"A Critical Analysis of the Interactions of the Corporeal Body with Bodies of Knowledge; focusing on Spatial, Technological and Communicative Shifts."

A thesis submitted for the degree of MPhil

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CONTENTS

ABSTRACT

This project argues for the importance of considering contemporary corporeality in light of new structures of knowledge, focusing on space and time, communication, and science and technology and looks for evidence of shifts in these areas at a qualitative, experiential level.

Structures of knowledge are in the process of radical transformation which correspond with shifts in three key areas – space, language and technology. Central to these shifts are alterations to the ways we understand and experience our subjective and bodily location. This argument is developed in the context of the Enlightenment, where these key factors are explored as fundamental to significant transformations in explanations and experiences of corporeality.

The interaction between new ways of knowing the world and ways of knowing corporeality in the historical analysis is demonstrated in order to establish the validity of four main research questions in a contemporary context. These are: firstly, in what ways do current configurations of space, language and technology suggest an altered corporeal experience? Secondly, how might new scientific/technological models, and particularly cartographies, inform explanations of corporeality? Thirdly, in what ways might corporeal experience be seen to be revalidated within emergent contemporary structures of knowledge? And finally, to look for places where qualitative evidence of a new experience of corporeality might be demonstrated.

The first chapter examines new technologies, new forms of communication, and the processes of globalisation to show firstly that the key factors which led to radical alterations to corporeality in the past are present and secondly to show the prevalence and significance of disruptions to scale, location and boundaries in a contemporary context. Chapters Two and Three demonstrate in depth the interactions of space, language in defining the body. Chapter Four examines twentieth/twenty first century science to demonstrate a departure from classical science and outline the dramatically new models for explaining the world that these provide.

In conclusion it is argued that corporeality is refigured materially, conceptually and perceptually in relation to emergent ways of knowing the world and that the authority of the imaginary and of the tactile in contemporary thought is indicative of a new validation of corporeal knowledge. It is suggested that by examining the science and experience of medical imaging techniques a qualitatively different experience of corporeality might be demonstrated, where concepts of interiority and exteriority and of location are transformed in powerful correspondence with transformations in space, language and technology.

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This is dedicated to my children: Luca, Milo and Ruby.

NOTE.

This project was undertaken and developed as a Phd. Unfortunately, due to family and financial pressures, completion became urgent and the work has been adapted to an MPhil.

Amidst general doom and gloom about the way the world is going, I needed to express a sincere optimism about this new world. I think we have forgotten too easily how things were before these varied cultural freedoms became our lives.

We are in the process of intense transition, which makes it vital to document what is now, how it feels to be living now: this project is an attempt towards this.

CHAPTER ONE.

CONTEMPORARY INTERPRETATIONS OF THE BODY IN RELATION TO NEW FORMATIONS OF SPACE, LANGAUAGE AND TECHNOLOGY.

1.1 DEVELOPMENT OF RESEARCH QUESTION.

"If the convergence of new spatio/temporal perspectives with new modes of communication and new scientific/technological models operate in articulation with a new formation of the subject and new ways of understanding and experiencing the body (as to be demonstrated in the historical analysis) what will be the impact of comparable current developments on the contemporary body?"

This project was initiated by readings of feminist theories of subjectivity, where identity is discussed variously as contingent, multiple, fluid and culturally constructed. Much of this theory has an overt anti-Enlightenment agenda: non-objective, non-fixed, non-phallocentric and against metanarratives. While these theories were useful as new tools by which to explain bodily subjectivity, they did not answer questions about how a refigured bodily subjectivity might be experienced at the sensory corporeal level.

This led to an interest in the possibilities for fluid identity allowed by virtual interaction and so to a reading of Mark Poster's essay "Postmodern Virtualities" (Poster 1996), where he begins by comparing the contemporary subject with the subject in the late middle-ages, just prior to the emergence of the period of Enlightenment. (1)

(1) The beginnings of the period of Enlightenment are identified here as the late fifteenth century when the "discoveries" of Columbus and the work of Copernicus dramatically altered conceptions of the boundaries of the world. The emergence of Classical Science in the late seventeenth century is understood as a progression of Enlightenment thinking, however, the period is identified here as the emergence of new knowledge before being developed into the full blown structured discipline of Classical Science.

> ...the technically advanced societies are at a point in their history similar to that of the emergence of an urban, merchant culture in the midst of the feudal society of Middle Ages.../ A new identity was constructed ... among the merchants in which a coherent, stable sense of individuality was grounded in independent, coginitve abilities. In this way the culutral basis for the modern world was begun, one that eventually would rely upon print media to endcourage and disseminate these urban forms of identity. In the twentieth century electronic media are supporting an equally profound transformation of cultural identity. (Poster 1996, p183/4).

This analogy between the late middle ages and the late twentieth century (where the convergence of new ways of communicating with transformation in space and with new media brings about new ways of identifying the self) foregrounded the importance of positing today's subject not in opposition to the Enlightenment subject but rather of finding the comparisons, as well as significant differences, between the Enlightenment subject and the contemporary subject. The connection was also made for the first time between new media, new geographical exploration (or spatial transformation) and new subject identity. The idea was formulated that the subject is undergoing a period of transformation not just in theory, as a consequence of feminist and poststructuralist thinking, but in real terms in relation to specific cultural, geographical and technological changes.

The next text I came to was Sawday's investigation of anatomical explorations in Renaissance culture (1995), which revealed both the depth and extent of commonality between the two eras. Sawday shows that anatomical explorations were rooted in and dependent upon, in terms of language and approach, the "discoveries" of the "new" world, and demonstrated how these articulated with new structures of knowledge and new meanings of corporeality. (2)

There was the realisation that the resonances between the periods are as powerful as the oppositions. In this early period spatial changes and revelations led to an impulse toward controlling and mastering space, at the same time as anatomy revealed the spatially complex bodily interior and Copernicus' treatise told of a heliocentric universe. This

(2) Corporeality is the quality of having or being a material body; bodily substance. (Concise Oxford Dictionary)

coincided with the development of the printing press - a new technology of communication. The comparisons between this era and that could not be more striking. Amongst all this change a new individual emerged into a new world with new models and metaphors for explaining the world. What Kuhn calls "picking up the other end of the stick", (see p78) but on a grand scale. Knowledge was opened up. Science was made possible. The realisation was that the same sorts of things are happening now - but faster, and that a new sort of individual would therefore again be expected to emerge in direct correlation with the metaphors and models of new knowledge. While the Enlightenment individual was understood as a bounded thing containing an autonomous individual, this construction has changed so that the collective, in this case new structures of knowledge, is no longer understood as monolithic but rather as culturally and socially produced, variously differentiated and not fixed. The individual who operates in articulation with these forms of knowledge is thus also defined in terms of fluidity and multiplicity.

Sawday demonstrated that the discoveries and transformations of the early Enlightenment, or Renaissance, operated in direct articulation with transformations in the meanings, understandings and experience of corporeal existence. So as new knowledge structures were developed and the concept of a (male) rational, coherent, thinking individual emerged, perceptions of and approaches to the body also changed and became separated from both the internal soul and the exterior world, and most importantly were made distinct from the knowing, rational subject: in short corporeal knowledge was invalidated. The question this then demanded was: if new structures of knowledge have become evident at a corporeal level in the past how might features of contemporary ways of knowing the world become evident corporeally?

I then started to look for works that would link theories of the late postmodern age with corporeal experience. How might altered structures of knowledge - the new universal, global, local, quantum perspectives, new communication systems, the dissolution of boundaries, the disruption of ideas of interiority and exteriority - which exemplify the late

postmodern, globalised world, be found at a corporeal level? If, historically, the body has been made sense of anew by the models of geographical terrain or the machine, how will scientific and technological models of, for example, the interface, quantum and universal scales, or virtual interaction make new sense of corporeal existence? (The three key features are summarised as space, language and technology, however in the contemporary analysis time is discussed alongside space and science alongside technology.)

Common daily evidence would seem to testify to alterations in our bodily experience. We can, via ultrasound, endoscopy and Nuclear Magnetic Resonance Imaging (NMRI) techniques, see our internal organs in real time, we are able to talk to a person (or people) anywhere, anytime via the internet or using a mobile phone, we can place a nicotine or hormone replacement patch on our skin and experience rapid internal relief, we can play simulational computerised games and fly or morph. Post-structuralist theories across disciplines focus on exchange across boundaries and fluidity of identity, and artistic and cultural production is preoccupied with the body and bodily fluids (exhibiting a fascination with the grotesque as it did in the early Enlightenment). However, I was unable to locate a theory to explain the articulation between emergent ways of thinking and living in the world with emergent ways of experiencing the body in the world. It appeared that there was still work to be done on the actual corporeal experience of living within these new spatio-temporal formations and of interacting with these new technologies and new modes of communication; the actual experience of being the multiple, diffuse, unstable subject that Poster defines as characteristic of the late postmodern age (Poster 1996, p191). Mary Douglas (Douglas, 1966) has usefully focused on exchange across borders of the body in relation to social structures but not in a relationship with the new models of science or new interactive technologies and modes of communication.

In the historical analysis it is shown that the emergence of a new structure of knowledge was based on the interaction of new spatial formations, new technological models and new forms of communication, and that these key factors can be seen to be, in retrospect, inextricably linked with new ways of understanding and talking about the body -

subjectively and materially. So given that these key features, space, language and technology, are again in the processes of radical transformation it appeared plausible that amidst a contemporary restructuring of knowledge our ideas and experience of corporeality could be expected to correspond and interact with these changes. The particular interaction of these key features with corporeality has not, to the best of my knowledge, been systematically expanded in a contemporary context and it was on this basis that the research question was developed.

Although this work does not claim that the body is gender neutral, discussions of the gendered body are thoroughly explored by others (Irigaray 1985, 1983, Butler 1990, Grosz 1994, et.al.) and so not expanded here. Similarly, while the body is understood as, at least partially, culturally specific, analysis of the body in relation to different cultures is again left to the work of others (hooks 1990, Said 1985, Bhabha 1994, et.al.), and it is acknowledged that this writing is from a white, western and female perspective.

So, this project reviews the literature dealing with space and time, science and technology, communication and language and the articulation of these with the corporeal body and brings these readings together to argue that a new understanding and experience of corporeality is emerging in correlation with these identified features of the contemporary era.

The project chooses not to focus upon modes of production, or cause and effect, because the interest lies not in why these various processes are occurring but rather in the particular relations between these processes and the body. It is recognised that by siting the work within a field of knowledge, rather than in relation to specific causes and effects, that generalisation will occur; this is considered justified by the depth of contextualisation and by the demonstrated prevalence of these elements across a range of disciplines.

1.2 LITERATURE REVIEW

The selection of literature and the readings to which it is subjected are based upon the project outlined above. The literature reviewed has been selected on the basis of critical theory of the late twentieth and early twenty-first centuries, aiming to re-evaluate the relations between the significations and significance of embodied subjects and material, conceptual and perceptual environments.

Three main bodies of literature have been examined: new feminist perspectives on embodiment, postmodernist theories with a focus upon space and time and technology and what are here broadly termed post-colonial theories whose interest is the location of marginal subjects, with a view to identifying problematics, commonalities and spaces for intervention. These works are interested in the body in its relationship with culture and society, and technologies of the body which are subject to new forms of regulation and legislation. It is through a critical evaluation of the selected literature that the methodology has been developed and the research question formulated.

FEMINIST PERSPECTIVES ON EMBODIMENT.

Feminist perspectives on embodiment were developed throughout the 1990s, in part these arose as a response to new critical negotiations with strands of post-structuralist theory. As demonstrated in chapters Two and Three, in a period of transformation the body tends to be foregrounded as the site of intense cultural activity; a preoccupation with the body is evident in artistic production and television programming for example and the body has been a primary subject for feminist theory in the last two decades. Of particular interest to this project is the work of Elizabeth Grosz (1993, 1994), who focuses upon the exchange between interiority and exteriority where the surface of the skin is the site of exchange, and the work of Judith Butler (1990, 1993) and Donna Haraway (1985, 1988).

Butler's influential Foucauldian analysis of the subject, as created in interaction with knowledge and power, was one of the earliest key works in a transdisciplinary preoccupation with bodily subjectivity, for example philosophical (Butler 1990, 1993, Benhabib et.al., 1995, Scheman 1993), anthropological (Moore1994) and geographical (Massey 1993, Rose 1993). Haraway offers an ironic, imaginative and politically driven analysis of the cyborg (hybrid of organism and machine), suggesting that the cyborg could find political freedom by escaping the desire for ultimate or complete knowledge through the abandonment of history.

One of the difficulties with these works is that the subject is conceived of in purely discursive terms. In Butler's writing the subject comes into being only in an interaction with culture. This is a useful philosophical method for thinking in new ways about the means by which we define ourselves and are shaped by culture but with no reference to how it feels to be a body - the subject is dissolved into signification, or discursive effects or, in other works, to the psyche (Braidotti 1991), also her insistence on the subject as a purely cultural construct seems untenable, particularly in the light of recent genetic study. Haraway's call to become a cyborg and escape history is brave, but also largely metaphorical. Her work is politically driven and most useful in that she is interested in dissolving boundaries; organism/machine, nature/science for example. In these ways these works have initiated a project by offering stimulating and useful analyses, but also by demanding further questions about how it feels be a body spatially and temporally located in a physical environment, which requires more than a decentred, discursive explanation.

The writing of Sadie Plant (1996a,b, 1988) is of particular interest because she offers an optimistic discussion of the operations of new technologies as compatible with and expressive of feminine experience. The writing is also important in that it uses new technological models, digitisation, the network and the interface, as explanatory of subjectivity, focusing on connectivity and invalidating concepts of centre and periphery. The neural net, Plant says, operates in a way that disrupts old epistemological models, it is exemplary as a new model for both thinking and explaining the world, as well as operating

in the world, and marks a departure from specular, patriarchal economy. "Neural nets function in a way which has less to do with the rigours of orthodox logic than with the intuitive leaps and cross-connections which characterize what has been pathologized as hysteria" (Plant, 1996, p331). This offers an indication of the ways in which new models and metaphors might be developed as descriptive of the body in physical interaction with its environment and so could be explored as potentially viable models to describe qualitatively different perceptions and conceptions of bodily experience.

Plant's work approaches in a contemporary context some of the key points raised in the historical analysis; that different modes of communication can bring about shifts in subject identity and also a reconfiguration in the prioritisation and validation of the different senses in relation to knowing the world. This is important because a valorisation of sight as an objective and detached sense can be seen as intrinsic to the development of science as a discipline, and in the process whereby knowledge became detached from corporeal experience. Plant asserts tactility to be the dominant sense in contemporary communications: "Communication cannot be caught by the gaze, but is always a matter of getting in touch, a question of contact, contagion, transmission, reception and connectivity. If sight was the dominant and organising sense of the patriarchal economy, tactility is McLuhan's "integral sense" ' (Plant, 1996, 332). An epistemological shift such as this refiguration of the sensory hierarchy is supportive, in theory, of an alteration to corporeal experience.

POSTMODERN THEORIES WITH A FOCUS UPON SPACE, TIME AND TECHNOLOGY.

This body of theory was also developed during the late twentieth century and is important because of its emphasis upon the social and cultural implications of new technologies.

The work of Paul Virilio (1997) focuses on speed, new concepts of time and distance, loss of intimacy and of the journey, and destruction of geographical space by technologies, and so is of interest. However his analysis is apocalyptic, where technology not humanity is the determining agent and his prediction for the corporeal body is atrophy and inertia.

Jameson's work (1992) is a theoretical analysis of postmodern cultural production where he asserts the ahistoricity and dislocation of the postmodern period. His analysis is informative of specific contemporary relationships to time and duration, but the theory is entirely self-referential so that, while mourning the dislocation from history and depoliticization of postmodernity, it chooses not to consider social and cultural indications which might mark a departure from these.

The work of Baudrillard (1995), brings together for the first time the study of daily life with semiology to develop an analysis of hyperreal simulated culture. The focus on the impact of technology upon the subject is useful, however, Baudrillard focuses exclusively on signification, predicting the utter dislocation of the subject within culture, where the only remaining viable political action is nihilism. The deterministic tendencies of these works preclude positive political or cultural development and present only pessimistic predictions for the corporeal subject and body.

The historical analysis carried out in chapters Two and Three demonstrates the severance of knowledge from corporeal experience in the processes of the Enlightenment and it is suggested that a revalidation of corporeal knowledge might be expected in articulation with emergent contemporary structures of knowledge. None of the above theories engage

with this possibility, instead they predict the opposite, a devaluation, a stagnation of corporeality. It is in part as a response to such pessimistic theories, which were dominant in the 1990s, that this project was initiated.

