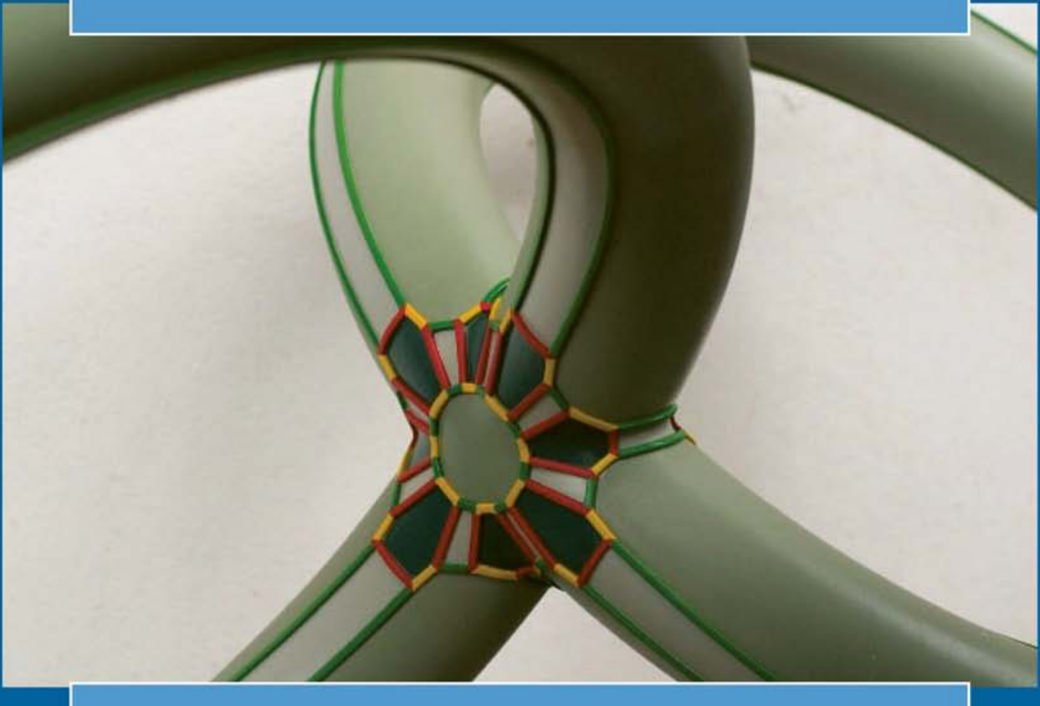
TRANSDISCIPLINARY STUDIES

Towards Humane Technologies

Biotechnology, New Media and Ethics

Edited by

Naomi Sunderland, Phil Graham,
Peter Isaacs and Bernard McKenna



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Towards Humane Technologies

TRANSDISCIPLINARY STUDIES
Volume 2

Scope
Transdisciplinary Studies is an internationally oriented book series created to generate new theories and practices to extricate transdisciplinary learning and research from the confining discourses of traditional disciplinarities. Within transdisciplinary domains, this series publishes empirically grounded, theoretically sound work that seeks to identify and solve global problems that conventional disciplinary perspectives cannot capture. Transdisciplinary Studies seeks to accentuate those aspects of scholarly research which cut across today's learned disciplines in an effort to define the new axiologies and forms of praxis that are transforming contemporary learning. This series intends to promote a new appreciation for transdisciplinary research to audiences that are seeking ways of understanding complex, global problems that many now realize disciplinary perspectives cannot fully address. Teachers, scholars, policy makers, educators and researchers working to address issues in technology studies, education, public finance, discourse studies, professional ethics, political analysis, learning, ecological systems, modern medicine, and other fields clearly are ready to begin investing in transdisciplinary models of research. It is those many different audiences in these diverse fields that we hope to reach, not merely with topical research, but also through considering new epistemic and ontological foundations for of transdisciplinary research. We hope this series will exemplify the global transformations of education and learning across the disciplines for years to come.

Towards Humane Technologies

Biotechnology, New Media and Ethics

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SECTION I INTRODUCTION

JEREMY HUNSINGER

SERIES INTRODUCTION

We chose transdisciplinary studies as the basis for our book series because it embodies a universally embracing set of practices and knowledges. Transdisciplinary research comprises an approach to research that recognizes that for many research questions, disciplinary perspectives cannot provide a complete or even an adequate understanding of the systems and processes involved. Recourse to transdisciplinary modes of inquiry often occurs upon the recognition that the disciplinary or interdisciplinary perspectives used comprehend the object of research are insufficient, and that no addition of another disciplinary or interdisciplinary technique will be sufficient. The moment that a research team recognizes the insufficiency of their approach based on an understanding of the globality of the research object, they can either forgo further research or turn to the broader dialogues of transdisciplinarity (Genosko, 2002). The research team can engage with other disciplines that will lead to meta-questions regarding axiomatics and axiologies (Hunsinger, 2005).

A discipline's axiomatics and axiologies inhabit its community of researchers and. as such, defines its territory, perspectives and boundaries. Once a research team takes up questions of axiology and axiomatics in relation to objects of research, in order to build a global understanding of the object of research, then their research is transdisciplinary research. Accordingly, the research team will depend on many different knowledges and understandings that will have to function in dialogues with each other, as the researchers continually explore the relations and relationships possible between the various contending knowledges. These dialogues, allowing for new interpretations of central questions, help to dissolve the disciplinary boundaries that constrain perspectives in disciplinary research. This dissolution opens up the axiologies and axioms to reconstruction, which reconstructs the horizon of understanding that was built into the disciplinary or interdisciplinary perspectives. The opening of the horizon of understanding opens new questions for inquiry and research.

In comparison to interdisciplinary research, which is bound up with the contestation and borrowing of techniques from various disciplines in order to map a knowledge domain, transdisciplinary research questions the very nature of the map, and the foundations of the techniques that produced it. Transdisciplinary research cuts across two or more disciplines, unifying them at the foundations through constructive dialogues and practices that lead to shared assumptions and thus a more global understanding. Interdisciplinary research, much like disciplinary research can participate in transdisciplinary research, but the terms are not synonyms nor are their modes of praxis similar. Central to interdisciplinary research is the

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idea that knowledge can be shared, and techniques and insights can be transposed or relocalized, across knowledge domains, whereas transdisciplinary research takes as it central idea that the practices of production of knowledge are bound to axiomatic and axiological assumptions that constrain the sharing of knowledge, and that sharing of knowledge from a disciplinary or interdisciplinary perspective is to share a perspective on the knowledge that then has to be transposed or translated across knowledge domains. Transdisciplinary research engages in a negotiation and translation of the axiomatics and axiologies that construct the perspective, hoping to reconstruct those assumptions into a new shared whole that then allows greater understanding about the object than is possible from any single perspective. By engaging in dialogue at the level of the foundations of our knowledges and research practices, transdisciplinary research find ways to resolve the contestations of the interdisciplinary and disciplinary translations and transpositions. In resolving these contestations over boundaries through discussion of foundations, transdisciplinary research engages in a reconstruction of understanding that can engage broader publics, across disciplines and across divided ethos (Snow, 1993).

Disciplinary, interdisciplinary, and transdisciplinary research each contribute to the system of knowledge production in our current age of late capitalism. Each produces results that have merits for society, and each has unique relationships to the way it understands the systems of knowledge and the production of knowledge in relation to those systems. That is not to say that the knowledge produced from these modes of research cannot have uniquely different ends. Instead, the ends of research depend much more on the context of production of knowledge than on the mode of research. The context of production of knowledge stands in relation to the broader context of the audience of the research, the public's understanding of the research, and its applicability to the general mode of production found in our current world.

It would be a cliché to say that research is changing, or scholarly production is changing, just as most production is changing in late capitalism. All are clichés. Inasmuch as these clichés are games, in Lyotard's sense, the game/clichés are producers of systems of legitimation that concretize the changes as they happen. They are not part of systematic metanarratives of progress, but operate merely as the everyday practices of research, scholarly production and production in general in the world. There is constitutive difference in our thoughts about knowledge that cannot be negotiated without some of these cliches. When we talk about research, we say things about the practice that approximate "This is how research is done," and then we abstractly represent the knowledges about those practices, "These are our beliefs about research." The movement from practice to belief and fact is one of textual transformation in relation to a broad field of signs existing in a system of legitimation and justification (Thévenot, 1984, 2002; Latour, 1986; Boltanski and Thévenot, 2006). The cliché of change in relation of research help perform the paralogics necessary to move between our practices and our knowledges (Lyotard, 1984).

