformities, an unwillingness to grow in industrial vats, or a simple refusal to produce sufficient quantities of a desired compound. While laboratories have mostly proved to be an ally of industry, their failure to deliver on the grand promises of genetic technology runs counter to the logic of short term financial markets. Universities also have failed to create stronger bonds with industry in Canada, hindering the potential commercialization of important discoveries made by researchers working in Canadian universities. Canadian scientists have betrayed the National Biotechnology Strategy by seeking opportunities in other countries. In Canada, venture capitalists have acted against the interests of small firms in biotechnology and the aims of the National Biotechnology Strategy through refusing to invest in their activities. The resource industry has resisted the aims of the National Biotechnology strategy through its failure to sufficiently invest in

biotechnology. The Canadian government has also proved to be a source of resistance to biotechnology firms through its failure to develop clear and consistent regulations concerning biotechnology, the failure to allow patents for transgenic animals, delays at the patent office, and by not granting skilled technicians from abroad immigrant status so that they can work in Canadian laboratories. The resources which political authorities have allocated to biotechnology have generally been considered to be insufficient to foster the commercial development of biotechnology in Canada. (Heller 1995; OECD 1988) The failure to amend Canada's patent laws expeditiously is cited as a factor which may have discouraged potential investors. The public has yet to be fully aware and become fully convinced of the potential offered by this new technology. This resistance leads to new regulatory efforts and even larger projects of governance.

Conclusion:

The production of *Biotechnology: International Trend and Perspectives* was an event which served to denote and record a growing interest on the part of governmental agencies on how to promote the commercialization of biotechnology. The domestication of biotechnology is a complex, ongoing process that involves the mobilization of texts, experts, state institutions, financial resources, intellectual technologies, laboratories, and corporations as part of an attempt to render this technology thinkable and made to work for economic, political and social objectives.

Through the production of official publications, the character or identity of biotechnology has become defined as an environmentally-friendly technology that possesses the capacity to enhance and maintain the competitive position of advanced

capitalist states. Through the intellectual technologies of defining, comparing, and analyzing, the identity of biotechnology and genetically modified organisms emerges as part of attempts to establish particular socio-material relations. Bureaucracies and the human sciences have played a prominent role in facilitating the appropriation of life by transforming it into an entity that is knowable and calculable.

The constitution of biotechnology as a object of knowledge forms an important element in the heterogeneous processes through which life is being appropriated. The transformation of this knowledge into regulatory or legislative form constitutes the basis of the next chapter. Through an examination of changes to Canada's patent regime, it will be possible to explore how official knowledge is translated into regulatory and legislative form. Changes to Canada's patent regime involve the mobilization of range of texts, forms of knowing, social actors, international negotiations, and a range of regulatory interventions. The body of knowledge mobilized in official publications is constitutive of the processes through which appropriation of life is being accomplished.

Chapter 5

Governing the Appropriation of Life: *Genetic Technologies* and Reforms to Canada's Patent Regime

Through an examination of reforms to Canada's patent regime, this chapter explores a further process through which the legal appropriation of life is being achieved. In the case of genetic technologies, changes to Canada's patent regime have been guided by a strategic concern to reduce the uncertainty surrounding the patentability of lifeforms and an attempt to harmonize Canadian law with international practices. (Consumer and Corporate Affairs Canada 1988) In this light, reforms to Canada's patent regime form part of the multiform strategies and tactics that seek to promote the commercialization and diffusion of genetic technologies. The processes through which genetically modified organisms are being incorporated into the domain of patent law are not the result of a global strategy, but rather an outcome of a series of clashes and alignments amongst a multiplicity of strategies pursued by social actors on a variety of social and spatial scales. The legal appropriation of life is being accomplished through a transformation in the political rationality invested in patent regimes, the discourses of patent agents, legal decisions handed down by the courts, state projects, and the harmonization of patent legislation through international negotiations. Despite successive changes to the *Patent Act* and the declaration that microorganisms are considered patentable subject matter, the patentability of higher lifeforms such as plants and animals remains unresolved in Canada. The failure of Canadian patent legislation to allow product *per se* claims over higher lifeforms serves to highlight the complex processes of negotiation and struggle that are involved in modifying and extending social configurations. The successful

mobilization of intellectual property rights to facilitate the commercialization and diffusion of genetic technologies requires dealing with the legacy of past social struggles crystallized in patent law and patent granting practices. Legal discourses thus present an element of strategic and discursive selectivity upon the actions of social agents.

A condition of possibility for the patenting of lifeforms is a transformation of the regulatory objectives of the patent regime, a redefinition of the meaning life, and the domestication of genetic technologies for economic and political objectives. The social and discursive processes through which patent law and patent granting practice are being modified in Canada are of interest as they combine scientific, economic, legal, and ethical concerns. Distinctive forms of scientific, regulatory and legal knowledge form a crucial resource that is mobilized in the process of redefining and renegotiating the boundaries of what constitutes a patentable invention, the procedures through which patents are granted, and the scope of protection that should be afforded to patented inventions. Wherever possible, the basic requirements of patent law discussed in Chapter 2, such as statutory invention, novelty, and disclosure, will be used to give structure to the discussion in each of the sections.

Governing Invention in Canada throughout the 1970s and early 1980s:

The patent regime has been constituted as an object of knowledge by a number of government studies. These reports are characterized by an attempt to define an economic role for the patent regime and its place within the economic technologies deployed to govern the economy. The constitution of patent regimes as an object of regulatory knowledge forms part of the problems that political authorities have posed for themselves

at particular historical moments. Throughout the 1960s to 1970s, the predominant question which guided the production of statements about the patent regime was whether it was serving to promote invention and innovation in Canada.

During this time, concerns over high drug prices and restrictive trade practices in Canada led to the commissioning of number of studies to evaluate the effects of patents on the economy. (French 1987; Henderson 1970: 186) These studies revealed the lack of a strong body of evidence to support the argument that patents played a major role in stimulating invention.