The writing of Mark Poster has been most influential because he takes account of postmodernism and the impact of technology yet also sees the positive and progressive features of contemporary culture and understands these processes to have a real, material effect on the individual subject.

Poster brings together theories of the postmodern with theories of new communications - defining postmodernism as that which "indicates communication practices that constitute subjects as unstable, multiple and diffuse" (Poster 1996, p191). Poster understands technology to be one cultural factor among many, and so not deterministic, and sees the democratising and positive potential of new technologies while recognising the unequal distribution and access of these currently. Most pertinently, for this project, Poster explains virtual technology as having the potential to effect a shift in concepts of material embodiment and also as legitimising imaginative and playful elements in the formation of identity, so revalidating imagination in a relationship with knowledge.

> "Virtual realities are fanciful imaginings that, in their difference from real reality, evoke play and discovery, instituting a new level of imagination....By directly tinkering with reality, a simulational practice is set in place/ which alters forever the conditions under which the identity of the self is formed" (Poster 1996, p189/90).

David Harvey's seminal work "The Condition of Postmodernity" (1989) describes "the compression of space and time" which it seems has become such common currency that this phrase is now often used without mention of his authorship. Harvey, a geographer who focuses on political and economic systems, is important for this project because he explains the complex shifts in our spatial and temporal experience with apparent simplicity. Although he does not fit easily into this category of postmodern theorists, he has various problems with postmodern theory; his writing is specifically concerned with space and time and, to a lesser extent, technology and he describes transformations in these areas as

having a direct effect on our material, cultural lives as well as on our sense of self in relation to the world.

POST-COLONIAL THEORIES

This body of work falls under the umbrella of post-colonialism. These theories are informed by postmodernist discourse but with a focus upon space and particularly marginal subjects and the operations of centres and peripheries. While these theories relate clearly to the idea that a new subject may be emerging in articulation with new ways of imagining the world, precisely the sorts of subjects that were excluded by Enlightenment discourse, and that these new subjects succeed by crossing boundaries (bell hooks 1990), this body of theory is as useful in developing a methodology as it is in developing the research question.

Methodologically and theoretically these works aim to disrupt dualistic discourse by focusing on in-betweens (Bhabha 1994) or third spaces (Soja 1996, Lefebvre 1991) and in doing so disrupt the concept of exteriority and interiority. In this way it is fitting for the research question which is concerned with the changing articulation and interaction of body and environment and especially the exchange between corporeal interiority and exteriority where the bodily surface, skin, is the interface or the site of exchange. So, these theories are in alignment with the emergent structures of knowledge that are of interest to this project in that they focus on exchange across borders and disruption of categorisation. As the research question is concerned to see how these new ways of thinking are evident at a corporeal level these theories, or approaches, are most fitting for they correspond theoretically and methodologically with the aims of the research question.

1.3 METHODOLOGY AND ORIGINALITY.

This is a multi-disciplinary, textually based, analytical project which operates by bringing together the work of others, in an original synthesis. Broadly; the methodology developed through a reading of the literature and especially postcolonialist theory, as outlined above, provides the encompassing approach to the project, the underlying discourse.

In relation to the way the research has developed, this discourse is apparent in the way a number of overlapping arguments are utilised each bringing in different aspects of the same elements (space, language, technology and the body) in various discussions with the intention of layering and cross-referencing the evidence in support of the research question.

Chapters Two, Three and Four are an interpretation of the events of the Enlightenment, the scientific revolution and twentieth century science. The theme of all chapters is the relation between the identified key factors, space/time, language, science and technology and the focus is on the implications of these for understandings and experiences of the body. These chapters synthesise the work of others in order to demonstrate the validity of the research question.

It is worth noting that the fourth chapter, which outlines the underlying principles of contemporary science, has been largely reliant on popular scientific books. These books are best sellers, they testify to the cultural availability and popular currency of new and difficult scientific concepts and as such were appropriate sources for this chapter.

The final chapter describes how we might, in a contemporary context, demonstrate and explore evidence of a qualitatively different experience of corporeality in direct articulation with the key themes of the historical and contemporary analyses. It argues that the authority of the imagination and tactility in contemporary thought relates to a revalidation of corporeal knowledge. It also proposes that by looking at the processes, the experience

and science of Nuclear Magnetic Resonance Imaging all the key elements of the discussion are evident and most significantly, notions and experiences of exteriority and interiority can be shown to be disrupted. So this last section proposes qualitative methods of research as well as discursive and textual methods, although it is beyond the limitations of the MPhil to carry out this qualitative research.

The originality of this project is broad. Firstly, the argument that spatial shifts, in articulation with new technologies and modes of communication, result in radical transformation in systems of knowledge has not, as far as I am aware, been developed in this particular way by others. Secondly, the comparative analysis of the direct interaction between the identified features with meanings and experiences of the body is, to the best of my knowledge, original. The brief textual analysis and proposed study of NMRI imaging as evidence of transformation in concepts and experiences of bodily interiority and exteriority is an original idea, as is, lastly, the argument that the tactile and the imaginary converge at the bodily level to revalidate corporeal knowledge.

1.4 INTRODUCTION.

This first chapter is concerned with the main hypothesis: namely that structures of knowledge are in the processes of radical transformation which correspond with dramatic changes in three key areas - space, language and technology and that, in accordance with these alterations to the ways we understand and experience our world, alterations to the way we understand and experience our bodily existence - our corporeality - can also be expected. This hypothesis has been developed from the critical and selective review of historical literature, in chapters Two and Three, in which these key factors are identified as fundamental to significant transformations in meanings and experiences of corporeality historically. This chapter indicates the relations between technologies of communication, spatial and temporal frames, and the languages and models by which we describe and understand the workings of the contemporary situation, in the West (1), as corresponding with shifts in conceptual, perceptual and material knowledges of embodied selves and subjects.

As a whole this project will trace ideas about the ways in which our systems of knowledge operate to delimit or define the ways in which we are able to talk about and make sense of corporeality. In Chapter Three, the Enlightenment and Scientific Revolution (2) are discussed as founded on the premise of a rational, coherent, stable individual, and corporeal experience is shown to have had little or no authority in relationship to this. The association of vision with truth and knowledge, enabled a metaphorical detachment of sensual experience from knowing. This was achieved by the association of seeing, not with the physical and subjective eye, but with the light of

(1) This does not refer only to the Western World or indeed to all of the Western World, it is rather a term meant to describe culturally diverse, technologically advanced, richer parts of the world, as there are substantial parts of the globe where the developments of globalisation are ineffectual, or have largely a negative impact. In some of the poorest parts of the world a person may have no running water but have access to a mobile phone. So, "Western" is utilised to explain that access and control of these developments is unfair and uneven and operates as part of economic distribution.
(2) The Enlightenment and Scientific Revolution. These periods are termed as distinct for ease of description but are understood as part of a progression, a development of thinking which has characterised modern approaches to knowledge and the body. Enlightenment discourse is understood as reaching its ultimate conclusion in the establishment of Classical Science which became the dominant doctrine of the modern world. A marked departure from this line of progression is identified as occurring in the early twentieth century with the work of Einstein and also arguably, Freud.

truth. A distance was imposed between the body and knowledge and this detachment was facilitated by disguising the underlying metaphorical basis of that knowledge.

In articulation with these processes, language is central to and definitive of experience. The words we have available to describe our feelings or to explain our thoughts, and the authority that these words hold, are inherent to the limits within which the world and our place within the world are made sense of, and to the significance or validity accorded to various experiences. These words, in operation with available conceptual models and tools for understanding new technology and science, are foundational to explanations of the operations of the body. In the most basic of terms, geographical terrain and the machine have had dominant currency as explanatory metaphors for the body in the past - analogies between the computer and the brain (Plant 1996), the body and interface (Moore 1994, Braidotti 1991), are current examples. New spatial and technological or scientific models, by offering new ways of imagining and new metaphors for describing the spatial body operating within a spatial environment are useful tools by which to make sense of corporeal being. Or rather, as explanatory tools are expanded, the breadth of validated experience is also expanded or altered. as well as allowing linguistic and conceptual developments, spatial and technological change affects our sense and experience of location which, in turn, affects our corporeal experience, materially and subjectively. Theories of fluid, multiple, dislocated subject identities have driven all major strands of late twentieth and early twenty first cultural theories (feminism, poststructuralism and postcolonialism, see Introduction) and the material effects of these shifts, the forces of globalisation, are definitive of our era. The consequences of comparable transformations in the past have resulted in a complete refiguring of the meanings of the body and, retrospectively, have resulted in a new sense of self and of community (see pp54/55).

In the following chapter the Enlightenment body is shown to have occupied an intermediary position between discoveries of the "new" world and discoveries of the bodily interior and to have become the focus of philosophical and theological debate. In contemporary terms, the body occupies an intermediary position between recently

discovered universal and quantum scales and between the "real" and "virtual" worlds, as well as being the material and ethical focus of new biomedical techniques and cultural production.

As part of these large scale processes a refiguration of sensual experience is also occurring: "If light is a thing of value, the sense of sight and the power of being visible are linked together by a very precious bond, such as unites no other sense and its object" (Timmeaus cited Keller and Grontkowski 1996, p189). These tenets of Platonic philosophy were established in an era when the visual in a literate age surpassed the oral, the spoken word, as the authoritative media. Vision superseded sound and a whole new approach to knowledge and language were born (see p64/65). In relationship to new media and virtual technologies today, the power of being visible is, in certain arenas devalued. The capacity of sight to render the visible and reveal the "truth" is not always authoritative, and if the association of seeing with believing is complicated, as it is by computer animation, computer games and so on, then the authority of sight is also complicated. So, within the authority of vision a separation is occurring. For example, in many current forms we see things that we know are fictitious, or highly subjective (heavily edited, digitally modified) and yet we are able, for example, to believe the pictures which are being sent back from Mars. Now, it is suggested here and developed in conclusion, a renewed emphasis on tactility and imagination as tools for understanding a changing world marks a shift in sensory experience that itself is an indication and correlate of a fundamental shift in structures of knowledge. In the context of the subsequent historical analysis it is argued that this sensory shift, in interaction with new languages and conceptual models, will underpin new interpretations of corporeality.

1.5 THE CONTEMPORARY BODY.

Within the culture of discovery in the nascent stages of the Enlightenment, the dominance of the map as a tool for making sense of the new was essential. The methods of cartography - the establishment of borders, claiming of territory - were transposed directly onto the newly discovered physical interior, in anatomical exploration (as shown in the next chapter). This model is explained here as fundamental to the tendencies of the structures of knowledge that subsequently developed and also as definitive of a developing language of the body. The articulation of the compartmentalised, self /other approach with the methods of classification, which were developed as a method for processing vast amounts of new information, have been vital elements in the structuring of modern thinking, and reached maturity as the doctrine of Classical Science - the dominant explanatory discipline of the modern world. These ways of understanding a changing world are shown in the following chapters to have had a direct effect on meanings and experiences of corporeality. Tendencies in emergent forms of contemporary mapping are thus of central importance as signals to the ways in which new knowledge might be structured, and thus corporeality newly interpreted. The collapse of boundaries is immediately evident as a theme common to the material and cultural effects of globalisations (3) and to theories of the self and theories of culture (see Introduction). This is also central to new scientific understandings (see Chapter Four), where an emphasis on fluidity, connectivity, and spatio/temporal location is apparent. As the significance of national borders diminishes - physical location is freed of many constraints (at least for those with access to a mobile phone, plane ticket or e-mail). This alteration to the behaviour of boundaries is apparent in geographic terms, but also in discussions of cultural and virtual space, where a particular focus on the fluid, connecting aspects of new spatio/temporal locations is evident. This chapter extrapolates the implications of these

(3) Globalisations. This acknowledges the multiple implications and effects of global processes: "For different social groups and different individuals are placed in very distinct ways in relations to these flows and interconnections. This point concerns not merely the issue of who moves and who doesn't... it is also about power in relation *to* the flows and the movement. Different social groups have distinct relationships to this anyway-differentiated mobility: some are more in charge of it than others some initiate flows and movements, other don't; some are more on the receiving end of [it] than others; some are effectively imprisoned by it" (Massey 1993, p61) So while the monopoly of international corporations and unfair trade laws are widely viewed as a negative consequence of globalisations, heightened cultural exchange and the positive impact of new technologies pull in a different direction and different people are affected in different ways by these developments.

features of contemporary experience for corporeality.

The spatio-temporal effects of the processes of globalisation, new science and technology and new communications cause perceptual and conceptual, social and material effects which are evident at a corporeal level. The heightened levels of cultural exchange, disruption of location, diminishing significance of national and other borders affect our sense of self in terms of our identity and sense of place. Mobile phone, texting, e-mail, the constant cultural exchange of inner-city language, are all evidence of new forms of communication and language via which these new ways of knowing are expressed and experienced. New medical scanning techniques allow ideas and experiences of bodily interiority and exteriority which are dramatically new. All these areas are both described and driven by a collapse of boundaries; the new topographies and languages that are developing in these areas are fundamental to how the body is newly described.

These aspects of contemporary social and cultural life are defined by transformations in space, technology and language which are shown in the historical analysis to have been central to the transformation of systems of knowledge broadly and corporeal experience specifically. Most importantly, in this contemporary study, all aspects show a tendency to disrupt established boundaries and lead to a focus on the surface of the body as a site of change and exchange between interior and exterior worlds. A plethora of works on the skin in mainstream and academic disciplines testifies to this renewed preoccupation with the bodily surface (Connor 2003, Benthien 2002).

One of the most apparent and significant alterations to contemporary spatial location is the diminishing significance of traditional geopolitical boundaries, particularly here in relation to subjective perceptions of individual, local and national location in the world. Heightened flows of cultural exchange permit collective, unregulated exposure to different ways of thinking and imagining our embodied selves so that formations of identity - "self", "other" and "community" - and the relations between these are, in the developed world, less determined. The heightened levels of cultural exchange amongst merchant traders permitted a new sense of identity; a rational thinking individual, and this was an essential and determining feature of the early Enlightenment. The intense

levels of cultural exchange that contemporary subjects experience through media, through the Internet and by living on the streets of cities, like those that the merchant traders encountered, facilitate a freedom permitted by knowledge of the diversity of other cultures and at the same time bring an increased awareness of the particularity of one's own cultural and physical location: "Hence one paradoxical consequence of the process of globalization, the awareness of the finitude and boundedness of the planet and humanity, is not to produce homogeneity but to familiarize us with greater diversity, the extensive range of local cultures" (Featherstone 1993, p169). Just as the traders in the Middle Ages were suddenly communicating in new ways with new people, so global communication is "greatly amplifying its diffusion by bringing more practices and more individuals within its pattern of formation" (Poster 1996, p191). The discoveries of the Enlightenment brought into crisis religious and philosophical assumptions about the place of man within God's universe; in the contemporary context the power of science and technology to alter our sense of location and also to supplement or change the physical body, in terms of prosthetics, or genetics for example, forces questions about the role of humanity and the usefulness and relevance of the human body; corporeality is foregrounded.

The possible spheres for communication that are available to those in the technologically developed world have become numerous: face to face, e-mail, telephone for example (4), which means on the one hand that identity is impacted by

having to interact in more numerous ways, more varied formats and with potentially more disperse and numerous people and, on the other hand, means that the arena within which that identity can be expressed is broadened, that there is an increased capacity for communicating identity in multiple and various ways. These new interactions and communications contribute to shifts and multiplications in subjective identities while, at the same time, facilitating more complex and varied possibilities for expressions of identity.

(4) Just using a telephone several modes of communication are available to suit the particular, urgency, tone or intimacy of the call; distinctions between speaking on the phone, texting, leaving a voice mail message, leaving an answer-phone message are subtle but useful, there is increased space for manipulation.

What then are the implications of these developments in communication for corporeal experience? The result is that in transformational periods the body becomes the primary point of reference, in terms of spatial and temporal location and in terms of identity. When there is continual development and multiplicity in the exterior world, the significance of the body as a vantage point is increased, the body becomes crucial as a point of reference (5). As the anthropologist Henrietta Moore says: "Many people ..., have occasions when they find it extremely difficult to conceive of themselves as rational, autonomous and unitary" (Moore 1994, p33). She argues that when everything around us is in flux, our constant is our physical being, our bodily existence:

> Within philosophical discourse, the question of what constitutes personal identity focuses on the question of what establishes the continuity or self-identity of the person over time... In terms of anthropological discourse it seems quite evident that the most important characteristic of the person over time, and the one which constitutes its identity, is the fact of human existence. (Moore 1994, p36).

Expressing a non-unitary, non-rational identity is problematic if the world within which that identity exists is described in stable, unitary and rational terms. However, if the world is understood as changing and varied and our modes of communication allow multiplicity and fluidity in expression of identity then this conflict is resolved. Further, as Moore says, these factors lead to an increased emphasis on physicality, a revalidation of sensory experience in relation to knowing oneself in articulation with the world.