The legitimation of transdisciplinary research is often found precisely in its engagement with the popular, the political, and the applied research that is frequently missed by disciplinary and interdisciplinary efforts. Transdisciplinary research is often driven by an interest in solving a particular problem that is too complex to have been successfully dealt with from any given disciplinary perspective (Gibbons, et. al, 1994). Its legitimation is found in the applicability and thus fundability of its research regimes, which ends up being a pragmatic aspect as much as a defining condition, not in its attempt to resolve axiological or axiomatic conflicts.

The new generation of transdisciplinary researchers and the problems they address are, on one level, working collectively on a plurality of problems. However, it should be noted that there is no necessary unity to the problems they approach. Other than a central concern with the dissensus of knowledge production and knowledge systems bound by disciplines and interdisciplinary research, these researchers are working individually or in teams pursuing their own particular resolutions to the complex issues that they are engaged with. The plurality of modes of research in which they are engaged is representative of the recombinative possibilities of questions and perspectives that they and their teams engage in pursuing.

Researchers researching research can admit that the existence of a plurality of modes of research and the different ways of producing the wide variety of knowledges about the world demonstrates the transformation of research. As we move away from our unitary and disciplinary conceptions of knowledges toward questions that can only be answered from transdisciplinary inquiry, we are faced with the problems central to opening any new dialogue constituted in the contestations of in the foundational axiomatics and axiologies of what we think of knowledge itself (Hunsinger, 2008). Even our ability to communicate the nature of our individual knowledge from one discipline to another becomes a seemingly insurmountable organizational problem. The reconstruction of research and research communities has always been a social and organizational problem but, as research is continually changing, it is becoming more transdisciplinary.

It is not surprising that more people are challenging the meta-problems of pluri-disciplinarity, such as those found in transdisciplinarity. Our book series, Transdisciplinary Studies, aims to challenge those problems as we search for texts that dissolve disciplinary boundaries, build new axiomatic and axiological relationships, and provide pathways for future research.

Towards Human Technologies, the first in the series, opens a discussion on three interrelated topics. Starting by questioning the interrelationships of biotechnology, new media and ethics, the editors juxtapose a series of articles from significant scholars centered around contextualizing and contesting the knowledges of biotechnologies and media, their interrelationships, and, in the end, provide a basis for transdisciplinary dialogues on these topics.

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BERNARD MCKENNA

1. INTRODUCTION

Given the considerable space used up in writing about biotechnology, one may well ask why this book has been written. The unique perspective that this book collectively provides is that it links biotechnology with media and citizenship. Biotechnology here means the direct manipulation of genetic material, and not the broader conceptualisation of any manipulation of organic life such as food fermentation. Media has a dual meaning: the representation of biotechnology in the (mass) media and the important role of data storage and manipulation in the biotechnological processes. Citizenship is concerned with the moral responsibility for the wellbeing of society now and into the future. The ethical disposition of the book is to provide spaces for alternative and dissident voices so that theorists and policy makers have the opportunity to step outside the hype that surrounds biotechnology and consider the issues from a position of humanity.

The book is in three sections:

i. Contextualising Biotechnology and New Media;
ii. Sites of Contestation; and
iii. Responses.

In the first section, Contextualising Biotechnology and New Media, Phil Graham begins by providing a political economic framework for considering biotechnology. Eugene Thacker considers how our extropian tendencies lead to the potential de-humanising of the body. Ross Barnard and Damian Hine continue in this line by considering how positivist tendencies in biotechnological education need to be tempered by more humane concerns. Joseph Vogel considers the impact of commodified biotechnology of the North from the persepctive of the megadiverse South. The Sites of Contestation considered in the second section raises critical issues of concern. Bonfiglioli considers the way in which the media construct our perceptions of biotechnology. Clapton expresses concern that the marginalizing of certain groups of people could lead to inhumane choices that deal with procreation, foetal diagnosis, and disability. Milligan sees in the discourses of ethical institutional frameworks notions of individual choice, individualism, and rationality. Lassen looks more closely at the discourses of biotechnological to traces of the need for progress, economic benefit, and legal-technical issues, which empirically reinforces the concerns raised by other contributors. The book's closing section, Responses, provides useful directions for future ethics-based considerations of biotechnology, particularly from a discourse perspective. Peter Isaacs stresses the need to understand

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our embeddedness by critically evaluating the discourses that valorise reason, autonomy, and freedom by listening to alternative voices outside the established traditions and norms. Clare Christensen's analysis of what it means to be scientifically literate also emphasizes that the capacity to step outside our social constructedness is crucial to effective citizenship when dealing with biotechnological questions. Finally, Naomi Sunderland explains how the processes of mediation within biotechnology industry and research and in the broader mediation to society can detach or sideline our humane impulse thereby producing social, political, and economic outcomes that we would not have intended to happen.

Implicit throughout the book is the understanding that biotechnology is not just concerned with a particular branch of applied science. Because biotechnology in the current phase of capitalism is commodified, it is woven into the political and economic fabric of society. Using a Marxist approach, Phil Graham's political-economic analysis considers how social phenomena, material and immaterial, are valued, distributed, and exchanged, while also considering how the collective and individual interests are settled. Essentially he tracks two tributaries leading to the current state of biotechnology: the link between biology and engineering, and the emergence of corporate capitalism. Up to the 1960s, he argues, biotechnology was predicated on engineering people to fit machinic purposes. However, a cultural turn including a greater concern with the state of the environment, led to a totalizing notion of biotechnology controlling and automating everything. Then, pointing out that contemporary corporatist capitalism relies heavily on perceptions of future value, Graham says that biotechnology is particularly suited for such a phase. While companies such as Biogen have produced worthwhile biotechnological products, the whole biotechnological industry is essentially concerned with the potential for investors to become wealthy by buying stock early. With so much speculative investment resting on the outcomes, the potential for risk will be understated and the potential for benefit will be overstated, he says, and problems will be shaped in such a way that favors corporate capitalism. Understanding this broader political economic context should lead us to re-consider the human issues involved and to set aside the economic imperatives. After all, biotechnology is very much concerned with the essence of life itself.

The relationship between the technologies of data-collection and the technologies of human biology has not been considered much outside of speculative fiction. This is why Eugene Thacker's paper is a timely effort to set this right. Designating the relationship between information technologies and biotechnologies as 'biomedia', he then places this phenomenon in the broader sociocultural context of posthumanism, which has two opposing strands: extropianism and a critical perspective. Because extropianism is technophilic, it is relatively sanguine about the implications of the changing technologies; however, the more critical perspective raises quesions about what it now means to have a body, to be a body, to create a body. Because extropian discourses incorporate Enlightenment discursive concepts such as progress, optimism, open society, and rational thinking – Thacker calls it smuggling humanist-based conceit – opposition can appear reactionary, a point made also by Sunderland. At the heart of his concern is the blithe ontological separation between human and machine that the extropians make, which paves the way to neutralize technology. The more critical posthumanists acknowledge the advances made by biotechnology, but are less prone to utopic considerations and are more interrogative of the potential implications of the 'new relationships between human and machine, biology and technology, genetic and computer information'. Drawing on the work of Claude Shannon and Norbert Wiener, Thacker concludes that when any sort of information is transmitted, it becomes disconnected from the language, culture, and context of real human life. The implication of this for biotechnology is that when the body is reconstrued as information, this disconnection occurs, rendering it easier for the body to be technically manipulated, controlled, and monitored. This happens through a process of translating, recoding, and decoding. In a sense, Thacker's concern is the ethical implications of a biotechnology that detaches human life and life components (e.g., stem cells) from humanity – 'lateral transcendence' – by the processes of biomedia. Such possibilities are not being considered in the headlong rush by First World countries to achieve bio-technological breakthroughs.

Barnard and Hine begin their paper by acknowledging the importance of traditional scientific methods in developing effective modern medicine that has helped to prevent disease, reduce childbirth risk, and increase our life expectancy. Nonetheless, they argue, the positivist foundations of modern science and Cartesian dualism must now be tempered by contemporary ontological and epistemological challenges. Furthermore, they argue, because biotechnology is based on a utilitarian ethic that is product focussed, the crucial role of fundamental research is being forsaken. In the Australian context, they point out that the increasing market orientation of universities is reducing science funding, especially in pure science, and is reducing the quality of the educational outcome. Collectively these factors reinforce positivist and Cartesian science. They want to replace this with a new science education paradigm that maintains technical and practical competence, but presents students with an understanding of the epistemological assumptions that underlie any body of knowledge. Indeed, students should be capable of deconstructing their knowledge base. Such a capability is important, they say, for the sorts of dialogues in which future scientists should engage, dialogues that incorporate the social and the ethical as well as the scientific.