One of the first reports which evaluated the role of patents in the Canadian economy was the *Report on Patents of Invention* (1960) undertaken as part of the *Royal Commission on Patents, Copyright and Industrial Designs*.¹⁴ The mandate of the Commission, established in 1954, was to determine whether the intellectual property system in Canada promoted invention, the disclosure of technical information, and Canada's economic and scientific interests. (Canada 1960: 5) After a review of the patent literature and a summary of its relevance to the Canadian situation, the following evaluation was reached:

On the whole, we have come to this conclusion that even in Canada with its large preponderance of foreign owned patents the words in the concluding passages of Fritz Machlup's study apply –“if we did not have a patent system it would be irresponsible, on the basis of present knowledge of its economic consequences, to recommend instituting one. But since we have had a patent system for a long time, it would be irresponsible, on the basis of our present knowledge, to recommend abolishing it.” (Canada 1960: 15)

¹⁴ Canada (1960).

Growing concerns over the impact that patents had on drug prices and the perception that they contributed to high levels of foreign ownership of the Canadian economy, led the Liberal government in 1966 to commission the Economic Council of Canada to conduct a study regarding reforms to Canada's patent laws. (Economic 1971:

1) A specific concern was to bring the patent regime into alignment with broader economic objectives and orient it in favor of consumers. (Basford 1969; Firestone 1972)

After conducting an economic analysis of the patent system, O.J. Firestone concluded that:

...while a majority of companies look at the patent system as a major inducement to innovate, a large part if not the major part of R&D work would continue to take place in Canada even if this country had no patent system or if the protection currently provided under the system would be considerably reduced. (Firestone 1971: 169)

Firestone's report suggested that the major beneficiaries of the patent system consisted of large corporations which possessed the resources to defend patents in court and the R&D capacity to invent around patents. Foreign corporations were deemed to be the primary beneficiaries, accounting for 94 percent of all patents issued. The overall conclusion reached was that patents tended to reduce competition in the domestic market and facilitated foreign domination of Canadian industry.

Added to concerns over foreign domination of Canadian industry were debates over the impact of patents on drug prices. The drug patent question entered the deliberations of several other commissions and committees established during the 1960s.

¹⁵ Patent law increasingly became associated with the restriction of competition in the

¹⁵ These committees consisted of the Restrictive Trade Practices Commission (1962); The Royal Commission on Health Services (The Hall Commission, 1964); and the House of Commons Special Committee on Drug Costs and Prices (The Harley Committee, 1966).

pharmaceutical industry, causing Canada to have some of the highest drug prices in the world. To counter the negative economic impact of patents, attention was focused on the use of the compulsory licensing provisions contained in the *Patent Act* to ensure that these rights were not abused and as a means to promote greater competition in the Canadian economy. The recommendations of these reports would subsequently become inscribed into legislative form through the 1969 amendments to the *Patent Act*. These legislative reforms changed the scope of the compulsory licensing provisions in order to increase competition within the pharmaceutical industry and reduce the cost of prescription drugs. (Henderson 1970)¹⁶ The logic which underpinned this policy was an attempt to reduce the barriers to market entry for new competitors in the finished pharmaceutical products industry.

Throughout the 1970s, studies of the patent system increasingly began to emphasize the stifling impact patents had on Canadian industrial development. These reports suggested restricting the terms of patent protection and orienting the patent system to favor endogenous industrial development. The Economic Council of Canada's *Report on Intellectual and Industrial Property* (1971) chose to locate the study of patents and intellectual property within the context of innovation and information policy. The patent system was considered against a background of a global economic change towards a "post-industrial" stage where economies would become increasingly dependent upon

¹⁶ Canada had enacted compulsory licensing provisions since 1923 which stipulated that upon proof of the abuse of a patent monopoly, the grant of a compulsory license could be awarded. The 1969 amendments made it possible for a compulsory license to be awarded to patented articles intended for food or medicine available upon request to the Commissioner of Patents.

knowledge and knowledge production.¹⁷ A specific objective of the report was to demonstrate how patent law could be used to promote technological innovation and reduce Canada's technological dependence. The patent system was seen as a medium that could provide a market-place for new inventions, the dissemination of technical knowledge, the development of export markets, as well as the expansion of Canadian business into foreign countries. Nevertheless, the report concluded that Canada's patent system was not very effective at promoting industrial innovation or facilitating the rapid transfer of technology amongst firms. Alternatively, the Economic Council suggested that economic policy tools such as tax incentives, subsidies, and risk-capital financing could play a more important role than patents in reducing Canada's technological dependence. The recommendations of the Economic Council were vehemently opposed by users of the patent system as it suggested a reduction in the scope of protection afforded by a patent, and a shorter period of exclusivity through the compulsory licensing provisions. (French 1987)

A subsequent report produced by Consumer and Corporate Affairs Canada (CCAC) emphasized concerns over the extent to which patents contributed to the foreign ownership of the Canadian economy. (Canada 1976) This report elaborated a nationalist agenda that sought to reduce foreign ownership of the economy and promote the development of domestic industry. This study outlined changes that could be made to

¹⁷ The Economic Council of Canada suggested that patents should increasingly be examined in the context of public policy, but also in "...the larger questions of innovation and information with which they are concerned, far from being a relative intellectual backwater, are of central significance in the longer-term evolution of all economies and societies – particularly those which, like Canada, appear to be entering upon the so-called "post-industrial" state of their development, when economic advancement becomes increasingly knowledge-based." (1971, 2-3)

improve the patent system, and more fundamentally, “whether it is in Canada’s best interests to continue to maintain a patent law.” (1976: 1) A predominant concern which informed the study was the large number of patents issued to foreign corporations—a factor compounded by the preponderance of foreign ownership of the Canadian economy. After a critical review of the patent system, a conclusion similar to the Firestone study was reached: “Yet while there might appear to be a strong circumstantial case that would lead one to conclude that the Canadian patent system should be abolished, the case is not so overwhelming as to put the matter beyond a reasonable doubt.” (1976: 92) The report advocated the use of compulsory licensing provisions as a means of encouraging the local working of patents and diminishing the extent of foreign ownership. The report provided a reasoned account as to why the patent term should be shortened to nine years, with the possibility of extension for another five years if ‘local working’ had been established. While expressing serious reservations about the patent system, the report acknowledged a limited role that patents could play in reducing foreign ownership and encouraging the creation of a domestic technology base.