Sadie Plant (Plant 1996) expands on the contribution of new communications to a refiguration of the sensory hierarchy. She argues that because these communications operate in a realm of multiple and varied connections, touch becomes the authoritative sense, the sense that is aligned with "knowing":

> If the media were once as divided as the senses with which they interact, their convergence and transition into hypermedia allows the senses to fuse and connect. Touch is the sense of multimedia, the immersive simulations of cyberspace, and the connections, switches and links of all nets. Communication cannot be caught by the gaze, but is always a matter of getting in touch, a question of contact, contagion, transmission, receptions and connectivity. If sight was the dominant and organizing

(5) The current obsession with defining and redefining the home as a place where identity can be safely expressed is evident in the plethora of programmes on DIY and interior design on television. The home is understood as point of reference in anthropological works, in comparable terms to the way the body is understood as a point of reference here, see Janet Carsten, Steve Hugh-Jones "About the Home" (Oxford, Blackwell, 1994).

> sense of the patriarchal economy, tactility is McLuhan's 'integral' sense... The medium is the message, and there is no 'possibility of distinguishing what is touching from what is touched' (Plant, citing McLuhan and Irigarary 2000, p332).

Plant's discussion of tactility focuses on the contact of communication networks which she understands as a development of feminine communication. This then is not a new approach - but a newly validated approach, one where subjects who were excluded from previous dominant structures of knowledge (see Chapter Three), especially classical science, are at home, can flourish. Plant argues that until very recently feminism has found itself up against the wall with every attempt made to escape patriarchal economy: "Even Irigaray cannot imagine quite what such a transformation would involve" (Plant 2000, p327) yet unexpectedly, through the application of technology, an economy of connections, an arena has been opened up where women's identity can be expressed and is legitimate. It is argued here that other subjects who have been disempowered by Enlightenment discourse also enjoy a compatibility and are empowered by this new discourse, are at ease in interaction with this connective environment.

> After decades of ambivalence towards technology, many feminists are now finding a wealth of opportunities, spaces and lines of thought amidst the new complexities of the 'telecoms revolution'. The Internet promises women a network of lines on which to chatter, natter, work and play; virtuality brings a fluidity to identities which once had to be fixed; and multimedia provides a new tactile environment in which women artists can find their space. (Plant 2000, p325).

In postcolonial theories a corresponding idea can be found, where marginalized subjects, by standing at borders, possibly simultaneously at many borders, are theorised as occupying a powerful subjective position:

> Such diverse pleasures can be experienced, enjoyed even, because one transgresses, moves 'out of one's place.' For many of us, that movement requires pushing against oppressive boundaries set by race, sex and class domination. Initially, then, it is a defiant political gesture... Towards that revolutionary effort which seeks to create space where there is unlimited access to pleasure and power of knowing, where transformation is possible. (hooks' 1990, p145).

For hooks and others (Soja 1996, Bhabha 1994) observing and theorising from the outside gives you a view, an edge, an angle, a powerful place to stand in relation to knowledge. These arguments are so important here because the connective models of technology are understood by Plant as definitive of emergent structures of knowledge,

for Plant the useful metaphor and model is that of cross-connections. In postcolonial theory, subjects who stand at the edge of dominant discourse or who cross between categories hold a powerful subjective position by challenging, stretching and confusing categorisation. For this project, where the metaphors and models of science and knowledge are understood to be crucial to the ways we define and understand corporeality, this model of connectivity brings the site of interest to the point of connection between the interior and exterior body, the surface - skin.

The language of digitization is central to Plant's work "Zeros and Ones" (Plant 1998), where "Digitization sets zero free to stand for nothing and make everything work. The ones and zeros of machine code are not patriarchal binaries or conterparts to each other: zero is not the other but the very possibility of all the ones." (Plant 2000, p333) It is suggested here that the economy which Plant describes as invalidated by digitization is not only the patriarchal economy, this binary economy is the basis of Enlightenment discourse, so that digitzation escapes patriarchal economy but also escapes the broader economy of difference: light and dark, good and bad - these metaphors can be extended endlessly - inside and outside, self and other. In contemporary discourse all these oppositional definitions are ruined, the interest is in the exchange or connections between fluid categories. If this model is thought about in the context of corporeality, the site of connectivity and exchange is the border of the body. The bodily surface is the site of connection between the anatomical exterior and interior; skin becomes the focus of intense activity, material and symbolic. These theories further exemplify the dissolution of fixed, bounded space and expound the success of previously excluded subjects within these new cultural, social, and ontological arenas. It also reinforces the argument that a radical restructuring of our approach to knowing is occurring and re-establishes the interaction between formations of knowledge and scientific/technological models.

Plant does not extend her discussion to the validity of touch in the corporeal sense, i.e. the physical body in touch with a material world. So the next progression in the argument for this project is to extend this theory and demonstrate that these shifts correlate directly with new experiences and meanings of corporeality and to show that these new freedoms of identity and communication, alongside a renewed emphasis on

tactility and imagination, have an impact upon the experience of the physical, material, sensory world.

Mark Poster's work theoretically affirms this suggestion, arguing that virtual technologies have the potential to effect shifts in concepts of material embodiment (see Introduction)and revalidates imagination in a relationship with knowledge. He discusses indications of the legitimisation of an imaginative and playful element in the formation of identity, qualities which were invalidated by scientific discourse.

The playful, imaginative element discussed by Poster in relation to electronic communications is evident in the new languages that are developing in interaction with new media, as he suggests, but are also revealed in the cross cultural influences of spoken language in the cities. These languages are distinctly different from previous languages - the metaphorical, playful elements of the language are overt and the constant process, evolution of language is transparent. These elements are not only not disguised, but desirable, are central to the appeal and relevance of these languages. Texting, e-mail, "deconstruction and electronic writing understand the volatility of written language, its instability and uncertain authorship. Both see language as effecting a destabilization of the subject, a dispersal of the individual, a fracturing of the illusion of the self" (Poster 1995, p72). In Poster's argument these developments can be understood in the context of the history of media, where subjectivity is formulated in direct correlation with contemporaneous media and modes of communication:

> Proponents of print culture,..., link the gap in language to the subject as centred in reason... Electronic culture permits a different interpretation of the gap. The tremendous extension of the space between speaker and listener in the mode of information upsets the confinement of the gap to the self-identical subject. The combination of the enormous distances with temporal immediacy produced by electronic communications both removes the speaker from the listener and brings them together. These opposing tendencies - opposite from the point of view of print culture - reconfigures the individual so drastically that the figure of the self, fixed in time and space, capable of exercising cognitive control over surrounding objects, may no longer be sustained. Language no longer represents a reality, no longer is a neutral tool to enhance the subjects instrumental rationality: language becomes or better reconfigures reality. (Poster 1995, p60).

Language never was a neutral tool, as explained in depth in Chapter Two, the exposure - celebration even - of this fact however, is an indication of a radical change

in the structuring of knowledge: significantly altering the relationship between truth and language. As the relationship between truth and vision is being disrupted, the relationship of truth with language has similarly become dispersed, multiple and complicated, allowing a freedom to play with words and syntax, legitimising the use of new words, giving voice to more people and disseminating the authority of language.

Comparable developments are evident in visual media: television, broadcasting and web design, for example, where:

> 'Their stories are becoming more and more idiosyncratic, interactive and individualistic, told in different forums to diverse audiences in different ways' This explosion of narrativity depends upon a technology that is unlike print and unlike the electronic media in the first age: it is cheap, flexible, readily available, quick. (Poster 1996, p195)

> The implications of the Web are astounding: film clips and voice readings maybe be included in 'texts' and 'authors' may indicate their links as 'texts'. In addition, other related technologies produce similar decentralizing effects. Such phenomena...are transgressing the constraints of broadcast oligopolies. (Poster 1996, p195).

Poster says that this new narrative position is evident in the return to the 'little story' which via Lyotard he discusses as that "which validates difference, extols the 'unpresentable' and escapes the overbearing logic of instrumentality that derives from the metanarrative of progress" (Poster 1996, p195). This turn towards the small narrative is apparent all around us (in reality television, obsession with minor celebrity, chat rooms, message boards, Tracey Emin's art, Sam Taylor-Woods installation of David Beckham sleeping at the National Portrait Gallery, the continuous murmuring of incidental text and mobile conversations) and these small stories provide greater context by which to understand the particularity of our subjective cultural and material location, which is picked out variously in relation to these many and varied interactions and connections. This is an obvious departure from the metanarratives of Enlightenment discourse, away from large objective truths and towards small subjective narratives.

Poster argues that notions of community and nation have always been dependent upon the imaginary, "In the case of the nation, generally regarded as the strongest group

identification in the modern period and thus perhaps the most 'real' community of this era, the role of the imaginary has been fundamental" (Poster 1996, p192) So:

> Just as virtual communities are understood as having the attributes of 'real' communities, so 'real' communities can be seen to depend on the imaginary: what makes a community vital to its members is their treatment of the communications as meaningful and important. (Poster 1996, p94)

The difference then is not in the role of the imaginary in the formation of social identity but in the fact that the imaginary element is exposed - just as the metaphorical nature of language and knowledge is now exposed - the importance of the imaginary in our conception of the self and our relation to others is revealed.

> Over time, as technology has grown increasingly complex, and in particular with the development of information technology (which addresses itself overtly rather than covertly to symbolic exchange), the role of technology in mediating the flow of communication between bodies and selves has become more ubiquitous and more indispensable. (Stone 1995, p86).

Certainly, in much postmodern theory it had been predicted that technology would devalue community and the body, causing atrophy and dislocation (Virilio 97). The work of Virilio particularly but also Baudrillard (Baudrillard 98), in the 1980s and 90s, predicted physical inertia and break down of community brought about by deterministic technologies. However, twenty years on the reality of the development of science and technology has not fulfilled these predictions: the development of robots, for example, has served rather to heighten interest in the intricacies of nature and the human body. The purpose of the building of Steve Grand's artificially intelligent baby orang-utan , the robot Lucy, was to find out how the human cortex operates, how people learn. The process of this has demonstrated what an enormous amount of soft and hardware is required to get Lucy to point at a banana, or stand up, or see dimly with one eye; the process has served not to supplant or render useless our physicality but rather to re-enchant both nature and the body. Another example would be the new "musclebots", robots 50 micrometres wide with legs powered by the muscle from a rat's heart, where the energy is generated not from electricity but organically from glucose (The Independent 26.2.04, p24). These examples of new technologies are based in the fusion of the natural with the technological, they are founded on a collapse of distinctions between organic and machine, nature and science,

it is in the interaction of these elements, (which in classical scientific discourse were considered not only to be distinct but to operate within a hierarchy of authority in relationship to truth), that developments like these thrive. These aspects of scientific and technological progress, as well as illuminating the collapse of disciplinary boundaries, support the argument that contemporary science is distinctly different to classical science. This is in itself another indication that a radically new approach to knowledge is occurring and that an important element of this is a heightened fascination and interaction with the intricacies of natural processes.

In a change accordant with the refocus on corporeality in light of scientific and technological breakthroughs, the decreased significance of national borders has operated in certain ways to heighten our sense of physical location, our awareness of the particularity of our situated self. David Harvey asks: "why it might be that the elaboration of place-bound identities has become more rather than less important in a world of diminishing spatial barriers to exchange, movement and communication" (Harvey 1993, p4). Suggesting that,

> While the collapse of spatial barriers has undermined older material and territorial definitions of place, the very fact of that collapse... Has put renewed emphasis upon the interrogation of metaphorical and psychological meanings which, in turn, give new material definitions of place by way of territorial behaviour. (Harvey 1993, p4).

Rather than becoming lost in this fragmented, multiple world, the specificity of our spatial, temporal and cultural location falls sharply into relief against our knowledge of the diversity of global cultures and the immensity of unpopulated universal distances. The significance of the body (and to an extent home and locality) as a primary point of reference becomes crucial.

The forces of globalisations are neither uniform or unidirectional, however, the underlying tendencies are largely defined by a compression of space and time (Harvey 1995). Yet with regard to the explorations and new knowledge of deep space, the universal scale, there is a marked tension with global perspectives. Where global spatial distances effectively diminish, on a universal scale spatial distance is the challenge, the terrain is so vast and so unknown and both our significance (in that, so far as we know, we are the only life in the universe) and insignificance (in relation to the immense space

and time of the universe) are evident. We have only recently become aware of the expanding universe and of the immensity of universal distances, both spatial and temporal, and these phenomena operate in contradiction to global phenomena and perspectives. Globally, due especially to air travel and to the use of mobile phones, where, subject to getting a reception, we are never alone, terrestrial space becomes less and less of an issue. The material experience of distance and location and the sense of being a located person are accordingly altered, yet explorations into space show a vast, expanding universe, where any form of cartography must take account of time as well as space - points are relational to space and time, they are moving. The old two dimensional cartographic methods are no longer adequate, like ideas of mapping in theories of virtual technology, the dimension of time must be factored in in order to take account of the transient nature of location. The spatio-temporal location of the body is again essential as a reference point. The relationship between the particular and the universal is taken away from oppositional discourse in this articulation, the particular and the universal are interactive and definitive of each other.

As expanded in Chapter Four, the major departure from a determinable mechanistic world came with the implications of Einstein's theory of relativity,

> Our vision of nature is undergoing a radical change towards the multiple, the temporal and the complex. For a long time a mechanistic world view dominated Western Science. In this view the world appeared as a vast automaton. We now understand that we live in a pluralistic world. Today we see everywhere the role of irreversible processes, of fluctuations, *science is rediscovering time*. (Prigogine and Stengers 1984, p218, my emphasis).

This sea change in the way the world is approached has facilitated all the theories discussed above. Quantum physics, which underpins dominant contemporary scientific explanations for the operations of the universe and us as part of that, cannot be visually proven or demonstrated, the comprehension of these theories, the acceptance of them as legitimate, requires an imaginative leap. Although the theories of classical science often also depend on deductive rather than visual proof (the forces of gravity can not be seen), it is argued here that at the very large and very small scales with which contemporary science is concerned, things operates in ways differently to those on our scale. Everyday experience and deduction would not lead us to the conclusions of contemporary science. This is very important in relation to the project as a whole

where it is suggested that the role of the imaginary plays a newly validated role in our understanding of the world. In the conclusion a qualitative and textual analysis of the science and process of NMRI is proposed. This is an example of a science, a technology and a topography that is based on the science of quantum physics which requires an imaginative leap in order to be believed. This leap manifests itself as a real time image of the functioning body, an image that can reveal the functioning brain, emotion and reason, or an image showing the activity of the heart or vascular system, before your very eyes. Siting reality in relation to all of this is complex, it is new and confusing, requiring the conjunction of imagination (the conceptual) and experience to be accepted as reality.

As NMRI is to be examined later as an example of a topography where science and the body, imagination, experience and reality meet, so cartography and the printing press are examined in the following chapters as especially significant. It is in these technological models and applications that the three key factors, which it is suggested are central to a transformation to our systems of knowledge, space, language and technology, coincide with each other and with the body. These technologies were spatially described and allowed a new use of language and new forms of communication and as such they were crucial, definitive and explanatory elements of Enlightenment discourse, as well as being essential to the development of Classical Science. This is why it is so important to examine new technologies of communication and new forms of mapping in the contemporary context; the language and models of these are likely, given what is known from the historical analysis, to be definitive of new concepts for understanding the body. The common distinguishing factors of contemporary topographies, are: spatio-temporal location, fluidity and connectivity. So, in relation to both virtual, quantum and deep space, contemporary topographies which use new cartographic models to take account of temporal as well as spatial points of location and require models that illustrate the complex and varied connections between places, are inherent to understanding bodily location. One of the primary purposes of this project is to explore the ways in which such topographies relate to the way we are coming to understand, define and experience corporeal location.

In the discipline of cyberculture an approach to theory and to style can be found in which many of these aspects fuse. In "The Cybercultures reader" (Bell, 2000), it is stated that the "mission" of the book:

> Is to attempt to understand the ways which cyberspace as a cultural phenomenon is currently being *experienced* and *imagined*... we need to consider the place of imagination and representation, cultural use and value, and focus our attention most squarely on human interactions with (and within) these emerging cybercultural formations. (Bell 2000, p1, my emphasis).

As an approach this is interesting because of the emphasis on imagination and experience. As our private space diminishes and the world gets busier, the imagination opens up as a realm, a realm freed up by new technologies and new multiplications of identity. The language of cyberspace explores explicitly the collapse of boundaries, this is its core. The collapse between nature, machine, human is its central theme, not just in terms of words - metaphor, jargon and literary style, (this discourse has found the freedom to play with language, to be creative rather than traditionally academic and uses this as an explanatory tool) but also as a partial explanation of how these technologies affect subjective identity and as an indication of the tendencies of new language.