As with any 'commodity', biological products have been commodified by capitalism. Joseph Vogel applies some basic economic tools to consider bio-prosepcting. He draws our attention to the fact that the mostly Southern megadiverse nations that provide the raw materials receive a 'picayune', and may, in fact, receive nothing when such materials are declared to be the property of no one. By contrast, the Northern nations that use these materials in biotechnological products are provided with monopoly patents, particularly in the U.S. which enforces the Trade Related Intellectual Property Rights (TRIPS) conventions on other countries. That is, the North's *Biodiscovery* is the South's *Biofraud.*

The media's strong influence over the public perception of biotechnology, particularly gene technology motivates Catriona Bonfilioli's chapter. Bonfiglioli points out that, despite claims to the contrary, positive coverage of biotechnological issues dominates negative coverage. In particular, she argues that genetic determinism is embedded in mass media texts. The effect is to increase public acceptance of many genetic technologies by normalizing genetic explanations for human problems. As a result, she fears that medical technologies can pave the way for genetic determinism. Given this intense focus on the genetic aspect, environmental components of disease will be rendered marginal or irrelevant. She refers to the common locution ‘the gene for’ as typical of such distortions, because it confuses genetic markers for genes. Although well-intentioned and useful, The Human Genome Project intensifies this focus on genes as the control centre of human biology. These **e**pigenetic developments run the risk of being appropriated by interests such as the insurance industry attempting to minimise risk. As well, pre-natal testing for ‘defects’ can lead us unthinkingly towards a new eugenics, but wrapped in a discourse of choice and rights. Thus, we need to be vigilant in how we ‘frame’ genetic research, policy, and public reporting. Unintended consequences such as eugenics and the diversion of resources and funds away from other areas of research and activity that also have legitimate claims need to be guarded against.

The discourse of biotechnology, which is infused with future-oriented intimations of hope –a characteristic identified also by Graham – based on cures and controls for disease and disability, implies an enhanced society. However, Jayne Clapton draws our attention to the citizenship implications of a society that necessarily eliminates those ‘things’ or beings deemed unworthy of life. Using the word-play of re-membering as a process of putting back together, as it were, as well as recollection, Clapton puts the case that contemporary imperatives should be scrutinized for what might be marginalized or excluded in our deliberations. Ethical practice, she argues, requires reflection based on *anamnesis* of past practices, not the comfortable process of amnesia. By denying access to groups of people who do not have access to ethical decision making, by not incorporating their voices, and by sanitizing practices and sites, we are complicit in amnesic practices, she says. Thus, contestation is muted or non-existent to the advantage of dominant discourses and dominant social groups. Because biotechnology frames the world primarily from a strongly reductionist and analytical philosophical paradigm, it necessarily creates a tension with a humanistic paradigm. Consequently, the biotechnological orientation tends to represent the person as ‘micro parts’, rather than a being within an expansive metaphysical realm. Associated with the scientific paradigm are other vast discourses of law and politics. Although proponents of biotechnology do not promote eliminating certain types of disabled people, there is nonetheless the risk that interpreting people’s lives in particular ways will orient choices about procreation, foetal diagnosis, and disability in particular ways. For example, however well-meaning a decision-maker may be, if they perceive disabled people as dependent and non-productive, then they are unlikely to be positively valued.

When we consider the history of the ‘institution’ or ‘asylum’, it should be obvious, Clapton argues, that practices and discourses developed around notions of care and control towards anomalous Others can lead to undesirable outcomes. Similar notions used in contemporary discussions about preventing the life of a person who might ‘suffer’ is outdated she says because the suffering is often the result of the different relationships between ‘normal’ people and the ‘other’. Incorporating narratives of the disabled as not othered will provide some countervailing force to the powerful rational processes of biotechnology. Thus tropes of acceptance, mutuality and interdependence will counter those of suffering, limitation and loss, thereby altering the balance of likely outcomes. Whether the powerful disciplines of contemporary biotechnological practices admit such narratives and tropes affects the ethics, practices and possibility of life itself.

The tension between liberating and eugenic tendencies in the new reproductive technologies is Eleanor Milligan's concern. This tension has been made particularly relevant given the widespread use of prenatal screening (up to 90% in First World countries). The apparent resolution of this tension is the notion of a patient's informed consent. However, Milligan identifies several concerns with this concept particularly in the context of the entrenched institutional pathways of routine screening, counselling, and predefined outcomes (over 85% of foetuses prenatally diagnosed as abnormal are aborted). As Milligan points out, the availability of this knowledge creates an expectation of some action, but it also raises the problem of defining what is abnormal or a disability. Of concern is that the decision-making process in this complex area occurs within a discourse of choice, and of uncontested science. Basing such life and death judgments on 'choice', itself part of a larger discourse of individualism, does not guarantee ethical integrity, she points out. In any case, the concept of informed consent to engage in testing and subsequent actions is also highly questionable for a number of reasons. A purely rational approach does not allow for non-rational aspects such as intuition and humane impulses. As well, the decision maker is not necessarily cognizant of the 'relevant' knowledge needed, and the available options are predetermined. Milligan points out that the predictive capacity of reproductive technologies is highly questionable in that pre-natal tests suggesting potential abnormality frequently are not borne out. An ensuing further ethical dilemma is created by the fact that the capacity to treat has not kept pace with the capacity to diagnose, and this then creates further imperatives for more technological interventions in the whole natal process. As a consequence, Milligan argues for an expanded ethical framework beyond the current formulaic procedure rooted in notions of individual choice, individualism, and reason-based science. Consequently, this new ethics must be seen as involved in human relationships beyond just the individual. It must also be based on an understanding of the interconnectedness of biotechnology as a science and as a political, economic, and social practice.

The possibility of dialogue between proponents and sceptics of biotechnology is Inger Lassen's concern. She linguistically analyses journalistic interviews of scientists, politicians, and a consumer organization representative in Denmark on the topic of food biotechnology. Infusing the discourse of these subjects were the intertextual traces of safety, the need for progress, concern for less well-fed people, economic beneficiaries, and legal-technical issues of patents. Rather than seeing these as points of difference, the implication is that these intertextual elements might form the basis of dialogue. A further optimistic element of the research is that both sides seemed to share the same goal, a world without suffering.

Peter Isaacs provides a genealogy of the dominant contemporary view that most biotechnological developments are either ethical or not matters for ethical consideration, thereby marginalizing or silencing criticism. He does this by providing an overview of the ‘technological impulse’ and a brief history of the Western ethical tradition. By technological impulse, Isaacs means that technology has increasingly dominated culture through the three cultural stages of hunter gatherer, agrarian, and the scientific-technological. However, the goal has changed from the most ‘primitive’ instinct of survival to the current situation in which the Industrial stage is giving way to the IT and Biotechnological Revolutions. Furthermore, the focus of activity has shifted from the natural environment to that of human meanings (information, knowledge, entertainment, media, culture) and to the environment that constitutes humans themselves as embodied, living organisms. Accompanying this has been the political-economic shift from industrial to consumer capitalism, the major characteristics of which are entrepreneurialism and commodification, even of bodies. The ethical tradition has also been complex, moving from polytheism to secular postmodernism. Isaacs locates Kant as the primogenitive source of contemporary secularism because of his assumption that individual decision-making constituted the moral form of life (of course, individual conscience was given considerable impetus by the Protestant revolt). God as the source of goodness was replaced by the categorical imperative and the assumption that, in the social order, people act rationally when they comply with the universal moral law. Concomitant with this, Isaacs claims, is that, in the natural order, people act rationally when they comply with scientific laws.

With technological development in consumer goods, transport, medicine, and luxury items, ‘paradise’ for many moved from the hereafter to the present, and so the meaning and purpose of life moved from the transcendental to the immanent. Consistent with this have been the ‘conditions of interiority’ that valorise not just reason, but also personal autonomy and freedom. All of this may seem to provide little encouragement to those who seek to challenge the hegemonic suite of discourses that incorporate achievement, personal freedom, progress, and entrepreneurial capitalism. However, Isaacs suggests that one way forward is to listen to voices outside the established traditions if we wish to reappraise what it is to be human, and what constitutes the good life. To be truly critically reflective, we must also negotiate our ‘embeddedness as human beings’. By becoming aware of our own biographies, understandings, hopes and fears at a personal level, and our embeddedness in culture, institutions, and communities at the social level, we are more likely to become aware of the assumptions that underlie our practical and ethical engagement with biotechnology.