Despite the comprehensiveness of these reports, their proposals for the reform of the patent regime were not translated into legislative form. Broader proposals for the reform of patent legislation were rejected due to opposition from industry groups dominated by large multinational corporations and a general lack of interest on the part of the government due to more pressing economic concerns. Nevertheless, the legacy of these struggles to reform the patent regime was expressed in the 1969 amendments to the *Patent Act*. These reforms allowed the Commissioner of Patents to grant compulsory licenses for patented products or processes involving food or medicine. The

crystallization of these struggles in the 1969 *Patent Act* would subsequently raise concerns over the patentability of biotechnology products that involved food or medicine — the area of genetic technology research where investment is most heavily concentrated.

Governing Invention during the 1980s and 1990s:

Throughout the 1980s and extending into the 1990s, the political rationality which framed the conceptualization of patents underwent a significant discursive shift. The question increasingly posed by authorities was whether the patent regime provided sufficient protection and scope of coverage to promote innovation and foreign investment in Canada. In marked contrast to the previous era which sought to use the patent system as a means to promote endogenous technological development, patents were increasingly constructed as a tool to promote the competitiveness of the economy and attract foreign investment. The conception of the economy that formed a background against which deliberations of the patent regime took place emphasized knowledge as a source for the creation of wealth. (Consumer and Corporate Affairs Canada 1990; Science Council of Canada 1990) Governmental discourses increasingly began to stress the promotion of high-technology, economic competitiveness through the use of market mechanisms, and the promotion of the internationalization of the economy through the harmonization of economic policy with that of other advanced capitalist countries. Within a growing neoliberal policy orientation, patents were accorded greater priority in the hierarchy of economic policy tools as they provide a market mechanism by which to promote invention and innovation. (Consumer and Corporate Affairs Canada 1988)

Throughout the 1980s, economic growth increasingly became located in high technology industries such as microelectronics, advanced industrial materials, pharmaceuticals and biotechnology. (Science Council of Canada 1982, 1986, 1989) The growing economic importance attached to high technology reoriented concerns about the patent system in terms of whether it was acting as a sufficient incentive to promote innovation in Canada. (Consumer and Corporate Affairs Canada 1988; Science Council of Canada 1990) The issue of whether the patent system actually served to promote innovation was taken as a matter of faith rather than an issue to be studied, as evidenced by the lack of comprehensive studies on the patent system similar to those that were commissioned during the 1960s and 1970s. By way of contrast, the capacity of the intellectual property system to adapt to emerging technologies and the issue of whether the patent system acted as a sufficient incentive to innovation became a predominant concern.

A significant discursive shift that occurred was the construction of an association between intellectual property rights and international trade. Concerns over the extent of foreign ownership of the Canadian economy gave way to a governmental preoccupation to harmonize patent law with that in other industrialized countries. (Consumer and Corporate Affairs Canada 1988, 1990) Despite Canada being a net importer of technology, the strengthening and extension of intellectual property rights was seen as a means of ensuring access to the world's latest technology. (Science Council of Canada 1990) In marked contrast to the previous era, strengthened terms of intellectual property protection was constructed as a factor that would encourage domestic firms to become more innovative and competitive.

As an economic policy tool, patents became constructed as a mechanism that could be used to create market conditions favorable to the production of new technologies and the dissemination of technical know-how. Intellectual property rights could be used to reduce a reliance on expenditure based programs to promote science and industry. Patents were further conceived as a means of reducing the gap between public sector research and its practical application in industry. The increased attention paid to patent regimes as an economic policy tool fits well into the discourse of innovation, competitiveness, and internationalization. This neo-liberal project involves a movement away from reliance on expenditure-based programs to promote technological innovation and diffusion to one that relies increasingly upon markets and property rights. These discourses transformed the patent regime into a agency that could be used to promote the development of high technology such as *genetic technologies*.

Discourses of Patent Agents and Legal Scholars:

The discourse(s) and practices of experts such as patent agents and legal scholars help to reconcile the principles of patent law with forms of 'invention' in the biological sciences. The prominent discursive resources that are mobilized consist of the *Patent Act*, domestic and international case law, and the legislative authority of parliament. Economic and ethical arguments are further employed to build a case for extending the scope of patent law to include higher lifeforms such as plants and animals. The primary texts that will be examined consist of articles published in the *Canadian Intellectual Property Review* and patent law textbooks, since they assist patent practitioners in the process of translating genetically modified organisms into a patent application. Through

these publications, specific domains of the Canadian patent regime are rendered problematic and programmes for reform are elaborated. The knowledge and skills of patent agents thus enter the processes through which the appropriation of life is being achieved.

A prominent concern with which patent agents have preoccupied themselves is the issue of whether lifeforms can be considered patentable, the types of 'biological matter' that can be patented, and how to claim them within the framework of a patent application. A distinction central to patent law that is mobilized in the patent literature is whether genetically modified organisms constitute a 'discovery' or a 'product of nature', as opposed to an invention. In contrast to mechanical inventions, genetically modified organisms present a problem since the issue of inventiveness is claimed to rest upon the modification of existing complexity. (Bent et al. 1987) Throughout the literature, the example of a "biologically pure culture" is used to highlight and reinforce this distinction. These cultures consist of organisms derived from the natural environment that are subsequently purified, isolated and cultured in order to select a microorganism that may be useful for the purposes of scientific research or employed in an industrial process. Although these cultures are derived from the natural environment they are not considered a 'discovery' on the basis that they are not found in a 'pure and isolated' state in nature, thus establishing their distinctiveness from their natural predecessors. This example is further extended to include 'biological matter', such as nucleic acid sequences and proteins. (Collard 1993; Maher 1985; McMahon 1993) The technical intervention required to purify and isolate these biological entities is considered sufficient for the process of isolation and the resultant product to be considered patentable. This issue is

brought to the forefront through suggestions as to how patent agents should go about seeking patent protection for these forms of biological matter. In drafting their patent applications, patent agents are recommended to stress the processes of isolation and purification that were employed, the distinctiveness of the culture or nucleic acid sequence from those found in nature, and a description of the different uses to which it can be put. (Bent et al. 1987; Maher 1985; McMahon 1993) Through these practical recommendations, the processes which intervene upon life itself allow for the reproductive capacities of organisms to be translated into the domain of property rights.