"Thinking about it cartographically or schematically, we can describe this hardware as a web, a network, a decentralized system - we can use the term rhizomatic to describe its infinite, uncentred, root-like structure." (Bell 2000, p2) this is also how the book is meant to be read, approached. This "infinite, uncentred, root-like structure" needs to be thought of then in relation to bodily location - the way we locate our identity in relation to a fluid, multiple world where location is uncentred and infinite. Although, as argued, bodily location becomes heightened in significance as the point of reference in a moving changing world, that is absolutely not to say that bodily location is a fixed point amongst change: it is changing and fluid in itself. This project is concerned with articulating these phenomena, these ontologically new phenomena, in relation to sensory experience.

The language of cyborg theory is useful: its primary tools are the metaphors of the interface, connectivity, and digitization, all the most useful models of contemporary discourses for the body. The work of Donna Haraway (Haraway 1985, 1988) has

been very important here, Haraway's collapse of boundaries between nature and machine or organic and technological preceded much of this theory, and also scientific practice: like Lucy the robot and "microbots". Her ironic manifesto also claimed that by becoming cyborgs we can escape history and so be free from patriarchy. This project diverges from Haraway's at this point: here it is argued that an escape from history even if possible is not desirable. When so much emphasis is on history now, embodiment now, as it happens, our past personal history is vital as reference. To pick up Ferguson's point made in chapter Four where she says that the only possible vantage point we have for looking at the universe is into the past, so, when the future is multiple and unpredictable, when there is little stability in the present from which to take a standpoint, history would seem to be vital as a tool and as an anchor.

These works explore the way in which bodies are experienced and imagined in cyberspace, they do not ask how these interactions affect the corporeal body, or how the experience of corporeality might be refigured in real space. It is evident however, that the discourse and models of this work is rich ground for metaphors for the corporeal body: the model of interconnections and of the interface and also digitization all speak a language explanatory of the body and its interactions. Virtual space is an imaginary realm and as Poster says: "Virtual and real communities mirror each other in chiasmic juxtaposition" (Poster 1996, p194). As our personal space is restricted and reduced (through data bases, CCTV, information on our hard drive etc.) an imaginary world correspondingly opens up.

It is clear then that cybory theory, feminist theory, postcolonial theory - all are operating in the same environment - exploring the collapse of boundaries, fluid identity in interaction with spatio-temporal theories of location. Evidence for the tendencies this project is concerned with are central to global processes, technological processes, cultural interaction, artistic production, all of which are interested in the interaction between categories, the collapse of distinctions, the creativity this releases: these tendencies are not in dispute. What this project aims to do is to identify the way these new experiences and understandings of our world might facilitate new explanations for corporeality: the activity between the interior and exterior worlds which is manifest in our physicality.

So, on material, conceptual and perceptual, levels, new interactions with space, language and technology are refiguring corporeality and the evidence for the validity of the research questions is demonstrated. A collapse of boundaries, and the centrality of spatio-temporal location, fluidity and connectivity are the common significant themes of new developments in space, language and technology. This is the factor to be discussed in relationship with the body in the final chapter, where it is demonstrated that imagination, corporeal experience and tactility are newly configured in relation to knowledge and an area for qualitative analysis of these phenomena is proposed.

Next is the historical analysis which contextualises the questions and develops the significance and complexity of the interactions of space and language and technology in defining knowledge and corporeal knowledge. The broadness and depth of the following contextualisation is important as a justification of the methodological approach, where, given the acknowledged subjectivity of the analysis, the richer the contextualisation the stronger the evidence (Harding 1987).

CHAPTER TWO.

THE BODY IN HISTORICAL CONTEXT.

2.1 INTRODUCTION.

It is argued that while the earlier modern period was concerned with categorizing knowledge and the marking of boundaries, geographically, medically, philosophically and metaphorically, what is significantly new about contemporary developments is that new knowledge, technologies, and cultural expressions succeed by the blurring of distinctions and the disruption of demarcations of difference. Theories of subjectivity have been preoccupied with these issues for at least twenty years. This project will explore the possibility that disturbances to concepts of exteriority and interiority and new metaphors and models for expression might transform the experience of the physical body in the physical world. It will be argued that that a new way of knowing the world will permit new parameters within which to experience corporeality.

So, this chapter examines concepts of the self and body in a direct relationship with emergent approaches to knowledge, beginning in the early modern era and continuing through to the scientisation of knowledge. This will serve three primary aims, to offer a historical contextualisation of contemporary developments; to point out strong commonalities between the two periods, which will support the suggestion that we have also entered a transformational era; and by doing so, to identify that which is significantly different about current processes for development in the last chapter.

Of particular interest here, because mapping can also be thought of as a way of locating the subject (and it is argued in the first and last chapters that the contemporary subject is mapped very differently to the Enlightenment individual), is the history and

language of cartography - both of the external world by the colonialists, and the mapping of the interior world by the anatomists. The ensuing scientific revolution brought about classification and categorisation of the physical body and the physical environment, and in this process a separation of the body from nature and from God was completed. A critical deconstruction of these processes is necessary in order to reach a deeper understanding, indeed many of the texts used are deconstructionist in approach. However, the motivation here is not to dismiss the discoveries and transformations of the period, rather it is to trace the process of alterations in ways of understanding the body in a relationship to its environment. This is in order to work towards an understanding of the articulation between changing concepts of space and time and changing concepts of the body.

In the current period of technological and information revolution the body has come, in a variety of ways, and often paradoxically, to occupy a position at the forefront of transformations. This has had the effect on the one hand of diminishing the significance of the corporeal body because there is the potential, with the aid of computer technology and medical technology, of enabling and enhancing the body beyond given physical capabilities (1).

On the other hand, such technologies intensify the significance of the body because, as its fragility and limits are exposed, this fragile physicality is simultaneously accented as the vital part of the body/machine fusion. So that, for example, representations in film and fiction of the cyborg (a hybrid of machine and body) (2), rather than substituting

(1) Examples of enhancement of the body by technology range from spectacles, hearing aids and pace makers to advanced prosthetic limbs, computerised voice boxes or goggles which allow the blind to discern basic shapes. Virtual technologies, which are still in their infancy, allow the participant to enter a world where the limitations of corporeal existence are lifted, "one can fly or go through walls since the material constraints of earth need not apply" Mark Poster "Postmodern virtualites", *Futurenatural* eds Robertson, Mash et. al. (London, New York, Routledge 1996) p189. Players of computer games are used to experiencing such phenomenon on a far more removed level.
(2) Donna Haraway says a cyborg is: "a cybernetic organism, a hybrid of machine and organism, a creature of social reality as well as fiction." 'A Manifesto for Cyborgs: Science, Technology, and Socialist Feminism in the 1980s.' (*Socialist Review* No. 80:65-106 Vol. 15, No 2, March April 1985) Vivian Sobchack, who has an artificial leg, defines both herself and Stephen Hawking, who uses a voice box, as cyborgs or "techno-bodies" in "Beating the Meat/Surviving the Text, or How to Get Out of this Century Alive" in *Cyberspace/Cyberbodies/Cyberpunk* ed. Mike Featherstone and Roger Burrows (London, Thousand Oaks, New Delhi, Sage 1995).

the ordinary human body for a mechanically, technologically advanced version, often serve to affirm the corporeal, "Popular culture has appropriated the scientific project; but instead of effacing the human body, these texts intensify corporeality in their representations of cyborgs" (Springer 1991, p304). By becoming aware of possibilities extra to corporeality, the boundaries of corporeality are sharpened and can be focused on. In these ways the body stands on the front-line of technological developments and, in terms of computer technology, is placed at the interface, both physically and virtually, of the virtual (3) and the corporeal worlds.

The position in which the body is now sited; at the interface of spatial transformations and the place it occupied in the Enlightenment - looking outwards towards new worlds and inward into an unfathomable body, a medium between discoveries of the exterior and interior world, at the core of religious and philosophical upheaval, are not dissimilar - both are revolutionary sites. The key argument of this chapter is, that in periods of spatial and temporal revolution, the body is foregrounded as the site of cultural activity and that in the process of such revolution the body itself is also revolutionized.

Rapidity of communication and dissemination of information, facilitated by technology, exponentially quickens the rate at which new cultural developments are assimilated into the general milieu. In the slower development of Enlightenment thinking, comparable phenomenon can be seen as essential factors in the formation of new ways of thinking the self, individually and collectively, these being: the influences of cross-cultural exchange, which demanded new modes of communication and broadened horizons, and the advent of print capitalism which disseminated new ideas and enabled a new sense of national collective identity (Anderson 1991).

(3) Mark Poster defines virtual space as "a computer generated 'place'" (Poster 1996, 189). Just as Haraway defines the cyborg as being of "social reality as well as fiction" above, virtual space can be used as an extension of, or alternative location for, social reality but also allows and encourages an imaginary element, unrestricted by terrestrial spatial and temporal location and identity: "virtual realities are fanciful imaginings that, in their difference from real reality, evoke play and discovery, instituting a new level of imagination" (Poster 1996, p189).

The profusion of spatial language, both actual and metaphorical, immediately reveals itself as common to both periods, which at first makes the comparisons appear quite direct and simple in their linearity. In fact, the reason the periods connect so tightly is because the connections are so multiple, complex and entwined. In part, this is because the language of discovery, born in the Enlightenment, has influenced the language of and approach to subsequent discoveries. So, as the discoveries of the Americas effected actual spatial revolution, and the subsequent explorations into anatomy were conceived of within the same spatial language (a language of demarcation and boundaries of defence) so these particular ways of describing space were forming influences in the categorisation of science. The density of spatial metaphorical connections between the two eras presents a need to pull away the layers of meaning of language to attempt to gauge the extent to which the same metaphors are being employed for different meanings and to what extent similar transformations are actually being experienced. As Nancy Leys Stepan says: "We need a critical theory of metaphor in science in order to expose the metaphors by which we learn to view the world scientifically, not because metaphors are necessarily 'wrong' but because they are so powerful" (Stepan 1996, p133). The centrality of metaphor to systems of knowledge is examined in depth in the next chapter.

This issue has been confronted by geographers, where distinctions are made between "real" and "metaphorical" space, or "geographic space" and "cultural space" (Rose 1993, p58). Such definitions are required for clarity of meaning, yet there is also a move amongst theorists toward a "third space". "Third space" defies the dualistic nature of distinctions such as material or metaphoric and recognizes that space cuts across many spheres of experience simultaneously and therefore is not best understood by contained definitions. Contemporary spatial theorists, notably Linda McDowell, are working in this area and similar ideas can be found in the work of Henri Lefebvre. He "opens the way to a trialectics of spatiality, always insisting that each mode of thinking about space, each 'field' of human spatiality - the physical, the mental, the social - be seen as simultaneously real and imagined, concrete and abstract, material and metaphorical" (Soja 1996, p64-65). These ideas will be examined elsewhere, here

attention is drawn to the problematics of defining and talking about space and to acknowledge that spatial understandings and meanings are not fixed.

The period of Enlightenment holds a key to understanding contemporary systems of knowledge and to our language as intrinsic to this knowledge; the development of the two cannot be separated for it is by their interaction that a core of integrated meaning has been built. The language and discourse of the Enlightenment was fundamentally built on the concept of light as knowledge, opposed to dark as the unknown, a dichotomous and elitist discourse which, in order to move away from, recent theory has had to try and take apart. Unpicking the language from the science can only be done on a surface level as they are constitutive of each other and because this discourse and language have become our discourse and language, we cannot take a view from nowhere (Harding 1987). In this sense a history of the body is as much about language as it is about the physical.

Just as the Enlightenment was an epoch, the beginning of a new era in knowledge, so we now stand at the emergence of an information and technological revolution. Luce Irigaray has argued that "A change of epoch requires a mutation in perception of space-time, the inhabitation of place and of the envelopes of identity" (cited Whitford 1991, p155). This chapter will trace the form or pattern of some of these mutations. Space and time are interactive and difficult to talk about in isolation so while changes in temporality will be raised here the focus is the effects of transformations in space upon the body: the interstices of space and time will be thematic to other sections.

Frederic Jameson is one among many cultural critics to declare time as defunct, postmodernism is "a scene in which the matrix of space has abolished categories of time" (cited Kirby 1996, p49) and in the seventeenth century Jonathan Sawday writes that "space not merely challenged the supremacy of Chronos, but revealed possibilities hitherto undreamed of" (Sawday 1995, p91). However, a broad chronology will be used as a framework here: looking firstly at early colonization and then at anatomical discoveries, inherently spatial projects that both revealed new spatial models and

demanded some sort of mastery or control of space. In doing so an attempt will be made to trace the refiguration of the body in its articulation with spatial transformation. The next chapter will follow on to look at the far reaching effects that classification and standardization of scientific discourse had upon language and knowledge, and begin to explore changing concepts of time.

2.2 DISCOVERING AND MAPPING THE NEW WORLD.

> A group of people living on a few acres of land will set up boundaries between their land and its immediate surroundings and the territory beyond, which they call 'the land of the barbarians' ... To a certain extent modern and primitive societies seem thus to derive a sense of their identities negatively... Yet often the sense in which someone feels himself to be not-foreign is based on a very unrigorous idea of what is 'out there', beyond one's own territory. All kinds of suppositions, associations, and fictions appear to crowd the unfamiliar space outside one's own. (Said 1978, p54).

The territorial human condition, perceptively described here by Edward Said, explains the fear of unknown territory and the strategies by which people cope with this fear: marking off a known safe area, effectively claiming it, and, in so doing, establishing a distinction from the unknown, boundless, outside area which is named as dangerous. Although international trading systems can be traced back as early as 2500 BC (4) and DavidHarvey states that the *re*-discovery of the Ptolemaic map in Florence in the 15th Century was "a fundamental breakthrough in the construction of geographical knowledge of the world as a single global entity" (Holton 1998, p34), Columbus's discovery of the Bahamas in 1492 marks the beginning of modern Western man's

(4) Richard Holton argues in *Globalization and the Nation State* (Macmillan Press Ltd, Hampshire, London, 1998) that there is evidence of world trade from as early as 2500BC. In terms of economic trade "Janet Abu-Lughood (1989)...discerns the existence of a world-economy based on long distance trade between Europe and Asia, organized through a chain of trading cities from Bruges to Venice, via Cairo and Baghdad, to Samarkand and Canton, as early as the 13th Century" and "Andre Gundar Frank (1990), ...speaks of 5000 years of 'world system history, taking the analysis back to 2500BC and before...These include trade but also involve cross-cultural contact through conquest and through the diffusion of cultural ideas and practices." Holton identifies the recent global period as significant in its sustainability and beginning with the "consolidation and expansion of Western Capitalism from the 16th Century onwards" (p 26) but stresses that a "forseshortened sense of time horizons inevitably gives pride of place to the Western World" (p42).

journey into the outside dangerous world and was a crucial trigger for Enlightenment thinking. The defensive fear described by Said underpins much of the response or treatment of "new" lands and people. The "ours" and "theirs" philosophy is one of othering upon which the Colonialist project is built; a divisive, defensive mechanism. Said describes Orientalism as an appropriation by the West of that which is not Western as Eastern. This is a discourse resonant with all discourses that were born out of the Enlightenment in that it is based on creating an other in relation to the knowing subject where the knowing subject is Western man. This fear that Said identifies goes some way toward explaining the deep significance that the map held in the processes of these discoveries and the power that cartography held as a method, a language. However, although the "universal" strategy that Said refers to is the basis of the approach that the explorers had to these "barbarian" lands, the attitude of conquest and possession can not be comfortably explained away as a universal human strategy. The strategy of domination and ownership is something more than making safe a home and the inequity of this strategy is intensified by the exclusivity of the grouping of the explorers. The mechanism of demarcating boundaries as a means of defining the known and containing the unknown became the basis for charting progress through new territories. The motivation was to forge onwards, to claim not just more land but more knowledge, under the umbrella of Western progress.

The significance of the map in this domination is that it became a strategic tool of power, the map was proof of ownership, a claim to conquering the unknown, and the fact that it was white men making the maps came along with other strategies of white male dominance to place them as masters of language and knowledge. "As an exemplary icon of imperial 'truth', the map like the compass and the mirror, is what Hulme aptly call a 'magic technology', a potent fetish helping colonials negotiate the perils of margin and thresholds in a world of terrifying ambiguities" (McClintock 1995, p28), so that "Map-making became the servant of colonial plunder" (McClintock 1995, p27).