The fact that only 5% and 15% of the adult population in most Western countries are scientifically literate motivates Clare Christensen to consider what scientific literacy is. This is particularly important given that our ‘knowledge’ society is primarily scientific and technological, and that our ‘risk’ society is concerned with applying new technologies. Effective citizenship requires that people have the capacity to deal with the ethical, social, and physical implications of technolgical development and change. However, defining scientific literacy is difficult. For example, in broad terms, there are different emphases between Anglophone and European approaches to scientific literacy. The former see literacy as the ability to cope with scientific information meaningfully, as well as being interested and confident. The ‘European’ approach, however, is more concerned with developing a ‘scientific culture’. The OECD seems to provide useful guidance by drawing together these approaches such that schools would develop ‘the capacity to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity’. In the face of exponentially growing knowledge and the technological imperative, it appears that relying on providing only a knowledge base at school, though necessary, will not in itself provide the requisite skills of effective citizenship in dealing with scientific issues. This is because citizens need to deal with technical, methodological and epistemological scientific uncertainty, which is realised when scientists give differing accounts or interpretations of phenomena. In other words, effective citizens need the skills to evaluate evidence. However, coping with expert disagreement is something that is rarely encountered in school science, according to Christensen. To deal with this, students need to become aware of how scientific knowledge is socially constructed. As well, if literacy were understood in the sense that it currently applies in language literacy, then it would be seen as a social practice that is situated in social situations and social contexts. In this way, emerging citizens would ask the appropriate critical questions such as whose version of science and technology is presented and, as it is applied, whose interests are served. A critical scientific literacy is clearly crucial to effective citizenship, particularly when dealing with complex biotechnological issues.

The way in which biotechnological interventions are framed is Naomi Sunderland’s concern. Understanding the framing process provides insight into the relationship between biotechnology, ecology and society. Such a relationship inexorably leads us to see biotechnology as a political and ethical issue. She says that biotechnology as a social practice occurs through the discursive mediating processes of Alienation, Translation, Recontextualisation, and Absorption. To understand this, we must first extend our understanding of media beyond the current conception of television, radio, or print to consider other processes of mediation. Broadly, mediation occurs when meaning moves ‘from one text to another, from one discourse to another, from one event to another’. Furthermore, biotechnological mediation must also be understood as a form of political economy. That is, the very foundations of life, something of awe, mystery, spiritual and scientific significance is translated into a product, accessible to few people. Sunderland’s prism is the relationship between social practices and discourses. Biotechnology constitutes an array of related practices and discourses. She is concerned that when social practices and discourses become detached from their social environment by discursively constituted boundaries, we are at risk of losing social control over the practices of biotechnology. Sunderland identifies the mediating movements of Alienation, Translation, Recontextualisation, and Absorption that constitute discourse construction.

The concept of alienation is built from the notion of property, which has three characteristics: alienability, rivalry, and excludability. These are present in biotechnological processes when genetic technologies dissociate biological materials from one ‘owner’ (any living organism) or context to another ‘owner’ (e.g., “intellectual property”) or context (human DNA from the body to a database). Translation, the most overt discursive function, recasts systems of meaning so that an object or process can be recontextualized and recast. It *fixes* meaning in particular ways. At its simplest, biotechnological discourses shift meanings from a "language of life" into technocratic, scientific discourses. Implied in the term, technocratic, is a political and economic aspect, as well as the scientific. Thus, there are biotechnological commercial goods and services, and biotechnological political imperatives. Accompanying this discursive shift is the process of recontextualisation, or the actual material presence of such biotechnologically-related objects within new social systems and contexts. Such objects include the living organism itself, the site in which it is manipulated, to say nothing of the extensive legal, social, political, financial and economic processes within which it is now enmeshed. Finally, absorption occurs when these biotechnological processes and artefacts enter seamlessly into everyday discourse and practice. In biotechnology, this occurs when the inalienable is commoditised and when the new technology or product becomes the familiar. This is most likely to occur when a process is considered desirable, acceptable, and familiar.

We see in the discourses of government and industry, often rarely distinguishable, a sense of the imperative based on urgency, an unquestioned notion of advancement that will secure a better future, and a fear of missing the technological revolution. To question any of this automatically places the questioner in a highly unfavourable subject position, that is, as a reactionary, a zealot, someone who would limit an infertile couple's chance of having a child, or a cancer sufferer from extending their life. Consequently, there is little chance that those who simply ask questions about consequences, intended and unintended, can be heard because the whole apparatus of economy, education, science, commerce, and politics has been 'frameshifted'. Alternate and dissident discourses beat on the outside of very tall and very thick discursive walls.

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SECTION II CONTEXTUALISING BIOTECHNOLOGY AND NEW MEDIA

PHIL GRAHAM

2. POLITICAL ECONOMIC PROVENANCES OF BIOTECHNOLOGY

In this chapter, I take political economy to have two distinctly different but interrelated meanings. The first is an approach to understanding human social systems in terms of the ways in which values are produced, exchanged, and distributed (the economic), the ways in which power is produced, distributed and enacted throughout social systems (the political), and how these aspects of human activity interrelate. The second meaning is more strictly etymological: in this view, political economy provides a means of seeing the intersection of *polis* and *oikos*: the complex relations between public and private; between overarching government of a public collective (*polis*) and the private realms of quotidian human existence (*oikos*). These meanings are inextricably linked because the ways in which the mass of people produce values on a daily basis is conducted according to overarching systemic principles.

I take an essentially Marxist approach to the present analysis of biotechnology, treating it as an historical and material phenomenon and investigating it through historical materialist dialectics, an approach to political economic analysis developed by Marx (Fairclough and Graham, 2001). The specific theoretical stance I take is 'cultural realism' which assumes that: the defining values of a culture are expressed through its institutions, media texts, arts, and sciences; that these have real, material bases in human social relationships; that they have real and material effects on individual constituents of a culture; and that those effects are objectively accessible through analyses of relationships between people, their values, their cultural texts, and their institutions (Smythe, 1981: 192-216).

Such an approach would no doubt present difficulties for some Marxist schools of thought since, in the present context, the term "biotechnology" refers almost exclusively to informatic processes. That is to say: contemporary biotechnology consists of firstly abstracting ideal types from decoded DNA and reconfiguring these abstractions to produce changes in the more concrete realm of biological entities—it proceeds from what many Marxists would call "the ideal" to the "real" and is therefore an idealist pursuit that cannot permit of a direct materialist reading (see Jones, 2004).

Yet the very fact of biotechnology's informatic approach indicates that contemporary biotechnology signals a return to the most ancient cultural impulses: at their most advanced, they are not technologies to merely tame or control the external environment; the 'most promising' of biotechnologies is 'gene therapy', an approach that will ideally reorder our biological selves based on informatic

Naomi Sunderland et al. (eds.), Towards Humane Technologies: Biotechnology, New Media and Ethics, 17–34.

re-engineering (European Union, 1994). Here is what the EU had to say about gene therapy in 1994:

> Scientists generally agree that somatic gene therapy is one of the most promising ways of allowing to alleviate, to cure or to prevent a growing number of genetic as well as acquired diseases, including cancer and even perhaps AIDS. Somatic gene therapy has indeed recently entered the clinical setting as a highly experimental therapeutic procedure. An important and long lasting research effort is still required before routinely performed medical applications can be envisaged. (1994: 1)

Gene therapies remain in the 'most promising' category of biotechnology. That is to say: *ideally* they will provide all sorts of benefits, but nothing much has happened yet in material terms. Such texts are typical of contemporary policy about new technologies – it is typical 'hype' in an age of 'hypercapitalism' (Graham, 2006).

CULTURAL REALISM AND HISTORICAL MATERIALIST DIALECTICS

The approach I take to this work hangs together in the following way: cultural realism is based on the assumption that we can understand cultures through an analysis of social relations, arts, sciences, and institutions, and the texts they produce, and that such texts will give us insight into the values of that culture. Classical dialectics proceeds on the assumption that, on any given topic of any importance, various experts will express differing and sometimes opposing definitions or explanations of the topic (Grote, 1872). The main assumption of historical materialism is that people living together in historically specific social relations shape their reality with the materials they have at hand and, that as these materials change, so to will social relations (Marx and Engels, 1846/1972). By tracing the history of biotechnology as an institutional terminology to describe many different aspects of life, I am attempting not only to show how biotechnology has come to be the set of concepts, practices, and attitudes that it is in today's society, I am also showing the development of the current political economic climate through dialectical investigation of the term "biotechnology"[i] After outlining the genesis of technological trends that long predate the emergence of biotechnology as a distinct term, I show how biotechnology has been used by various institutions throughout the last century.

DEEP-SEATED TECHNOLOGICAL IMPULSES OF "WESTERN" CULTURE

The Judeo-Christian religious tradition pervades and underpins technological developments throughout western societies (Noble, 1997). And political economy is itself an essentially religious and moral project with roots in the mediaeval church (Langholm, 1998). The religious and therefore moral rationales for biotechnology can be traced to the earliest pages of our oldest moral texts.The Book of Genesis contains the following:

> Let us make man in our image, in our likeness, and let them rule over the fish of the sea and the birds of the air, over the livestock, over all the earth, and over all the creatures that move along the ground. (NIV Bible, Genesis 1:26).