The question of whether biotechnological inventions can satisfy the disclosure requirements of patent law has also caught the attention of patent agents. Throughout the literature, the ability to describe highly complex living organisms through written text is rendered problematic. Patent practitioners are advised to provide as much morphological, taxonomic, and physiological information as they can in order to help satisfy the disclosure requirement. (Bent et al. 1987; Maher 1985) However, the capacity of these representations to allow a 'person skilled in the art' to replicate a biotechnological invention due to its complexity and specificity is further problematized. A solution to this problem is presented in the form of allowing inventors to deposit a sample of the organism as part of fulfilling the disclosure requirement. This practice posed problems until relatively recently since Canada was not a member of the Budapest Treaty and the *Pioneer Hi-Bred* case questioned whether this practice satisfied the disclosure requirement. Throughout a number of articles which appeared in the *Canadian Intellectual Property Review*, appeals were made for Canada to accede to the Budapest Treaty and to harmonize Canadian laws with the international practice of allowing

inventors to deposit a sample to meet the disclosure requirement. (Hayhurst 1991; Ledgley and Stewart 1991; Maher 1985; Morrow 1993; Robinson 1993)

The arguments of patent agents become significantly more complex when they begin to address questions regarding the patentability of higher lifeforms. These arguments are discursively selective in that they are predominately addressed within the context of existing legislation and patent granting procedures. The authority of the *Patent Act* and case law is primary, whilst the legislative authority of parliament is invoked solely in cases where an impasse appears to have been constructed by current interpretations of existing legislation. Throughout the patent literature, the development of a *sui generis* approach (such as the *Integrated Circuit Topography Act* or the *Plant Breeder's Right Act*) is perceived as being unnecessary to deal with invention in the biological sciences. (Bent et al. 1987)¹⁸ This discursive selectivity is premised on the argument that the definition of patentable subject matter contained in Section 2 of the *Patent Act*¹⁹ is sufficiently able to accommodate new and unforeseen technological developments. (Morrow 1989; Rudolph 1996) As a means of reinforcing this argument, the authority of the courts is cited as being decisive in terms of reconciling the principles of patent law with the increased ability to genetically alter living organisms. The decisions handed down in the *Chakrabarty* and *Abitibi* cases are considered to have extended the terms of patent protection to microorganisms, while the U.S. jurisprudence

¹⁸ Patent law is generally preferred since it has a long legislative history and well developed body of case law exists from which patent agents can build their cases. The development of a *sui generis* approach is considered unfavorable due to its uncertainty, concerns over the scope of protection that it would confer, and the absence of a body of case law.

¹⁹ Section 2 of the *Patent Act* states that "...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" made be considered patentable so long as it meets the other requirement of the *Act*.

developed in the *Allen*, *Hibberd*, and the *Harvard Mouse* cases are considered resources that can be mobilized to extend patent protection for higher lifeforms in Canada. The failure of Canadian courts to expand the scope of patent protection to higher lifeforms in *Pioneer Hi-Bred* (1986) has sparked appeals to the authority of parliament and the government agencies responsible for the administration of the *Patent Act* to remove this restriction. (Avisar 1993; Hayhurst 1991; Hoffmaster 1989; Ledgley and Stewart 1991; Rae 1993; Rudolph 1996)

Whilst the authority of the *Patent Act* and case law are primary, a range of economic and moral arguments are also invoked. These arguments are nonetheless couched within the logic through which patents are granted. A recurrent theme throughout the patent literature is that inventors and biotechnology firms need patent protection in order to recuperate the heavy front end costs involved in developing new processes and products through biotechnology. This argument is extended to argue that nations will lose their competitive advantage or that firms will choose to patent or locate their R&D efforts in countries which offer greater patent protection for biotechnology. The failure to provide adequate patent protection also raises the specter that firms may resort to trade secrets, thus robbing society of the public disclosure of an invention and a subsequent increase in its knowledge. The failure of courts and the Canadian Patent Office to grant patents for higher lifeforms is constructed as inconsistent with international practice. (Hirons 1989; Ledgley and Stewart 1991; Morrow 1993; Rudolph 1991) At this point, the authority of parliament and the state agencies responsible for administering the *Patent Act* are invoked to remedy this situation.

Throughout the patent literature, the patent system is acclaimed as not a proper forum to address the ethics of the patentability of higher lifeforms. (Avisar 1993; Crespi 1995; Dresser 1988; Hoffmaster 1989; Morrow 1993) The patentability of living organisms is claimed to rest on whether a particular invention falls within the terms stipulated in the *Patent Act*. As such, the patent system is discursively limited to concerns for the advancement of science and technology. (Crespi 1997; Merges 1988; Morrow 1989) Nonetheless, ethics seep into their arguments through allusions to the social goods biotechnology promises to provide and the construction of deviance through narratives of intellectual property piracy. (Halbert 1997) As in the case of the commercialization literature discussed in the previous chapter, throughout the patent literature, biotechnology is associated with the potential to help feed the world's hungry, improve the quality of food sources, reduce the use of harmful pesticides and fertilizers, provide powerful new treatments to help remedy dreaded diseases, facilitate the degradation of toxic substances, and allow for environmentally-sustainable industry.

Narratives of intellectual property piracy permeate the patent literature with references to the heavy front end costs, long term investment, and regulatory hurdles that must be overcome to bring a single biotechnology product to market. The ease with which biotechnological inventions can be copied, as they entail self-replicating matter is repeatedly stressed throughout the literature. (Morrow 1989; Rae 1993) Lumped into this moral debate is the issue of whether scientific researchers should be granted an exemption to experiment upon patented lifeforms and whether farmers should have the right to replant seed or breed animals that have ownership rights attached to them. (Dresser 1988; Hoffmaster 1989; Merges 1988) While the ethical debate concerning the patentability of

higher lifeforms is claimed as being outside the purview of the patent system, the 'morality' of denying patents to corporations based on the form which their inventions take constitutes a legitimate subject matter.