The enormity of the colonialist project and the fear that this project demanded should not be underestimated; sailing into the unknown is, from a contemporary perspective, hard to invoke, perhaps an astronaut might have some insight, for "(t)he environment that the explorers experienced may have had little to do with the fixed space that we are accustomed to occupying now" (Kirby 1996, p48). Indeed, prior to the nineteenth century and precise calculations for longitude, the mapping, understanding, and so experiencing, of space was from an entirely different perspective:

> When one realizes that in the beginning the best that navigators could do to measure speed was to throw an object overboard from the bow and see how long it took to float past the stern: that for want of suitable timers, seamen had to rely on some subjective verbal standard - the time say of an Ave Maria... then one can well understand that such calculations were often wildly inaccurate. (Landes 2000, p112-113).

So, although the map was a method by which to contain fearful areas, until after the invention of the chronometer in 1761, these maps were as much symbolic as actual tools of domination, for they betrayed a high level of inaccuracy. The precise mapping of space made possible by John Harrison's chronometer was entirely dependent upon the accurate measurement of time which was clearly understood as a constant, exemplary of the order of the universe (the measurement of time being one of few areas in which consistent progress was made in the middle ages). (Landes 2000) Until methods could be found to bring space under the same control, i.e. confidently measured and predicted, the map served as an interim emblem of spatial conquest.

> The pernicious effects of longitude were multiplied by the consequences for cartography. The map after all, was the primary medium for the transmission of information and experience in matters of navigation - just as the book was in other areas of knowledge. In the international contest for access to the riches of the Indies, maps were money, and secret agents of aspiring powers paid gold for copies of the carefully guarded Portuguese *padrons*. Bad measurements made bad maps, though, and many a ship spent precious days searching for land that showed only on paper. Cartographers had a dearth of accurate information and a plethora of guesses to go by, so that even contemporaneous maps differed in detail (Landes 2000, p114).

After the accurate measurement of longitude however "the entire planet's curved surface had been subjected to a geometrical grid which squared off empty seas and unexplored regions in measured boxes. The task of, as it were, 'filling in' the boxes was to be accomplished by explorers, surveyors, and military forces."(Anderson 1991,

p173). By using the measurement of time, the spatial surface of the earth was brought under measured control, was mastered, this cartographic confidence meant that surface areas were quantifiable before exploration. In this sense the mapping grid predicts or precedes the territory, rather than the other way round. Cartography had found a system of order for surface space that, as expected, appeared to reflect, and was bound to, the order of time.

A more recent example of the strategic power of the map can be found by looking at Siam, to whom modern cartography and print capitalism came in the late nineteenth century. Benedict Anderson, reliant on the thesis of Thongchai Winichakul, "Siam mapped: A History of the Geo-Body of Siam" (Ph.D. Thesis, University of Sydney, 1988), looks at the convergence of the map with census taking and with print capitalism in the formation of a national identity. Although in this case the map was to become a tool of resistance *against* colonization, it is a case worth recounting as it illustrates the influence of the map both in the structuring of identity and as a strategic political tool.

Prior to the accession of Rama IV to the throne in 1851, Siam was not conceived of as having a form or shape enclosed by fixed boundaries. The British were moving into Siam from Lower Burma and although boundary stones were placed "discontinuously at strategic mountain passes and fords ... They were understood horizontally, at eye level, as extension points of royal power". Until this time,

> only two types of map existed in Siam.... One was what could be called a "cosmograph," a formal symbolic representation of the Three Worlds of traditional Buddhist cosmology... The second type, wholly profane, consisted of diagrammatic guides for military campaigns and coastal shipping.... Their main features were written-in notes on marching and sailing times, required because the mapmakers had no technical conception of scale... Thongchai points out that these guide maps, always local, were never situated in a larger, stable geographic context, and that the bird's-eye view convention of modern maps was wholly foreign to them. Neither type of map marked borders. (Anderson 1991, p171-172).

Anderson states that print capitalism was flourishing by the 1870s, with the first printed geography by W.G. Johnson being published around 1900 and "Thongchai notes that the vectoral convergence of print-capitalism with the new conception of

spatial reality presented by these maps had an immediate impact on the vocabulary of Thai politics" (Anderson 1991, p173). For the first time the concept of, and word for, "country" was introduced and rapidly replaced the sacred domains that had previously made sense of place. While the early colonizers used cartography as a tool for possession of new territories, in Siam the map was required as a tool by which to describe what was already theirs and so to resist colonization.

> In terms of most communication theories and common sense, a map is a scientific abstraction of reality. A map merely represents something which already exists objectively 'there'. In the history I have described, this relationship was reversed. A map anticipated spatial reality, not vice versa. In other words, a map was a model for, rather than a model of, what it purported to represent... It had become a real instrument to concretize projections on the earth's surface. A map was now necessary for the new administrative mechanisms and for the troops to back up their claims... The discourse of mapping was the paradigm which both administrative and military operations worked within and served. (Thongchai 'Siam Mapped' in Anderson 1991, p173-174).

In a neat reversal of the way in which colonizers had used the map as a claim to ownership, the advent of a bounded form for their country enabled Siam to both name what was theirs in a language shared by potential colonizers and to generate a national identity with which to resist colonial forces. The map became a powerful symbol of belonging just as it had also been used by other regimes as a symbol of conquest. This is how Anderson describes the development of the "map-as-logo":

> Its origins were reasonably innocent - the practice of the imperial states of coloring their colonies on maps with an imperial dye. In London's imperial maps, British colonies were usually pink-red, French purple-blue, Dutch yellow-brown, and so on. Dyed this way, each colony appeared like a detachable piece of a jigsaw puzzle. As this "jigsaw" effect became normal, each 'piece' could be wholly detached from its geographic context. In its final form all explanatory glosses could be summarily removed: lines of longitude and latitude, place names, signs for rivers, seas, and mountains, *neighbours*. Pure sign, no longer compass to the world. In this shape, the map entered an infinitely reproducible series, available for transfer to posters, official seals, letterheads, magazine and textbook covers, tablecloths and hotel walls. Instantly recognizable, everywhere visible, the logo-map penetrated deep into the popular imagination, forming a powerful emblem for the anticolonial nationalism being born. (Anderson 1991, p175, original emphasis).

The figurative importance of the map as a representation of conquered territory is exemplified here and it is reasonable, it is suggested here, to assert that the map held an equally persuasive role as an emblem of power in the colonization of territory as it

has also done as a language and a symbol by which to resist colonization in the above case.

The language of cartography set a precedent, for as the anatomists began to dissect the human body they too imagined this as a voyage, although this time a voyage inwards and they took the language of colonization with them. Consequently the motivations of the explorers and the language that expressed these motivations, were transposed onto the body and a cartography of the body was initiated. For this reason the language that was employed in describing the newly "discovered" world, is crucial in coming to an understanding of the way the anatomical body was thought about and described in the earliest anatomical explorations.

Faced with the unknown, the familiar metaphor that the explorers took from their established knowledge, the known experience that could be likened to this new experience, was the unknowable nature, the otherness of woman. So as the land was colonized and maps were made of the "captured" land, lines were drawn, borders were established and at these borders the language of the feminine was employed to describe the threshold and those areas as yet unknown, not yet made safe:

> As European men crossed the dangerous thresholds of their known worlds, they ritualistically feminised borders and boundaries. Female figures were planted like fetishes at the ambiguous borders contact, at the border and orifices of the contest zone... In myriad ways, women served as mediating and threshold figures by means of which men oriented themselves in space, as agents of power and agents of knowledge. (McClintock 1995, p24).

Although the language of the feminine is apparent in the demarcation of the unknown, the other was not only feminine, the other was a complex amalgam of metaphors for that which was unsafe or strange. *Dark*, the most basic en*light*enment metaphor for that which is not light, where light is knowledge, also speaks of racial difference, so that the "trope of the dark continent" for example merges:

> Two unknowabilities, racial difference and sexual difference...Otherness, whether sexual or racial, is usually articulated as a problem of the limits of knowledge and hence of visibility, recognition, differentiation ... The trope, however, reduces and oversimplifies the extremely complex relations between racial and sexual difference

> articulated by the colonialist enterprise" (Mary Ann Doane, 1991, quoted in Lindenmeyer 1999, p56).

It is important also to recognize that the metaphor itself did not create the position of other. As Renee Heller argues: "The basic values of a culture are usually compatible with the metaphorical structure of the fundamental concepts in the culture, so '[n]ot surprisingly, the social groups represented metaphorically as "other" and "inferior" in Western Culture were socially disenfranchised in a variety of ways.'" (Heller 1996, p72 quoting Stepan 1986, p265) Yet the dependency of a new language of knowledge upon such metaphor certainly served to compound the position of the disenfranchised and to exclude them from active participation in, or contribution to, emerging ways of knowing the world. Equally, ways of knowing the world from the position of other were discredited.

It was necessary to make safe, to shore up the individual, precisely because man's place in the universe was made so unstable by the discoveries of previously unknown inner and outer worlds. Map making was one of the ways in which the dangers were limited by containing within maps the discovered, the conquered, and describing the feared and desired unknown as dark or female. So, as the Enlightenment individual began to establish himself, it was on the basis of exclusion, so that women and those from outside Europe were excluded from the position of subjectivity. The map was one of the methods by which the white male subject placed himself in the central position of holder of knowledge.

> The similarity of mapped space and the mapping subject stems from the way the boundary between them is patterned as a constant barricade enforcing the difference between the two sites: part of the function of mapping is to ensure that the relationship between the knower and the known remains unidirectional. (Kirby 1996, p54).

Kathleen Kirby argues that the new subject emerging in the Enlightenment did so in articulation with new emergent concepts of space, so that the subject and space established their meanings in a mutual dependency. A new subjectivity is only possible in operation with spatial changes. She says that:

> the development of the Enlightenment individualism was... Inextricably tied to a specific concept of space and the technologies invented for dealing with space... The Cartesian subject, the Enlightenment individual, the autonomous ego of

> psychoanalysis: all appear to be reducible to this same graphic schema. The 'individual' expresses a coherent, consistent, rational space paired with a consistent, stable, organized environment. Cartography...is both an expression of the new form of subjectivity, and a technology allowing (or causing) the new subjectivity to coalesce. (Kirby 1996, p45).

This presents the possibility that current spatial transformations will develop in coexistence with transformations in subjectivity: "The new styles of space forming the foundation of postmodernism may offer precisely the material for building a new kind of subjectivity, one that will not leave non-dominant subjects at the theoretical and political margins" (Kirby 1996, p46). Current theory finds its interests in the margins, the interface, as the area of most intense poilitical-cultural activity, the exchange and change, while the Enlightenment was concerned with marking off solid areas of knowledge, "truth". So the subject formed within these stable, consistent spaces, is not a subject that will survive in the fluctuating, in-between regions of postmodern space. While cartography is concerned with the boundary as defining the claimed and known, the boundary is not a point of interaction but rather a point of defence. Kirby claims that this is an "interface", "mediating the relationship between space and the subject and constructing each in its own particularly ossified way" (Kirby 1996, p47), whereas today's is a site of activity and potential development and this site is constantly shifting.

There are, at the same time, ways in which the boundaries at which the colonialists stood can be likened to the ways that boundaries are envisaged in contemporary theory. As the boundary marked the limit of discovery, it would be developed and extended as more land was claimed, the boundary would be moved as more of what had been unknown was assimilated into the known. McClintock argues that this liminal status which the colonialists held was a threshold position, a position of possible danger, in much the same terms that cultural boundaries are described today. "There on the margins between known and unknown, the male conquistadors, explorers and sailors became creatures of transition and threshold" (McClintock 1995, p24-25). In this sense they occupied a privileged position, they physically stood at the point of transition which, metaphorically, cultural theorists attempt to stand at today

and, perhaps paradoxically, is the place at which those not accounted for by dominant subjectivities find themselves today: at the margins.

From this place, in retrospect, the explorers can be seen to have held a position of enormous influence. The significant difference between these marginal figures and those that stand at the metaphorical margins today, is that these were an exclusive group in a position of power, unlike the most ostracized, least powerful groups who occupy marginal positions in contemporary society. From a theoretical angle these marginal groups, by challenging dominant discourse, have the power to alter cultural activity, the power to change meanings: a metaphorical rather than actual power, just as they stand at a metaphorical rather than actual border.

The slightly later period of classification and measurement, after Descartes, is when our modern systems of knowledge were built; this early colonialist period is especially important as the one in which our modern language was established, a language based on self and other, ours and theirs. This is the language of a cartography developed in conjunction with a new subjectivity where the subject was a white male and this divisive language is the one that has defined modern structures of knowledge.

Sadie Plant argues that women have found their symbolic home, their language, in the matrix, in the networks of information technology (Plant 1998), in this argument, the same subject marginalized by Enlightenment thinking and the same approaches to knowledge that have been through this period excluded, are those that are thriving in the connectivity of technology. This very different subject coming to the fore in accordance with the very different spaces that are emerging in the late twentieth, early twentyfirst century has been examined in the previous chapter.

2.3 ANATOMICAL DISCOVERY - SPATIAL REVELATIONS.

The anatomisation of the body from the sixteenth century was an inherently spatial process: "space, the positioning of the body within a three dimensional matrix, was the key to anatomical understanding. And the discovery of space was one of the key conceptual shifts that took place in Europe in the early modern period...The study of anatomy *was* the study of space" (Sawday 1995, p86, original emphasis). In the medieval period one's body was a standard for spatial measurement: "Space whether immediate, geographical, sociological or cultural, was basically linked to physical perception, especially that of the hand and the arm" says Le Roy Ladurie in his history of a French medieval village where, "Their notion of it [space] was bounded by two philosophical concepts of Montaillou, *corpus* and *domus*, body and house. The body was the measure of the world, in the first place and when the world was too large to be measured by the body its place would be taken by the *domus*." To use Le Roy's examples: "I was sunning myself behind my house and four or five spans away Guillame Andorran was reading a book." Whereas "If you want to have an idea of Heaven ... Imagine a huge *domus* stretching from the Merens Pass to the town of Toulouse" (Le Roy Ladurie 1978, p282-283). Where the body had been used as a consistent measure of the world, anatomical discovery exposed the body as a whole new spatial model in itself, a model inconsistent with the exterior world, requiring new explanations of space rather than being explanatory of space. In articulation with such reconfigurations of the body in relation to the world were alterations to the meanings invested in time. This section will show that in this early modern period, spatial revolution and its accordant impact on the relevance of temporal order, was tied to a fundamental change in the concept of the body and the subject, an indication that we might expect some significant alterations in concepts of the body as part of current spatial and temporal shifts. It will later be argued that the disruption of boundaries and exchange across borders, actually and metaphorically, is that which is significantly new in an emergent thinking about the body, so this section will look at some of the religious, philosophical, scientific, linguistic foundations upon which those conceptual

divisions were founded, and briefly illustrate their expression in a language of maps where a line of defence was drawn between the exterior and the interior of the body.

Andreas Vesalius was the Flemish anatomist who challenged the established theories of Greek physicist, Galen, and began a new era of scientific investigation. His major work *The Seven Books on the Structure of the Human Body* was published in 1543, the same year of Copernicus' death and the publication of *De revolutionibus orbium coelestium* which placed the sun, rather than the Earth, at the centre of the Universe. Vesalius' work contained the first accurate descriptions and depictions of human anatomy. Here began a period in Europe of intense fascination with dissection, a fascination that operated on a grotesque, morbid level as well as on a scientific plane and the anatomy theatre was exactly that, a theatre where crowds would gather to witness the performance of dissection, just as they might visit a play. In this performance the anatomist not only played the starring role, he was the "heroic voyager and intrepid discoverer" (Sawday 1995, p24).

The interdependency of the colonial project and the anatomists project was such that if one failed so would the other, they shared a goal - the mastery of space, a language, a tool - the map, and an attitude, one of conquest. Accordingly, the fear of the unknown, evident in the strategies and language of explorations of the "new world", is also a defining factor in shaping concepts of the body. Fears associated with the body could not be externalised as unconquered or unknown territories could, instead the fear was of what might lie within, a fear of self, and this posed philosophical and spiritual dilemmas at least as challenging as the material tasks. The fear of, and associated fascination with, the bodily interior is reflected in the cultural production of the Renaissance, particularly in the poetry of John Donne (1572 - 1631) and others of the metaphysical school, where images of the body devouring itself, of the monster within, are thematic (Sawday 1995). Whereas in geographical mapping the monsters were left lurking in the margins and gaps left by failures in knowledge, dissection began to reveal what seemed, at first, to be the monstrous interior of the body, and this monster was within every individual. One illustration of the quite different perception

of boundaries in contemporary theory, is that the monster has now become a powerful metaphor for hybridity and for the freedom to be found in the spaces between subjectivities. (5)

To appreciate the philosophical and spiritual implications of what the interior body revealed to the early anatomists it is necessary to firstly understand the held expectations and assumptions with which these explorations were entered into. In this pre-scientific era, the whole approach to the world was underpinned by a deeply held religious belief, that of the divine creation of the Universe, and of man within this creation. The interior of the body was expected to be a microcosm of the exterior world, it was anticipated that the unified and harmonious construction of the world would be visibly reflected in the physical ordering of the internal organs, so it was with this conceptual framework that the anatomists entered the body - armed with the language and tools of geographical exploration.