The development of technologies through which we have achieved external domination has been so dramatic in recent history, Benjamin Franklin's assertion that human beings are "tool-making animals" has become generally accepted as the sole distinguishing characteristic of the human species (Mumford, 1966). The result of this view is a kind of 'technical narcissism' in which all we see in the development of our species is the succession of tools we have used along the way (Mumford, 1966: 108). The opposing view is that the development of a complex symbolic culture is humanity's primary achievement and distinctive feature; that the tools we have made along the way spring from this aspect of our nature; and that to think of the human being 'as primarily a tool-using animal is to overlook the main chapters of human history' (1966: 8). If we take the capacity for mind, culture, and complex symbolism, especially language, as being definitive of the human condition, the primary motivating force in human development, and understand that technologies have merely 'supported and enlarged the capacities for human expression', we can better understand the historical meaning of new technologies (1966: 9). Put briefly, the view that technology leads to complex minds and cultures has entirely different political and moral implications than its opposite: that 'the evolution of language—a culmination of man's [*sic*] more elementary forms of expressing and transmitting meaning—was incomparably more important to further human development than the chipping of a mountain of hand- axes' (1966: 8). That is because in the "mind first" thesis, aspects of culture are firstly about self-control, self-understanding, and self-expression, whereas the "technology first" thesis suggests that technological development is an unquestionable cultural good because it produces more developed minds. The "mind-first" view of human development suggests a moral imperative for self-control, understanding, and the flowering of expression. The "technology first" thesis contains a moral imperative for the unobstructed development of technology, regardless of human or environmental costs, because it will always be beneficial to the majority of people.

In case my description of the "technology first" thesis seems too strong, let me present some evidence from current research into the early development of humans:

> The manufacture and use of early stone tools represents a major evolutionary advance in the behavior of early hominids. Identifying any shifts in brain and cognitive function that may have been associated with this innovative behavior has long been priority in paleoanthropological research. (Stone Age Institute, 2006).

This statement from the Stone Age Institute (2006) makes the assumptions that tool-making modified human intelligence and that behaviour precedes cognitive development. More explicitly, Ambrose (2001) argues that

> Human biological and cultural evolution are closely linked to technological innovations. … Stone tool technology, robust australopithecines, and the genus Homo appeared almost simultaneously 2.5 [million years ago]. Once this adaptive threshold was crossed, technological evolution was accompanied by increased brain size, population size, and geographical range. Aspects of behavior, economy, mental capacities, neurological functions, the origin of grammatical language, and social and symbolic systems have been inferred from the archaeological record of Paleolithic technology. (Ambrose, 2001: 1748)

Ambrose does not posit an explicit causal link between the development of technology and increased capacities for symbolic complexity and cognition, but the assumption that technology—the 'innovative behaviour' referred to by researchers in the Stone Age Institute—leads the process is clear. Understood as behavioural units, the production of complex technologies, argues Ambrose, is technically comaparable to language:

> Stone-tipped spears, knives, and scrapers mounted in shafts and handles represent an order-of-magnitude increase in technological complexity that may be analogous to the difference between primate vocalizations and human speech. […] Assembling techno-units in different configurations produces functionally different tools. This is formally analogous to grammatical language, because hierarchical assemblies of sounds produce meaningful phrases and sentences, and changing word order changes meaning. Speech and composite tool manufacture involve sequences of nonrepetitive fine motor control and both are controlled by adjacent areas of the inferior left frontal lobe. (Ambrose, 2001: 1751)

The basic assumption is made even clearer when Ambrose asserts a relationship between complex tool-making and neurological evolution in the species:

> The complex problem solving and planning demanded by composite tool manufacture may have influenced the evolution of the frontal lobe. Functional magnetic resonance imaging demonstrates that the frontopolar prefrontal cortex selectively activates only when imagining a main objective while performing related secondary tasks ... Composite tool manufacture demands the planning and coordination of different kinds of subsidiary tasks and may have coevolved with this frontal lobe parallel processing module. (2001: 1752)

Again, and although co-evolution is proposed, tool-making makes the demands for expanded cognitive capacities. Yet there is a glaring contradiction evident here: Ambrose's conclusion that the development of language and culture might actually be the 'autocatalytic' driver of technological development. It is as if complex 'planning and coordination' could proceed without highly advanced means of cooperation (language), or even that planning could exist without a very complex, communally-shared concept of a future that is susceptible to human planning and coordination. Put differently, Ambrose's whole argument depends on the pre-existence of a socially shared imagination of a future that had not happened yet, and which was strong and clear enough to motivate the production of complex tools. That requires at the very least language with a complex tense system. So much for the “tools first” hypothesis of human culture, communication, and cognition. Yet again and again it appears in “Western” theories of human development: technology leads and humans benefit. With this understanding of “Western” technological traditions in mind, I move on and in the following section specifically to the place of “biotechnology” in recent political economic history.

THE BIOTECH CENTURY: ENGINEERING EVERYTHING FROM BEER TO BABIES TO BODY PARTS

The first recorded mention of biotechnology I have found is by a brewery in Leeds, England (Murphy & Sons, 2007; cf. Bud, 1991, Hulse, 2002). The Bureau of Biotechnology was established in 1899 to investigate the best ways to brew beer by testing various combinations of organisms, metals, and chemicals and to advise other breweries on these matters (Murphy & Sons, 2007; cf. Hulse, 2002). The bureau is later mentioned in Society Proceedings of the *Journal of Parasitology* as having provided a live culture of fungus identified as impeding a ‘sheepskin sweating and tanning process’ (1925: 218).

It is not surprising that one of the oldest chemical processes in recorded human history (fermentation of alcohol) gets shifted into the realm of science at the turn of the 20th century. It is the period during which the dominant institutions of the West were all refashioning themselves along scientific lines: F.W. Taylor had laid far-reaching claims for “scientific management”; Woodrow Wilson, later elected US president, had coined ‘scientific administration’ (1887); Dewey sparked generations of debate that continue down to today about what a ‘science of education’ might mean (Graham & Luke, 2005; Williams, 1959). The new industrial sciences of war had had an overwhelmingly successful applied trial in the American Civil War. Emblematic of this is the Chicago meatworks that was transformed into the first ever production line for Winchester rifles (Standage, 1998).

Given that alcohol was an important part of international trade at the time, and that science was a passion for many in the middle class, the Leeds Brewer who coined the term is very much an historical cipher for the “scientific” spirit of the age. And so it is with subsequent meanings of biotechnology throughout the twentieth century (Bud, 1991). Throughout the course of the twentieth century, argues Bud, and from whichever perspective, biotechnology mediates between biology and engineering (1991): between *what* we do with biology and *how* we do it. And, as David F. Noble puts it, ‘the technical work of the engineer’ in Capitalism has rarely been anything other than the ‘scientific extension of capitalist enterprise’ (1977: 33). Noble quotes Henry Towne, who in 1886 says that ‘the dollar is the final term in every engineering equation’ (1886, cited in Noble 1997: 34). From its earliest formalisation as a widespread and purposive scientific enterprise, “biotechnology” has ultimately been about writing “scripts” for the interaction between machines, bodies, cultures, external environments, and minds. Here is an example from *Science* in 1947:

> The capacity, efficiency, and endurance of the human machine in physical labor is the concern of every engineer who assumes administrative duties, and doubly so for the production engineer. These factors underlie the principles of scientific management and time-and-motion analysis. When the additional stresses of environmental temperature, pressure, or anoxia accompany the work, physiological tolerance may be a critical concern. Hours of work, on-the-job feeding, rest periods, etc. are also phases of the physiology of work which form an important part of a comprehensive biotechnology (Taylor & Boelter, 1947: 217)

These enthusiasts of a new biotechnology in 1947 encapsulate the spirit of the preceding five decades. Control of workers had been reaching steadily inwards, past the raw physical aspect of activity, past time and motion studies, into psychology, nutrition, hygeine, and leisure. In this political economic context, biotechnology is directly aligned with strategic management and claims to be its necessary extension. This is a different era of management than the present day. Labour is still understood in classical terms as unruly, *variable* capital (variable capital being the relatively unpredictable amount of work done by labour as opposed to the more predictable “fixed capital”, such as machinery and buildings). Today’s corporatist managerial class is largely separated from productive factory work which is now typically outsourced and carried out on contract. We can see in the above text that the scientific “pulling apart” of people has begun in earnest. Scientific management was firstly a technique designed to separate thought from action in the labour process; to reduce the variability of variable capital (or labour), separating the process of production into its smallest components; and simultaneously functioning to hide the social character of labour by separating workers from any personal connection with finished products (Smythe, 1981). In this engineering advance, not only is thought separated from action, action and thought are broken down further into their component parts so they can be engineered to conform with the stresses and pressures of physical labour.