Biotechnology confronts the Courts:

Quasi-judicial bodies and the courts have played an important role in expanding the scope of patentable subject matter and the terms under which patents are granted. The body of biotechnology-related case law is of interest as it intermingles scientific, legal and economic discourses. Throughout this section, reference will be made to Canadian and international case law in order to illustrate how it is mobilized by patent agents and state agencies. It will be argued that courts enter processes of strategy formulation since they are perceived as a means to expand the scope of patent law without having to engage in the process of patent law reform to accommodate the emergence of new technologies. (Consumer and Corporate Affairs Canada 1986) The courts are uniquely positioned to play this role as they mitigate between the social construction of the object that the *Patent Act* seeks to regulate with their manifestation in particular instances. The discursive authority of the courts is significant in that it has expanded the domain of patents to include genetically modified organisms and has shaped the conduct of patent offices and patent agents. As the discussion will reveal, judicial decisions are not exclusively confined within national borders, but serve to enter the discursive formation on biotechnology patents, inform the strategies of social actors and the decisions of Canadian courts. In Canada, the uncertainty that judge-made law has generated has led social

agents and state agencies to seek recourse to the authority of Parliament to help resolve the question of the patentability of lifeforms.

Similar in scope to the *Chakrabarty* case discussed in an earlier chapter, another ruling that is also constructed as a landmark is the decision handed down in 1982 by the Patent Appeal Board and the Commissioner of Patents in *Re Application of Abitibi Co.* (62 C.P.R (2d) 81) In this case, the inventors sought to patent a fungi culture used to degrade toxic waste produced by the pulp and paper industry. The application was initially rejected on the basis that a product claim involving living matter did not fall within the purview of Section 2. of the Patent Act. (84) An appeal was made to the Patent Office Appeal Board and the Commissioner of Patents.

In its ruling, the Patent Appeal Board acknowledged the importance of the *Chakrabarty* decision in determining the patentability of new lifeforms within the scope of the U.S. Patent Act. The Board recognized that it was now being called upon to determine whether similar subject matter was patentable in Canada. The Board reaffirmed the early intent of the patent system to “encourage and protect the manufacturing industries, which at the time [of its development] was thought of as relating to the production of inanimate objects...” (84) Recognition was made of the international and Canadian case law relating to process claims for micro-biological processes, the practices of the Canadian Patent Office with regard to this field of invention, and the growing body of academic treatises on the subject of lifeform patents. On the basis of this evaluation, the Board concluded that living inventions could be patented if they did not exist previously in nature, carried out a known useful objective, and involved an element of inventive ingenuity that made the ‘invention’ sufficiently different from known species.

This decision established the acceptability of patent *per se* claims over microorganisms within Canadian patent law.

The significance of this ruling was made all the greater by the *obiter* comments of the Board. These comments were developed with the intention of establishing some clear guidelines for applicants and patent examiners. The scope of this decision was extended “to all micro-organisms, yeasts, moulds, fungi, bacteria, actinomycetes, unicellular algae, cell lines, viruses and protozoa; in fact to all new life forms which are produced *en masse*...” (89) The Board also commented on the issue of whether this decision would extend to higher lifeforms such as plants and animals and found that it would not be a ‘far-fetched’ or ‘illogical idea’. (90) However, the Board made some effort to outline the difficulties in obtaining patent *per se* claims over higher lifeforms:

With still higher life forms it is of course less likely that the inventor will be able to reproduce it at will and consistently, as more complex life forms tend to vary more from individual to individual. But if it eventually becomes possible to achieve such a result, and the other requirements of patentability are met, we do not see why it should be treated differently.
(90)

Lastly, the Board made some suggestions with regard to the satisfaction of the disclosure requirements. The disclosure requirement could be fulfilled by a deposit of a viable sample in an appropriate depository. The board advocated the use of a written description and a deposit to ensure compliance with the statutory disclosure requirements. This decision provided a basis on which lifeforms could be considered patentable in Canada.

Subsequent to this decision, the Canadian Patent Office changed its practice and began to allow *per se* claims for microorganisms. The *Abitibi* decision was well received by the patent community as it was thought to provide a strong foundation upon which

later courts could seek to extend the scope of statutory subject matter to higher lifeforms. (Stotland 1984) This optimism was tempered by the realization that the Patent Office would limit the scope of the decision to unicellular microorganisms. (Woodley 1983; Stotland 1984) A central concern of the patent community revolved around meeting the disclosure requirements for biotechnology patents. The Patent and Trademark Institute of Canada (PTIC) Committee on Patents for Life Forms committed itself to working with the Patent Office to establish clear guidelines for the deposit of biological matter. The activities of this committee also encompassed attempts to extend the terms of patent protection to higher lifeforms. (Woodley 1983)

A number of subsequent interpretations by the United States Patent Appeal Board contributed to the growing body of biotechnology-related case law and extended the domain of patents to the plant and animal world. Plants were determined patentable subject matter in 1985 in the case of *Ex parte Hibberd* (227 U.S.P.Q:443) This patent application concerned an artificially cross-bred corn plant possessing abnormally high levels of amino acids. Despite the existence of other statutory regimes under which the corn variety could be protected, the patent was granted under the *Utility Patent Act*.²⁰ The patentability of animals was affirmed in 1987 in *Ex parte Allen* (2 U.S.P.Q 1425) where the Board ruled that it was possible to patent polyploid oysters possessing an extra set of chromosomes, although it rejected the application on the basis that it failed to meet the non-obviousness requirement. (Cherniawsky and Lown 1993) Immediately following this decision, the US Patent and Trademark Office (USPTO) issued a statement that it

²⁰ In the United States a variety of statutory regimes are in place for the protection of plants. This includes the Plant Patent Act and the Plant Variety Protection Act. The terms of the Utility Patent Act are very similar to Canadian patent laws.

would consider all “non-naturally occurring non-human multicellular living organisms, including animals, to be patentable subject matter...” (1993: 335) On the basis of this new policy, the USPTO issued a patent for the first time in 1988 for a transgenic animal referred to as the Harvard onco-mouse due to its susceptibility to cancer. Despite the considerable social controversy that these patents and policy statements generated in the United States, within the Canadian patent and biotechnology community they were perceived as being favorable to the establishment of patents for higher lifeforms in Canada.