However, the visible, tangible complexity of the physicality of the body repeatedly problematized this explanation. Rather than finding a terrain of hills and rivers, the body revealed compartments each unique in terms of structure and behaviour, within each cavity were further spaces, one small cavity might appear to contain pints and pints of blood, another would harbour yards of intestine, phenomena which in no way reflected a harmonious and divine construction. The unpredictability of volumes and depthlessness of cavities, defied reason; no overall pattern could be formulated as to

(5) For subversions of the monster metaphor see Nina Lykke 'Between Monsters, Goddesses and Cyborgs' and Rosi Braidotti "Signs of Wonder and Traces of Doubt: On Teratology and Embodied Differences" in *Between Monsters, Goddesses and Cyborgs. Feminist Confrontations with Science, Medicine and Cyberspace*, edited by Nina Lykke and Rosi Braidotti (London, Zed Books, 1996). Lykke subverts both the language of Enlightenment discourse, and the concept of the boundary as a part of that discourse, by asking "the monster metaphor to perform as a representation of boundary phenomena in the interdisciplinary or hybrid grey zone between the cultural and natural sciences" (p4) and by naming goddesses and cyborgs also as hybrid figures, where "Both are .... designed to transgress the borders between human and non-human" (p24). Braidotti uses the monster to disrupt Enlightenment rationalism: "Being figures of complexity, monsters lend themselves to a layering of discourse and also to a play of the imagination which defies rationalistic reductions" (p135). Both use the monster as a way of upturning the process of "othering" on which modern science has been built.

the spatial behaviour of different bodily organs or regions. Instead of reflecting the universe in its geographies, or time in its order, the body displayed completely new forms of spatial organisation.

The pre-modern era had been defined by a temporal order; it was the cycles of the sun, moon and seasons that shaped and framed human existence, defining the framework of the day, of a lifetime, and the divine creation of man was conceived of in terms of a chronology. "Time and order were virtually synonymous; indeed what was *dis*-order but an absence of the governing principles of time, a retreat into an unstable world of continual flux?" (Sawday 1995, p91, original emphasis). And the body represented precisely this instability, resistant to the established order of the universe, "The mystical relationship between body and soul ... were undermined to a degree from which a theology ... of existence was never to recover" (Sawday 1995, p92).

This is not to say that temporality was superseded by spatiality, but that the conjunction of spatial revelations brought about by colonization and anatomy, as well as astronomy and perspective as developed in the Renaissance from the 15th century, brought about the necessity of finding some spatial order to frame the universe, and of reasoning man's place within the universe, physically and spiritually, in spatial terms. As Sawday explains,

> to the inflexible rule of time, new science offered an alternative: the advent of spatial rather than temporal order... Space, whether conceived of as the limitless voids revealed by post-Copernican theory, or the dense articulation of space within the minute interstices of post-Vesalian dissection, not merely challenged the supremacy of *Chronos*, but revealed possibilities hitherto undreamed of. (Sawday 1995, p91).

Without a spatial key the anatomist was faced with a project from which there was no going back, he had embarked on an endless voyage into the depths of the body which appeared could be infinitely dissected, each revelation another variable, resistant to prediction. (Sawday 1995)

> "For all their continual assertions that the body mirrored harmonious orchestration of the universe, what they confronted in reality was something else: a structure of such bewildering complexity, such a confusion of function and organic integrity, that the outcome of every such interior voyage hovered on the edge of disaster. The inwardly directed gaze traversed not simply regions of doubt, but transformed the body into the locus of all doubt" (Sawday 1995, p88).

In the light of these early anatomical explorations, religious and philosophical debates about the relationship between body and soul became intense, if the interior of the body demonstrated such monstrous capacities and capabilities, how could it then be part of the divine creation? This fundamental challenge to the presumptions of religion was met, initially, by a determined effort to impose a geographical order on the body, but the body appeared to be consistent only in its inconsistency. So a process was begun whereby the body became separated from the divine, it became instead the corruptible vessel that housed the divine soul. "Calvinistic theology," for example, "with its seemingly obsessive desire to chart the inner state of each individual's spiritual well-being, was to argue with a conviction equal to that of a scientist that the division between the realm of the body and realm of the soul was now the concern of every thinking person" (Sawday 1995, p17). Differentiation was necessary between the monstrous physical interior of the body and the purity of the soul, and so the two were pitted against each other, the soul in continual battle with the corruptible body,

> 'Mastery' over the body, the conquering of its desires, the endless war against the ravages of sin, or 'soul sickness', is a feature of early modern culture which provides the determining framework in which the body's internal dimensions were to be understood. (Sawday 1995, p20).

The journey, through the bodily interior was traced like a map and with it came the cartographic terminology: "these early discoverers dotted their names, like place-names on a map, over the terrain which they encountered" (Sawday 1995, p23). By adopting the particular language of the colonialist, the anatomists moved under the colonial mantle of conquest and possession and assumed the divisive, elitist elements of a structure of knowledge that was to grow into modern science. That the body

experienced its first scientific investigations within such a discourse has set the framework for all future discussion around the body, so that:

> In the twentieth century it is virtually impossible to think about the body outside the prevailing medical-scientific discourse. What we consider to be primarily the focus of medical attention ... has in other epochs been entertained under quite different categories of description. Those categories, bounded by theology and cosmology - the polarities of ritual - did not admit the possibility of thinking about the body as a discrete entity. (Sawday 1995, p16).

Where cartography had found a, perhaps superficial, method by which to contain geographical space within an order akin to that of time, the body was resistant to such order, "its recalcitrant and rebellious longing for physical and sensual existence, delineates the battle-lines between material and immaterial existence, as well as between subject and object in a grammatical sense" (Sawday 1995, p20). Necessarily then, the body becomes increasingly separated from the divine and from the physical world which, at this stage, retained its status as part of the divine creation, and most importantly the body is distinguished from the self, the subject.

The body then, as now, can be seen standing in a position where its vulnerability is balanced by its power or potential, at the forefront of the Enlightenment. It was the body's physicality that was subject to scrutiny but this had resounding implications for spiritual and philosophical debates around body and soul and the divine creation; the body as "the locus of doubt" was also the locus of interest, of debate, of transformation. The early modern body seems in this way to be situated very closely to the body of today, that is, as a focus of cultural and scientific activity, acting almost as a litmus test for the acceptability or morality of new technologies or cultures.

As no overall governing principle to the organisation of the bodily interior could be found, each discovery was instead measured, weighed and recorded in careful detail and in this way tenuously claimed as known. Here lies a significant difference between the explorations of the "new world" and the exploration of the body: for the explorations of the body heralded measurement and classification - the two overriding

themes of the Scientific Revolution. Empiricism can be seen as a method by which the lack of principle in spatial construction was contained. The unknowable nature of the body's recesses were offset by methodical measurement, description and depiction.

In this transformational process the body and soul had become oppostional forces and a conceptual barrier had been forced between the interior and exterior environments, they had been distinguished, foreclosing the possibility of interactivity between inside and outside the body. "Spittle, blood, milk, urine, faeces or tears by simply issuing forth have traversed the boundary of the body. So also have bodily parings, skin, nail, hair clippings and sweat. The mistake is to treat bodily margins in isolation from all other margins" (Douglas 1966, p121). This is precisely the "mistake" of Western thought; the surface of the body has come to be conceived of as a defence between interiority and exteriority, a barrier between the harsh outside world and the corruptible interior body. Despite daily evidence to the contrary, the belief, firstly that the margins of the body are impermeable, and secondly that the stuff inside our bodies is discrete from stuff outside our bodies has been largely, until recently, sustained.

The spiritual problems raised by the body's resistance to spatial organisation were eased by altering the framework within which the body was conceived. Although the body was claimed as terrain, the geographical approach proved inadequate on its own and from the late seventeenth century the body as machine became the prevalent metaphor. By relinquishing the desire to incorporate the body into a divine scheme, at least some religious tenets could be upheld. This mechanisation of the body served, alongside the Cartesian philosophical separation of mind from body in the early seventeenth century, to complete the bifurcation of the subject. Not only was the thinking self distinct from the mechanised body but this bifurcated entity was further dislocated from the surrounding environment.

> Gazing introspectively into the interior in Cartesian meditation, the human subject had become aware that the 'self' was an apparently contingent mechanism... So,'selfhood' - the sense of having or being a unified self - was maintained only when the self ceased to think about the self. In the formulation of the *cogito*, only the "I" that was aware of itself thinking could announce the certainty of existence. And, paradoxically, in the very moment of certainty the sense of wholeness,

> ...,collapsed... The human subject oscillated, now, between unthinking unity, and reflective dislocation. (Sawday 1995 p159).

The Cartesian model, is not fully explanatory of changes to the idea of the individual. The political philosophy of Hobbes, documented by Macpherson as an early advocate of liberal democracy, challenges the immaterialism of Cartesian thought and posits the individual within grounded political terms, with:

> "... its conception of the individual as essentially the proprietor of his own person or capacities, owing nothing to society for them. The individual was seen neither as a moral whole, nor as part of a larger social whole, but as an owner of himself... Society becomes a lot of free equal individuals related to each other as proprietors of their own capacities" (Macpherson 1962, p3).

Hobbes was a self proclaimed 'modern' philosopher, which primarily entailed a rejection of Aristotelian political philosophy generally and the belief in the highest good of man particularly - the belief that good citizenship and leadership are infectious, that man moves towards the highest denominator. For Hobbes "the state of nature" is one in which each individual pursues their own happiness and, while this needn't necessarily lead to conflict, it often will - if an individual is greedy, or if an individual's desires do not coincide with an other individual's desires. To guard against such conflicts, which could devleop into war or violence, the individual must abandon the "state of nature" and entrust the protection of their safety and freedom to a strong state. (*Penguin Dictionary of Philosophy* 1997, 251-252) Sawday links Hobbes' fundamental rejection of Cartesian philosophy to the ascension of space over time, he says that: "The new philosophy of Francesco Patrizi ... posited the priority of space in what has been termed 'the order of time and being'. Patrizi's *spatium* - a forerunner of Newtonian conceptions of space, and a prelude to the discovery of the possiblity of spatial infinity - could be thought of as an anticipation of Hobbes's brusque, post-Cartesian demolition of scholastic philosophy on the grounds of corporeal rather than temporal existence" (Sawday 1995, p91). However, like Cartesian thought, Hobbes' thinking demands, from a different basis, separations for the individual: firstly there must be a rejection of the natural state and secondly the individual is placed in a defensive position in relation to other individuals. Evelyn Fox Keller argues that

elements of modern science are reliant on such a concept of the defensive self, a prime example being the selfish gene of Darwinian theory, where autonomy becomes equated with competitiveness and the individual must defend themselves against others and against the "state of nature".

> 'Hobbesian man': simultaneously autonomous and oppositional, connected to the world in which it finds itself not by the promise of life and growth but primarily by the threat of death and loss, its first and foremost need being the defense of its boundaries. In psychological terms, we might say that such an individual betrays an idealized conception of autonomy: one that presupposes a radical conception of self and simultaneously attributes to the relation between self and other an automatic negative valence, a relation, finally, not so much of independence as of dynamic opposition. (Keller 1996, p156).

The idea of the "possessive individual", and of society as constituted by a collection of such individuals, a politicised notion of self and community, can be seen as facilitated by the rise of print capitalism. Benedict Anderson has argued that the concept of "nation" rose from the abandonment of three primary tenets of belief:

> The first of these was the idea that a particular script-language offered privileged access to ontological truth, precisely because it was an inseparable part of that truth ... Second was the belief that society was naturally organized around and under high centre - ruled by some form of cosmological (divine) dispensation... Third was a conception of temporality in which cosmology and history were indistinguishable, the origins of the world and of men essentially identical. (Anderson 1991, p36).

The move away from the belief in a "divine dispensation" and the separation of cosmology from history can, as shown, both be seen as made necessary by the confusing spatiality of the body. Anderson says that these factors along with the rise of print capitalism "made it possible for rapidly growing numbers of people to think about themselves, and to relate themselves to others, in profoundly new ways" (Anderson 1991, p36). The new relations, enabled by print, would seem in some ways to reinforce the Hobbesian notion of the individual; "[b]y enlarging the gap ... As inherent in language, print allows a distance to intervene between speaker and listener and this gap permits the individual to think, coolly to judge the words of the other without his or her overbearing presence" (Poster 1995, p60). Print in this reading can be seen to leave the individual's defences intact, even to strengthen those boundaries, while at the same time the rise of the newspaper, and the shared experience of the news, strengthens the concept of collective circumstance.

> The obsolescence of the newspaper on the morrow of its printing ... Creates this extraordinairy mass ceremony; the almost precisely simultaneous consumption ("imagining") of the newspaper-as-fiction. ... The significance of this mass ceremony - Hegel observed that newspapers serve modern man as a substitute for modern prayers - is paradoxical. It is performed in silent privacy, in the lair of the skull. Yet each communicant is well aware that the ceremony he performs is being replicated simultaneoulsy by thousands (or millions) of others of whose existence he is confident, yet of whose identity he has not the slightest notion. (Anderson 1991, p35).

So, the challenges that the spatial organsation of the body posed philosophically and religiously can be identified as a crucial contributory factor in the reconfiguration of the subject, and the growth of print capitalism shown to be vital both in the dissemination and reinforcement of these new ways of thinking the self in relation to others. Indeed, Sawday connects the body and printing even more tightly together when he uses Walter Ong's argument that the development of movable type was a spatial process that contributed to the primatisation of space over time and was conceived of within the same framework as the anatomical spatialisation of the body.

> With the invention of printing came a much greater commitment to space - the organisation of knowledge according to spatial co-ordinates. The technique of printing after the invention of movable type - where letters in a font are cast from a 'matrix' , and then dispersed into "text" in an infinite number of possible permutations - corresponded, Ong has suggested, to the Ramist development of organising discourse in space ... This ordering of discourse was akin to the progressive partitioning of the body in anatomical demonstration, and thus indebted to a language of the body at every point. (Sawday 1995, p136).

Spatial and temporal transformation along with new modes of communication are in this period inextricably tied to transformational concepts of the body and the subject, and these sea-changes in thinking and knowing the world, triggered by discoveries and rediscoveries, and coexistent with an influx of new information,amount to a period of true revolution. The suggestion of Ong above exemplifies the interweaving of the body with space and communication as elemental to the modern framework of knowledge. Other chapters will argue that we have entered a comparable but intensified period of change. By tracing the direction of contemporary spatial, temporal and communication shifts and the manifestations of these trends in new conceptions of the body, it is anticipated that the possibility of a new experience of the

body can be shown. The above link between the body and text is particularly resonant because the body as a text, a surface inscribed by culture, has been a recent dominant theme (6), yet resonance does not mean the same and it is that which is different which must be identified in order to understand what is revolutionary in current developments. In this section various separations have shown to have been wrought: between man and god, body and soul, exteriority and interiority and self and others. In the following chapter the categorisation of science and disciplining of knowledge will be discussed as confirming and enforcing the modern compartmentalisation of knowledge and of the bounded body within such thinking.

(6) Judith Butler's *Gender Trouble. Feminism and the Subversion of Identity* (New York, London, Routledge, 1990) is probably the earliest explicit contemporary theoretical account of the body as a surface written on by culture, further developed by Butler in *Bodies that Matter. On the Discursive Limits of Sex* (New York, London, Routledge, 1993). A fictional and more fluid expression of such ideas can be found in Jeanette Winterson's work, *Written on the Body* (London, Jonathan Cape, 1992).

CHAPTER THREE.

SCIENCE: A LANGUAGE.

3.1 INTRODUCTION.

The significance of science to this project is that it is representative of dominant, modern, Western ways of knowing the world. This section will not talk a great deal about the body but rather concentrate on this particular system of knowledge, and its language, as the frame by which the body has come to be understood in relation to the rest of the world. The effects of new explorations which "abruptly widened the cultural and geographical horizon and hence also men's conception of possible forms of human life" (Anderson 1991, p16) have already been shown as a spark for the Enlightenment, and the process by which the soul was distinguished from a corruptible body and a harsh earthly existence has also been illustrated. A new language, fundamentally dichotomous in its nature, has been seen to develop from the foundations of cartography, with its markation of boundaries and lines of defence, and a new bounded modern subject, inhabiting a mechanised body, seen to appear.