The biotechnology program described above, which has been launched at the Engineering school at the University of California, is premised on: ‘the interdependence of man and machines’, ‘the progressive extension of artificial control of human environment’, and ‘the expanding role of the engineer in human affairs’ (1947: 217). It is a thoroughly pedagogical affair, a ‘curricular innovation’ that is justified on ‘practical as well as philosophical grounds’, and emphasising the necessity of adding ‘a biological phase to the technological equipment of the engineer’ (1947: 217). That the representatives of Capital feel it necessary to enclose not merely the physical energies of variable capital, but to take scientific control of psychology, biological processes, and the human environment, indicates that a large-scale move towards the scientific control of attitudes, abilities, and actions had become both feasible and desirable. Again, it is necessary to stress the thread that runs through this article for the journal Science in 1947 and the present hyperbole about the benefits of gene technologies: both have as their aim the abstraction of an ideal type worked out on a scientific basis and written directly into human biology. They differ only in terms of means and extent. It may be superfluous to note that humans, even in 1947, are idealised as mere objects to be manipulated for external ends – as a mere collection of mechanical things to achieve the ends of management and its machines. Three years later we are told that:

> The evolution of a field of human engineering was inevitable. It has as its prime goal the achievement of optimal man-machine relations. It asks the twofold question, How can a man be selected and train to operate the machine most efficiently, and how can the machine be designed so that the man can operate most efficiently? In one instance we select the man; in another, the machine (Mead & Wulfet, 1952: 373).

The situation could not be put any more plainly. By this time, worldwide data were becoming available from anthropology, psychology, and more importantly from a near global system of scientific management coordinated and disseminated through the media of academe (Mead & Wulfet, 1952: 373-378). Mead and Wulfet identify the impetus for an engineering-based, human-focused biotechnology as the greatly increased complexity in the new machinery of war:

> During World War II … it was found that, even with the application of the best selection and classification devices then known, the most up-to-date training techniques, and the most refined techniques of time and motion economy, there were too many instances where military operators were unable to perform the tasks complex modern warfare and its instruments demanded. […] It became clear, for perhaps the first time, that the human being could be the factor that prevented an engineering device from performing to its full specifications … (1952: 373).

Through to the late 1960s, "biotechnology" became shorthand for the science of integrating people into machine systems in the most efficient manner possible according to the lights of engineering and business administration. In essence this conception of biotechnology is neither different to, nor sperate from, the development of scientific management as a set of ideas and practices throughout the 20th century. The prevailing assumptions are: that machines are more reliable than people; that people must be therefore engineered to fit machines; that, as machines become more complex, they are more susceptible to human fallibility; and that increasing complexity of technology is an unquestioned good. The overall implication of this view is total automation.

In the mid 60's ethnicity – or more properly, culture – becomes a barrier to the "proper" engineering of human beings (Pierce, 1966). Again, it is the 'accelerated growth in technological complexity that occurred during World War II' that continues to drive the concept of biotechnology during this period (Pierce, 1966: 218). A strange twist becomes evident at this point: Pierce (1966) argues that it is not the machine component that is constant; rather, 'the design of the human component is fixed, and the type of task it performs is limited by its relatively unmodifiable design' (1966: 218). The overall purpose and orientation of biotechnology at this time remains practically unchanged since the early 1950s:

> The fundamental concept of biotechnology is that man should be considered, not as an afterthought to be included only when the major elements of equipment design have been completed, but rather as one of the various components which must be fully integrated into the system. All components, whether human or inanimate, assign certain tasks to perform in order to achieve the over-all goal of the system (Pierce, 1966: 218).

Although it seems that human beings are still considered to be indispensable in any total way, the implications remain the same. A complete statement of the aims of biotechnology at the time is as follows:

> To determine the nature and magnitude of the capabilities and limitations of the human component in the man-machine system; to appropriately allocate tasks to the human and inanimate components in accordance with their respective attributes; and to insure [sic] that the interface between man and machine be designed to most efficaciously exploit the distinctive characteristics of each (1966: 219)

Pierce argues that since ‘it is now clearly recognized that modern technological equipment can present serious problems in inefficient operation within our own society. It should be obvious, then, in societies which are less technologically sophisticated than ours … such problems could assume proportions which may appear to be virtually insoluble’ (1966: 219).

The text by Pierce is interesting for a number of reasons: first, there is a functional inversion of the classical categories of political economy based on *potentials*. Machines are seen as being functionally variable rather than predictable and fixed, whereas people are seen to be functionally fixed in terms of what they can do and how far they can be modified. This tells us much about the tense system at work in respect of technological and human potentials: as far as the future is concerned, the machine’s potential is unlimited in the mind of the engineer-administrator. But humans, at least as parts of a machine system, have limited functionality and therefore their involvement in this techno-complex is a hindrance and must be accommodated for at every stage. Even more interesting is the fact that culture begins to play a problematic role for biotechnologists of the day. The implication made by Pierce is that people from technologically less-developed cultures can only increase the problems experienced in the developed world. What is today called “the third world” is a problem to be excluded from biotechnology rather than as the “feed-the-world” moral rationale that it is today.

Aside from various versions of biotechnics – human oriented technologies designed to meet solely human needs, that operate at a human scale, and reintegrate humanity with nature (Mumford, 1934; Bud, 1991) – it is not until 1969 that the environment comes to the fore in definitions of biotechnology (Platt, 1969). By the end of the 1960s a general awareness of looming crises had emerged throughout the developed world, in part as a result of intellectual revolutions during that decade, in part because of the sheer pace at which technology was advancing, and in part because of a global awareness promoted by advanced communication technologies (and superpower posturing) of the sheer destructive power directed at the whole planet on a daily basis (Platt, 1969). Biotechnology, according to Platt, would play a key role in balancing tendencies of the human technological complex with a delicate ecosystem. For Platt, biotechnology would respond to the following problems:

> Humanity must feed into the children who are already in the world, even while we try to level off the further population explosion that makes it so difficult. Some novel proposals, such as food from coal, or genetic copying of champion animals, or still simpler contraceptive methods, could possibly have large-scale effects on human welfare within 10 to 15 years. New chemical, statistical, and management methods for measuring and maintaining the ecological balance could be a very great importance. (Platt, 1969: 167)

Harkins (1975) takes the prevailing winds of a “cultural turn” further, noting that any solutions to the massive problems that had emerged into general consciousness during the 1960s will not be merely technical (1975: 29-31). What the problems require is a complete paradigmatic shift (1975: 27). In this “transitional” text, Harkins sees biotechnology as one of the ‘hardware’ elements of a sociotechnical complex that needs to be reoriented (1975: 27). The term ‘software’ is understood in a very specific orientational sense here: ‘All software operates to control behaviour. The critical question is: What software for whose behaviour to what ends and with what implications?’ (1969: 27). Culture again presents a problem to any clear answer:

> Sociocultural technology in practice becomes a “problem” when paradigms generating past/present/future “realities,” desirable and undesirable, do not match up. In our type of society, the critical problem mentioned earlier becomes critical problems as more people become manipulatively, visibly, and widely involved in the cybernetic functions. Software/hardware developments are emerging to “deal with” conflicting stasis and change, but themselves will enter into complex feedback relationships, often of indeterminate dimensions and implications. (1969: 27-28)

Culture, the tense system, technology, an emerging new media complex comprised of computers, and the most ancient tendencies of human social systems must be addressed if the looming crises (extinction, planetary destruction, environmental disasters, unbearable tensions, participatory etc) are to be avoided—nothing less than a global program of re-education is required (1975: 30-32). Platt quite correctly sees education systems as the primary medium through which a global “re-engineering” of values, beliefs, and practices must be achieved (1975: 30-32). He contrasts ‘fixed’, ‘limited learning’, and ‘open information’ systems of education, arguing that the first requirement of the most desirable of these (open information) requires a hardware level that includes a:

> two-way interactive, broad-band communication system connecting every point on the globe with any other end to all space colonies. Each home has its own communication terminal which includes: (1) interactive, multi-channeled

> cable television; (2) picture-phone; (3) computer-computer, man-computer, computer-man communication; (4) combination of keyboards, like hands, printers and electronic logic and storage; (5) videotape porta-pack; (6) quad-sound unit including receivers, tape-deck, speakers and turntable. (1975: 32).