Following the Abitibi decision, legal developments in Canada were not as fortuitous as those in the United States. The widely criticized case of *Pioneer Hi-Bred* (1986 11 C.P.R. (3d) 311) served to douse the hopes of those who wished patents to be issued for higher lifeforms in Canada and led to activism amongst the biotechnology community in Canada. Although the scope of this particular invention was similar to that of *Ex parte Hibberd*, the courts challenged the degree of control humans have over organisms’ reproductive capabilities and the extent to which the scope of the *Patent Act* should be extended. The courts also questioned the ability of biotechnological inventions to satisfy the disclosure requirements.

In 1986, the Canadian Patent Appeal Board issued a ruling on the patentability of plants in *Re. Application of Pioneer Hi-Bred*. (11 C.P.R. (3d) 311) This application concerned a variety of soybean created through traditional cross-breeding techniques. The appeal was refused on the grounds that the plant variety did not constitute an invention in terms of ‘manufacture’ or ‘composition of matter’ within the meaning of the *Patent Act*. The Board recognized that “While the definition of invention in Section 2 of the *Act* is

broad in its wording, it has for a long time been recognized by the Canadian Courts that they must interpret the Section carefully to give it some reasonable boundaries.” (315) It pointed out that while there were similarities between the definitions of invention in Canada and the United States, Canadian courts had interpreted it differently. The Board stated that due to the absence of specific legislation intended to protect plants as in the United States, the extension of patentable subject matter to plants was not warranted. Lastly, it was concluded that the Court found no direction for “a plant growing according to the laws of nature, should be considered a manufacture that may be acceptable under Section 2.” (319) The case was later appealed at the Federal Court of Appeal where it was hoped that the issue of whether lifeforms were patentable would be resolved and the law relating to this subject matter would be clarified. (Creber and McKhool 1986)

In spite of the hopes placed on the Federal Court of Appeal, the patent community was disappointed and greater uncertainty over the terms of protection for higher lifeforms was introduced. While the Court was prepared to “accept that Canadian patent legislation does not support the assumption that life forms are definitely not patentable.” (*Pioneer Hi-Bred* 1987 C.P.R. (3d): 495) it chose not to extend patent protection to plants. Affirming the earlier ruling, the Court stated that the novel soybean variety could only ‘metaphorically’ fall within the scope of ‘manufacture’ or ‘composition of matter’ as specified in the Patent Act. The Court argued that the exclusion of references to plants and to plant breeding terminology within the *Patent Act* did not justify the extension of the law into this realm; although it recognized that plant breeders should receive some type of legislative protection for their creations. (496) Lastly, the Court contributed to the growing uncertainty surrounding the satisfaction of the disclosure requirements by stating

that a third party should be able to replicate the invention using written description alone. The argument was made that the practice of depositing samples to satisfy these requirements as reached in *Abitibi* was 'clearly wrong' (493) This case was then appealed to the Supreme Court of Canada, where once again, it was hoped that clear guidelines would be established.

The issues that the Supreme Court chose to focus upon were twofold: whether an artificially cross-bred plant represented a patentable invention and whether the specification fulfilled the statutory disclosure requirements. (*Pioneer Hi-Bred*, 25 C.P.R. (3d) 257) The significance of this ruling lies in that the Court challenged the broad definition of biotechnology by differentiating between traditional cross-breeding techniques and genetic engineering. (264) On the basis of this distinction, the former techniques were determined as long being considered unpatentable since they followed natural rules of reproduction over which a claim to invention could not be upheld. (264-5) Although counsel asked the Court to consider the impact that a negative decision would have on biotechnology research and development in Canada, the Court felt that it did not have the "right to stretch the scope of patent protection beyond the limits of existing legislation." (271) The question of patentable subject matter was skirted in preference to denying the patent on failure to make adequate disclosure. The Court did not make any judgments on the Federal Court of Appeal ruling on the issue of disclosure, although its ruling suggested that a written description and a deposit should be used to satisfy the statutory requirements.

The failure of Canadian case law to extend patent protection to higher lifeforms served to orient the strategies of patent agents and the biotechnology industry to seek

legislative reforms to extend the terms of patent protection. Within the patent community, the *Pioneer Hi-Bred* decision was considered as “a burden which must be overcome.” (Ledgley and Stewart 1991) The absence of any references within the *Patent Act* relating to the protection of higher lifeforms was cited as a central obstacle that needed to be overcome. The disclosure requirements of patent law were targeted as the Canadian *Patent Act* did not contain any particular sections relating to the deposit of lifeforms. This more limited strategy was pursued since the scope of the *Abitibi* decision was perceived as providing sufficient grounds on which to establish the patentability of higher lifeforms. Recognition was also made that it would be more difficult to attain specific legislation relating to lifeform patentability due to the considerable uproar caused by the introduction of the *Plant Breeder’s Rights Act*. (Ledgley and Stewart 1991) To this end, the Intellectual Property Group of the Canadian Bar Association (CBA) took the initiative by submitting draft legislative amendments that would allow for the use of deposits to satisfy the disclosure requirements. (Ledgley and Stewart 1991; Morrow 1993) A similar proposal was also submitted by the PTIC Lifeforms Patentability Advisory Committee. Despite the commitment to legislative reform, the construction of a body of case law in Canada relating to genetic technologies was also advocated. As part of this objective, patent agents were advocated to include in their disclosures “...as much description and characterizing information as we can, about the structure and properties of organisms, if possible right down to the nucleic acid sequences and structure so far as its novel parts are concerned.” (Hirons 1991: 206) Both through legislative reforms and appeals to the courts, obstructions in the path relating to the patentability of higher lifeforms could eventually be cleared.