It was in the emergence of a scientific explanation of the world that these concepts were crystallised and validated for, as will be argued, classical science, founded on the perceived constancy of time and an order observed from nature, and with its particular approach and language, purported to hold a relationship to truth that allowed it the position of a doctrine, a system of belief. The relevance of this to the project is that the success of science in explaining the world has both defined a particular approach to the body and tended to detach corporeal experience from the realm of "truth" and knowledge. This section will illustrate the power and authority of the language of science - as representative of a mechanised system of knowing - from its roots in the observations and categorisation of nature through to Newtonian science. The following chapter will then develop these ideas in relation to scientific activity in the twentieth and twenty first century where alterations to such approaches and explanations are apparent. Detailed attention is paid to the centrality of metaphor in

the development of a scientific language, this is because when contemporary indications of change to the way we know our world are examined, the possibility of describing this altered world is also demonstrated as framed by new metaphors and models, largely revealed by science and technology.

3.2 ORDERING NATURE AND THE METAPHORICAL FOUNDATIONS OF CLASSIFICATION.

This section focuses on the categorisation of the natural world and particularly on the processes of transition from a cosmic, holistic language to a compartmentalised, disciplined scientific language. The second chapter described the emergence of a defensive language defined by self and other which developed in articulation with a newly spatial world, but the alterations to language require further exposition because it is the parameters of language that frame the limits within which it is possible to describe, and hence to legitimately "know", the body in relation to a concept of self and to the rest of the world.

Through the middle ages learning was contained and hidden in the libraries of monasteries, where access to ancient texts was restricted or even censored, and where knowledge was shared only among a selected few. It is unsurprising that within such a culture learning did not tend to progress, indeed amongst the learned monks was an awareness that a great deal of what had once had been known had been lost, learning was a matter of retrieval rather than of progression, and retrieval of ancient knowledge and technologies was severely curtailed by the often possessive and protective guardianship of monasteries.

However, the processes of the Enlightenment were concerned with the bringing to light, the revelation, of knowledge, "the task of scientific enlightenment - the illumination of the reality behind appearances - is an inversion of surface and interior, an interchange between visible and invisible" (Keller 1992, p41). Where knowledge had been previously guarded, the culture of knowing was turned inside out so that the mysteries of the natural world became the territory of Science, where the role of the

scientist came to be the revelation of the secrets of nature. Keller argues that early knowledge of the natural world was perceived as an insight into the workings of God and therefore necessarily kept as secret; indeed conditional to knowing the workings of the divine construction was the preservation of those mysteries.

> *Arcana Dei* signalled forbidden knowledge, the hidden affairs or workings of God... To be allowed to share in God's secrets meant to be enclosed by the same protective veil. The knowledge acquired by those privileged few who *had* gained such access remained similarly (and properly) shrouded in secrecy. Once known secrets did not become open knowledge in our sense of the term: rather knowledge itself remained secret. (Keller 1992, p57, original emphasis).

It was within the turbulent period of the early Enlightenment that Copernicus, a canonised Catholic, wrote his treatise on a heliocentric universe, and the enormous conflicts he felt between the value of his science and his religious faith epitomise the antagonisms between the old and new. While for some "It seemed as though a new world was on the point of birth. All that was a strong and youthful and vigorous revolted against the past. Never, perhaps, have the social authorities so unanimously supported the intellectual movement" (Henri Pirenne, quoted in Banville 1976, p204), Copernicus' faith aligned him far more closely with the concept of *Arcana Dei*, and he feared the consequences on the peoples faith that his treatise might have, a fictionalised account puts it this way, "But very soon they [the people] will come to see what it is I have done, I mean what they will imagine I have done, diminished Earth, made of it merely another planet among planets, they will begin to despise the world, and something will die..." (Banville 1976, p207). His science was in direct contradiction to this faith and his extreme reluctance to publish, which only occurred in the year of his death, is exemplary of this.

Had Copernicus been working slightly later such a conflict might not have occurred, for just as the corporeal body had been separated from the realm of God as a means of preserving a faith in the divine construction of the world, an accordant move can be seen to have occurred in the realm of nature, what Keller describes as a "rhetorical shift in the locus of essential secrets from God to Nature" (Keller 1992, p56-57). This relocation of the mysteries of life in conjunction with the equation of knowledge with

truth and revelation meant that whereas "the idea of *Arcana Dei* invited privileged entrance into a veiled inner sanctum, the expression 'secrets of nature' came to be heard as an invitation to dissolving, or to ripping open, the veil of secrecy" (Keller 1992, p57).

As nature was freed from God, enquiring minds were at liberty to look for a key or an order to the world within the domain of nature. "The secrets of nature are no longer secrets, the intellectual boldness of scientists will put Nature's gifts at our feet" (Carlo Ginzburg quoted in Keller 1992, p58). Just as the challenge of the complexities of the interior body had been met by the internal voyagers with detailed measurement, description and depiction, the bold scientist's approach to the diversities of the natural world was one of recording, depicting and most importantly categorising, and in the emergence of a natural history, modern Science found its footing in classification.

Whereas the earlier conception of the universe and man as harmonious elements of a divine construction had necessarily demanded an interconnected way of understanding the world, in the Enlightened age categorical boundaries were drawn between various aspects of the world and commonalities or correspondences between categorisations were underplayed, as a means to finding a much sought after order. The development of this approach, Renee Heller argues, has resulted in science distancing itself from the big questions about the operations of the natural world, finding its role instead in attempting to understand increasingly specialised aspects.

> The methodological and sociological specialisation of science - beginning with the scientific revolution and refined in the nineteenth century with the professionalization of the sciences - led to the abandonment of broad and general questions about cosmic interrelatedness. Before the scientific revolution, cosmologists studied the tracks of the planets and stars not just for timekeeping. They also considered them as important conveyors of religious and symbolic meaning, and they speculated about the place of humanity in the cosmos. With the growth of specialised disciplines, these functions became separated. Metaphysical questions on 'the Whole became the other of science. This is an aspect of the reductionism of modern science. (Heller 199a6, p75).

Contemporary criticism of the reductionist tendencies of science must be countered by an understanding of why such contained methods developed, and also recognition of the vast progress in certain aspects of knowledge that this approach enabled. The anatomists had tried to find a system of fitting the interior of the body into a cosmic

explanation and failed, they had found themselves unable to answer a big question and instead focused on answering lots of much smaller questions, in this they could succeed. So when Alvin Toffler writing on the reemergence in the twentieth century of large questions into the arena of science, says:

> One of the most highly developed skills in contemporary Western civilization is dissection: the split-up of problems into their smallest possible components. We are good at it. So good, we often forget to put the pieces back together again. This skill is perhaps most finely honed in science. There we not only routinely break problems down to bite-sized chunks and mini-chunks, we then very often isolate each one from its environment by means of useful trick. We say *ceferis paribus* - all other things being equal. In this way we can ignore the complex interactions between our problem and the rest of the universe. (Toffler 1984, xi).

It must also be said that it is perhaps only possible to return now to the larger issues because the smaller ones have, at least partially, been resolved. To use Thomas Kuhn's analogy of a jigsaw puzzle (by which he describes the methods and rules of science), a sensible first step when you tip out the box and are faced with hundreds of jumbled pieces is to sort them out into different basic types: corners, edge, sky. Although this involves generalising, it is very difficult to solve the jigsaw, to start to put the picture together so to speak, until you have done so. However, there are other ways to go about solving a jigsaw and one of the problems with the processes of modern science, is, due to the privileged status it came to hold in relationship to truth, all other methods and ways of knowing were excised or invalidated

So, in the study of nature; different plants, animals, environments and people were organised into classified groupings and, unsurprisingly perhaps, in view of the vastness of the project, there came an homogenising of difference within each group, as Cuvier (1) says, classification is "the best means of covering the properties of beings by general laws" and these general laws were established by finding the dominant - or rather the most common characteristics: "The parts, properties or traits that conform with the greatest number of others, or, in other words, that have the most marked influence on the whole of the being, are called the *important characters*, the *dominant characters*; the others are called the *subordinate characters*, and there are degrees of each "

(1) Baron George Cuvier, 1769-1832, developed a system of classification for grouping of animals. based on his studies of skeletons and fossils. This system which grouped animals into four phyla was an advancement on the system of Linneaus.

(quoted in Ridley 1986, 104, original emphasis). In this system, which in the jigsaw analogy makes very good sense, the more rare or specialised a characteristic the lower it is in the classification system, the broader, more general characteristics are prioritised. In practice such a system when used, for example, in the classifications of people, required that individual characteristics within groups as well as commonalities between groups be overlooked as a means to asserting categorisation. The same can be said of cartography where, "The 'central bastions' of European mapping from the seventeenth century onward 'were measurement and standardization' (Harley 1989, p4/5). In both realms, idiosyncrasy, emotionality, physicality and specificity, are increasingly marginalized" (Kirby 1996, p53). There is almost a sense that the activity of categorisation was as important in itself, as a project, as was coming to an understanding of the natural world for which this order purported to make sense of.

This smoothing over of differences within groupings, the process of categorisation, can be seen as an expansion of the foundational metaphors of lights and dark themselves. As explained earlier, the metaphors of light and dark underpin modern Western thought, and the operations of the light and dark metaphor serves to assert a difference between that which is knowable and that which is not, at the same time as obscuring differences within these two categories; in exactly the same way as the examples of categorisation above. So the categorisation of the natural worlds, where the focus on broad and general differences between groups operates by homogenising difference within groups, can be seen as a development of the underlying metaphor of dark and light, which by grouping that which is knowable against that which is not, misleads us about the subtle and multiple ways in which it is possible to come to an understanding of our world, and tends to give a false confidence about that which is "known". "Irigaray calls the light of heliotropes the light of the Same... Difference, which can only be figured as an absence or invisibility, is ultimately reducible to an indiscriminate and overpowering light in which everything appears identical" (Vasseleu 1998, p7). Irigaray is speaking specifically about the concealment of maternal origin, the passage from the cave into light, which, she argues, is forgotten because "the fantasy which heliocentrism upholds is a masculine re-origination, or the appearance of giving birth to oneself" (Vasseleu 1998, p7), however her reading also illustrates that the obscuring

of subtleties in order to create differentiation between categories is a technique foundational to western philosophy, where all that is brought to light, to knowing, takes on a uniformity under the same blinding light.

The centrality of metaphor to the success of classical science as a system of thought will be expanded below, but it is clear that the power of this doctrine is itself inseparable from western philosophy which is also metaphorically based: "Derrida describes philosophy as a complex interplay of concept-metaphors which, far from being disposable or replaced by something more exact, are instruments that are inextricable from the field of philosophy which they constitute" (Vasseleu 1998, p5).

The metaphor of light has not remained static, it has developed in its relationship to dominant concepts of knowing and before examining the centrality of this language to a repression of corporeal knowing, it is worth offering a brief account of the development of the metaphor of light. The work of Evelyn Fox Keller, whose area of speciality is the role of language in science, is particularly pertinent here. Her analysis focuses on metaphor in a direct relationship to a hierarchy of the senses as defined by dominant modes of communication. In this way she makes the link between technologies of communication and metaphors for knowledge and the sensory body, connections which are so important in the discussion of contemporary shifts in knowledge systems.

Keller and Grontkowski use the work of Eric Havelock to suggest that the significance of light to Greek philosophy is directly associated with the culture of literacy that emerged in this period:

> [The] transition from an oral tradition to a literate culture in ancient Greece, occurring between Homer and Plato, [when] not only has 'the eye supplanted the ear as the chief organ' but that in the process a host of other changes was induced - changes from identification and engagement to individualisation and disengagement, from mimesis to analysis, from the concrete to the abstract, from mythos to logos. With the growing emphasis on the visual eye comes the growing development, even birth, Havelock argues, of the personal 'I'. (Keller and Grontkowski 1996, p188).

So in the earliest stages of an analysis of the relationship of light to Western philosophy, an alteration in media of communication is identified as a trigger for a

change, both to the language of knowledge and to the concept of the individual. The written word valorised the sense of vision whereas an oral tradition had valorised sound, and it is within a visual culture that light becomes a metaphor for knowledge. "All three components of the visual system - eye, the sun, and light - are used by Plato, both metaphorically and directly, to establish the characteristics of intelligibility" (Keller and Grontkowski 1996, p189). So in the literate culture of Greek philosophy these metaphors are established in a connection with knowledge and truth:

> ...visibility represents the ultimate certainty of a reality that must be confirmed visually. Seeing light is a metaphor for seeing the invisible in the visible, or seeing things in an intelligible form that holds all that exists together but is itself devoid of sensible qualities. By means of this metaphor Plato implies a natural relation between existence and truth...Rather than being a component of visibility, light has an originality of its own; it dawns with the appearance of things or the beings that come to light. (Vasseleu 1997, p3-4).

In the Enlightenment, with the (re)-appearance of a rational, thinking individual within a culture of discovery, an expansion of the Greek analysis of light and knowledge occurs. Although light is still the medium by which truth is revealed, the Enlightenment individual has an active part to play in this process, there comes the belief that things, rather than being revealed by the dawning of light, must be brought to light from darkness:

> Man no longer finds accommodation for himself in the light, or the fixed structure of an objectively perceived world; he himself becomes an emanative force. In modern Enlightenment thought light is a realization of man's own nature that he brings into being in his transformation of the world. (Vasseleu 1997, p4).

It becomes the role of the Enlightenment individual to expose that which was previously invisible, he has the authority to reveal that which was unknown: "Light is associated with the imperialist cultural aspirations of 'white man', or the man of metaphysical enlightenment for whom all that falls beyond logos is the indeterminate darkness that must be overcome and brought to the truth of common (sun)light" (Vasseleu 1997, p6).

A further development, again in articulation with a developing idea of the modern subject, can be identified in the philosophy of Descartes. By this time the metaphor of light is so embedded within the language that is almost forgotten to be metaphorical: "these connections between light and knowledge were so much part of the intellectual fabric that Descartes scarcely had to acknowledge his debt to Platonism in any of its

forms" (Keller and Grontkowski 1996, p192). Light and vision in Descartes are fused with an increasingly mechanised understanding of the operations of the world:

> As light and vision become more explicitly technical, physical phenomena, the eye itself a more mechanical device, the active knower is forced ever more sharply out of the bodily realm. The subject becomes finally severed from the objects of perception. With the move, the knowing agent has lost its last links to the percipient organism whose sense organs can now be relegated safely to the 'purely material' . Having made the eye purely passive, all intellectual activity is reserved to the'I', which, however, is radically separate from the body which houses it. (Keller, Grontkowski, 1996, p194).

In this way light and vision, the noble sense, becomes further associated with rational objective knowledge and the mind, and further distanced from the corporeal experience of the world. Keller and Grontkowski argue that vision is separable from bodily existence, that it can be conceived of beyond the body, where other senses can not, "We can imagine a disembodied mind having visual experiences but not tactile ones. Sight does not require our being part of the material world in the way in which feeling by touching does." (Vesey cited in Keller and Grontkowski 1996, p2000). Descartes work on optics, Keller and Grontkowski say, led, via a crisis to the absolute separation of a knowing mind from a physical body:

> Descartes' inquiries into the nature of vision an optics were of paramount importance in the Western acceptance of the copy theory of perception. He, perhaps more than any other Western thinker was responsible for laying the emission theory to rest, with the result that the eye was henceforth regarded as a purely passive lens which simply receives the images projected from without. The consequence of this shift for our theories of knowledge were critical... Either we accept the conclusion that knowledge itself if passive, or we abandon the visual metaphor,,, Descartes... Enabled us to retain *both* the conception of knowledge as active and the use of the visual metaphor by severing the "seeing" of the intellect and physical seeing - by severing finally, the mind from the body. (Keller and Grontkowski 1996, p192, original emphasis).

The association of light and vision with rational knowledge then has served to separate knowledge from corporeality, and the ways of knowing that come from sensory experience of living in the world, have come to be discredited as irrational and non-objective, when in fact, as will be shown, the objective truth claims of science have been achieved largely metaphorically, and sustained by the denial of that metaphorical foundation.

As discussed in the contemporary context, although vision is undoubtedly the primatised sense, it may be that associations of light and vision with truth require revision for,

> In a time when physics has once again altered our conception of vision and light, when we know that neither the apparent atemporality not the 'dynamic neutrality' of vision are features of reality, but only of our relatively coarse daily observations it seems appropriate to reassess our commitment to the ideal which these features imply. (Keller, Grontkowski 1996, p200).