In Harkins' ideal system, the whole of humanity would be connected, almost exactly as it is now, with the education system being 'everywhere and nowhere' (32). His exercise in the futurology of cybernetics is worth noting if only because it so accurate in terms of what has come about in the decades since then. Harkins' "hardware" layer for a generalised sociocultural technology suited for a globalised world includes: an 'automated inquiry system' (*eg* Google); an 'automated intelligence system' (NSA's STIC system), a 'talking typewriter' (on which I am currently dictating large sections of this chapter), an 'automatic language translator' (Alta Vista's Babel Fish), 'automatic identification system' that recognises fingerprints or voices (US Homeland Security immigration system), a 'computer psychiatrist' (Eliza), and a 'computer arbiter' that settles disputes (for example, the divorce information kiosks trialled in Australian Family Law Courts) (1975: 33). The total automation of human problematics is ideally solved with the emergence of such a system.

The overall thrust of Harkins' argument is that all these technological advances, as well as generalised access to them, are required for a *new humanism* that can cope with cultural diversity, global education, and an almost complete reorientation of values, including the values of art, music, and literature. In other words, what seems like a progressive, human-oriented turn in the development of technology, culture, and education again requires nothing less than the automation of every aspect of human being. The final item on Harkins' list of technologies required to address the problems created by technologies is a '*Creation and valuation system* … capable of creative work in such areas as music, art (painting, sculpture, architecture), literature (essays, novels, poetry), and mathematics, and able to evaluate the work of humans' (1969: 32). Although not systematically integrated, the components of such a system exist on a widespread, generally accessible scale today. It is at this point – the point at which a globally organised informatics system becomes both imaginable and technically possible – that preceding conceptions of biotechnology are explicitly conceived of as part of a totalising approach to the control and automation of everything human. The concerns of the cold war era, which include everything from total annihilation to world hunger to unbearable psychological stresses, permit only of technological solutions implemented on a universal basis – the same scale at which the defining conflict of the day operated.

The degree to which cultural and psychological stresses become apparent in intellectual tracts of the day indicates, I would argue, elite concerns with an emergent anarchism, meant here in a very literal sense as an explicit movement to do away with *all* official leadership in favour of an individualistic, self-governing political paradigm. The cultural and political revolutions of the 1960s, which took place under the shadow of two competing superpowers constantly touting their destructive capacities through threats, education, mass-mediated propaganda, political manoeuvering, and raw displays of destructive power in the form of nuclear weapons tests, were almost without exception expressions of a "people power" ethos, epitomised in the behaviour of the 1960s "flower children". The anarchist tendencies of the day were not confined to "the West". In Russia, China, Africa, and the Middle East, political disruptions and societal dissatisfactions were rife. Harkins' informational "revolution" consists of deploying every form of technology to bear upon the control factors, or 'cybernetics', of human society. Machines are presented as not merely more efficient in "material" terms, but as more efficient judges of everything from education to art to politics.

BIOTECHNOLOGY AT THE END OF CAPITALISM

> Until the latest of our world conflicts, the United States had no armaments industry. … But now we can no longer risk emergency improvisation of national defense; we have been compelled to create a permanent armaments industry of vast proportions. Added to this, three and a half million men and women are directly engaged in the defense establishment. We annually spend on military security more than the net income of all United States corporations.
>
> This conjunction of an immense military establishment and a large arms industry is new in the American experience. The total influence – economic, political, even spiritual – is felt in every city, every State house, every office of the Federal government. We recognize the imperative need for this development. Yet we must not fail to comprehend its grave implications. Our toil, resources and livelihood are all involved; so is the very structure of our society. (Eisenhower, 1961)

Allan Luke and I have argued elsewhere that the present system can no longer be described as "capitalist" because it has passed into a corporatist phase (Graham & Luke, 2003, 2005; Graham, 2006). The main distinguishing features of capitalism, at least from a Marxist perspective, are its two "great classes": capitalists (owners of the means of production) and workers (Marx, 1976). It has been decades since ownership was the general mode of control for the "ruling classes". What has emerged instead is a system in which the savings of millions have been mobilised to create a global financial system managed by corporate interests, resulting in the separation of ownership from control. Since the mid-1970s when Harkins was writing, the main mechanism for control of people, cities, states, and nations is debt (Graham & Luke, 2005). Eisenhower's farewell speech (1961) was a warning that this emergent system was either on the verge of taking control or had already done so.

Beginning with Watson and Crick's discovery of the DNA double helix in 1953, and following subsequent experiments with RNA conducted with the aid of new computer technologies and optics, the term "biotechnology" became what it is today in around 1980: a term generally taken to mean direct manipulation of genetic structures at the sub-nucleus level of DNA (Galton, 2001). It was precisely 1980 when the biotechnology "gold rush" began:

> The date on which molecular biology became big business was 16 January 1980. Reporters had been notified by telegram that are “major announcement” in molecular biology would be made by the company by again and two members of the scientific advisory board, Charles Weissman of the university of Zurich and Walter Gilbert of Harvard. The news delivered at the Boston Park Plaza hotel was that Weissman had cloned and got expression of the human leucocyte interferon gene in biologically active form. (Wade, 1980: 688)

In fact there was absolutely nothing new in the announcement at all, the human leucocyte interferon gene having been successfully manipulated in Japan sometime earlier with the results published in a Japanese journal (Wade, 1980: 688). The real news, as Wade notes, is the biological-corporate nexus that had been formed by the ‘mere context of the announcement’ (1980: 688). Linking ‘the recombinant DNA technique aith the possibility of manufacturing a promising anti-cancer drug’ was sufficient ‘to produce a major impact on the public imagination’, sparking a ‘cloning gold rush’ that doubled the paper value of the four major biotech companies without a single product being brought to market (1980: 688). The corporate complex had merged with gene technologies and trumpeted their potentials through mass media. The result was a a flurry of financial speculation (Wade, 1980).

It is almost three decades since the Biogen announcement. The corporation has since had five drugs approved by the US Food and Drug Administration (FDA): Rituxan, Zevalin, Tysabri, Avonex, and Fumaderm (Biogen Idec, 2007). It boasts an annual R&D budget of $US750 million with annual revenues of $2.5 billion and has issued just over 340 million shares (valued at $US43.30 at the time of writing for a market capitalisation of around $14 billion) since its initial public offering (Biogen Idec, 2005). Of the corporation’s total shares, a mere 1.9% are owned by those who control the corporation on a daily basis, its executives and directors (Biogen, 2006). Biogen has thus survived to become a typical corporatist enterprise: ownership is separate from control and the entire enterprise has become oriented towards public perceptions of its future value, thus becoming primarily a medium of biotech industry “hype” (Graham, 2006).

The 1980 Biogen announcement is the point at which the most basic processes of living matter become exposed to purely commercial interests. This is a fact of importance for any number of reasons some of which I will detail in the following section. It is also emblematic of the direction of corporatism more generally. Its development heralds a further movement “inwards” towards the commodification of more intimate and abstract aspects of life. Between 1947 and 1966, biotechnology was concerned with codifying the intermediate steps between the integration of raw physical labour into an industrial machine system and the integration of intellectual, psychological, cultural, and environmental factors of labour into that system by applications of engineering method. In the age of corporatism, “biotechnology” goes further, concerning itself with patenting new life forms and ancient biological processes in pursuit of future profits; purchasing speculative rights to genetic material on a mass scale; and generally shifting life into the future tense, whether in the form of debt, hopes for longer or never-ending life, or turning the fear of disease, death, and discomfort into a profit motive.

RECENT BIOTECH RUCTIONS IN AN EMERGENT "KNOWLEDGE ECONOMY"

From its ancient outset, engineering has been about harnessing, intensifying, and amplifying natural forces. Almost as soon as "engineering" turns its attention to "machining" basic biological processes for commercial ends, there begins to emerge a flurry of intellectual activity and institutional responses. Predictably, legal studies is among the earliest to enter the fray:

> Recent discoveries in the field of molecular biology that is popularly known as genetic engineering has given rise to a considerable amount of concerning debate both among scientists and in the wider community. The controversy serves to illustrate that genetic engineering experiments are of special importance because they pose unique and unpredictable threats to human life, to the environment and to agriculturally based economies. Ironically, those threats are counterbalanced by important medical, environmental and agricultural benefits … (Cripps, 1981: 369)

It was about twenty years after Watson and Crick's discovery that the potential for threat from genetic engineering was paid much official attention. Following an outbreak of smallpox in 1973 which began because of an 'accidental release' of the bacteria from a microbiology lab in London, and which caused two deaths before being contained, a flurry of legislative activity began (Cripps, 1981: 369). Against the tide of new and pending regulation, science responded on the grounds of curtailed 'freedom':

> On May 22, 1978, with the promulgation of the Health and Safety (Genetic Manipulation) Regulations, Britain became the first country in the world to regulate genetic engineering by legislative means. The regulations have, however, been severely criticised by members of the scientific community on the basis that they represent *unacceptable inroads into freedom of scientific inquiry*. It has also been claimed that the risks that relate to the use of genetic engineering techniques are not as significant as might have been thought—an argument which is reminiscent of the comments that have been made in the context of the nuclear debate. (Cripps, 1981: 370, my italics).