Biotechnology and Reforms to Canada's Patent Regime:

Through a variety of state projects, an attempt was made to reconcile the principles of patent law with genetic technologies. These projects sought to reduce the uncertainty surrounding the patentability of lifeforms and harmonize Canadian patent law with that of other industrialized countries. The now defunct Department of Consumer and Corporate Affairs Canada²¹ (CCAC) played a prominent role in setting legislative reform agendas and bringing in various industry groups to assist with these projects. A report entitled *Patenting Life Forms and Processes* (Consumer and Corporate Affairs 1986) outlined a strategy for removing the uncertainty surrounding the patentability of higher lifeforms. Although it recognized the important step taken in the *Abitibi* decision, it maintained the patentability of higher lifeforms remained uncertain as a result of the 'products of nature' doctrine and the disclosure requirements. The report encouraged the development of plant breeder's rights to afford the developers of novel plant varieties some form of intellectual property protection, which they were unlikely to attain under the terms of the *Patent Act*. However, the main policy option outlined by the report was to allow the law to develop on a case-by-case basis. This was seen as a more attractive option, as legislation may not be able to accommodate the specificity of the technology in question or develop quickly enough to deal with unforeseen technological developments.

A more comprehensive approach to intellectual property reform was developed in a subsequent policy paper by CCAC entitled *Outline of a Canadian Intellectual Property*

²¹ This agency was replaced by Industry Canada which now administers the intellectual property system in Canada.

Strategy. (1988) This report stressed the importance of reforming Canada's intellectual property regime in order to encourage investment in the economy by bringing it into alignment with the regimes of other advanced industrialized countries. The report continued the advocacy of allowing patent law to develop on a case-by-case basis with regard to emerging fields of technology. The central concerns outlined by the CCAC report were strengthening the terms of intellectual property protection, improving administrative efficiency, and negotiating international agreements that would provide rights for Canadian inventors abroad and stimulate investment in Canada. The participation of lobby groups in processes of legislative reform was ensured through the creation of the Intellectual Property Advisory Committee (IPAC) under the auspices of CCAC. The groups that were included in this committee consisted of the PTIC, CBA, IBAC and the Canadian Manufacturers Association. While this committee played an extensive role in reforming Canada's intellectual property regime and formulating a position on intellectual property rights in GATT and NAFTA, it was unable to introduce any specific legislation relating to the patentability of higher lifeforms.

After the considerable controversy that was generated by Bill C-22 which dealt with reforms to the compulsory licensing provisions of the *Patent Act*, CCAC abandoned comprehensive approaches to intellectual property reform in favor of smaller legislative initiatives. (Rosenberg 1991) A legislative initiative welcomed by the biotechnology and patent community was Bill S-17 which allowed Canada to join the Budapest Treaty. The treaty specifies internationally agreed upon standards for the deposit of biological samples for the purpose of patent procedures. (Bousfield 1988) The use of deposits to satisfy the disclosure requirements became an acceptable practice in Canada. Subsequent legislative

initiatives sought to amend Canadian laws so that they would be consistent with the principles outlined in GATT and NAFTA. While the biotechnology and patent community lobbied to include specific provisions within these international accords relating to biotechnology subject matter, member states can refuse patents for higher lifeforms if it contravenes *ordre public* and public morality.

International Dimension:

A problem which confounds the effectiveness of patents is the scope of protection and the subject matter that can be patented in different national jurisdictions. The harmonization of patent laws is constructed as a means of liberating patent holders from the constraints of international law. International trade negotiations such as the GATT Uruguay Round and the NAFTA are prominent forums which initiated changes to Canada's patent regime and facilitated the standardization of intellectual property rights on a global scale. Canadian legislation thus can be considered as a site that is encompassed by a more global strategy. The significance of these trade agreements is that they introduced a minimum set of standards with which signatories must comply. However, the terms of these agreements provide member countries with a policy space in which to develop national laws to meet local circumstances so long as they are consistent with the principles specified in the international agreement. This leeway facilitates the incorporation of local sites into more globally oriented ones. By adhering to the principles espoused in Trade Related Aspects of Intellectual Property (TRIPs) of both GATT and NAFTA, it provides a means of harmonizing Canadian laws with an established set of international standards. CCAC introduced amendments to the *Patent*

Act prior to the conclusion of these negotiations as a means of complying with the principles espoused in these international treaties. The negotiation of these international trade agreements provides a means of moving away from domestic industrial policy towards a more neoliberal global policy.

The choice of international trade negotiations as a forum for the harmonization of intellectual property law represents a significant departure from the traditional processes used to accomplish this objective. The inclusion of intellectual property within international trade agreements overlaps with the mandate of World Intellectual Property Organization (WIPO) whose concern is to deal with the harmonization of domestic patent laws. Furthermore, the choice of GATT is strategically selective in that it creates an association between international trade and intellectual property rights which was not present under WIPO. GATT was seen as a more viable institutional location by which to strengthen the terms of intellectual property protection on a global scale as it contains more effective enforcement measures that can be used against members states which fail to comply with the terms of the agreement. As a result of these negotiations, WIPO has been relegated to the role of an advisory body on technical questions related to patent issues and patent law harmonization. Through the choice of this forum, developed countries were able to get their way in terms of developing standards for intellectual property protection. The harmonization of patents on a global scale predominately benefits multinational corporations that possess the financial resources and capabilities to seek patents in a large number of countries.

Both the GATT and NAFTA contain TRIPs provisions that relate to patentable subject matter. Article 27 and NAFTA Article 1709:3 specifies that patents shall be

available for all fields of technology so long as they meet the normal conditions of patentability. However, member states may exclude higher lifeforms from the scope of patentability in order to protect *ordre public* and morality. Despite successive changes to the *Patent Act*, and the harmonization of the patent regime with that of other advanced industrial countries, higher lifeforms have yet to be considered patentable subject matter in Canada.

Conclusion:

A final sense in which the legal appropriation of life has been accomplished is through the expansion of patent granting practice to accommodate biotechnological inventions—a process that was mediated by judicial interpretations, in combination with the discourses and strategies of patent agents, lobby groups, business associations, and particular agencies of the Canadian state. A condition of possibility for the establishment of property rights over living organisms is the domestication of *genetic technologies* for economic, political and social projects. Reforms to Canada's *Patent Act* can be understood as one site amongst a multiplicity of strategies and tactics which seek to promote the commercialization and diffusion of biotechnology. The incursion of property rights onto the reproductive capacities of living organisms is made possible through a series of 'genetic discourses' and forms of scientific intervention which render the genetic matter of living organisms into an entity that can be described in a patent application. Lastly, the patent regime with its concern to regulate the creation of property rights over technology and technical know-how has been mobilized to facilitate the legal appropriation of life. The renegotiation of the objects which the patent regime considers

patentable has been effected through a series of judicial decisions and a transformation of the political rationalities invested in it. Nevertheless, in Canada the patentability of higher lifeforms remains uncertain at the present moment—a position that will be difficult to sustain as a result of a mentality and series of *genetic technologies* that render the reproductive capacities of living organisms docile and domesticated for economic, social, and political objectives.

Conclusion

Governing the Legal Appropriation of Life

The legal appropriation of life is the result of the intersection of a range of forms of knowing, scientific practices, governmental technologies, and state projects which seek to domesticate the reproductive capacities of living organisms for economic, political and social objectives. The incursion of property rights onto the reproductive capacities of living organisms has been made possible through a renegotiation of the objects that patent regimes consider patentable and through legislative reforms to Canada's intellectual property laws. In an important sense, the patenting of life has been made possible through a series of 'genetic discourses' and series of *genetic technologies* which ultimately allow humans to claim the right to have 'invented' new forms of life. Apart from placing humans in the demiurgic position of the creator of life, a further result of the discourses and practices of molecular biologists has been to render the reproductive capacities of living organisms 'docile' and productive for industrial, agricultural, pharmacological, and commercial objectives. The colonization and domestication of lifeforms for socioeconomic and political objectives has also been effected by forms of regulatory knowledge that seek to promote the commercialization and diffusion of genetic technologies. The patenting of life forms part of a series of strategies and tactics that seek to establish particular socio-material relations. These processes for achieving the appropriation of life can be defined as an instance of governance, as it captures how it is achieved through distinctive ensembles of social relations, forms of knowledge, modes of moral regulation, regulatory agents, and a profusion of shifting alliances between humans and non-human actants.

Part of the conditions of possibility for the legal appropriation of life are legislative reforms to Canada's patent regime and a series of judicial decisions that have extended the scope of patent law to microorganisms. Through courtroom proceedings and the discourses of patent agents, the boundaries of patent law have become renegotiated so that it is now possible legally to appropriate the reproductive capacities of living organisms. The forms by which this was accomplished involved the mobilization of scientific discourses and the authority of the *Patent Act*, with the result that humans can now claim to be the inventors of new forms of life. However, the patentability of higher lifeforms remains uncertain at present in Canada. This position will be increasingly difficult to maintain as a result of a transformation of the political rationality invested in the patent regime which seeks to use it as a tool to promote the development of high technologies and the competitiveness of the economy. Through a variety of state projects, attempts to reduce the uncertainty surrounding the patentability of higher lifeforms have been made in Canada. The current failure of these projects may eventually give way to a more global project that seeks to promote the commercialization and diffusion of *genetic technologies*.

A further sense in which the legal appropriation of life is being effected is through the domestication of *genetic technologies* for economic, political and social, objectives. The domestication of biotechnology has been accomplished by rendering passive the risks associated with genetic experimentation. Through the discursive and scientific pacification of the risks associated with *genetic technologies*, biotechnology has been constituted as an object of regulatory knowledge as part of an attempt to promote its widespread diffusion and commercialization. Through the production of a range of

official publications, authorities have created a policy space in which organisms, scientists, university laboratories, corporations, the public and particular state institutions are positioned to allow for the commercialization and diffusion of biotechnology. Through the constitution of a body of regulatory knowledge on biotechnology, the reproductive capacities of living organisms are rendered productive for social purposes.

A further modality of power which contributes to the legal appropriation of life are the genetic discourses of molecular biologists. Through these discourses it has become possible to transform the reproductive structures of living organisms into an entity that is knowable and calculable in physicochemical terms. The sub-microscopic processes governing vital life phenomena can now be represented on a two-dimensional surface and integrated into a patent claim. The laboratory practices which allow for the visualization of the sub-microscopic structures of living organisms also allow for a transformed hold to be achieved over reproductive processes, thus colonizing the interior spaces of cells. These practices can be considered as a more individualizing form of power as they target bodies at the sub-microscopic level rendering them docile and productive in new ways. A result of the practices and 'genetic discourses' of molecular biology has been to disrupt the modernist episteme in which the study of life was located. This disjuncture has created a space in which humans can be considered as the 'inventors' of new forms of life.

As a governmental technology, patent regimes have also contributed to the legal appropriation of life. In creating property rights over new technology and technical-know, the patent regime acts as an important vehicle through which the commercialization and diffusion of *genetic technologies* is being achieved. Through the

regulatory activities of patent agents and patent examiners, the categories which science employs have been successfully translated into legal form. Patent granting practices form part of the practices through which life is legally appropriated, through their action upon the conduct of social actors and the relations amongst them. As a regulatory configuration that mixes together law, science, technology, modes of moral regulation, economics, and politics in the process of creating property rights over new technology and technical know-how, patent regimes constitute an important site where the power relations implicated in the processes through which life is being appropriated converge.

Patent regimes are constitutive of these social relations by generating a terrain or field that is constantly renegotiated, contested, and struggled over. The processes through which life is being legally appropriated can be considered as a form of governance as it captures the practices, forms of knowing, modes of moral regulation, regulatory agents, strategies, and combination of human and non-human actants that are implicated in the legal appropriation of life. A relational approach provides a means of investigating the connectedness of the legal appropriation of life to a range of other social phenomena.

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