The advent of commercialised biological engineering is of particular concern for past and future legilation. Self-regulation – the shibboleth of a fast-emerging corporatism – is insufficient, according to Cripps:

> The risks that are involved a particularly acute in the private sector where companies are competing for patents in respect of new products and processes that arrive from the technology of genetic engineering. These companies are manufacturing and using genetically engineered organisms in circumstances which reduce the likelihood of adherence to restraints that lack the force of law. (1981: 371-72).

While legal constraints are necessary, says Cripps, the benefits of genetic engineering cannot be ignored.

> It is clear that the benefits that are embodied in genetic engineering lend the technology an urgency which should not be slowed by inefficient administrative controls. It is equally clear that genetic engineering that is conducted in the public and private sectors can be regulated in a manner that is consistent with its development and exploitation and with attempts to safeguard animal and plant populations. (Cripps, 1981: 372)

These two poles of debate – *clear* benefits versus *potential* risks – have basically defined most arguments around the deployment and regulation of genetic technologies ever since. These poles are underpinned by the "progressive" imperative on one side (technological development as unquestionable good) and a "conservative" morality on the other (we should not "play God" with new technologies). Given that the debate is framed in these terms, the outcome is fixed on the side of technology. That is because the term "technology" has come to be identified with the whole of '*modern civilization*' (Smythe, 1981: 217-219):

> "Technology" … is said to offer us all kinds of "good" and "bad" things. And when bad things come to pass, more technology in turn will cure them, if we use it to produce more good things, and not more bad things. And so on. … Humanity's ecological crisis will be the result of technology. Developing nations need not high technology but intermediate technology. Catastrophic world war, if it comes, is the result of our use of technology. (Smythe, 1981: 217).

In the future-tense operations of corporatism, the balance between the opportunities and risks of any new technology—assuming they can both be assessed—are invariably rigged in favour of "opportunities" for a number of reasons. First, the financial value of any corporation is now dependent upon market expectations of future performance, which is only to say that a company worth investing in is a company that promises the highest future return on investment. This is a principle that holds the private investor as much as so-called "institutional investors" (Graham, 2006). Second, because of this primary principle, all corporate news is ideally *good* news as a matter of financial sanity. Therefore, any talk of inherent risks in technology must be minimised to ensure that the company maintains its value as perceived by that amorphous entity called "the market". Third, and perhaps most importantly, the term "opportunities" is an integral part of the discourse of unlimited growth, without which the future of any corporation – indeed the entire speculative system – would be in jeopardy (Graham, 2006).

The realm of opportunities "opened up" by biotechnology does not always include overtly pecuniary interests. As soon as genetic engineering became a going concern for corporate interests, it took on a philanthropic mantle:

> Developing countries are naturally attracted to the potential applications of biotechnology research in solving problems of hunger, energy supply, and improving the quality of life. The priorities of the different countries vary

> widely, however. The National Institute of Biotechnology and Applied Microbiology in the Philippines, for example, has accorded priority to research on (i) biofuels; (ii) nitrogen fixation; (iii) food fermentation; (iv) plant hydrocarbons; (v) antibiotics, vaccines, and microbial insecticides; and (vi) biomass production. The National Biotechnology Board of India has chosen genetic engineering, photosynthesis, tissue culture, enzyme engineering, alcohol fermentation, and immunotechnology as areas of interest. Nearly every developing country has plans or programs for harnessing the tools of biotechnology for national development (Swaminathan, 1982: 967)

The rest of this article, again from *Science*, focuses mainly on increased production of food to feed the Third World. This surprising proliferation of Institutes and Bureaux in developing countries so soon after commercialisation exemplifies the propaganda value of "technology" (Smythe, 1981: Ch 10). However, any number of references from the late 1940s onwards could be cited to show that production of sufficient food to feed the whole of humanity had long since been achieved (Horkheimer & Adorno, 1947/1998; Saul, 1997; Lowe, 2007). At the time of writing, two kilograms of food per day per person is produced: more than sufficient to feed everybody (Lowe, 2007). It is not the food production system that needs fixing; it is the food distribution system (Lowe, 2007). Similarly with the development of drugs: the impacts of most serious communicable diseases, whether recent or long-term endemic, have been minimised in the developed world, but in the developing world, the pharmaceuticals required to achieve this remain unavailable due to serious flaws in a distribution system organised solely along monetary lines (Lowe, 2007).

Unfortunately, the philanthropic and humanitarian arguments for the uptake and mass public investment in biotechnology are all too often merely efforts in public relations, or "spin". But this should be surprising in an age of corporatism, where 'public education' about the character and nature of the future—literally, publicly conducted lessons on how to live better in a permanent future-tense—is an essential part of the system's survival (cf. Price, 1985 on 'the need for public education' about biotechnology). These lessons are taught all the more easily in a system guided by the tenets of technological innovation at practically every level, and evidenced every day by proliferating devices of varying and dubious social worth. As far as "biotechnology" goes, it would appear that the main game for the major corporations involved is control over the *meaning* of the term "biotechnology", a fact they recognised immediately upon the advent of its mass commercialisation (Kleinman & Kloppenberg, 1991). Since commercialisation, the meaning of biotechnology has become subject matter for legal studies (Cripps, 1981), political science (Funke, 1985), language and linguistics (Lassen, 2004), education (Sun, 1981), economics (Siekevitz, 1979), media studies (Hansen, 2006), cultural studies (Harkins, 1975), business (Wade, 1980), philosophy (Thacker, see this volume), ethics (Hulse, 2002), and sociology (Kleinman & Kloppenberg, 1991), (to name but a few), along with the many applied and pure disciplines required to actually implement genetic technologies in any meaningful way.

Children in developing countries can now attend schools that specialise in the teaching of biotechnology.

As part of an alleged “knowledge economy”, biotechnology is somewhat of a “superstar”: it requires endless pure and applied research that can only be conducted with the aid of massive and complex infrastructure and huge public subsidies; produces patentable material of the most abstract (and therefore elastic) kind; and is most easily and successfully deployed in those areas most fundamental to human survival: food production and health care. It has also sparked endless debate, all of it rigged in favour of the system it represents so fully. Such extensive and heated debate is food for all of us who make a living from intellectual pursuits. As long as the weight of opinion is divided in even a vaguely equal way “for” or “against” “biotechnology”, “genetically modified foods”, “stem cell research”, and so on, debate will continue to flourish, especially as the extremes of the “for” and “against” camps are pushed.

CONCLUDING REMARKS

The corporatist imperative is control of what the future means. The corporate “share” and its future value is quite literally all that matters to those whose work it is to “manage” corporations. Biotechnology, which has come to mean direct control over reproductive processes at the sub-cellular level, can be seen as just one aspect of corporatist control over people and places. From another perspective, the term “biotechnology” has remained little more than a cipher for the political economic systems in which it has been deployed. At the peak of science-as-paradigm (the turn of the 20th century) biotechnology meant nothing more than applying industrial research methods to the age-old process of brewing beer. At the peak of human engineering, between 1911 in 1960, “biotechnology” meant the process of integrating imperfect human beings into the neat, predictable, and unquestionably efficient world of machines. In the so-called post-industrial knowledge economy, biotechnology becomes a medium for systemic propaganda; it has become part of the daily curriculum to which the public is exposed in order to fit itself into an idealised future produced by a system that is entirely future-oriented and reliant upon new technologies.

The history of the term “biotechnology”, short though it is, reaches back into the depths of political economy, human history, and human culture. It can find legitimacy in the opening chapters of the Old Testament; precursors in the most ancient human techniques of selective breeding and fermentation; philosophical and political rationales in Plato’s idealism (Galton, 2001); and scientific rationales from late scholasticism to the present day. Most of all, and at the very deepest level, it reminds us that our first moves as self-conscious, culturally active beings was to write upon our own bodies, adding to and removing from our bodies: decorating, deforming, beautifying, and mutilating ourselves. The term is not merely a cipher; it is a reminder of our cultural and artistic origins and their relationships with what we see as beautiful, normal, desirable, and powerful. It reminds us that we are material beings with propensities for idealism, and that we make our environments, as far as possible, in our own likeness.

NOTES

[i] A similar approach has been called 'discourse historical' analysis (Reisgl and Wodak, 2001). It differs because it does not focus specifically on culture, technology, and political economy

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