Such a reassessment will also demand a reassessment of the validity of sensory, bodily ways of knowing. Not only has contemporary science altered our concepts of stability, location and objectivity, but also, in a world of computerised graphics and virtual technology, we are all aware that seeing is not always believing, so the equation of vision with truth is necessarily questioned. Hans Jonas, again cited in Keller and Grontkowski, argues that vision has a "distinctively spatial rather than temporal character.. a property uniquely responsible for our capacity to grasp the 'extended now'." (Keller and Grontkowski 1996, p197), which ideally locates the qualities of vision, within the framed spatial world of classical science.

Seeing at a distance implies, according to Jonas, an objectivity not available to the other senses, an apparent neutrality: "I have nothing to do but to look, and the object is not affected by that... and I am not affected" (Keller, Grontkowski 1996, p198). However Jonas sees this objective detachment as illusory, "At the same time, however, it is precisely by virtue of its causal detachment that sight is the 'least "realistic" of the senses,' and Jonas departs radically from Plato in concluding that when the 'underlying strata of experience, notably motility and touch' are rejected, 'sight' becomes barren to truth'." (Keller and Grontkowski 1996, p198).

The strength of the association of light with knowledge is then clear, and, as explained in the previous chapter, in the processes of exploring and explaining the "new" world and the interior of the body, this metaphorical foundation developed in interaction with a new concept of subjectivity to describe a knowing subject who was white, western and male and all those who were not white, western or male, were consigned to the dark and unknowing side of the equation. In the era of classification, where the criteria for classification are only same or different, this binary approach was extended

to encompass all observations of the natural worlds. Inherent to this framework was the exclusion of sensory, physical experience from the realm of truth.

The extension of this framework is the extension of the dark/light metaphor to all aspects of language, and by the seventeenth century a binarisation of language is completed; "the rhetorical shift in the locus of essential secrets from God to Nature" which allowed man to embark on a scientific journey of discovery, "Over time, the metaphorical import of this shift is momentous" (Keller 1992, p56/7). Evelyn Fox Keller explains that

> ...along with the change in meaning for the terms God and Nature went a simultaneous change of meaning for the terms man and woman. The very construction, 'secrets of nature', called forth a metaphoric convergence between women, life and nature that bound these terms together in a new way, and in so doing, contributed to changes in all their meanings. (Keller 1992, p59).

This categorical structuring of knowledge and the associated metaphorical process finally established the association of science with truth (and light), indeed as Nancy Leys Stepan goes so far as to "suggest that the metaphors functioned as the science itself - that without them science did not exist. In short, metaphors and analogies can be constituent elements of science." This metaphorical basis was successfully obscured so that "metaphor became associated with the imagination, poetic fancy, subjective figures and even untruthfulness and was contrasted with truthful, unadorned, objective knowledge - that is, with science itself' (Stepan 1996, p121).

Foucault asserts that in the seventeenth century "the written word ceases to be included among the signs and forms of truth... It is the task of words to translate the truth if they can: but they no longer have the fight to be considered the mark of it" (Foucault 1989, p56). Foucault argues that prior to the seventeenth century, Natural History, as it is now known, was a holistic discipline, where hearsay, myth, observation, uses of a plant or animal and so on, together constituted a knowledge. However as classification established itself as a method for understanding nature, these various ways of knowing a plant or creature were separated out and signs became signs *about* a plant or creature rather than an intrinsic part of plant or creature itself. In Foucault's words:

> History was the inextricable and completely unitary fabric of all that was visible of things and of the signs that had been discovered or lodged in them... The division, so evident to us, between what we see, what others have observed and handed down, and what others imagine or naively believe, the great tripartition, but for the much more precise and much more constraining reason that signs were then part of the things themselves, whereas in the seventeenth century they became modes of representation. (Foucault 1989, p129).

So it can be seen that language, and particularly the use of metaphor, is implicit in this fragmentation of meanings and that this period can be identified as the point from which symbolic language became operational within a purely dichotomous exchange. In finding a new language for a new world, other ways of understanding were invalidated, this process was to be consolidated in the alignment of science with "truth".

It is only in the twentieth century that this alignment of science with objectivity and truth has been called into question. The sense of loss, which characterises aspects of much twentieth century theory, and from which postmodernism has flourished, can be identified with this separation of language, into oppositions and away from the body. The work of Freud precedes anti-Enlightenment discourse and, in many ways, he anticipates it with his identification of the suppression of instinct by the constraints of culture as the source of "man's" neurosis. Yet Freudian psychoanalysis also succeeds in establishing a further dichotomy, between the conscious and the unconscious and in this sense can be seen as the most significant contemporary expansion of the dark and light dichotomy. Psychoanalysis finds it ground precisely in the split of consciousness from the unconscious, the dissociated psychoanalytical identity, and can be seen as the culmination of the split between man and woman, god and nature, self and other that was completed in the Scientific Revolution. This fission between self and other is embedded in the split Cartesian subject, but now the self, already separated from the corporeal world, is itself split; in the process of the development of the ego, in the defence and protection of the interior self, a separation is wrought between self and world (Freud 1930).

An in depth analysis of the difficulties with psychoanalysis are beyond the remit of this project, the relevance here is that subsequent readers of Freud, particularly what might be called the "French Feminists" (Cixous, Irigaray), have attempted to rescue language

from the oppositional discourse of Western philosophy, understanding this as the route to a reconnection with the body particularly, but also with forgotten ways of knowing. The writing of Helene Cixous is interesting because of her focus on language and metaphor, she "notes the generalized loss of the world resulting from the constrictive practice of language, from which she excludes herself" (Conley 1993, p79). Cixous hopes to reclaim "a natural language" through writing that turns oppositions into differences: "Presently in the Occident..., differences are turned by reigning ideologies into oppositions and hierarchies. These she sets out to expose and undo through a medium that privileges writing 'as' metaphor and 'more than' metaphor since it replaces nothing"(Conley 1997, p125). By so doing she aims to retrieve a non-oppositional language.

Focusing, like Irigaray, on the suppression of the maternal in the restrictions of this language, Cixous understands the body to be lost along with "natural" language. In her examination of Freudian psychoanalysis, Cixous sees "The masculine subject asserts himself through negation of the other. He spirals towards the spirit and leaves the body (that is, nature) behind. The world of 'natural' language, closer to body and affect, is lost. From there on, a phallocentric, martial culture puts everything under the sign of grammar and repression..." (Conley 1997, p125). Cixous hopes to resist this linguistic repression by a writing that disrupts the oppositional, this approach is informed by an understanding of technology as contributing to the separation of language from the body:

> Cixous proposes another type of knowing, an active condition, where the division between body and intellect (language) and between nature and culture are not clearly drawn. The separation between subject and object - here the maternal body and nature - hinges on language. Historically, this loss, beginning with the advent of modern science, is fancied to come about with writing and the printing press, with the shift that communication depended on voice and the body to mental abstraction involved with decipherment of symbolic characters. (Conley 1997, p126).

Again the printing press is cited as instrumental in changing understandings of the body. In the second chapter the spatiality of the printing press was closely aligned with new concepts of the spatiality of the body and location of the subject, Cixous understands it as contributing to the dislocation of the body from language. The body is displaced by the word, and at the same time, in Foucault's analysis, the word is

separated from meaning. A key aspect to this project is an examination of the connections between technologies of communication, or the mediums of language, and subject location and corporeal experience. A recognition of the key nature of printing technology in the dispersal of the language of the Enlightenment, with the associated separation of corporeality from knowing, supports the relevance of reading new communication technologies as facilitating of new subjectivities and understandings of corporeality. Indeed, the virtual world, which has been opened up by contemporary technology, encourages the imaginary element and facilitates new realms of imagination, aspects of expression which Cixous sees as restricted by technology.

Conley takes a critical view of Cixous' belief that she can exempt herself from inclusion within this repressive language, but is particularly critical of her antitechnological standpoint,

> By refusing to deal with technology in terms other than the process of 'writing' or 'representation', she wilfully decides not to look at many of the interconnections of the contemporary world... For feminists, like Cixous, the world of things, or nature, is lost through symbolic language and grammar. To let things speak, we have to recourse to presymbolic language. (Conley 1993, p80)

Cixous' route back to the body by a return to a presymbolic language is, it is argued here, not possible. Rather, new metaphors and frameworks, facilitated by technology, may actually permit a new expression of the body, one in which the oppositions, understood by Cixous and others, as so damaging, may be superseded or lose relevance. As mentioned in the first chapter, Sadie Plant (1996) says even Irigaray could not envisage a route out of the restrictions of language but that in the development of technology a language is forming in which the interconnections of the contemporary world can be expressed.

An indication of the conceptual distance that has been travelled from the pre-modern to the postmodern era and the transformations in language intrinsic to this process, can be found in the work of Benedict Anderson. Anderson analyses Sacred languages and the essential part they played in religious and dynastic communities. The cultural gap that he evokes illustrates the impossibility of a return to a presymbolic language. Anderson identifies the decline of these Sacred languages with the onset of commercial printing, the effect of which was the decline of religious and dynastic community and

the beginning of national identity (Anderson 1991). He locates a pure written language, unmediated, non-referential, where each symbol represents one thing, that has a purity of meaning. This is the clean unambiguous language which deconstructive theory aims to but can never know.

> ...written Arabic functioned like Chinese characters to create a community out of signs, not sounds (...) All the great Classical communities conceived of themselves as cosmically central, through the medium of a sacred language linked to a superterrestial order of power... (In fact the deader the written language - the farther it was from speech - the better: in principle everyone has access to a pure world of... signs). (Anderson 1991, p20).

For Anderson it is the rise of global communication, starting with commercial printing that has driven a "harsh wedge between cosmology and history" (Anderson 1991, 40). Communication trades in language, is the mediator of signs, so as communication increased, particularly between cultures, the exchange of signs takes on its own momentum, removing them further and further from their original simplicity of meaning:

> if the sacred silent languages were the media through which the great global communities of the past were imagined, the reality of such apparitions depended on an idea largely foreign to the contemporary Western mind: the non-arbitrariness of signs. The ideograms of Chinese, Latin, or Arabic were emanations of reality, not randomly fabricated representations of it... Until quite recently, the Qur'an was literally untranslatable (...) Because Allah's truth was accessible only through the unsubstitutable true signs of written Arabic. (Anderson 1991, p21).

This must of course be understood alongside the increased speed with which this new way of "thinking the world" could be disseminated once technology had enabled print capitalism. Prior to the advent of print capitalism the individual concerns of the scientist were not easily communicated in a wider arena, so, for example, growing evidence of inaccuracies in Ptolemaic's astronomical theories took centuries to be consensually recognised: "Because the astronomical tradition was repeatedly interrupted from the outside and because, in the absence of printing, communication between astronomers was restricted, these difficulties were only slowly recognised" (Kuhn 1970, p68-69).

Such a leap in comprehension that is necessary to imagine a non-exchangeable symbolic language, a truth language, is required to comprehend the universal shift in thinking that occurred in these periods. Anderson is careful to point out that the decline of religious community and the assent of nationalism happened within a climate that was ready, for, conducive to this change. He sees the explorations of the "new" world and the cultural and geographic expansion that these incurred, as the first to effect shifts in thinking. He says, "Beneath the decline of sacred communities, languages and lineages, a fundamental change was taking place in modes of apprehending the world, which more than anything else, made it possible to 'think' the nation" (Anderson 1983, p28). This receptivity, readiness for change, can be seen thoughout all religious, political, philosophical and scientific developments in the West. In concentrating on language, the socio-economic forces and their effects upon the individual's notion of self, of community and of location, the changes that interest Anderson, have been sidelined. These forces are examined in the first chapter in relationship with the current effects of global forces and technology on senses of location and identity.

In any revolutionary process something is gained as something is lost, and it seems that in this case the significant alterations are primarily linguistic, to do with having adequate language to describe the world and the feeling of being in the world. As a useful new tool for understanding the world, science categorised the natural world and in doing so, interconnected, corporeal, "unscientific" understandings were invalidated, precisely because science held a relationship to reason and 'truth'.(2)

As we can see from Stepan the relationship of science to truth was achieved metaphorically, linguistically, and the inadequacy of this language to explain our contemporary experience of the world serves to reveal the limitations of classical scientific discourse. It has been shown that new metaphors, new models for description and new forms of language are being tried for size: the body as an interface is an example of a dominant metaphor for theoretical interpretations of the self's

(2) It must be said that although scientific discourse dominates this period there are examples of discourses that are resistant to an over emphasis on reason and mechanisation, the poetry and writing of the Romantics would be an example, or the work of William Blake (1757-1827), another.

interaction with culture via the body - precisely because it uses a contemporary model of thinking. If we look at the new languages, for example, e-mail, text messaging, the language of asian/british/carribean/african people in the cities - the characteristic and appeal of, the *relevance* of these languages lies in their constantly evolving, cross-cultural nature. In these languages the overlaying of one meaning with another is intrinsic and explicit. The appeal and relevance of the language of natural history, classification through the markation of difference, was that it placed an order upon an unruly proliferation of new information, and the particular use of metaphor served to define and validate a new system of knowing in a turbulent world.

Before proceeding to look at the discoveries of the twentieth century and beyond, where it is possible to identify, not a return to, but an emergence of theories and approaches that might indicate a renewal of certain aspects of the world, the following section will look at the power and authority of classical science, its systems and language.

3.3 CLASSICAL SCIENCE

The reliance of the development of Natural History on categorisation and a splitting of language has been illustrated, in the late seventeenth century Newton's laws of motion and of gravity were accepted as a real model of the way the universe worked and classical science was born. Thomas Kuhn argues that prior to Newton there were competing schools of thought, where there were no commonly accepted theories and so no basis form which to work, but rather a variety of explanations with no consensual basis. According to Kuhn, there have been "successive transition[s] from one paradigm to another via revolution" (Kuhn 1962, p12) where a paradigm is defined as a theory or group of theories that is accepted as a factual basis by the scientific community. Kuhn says that without paradigm there is no science, here it is suggested rather that without paradigms, there is no classical science.

The period in which Newton's laws of motion and gravity, which showed the world to be constant and predictable, were accepted as a basis for scientific endeavour, is identifiable as the time at which one way of knowing the world was finally rejected in favour of another. This altered world view was not because of science, nor is science the only manifestation of this altered perspective, but the power of science to speak of this altered world and the privileged relationship to truth that it came to hold means that classical science is representative of the modern approach to knowledge. The appropriateness of science to speak for a mechanised culture, Alvin Toffler argues, is a large part of the reason that Newton's theories were taken up so readily, for they were based in a world where "initial conditions that were at least in principle, determinable with precision. It was a world in which chance played no part, in which all the pieces came together like cogs in a cosmic machine" (Toffler 1984, xii). Science, in part, succeeded because it corresponded with dominant understandings of the way the world should be expected to operate, in this case the machine, it also entered the arena at a time when religion had lost the authority to speak of all aspects of the world. Toffler places the acceptance of Newton's laws firmly within a particular socio-economic climate:

> The Newtonian system arose at a time when feudalism in Western Europe was crumbling - when the social system was, so to speak, far from equilibrium. The model of the universe proposed by the classical scientists (even if partially derivative) was applied analogously to new fields and disseminated successfully, not just because of scientific power or 'rightness', but also because an emergent industrial society based on revolutionary principles provided a particularly receptive environment for it... It still makes sense to me to regard the Newtonian knowledge system as, itself, a 'cultural dissipative structure' born of social fluctuation. (Toffler 1984, xxv/xxvi).

For the first time a set of laws were agreed upon as the basis for scientific endeavour, Newton presented theories with associated laws and methods of application, and the scientific community agreed with him - this is what Kuhn calls a paradigm. According to Kuhn it is the consensual paradigm that distinguishes science from other disciplines, and science achieves a high status largely due to the relationship to truth that the consensual paradigm would seem to achieve and, Kuhn argues, due to "the detailed, esoteric" work that an established foundation allows. Paradigms will succeed, as Newton's did, because they are "sufficiently unprecedented to attract an enduring group of adherents away from competing modes of scientific activity. Simultaneously [they are] sufficiently open-ended to leave all sorts of problems for the redefined group of practitioners to resolve" (Kuhn 1962, p10). This is the arena of what Kuhn calls "normal science", research based on an accepted paradigm where the role of the scientist is to illustrate the paradigm in more detail, or with increased accuracy or in new applications. Normal science is not looking for the unexpected but rather aiming to achieve a result already defined by the paradigm. So normal science is the "mopping up" of a paradigm, "No part of the aim of normal science is to call forth new sorts of phenomena.... Nor do scientists normally aim to invent new theories... Instead normal scientific research is directed to the articulation of those phenomena and theories that the paradigm already supplies" (Kuhn 1962, p23). Kuhn equates normal science with a jigsaw puzzle, there are rules that must be followed and there is a set outcome, an assumed solution. The aim is to meet the prediction based on the paradigm by following the rules pertaining to the paradigm, or to develop new equipment to allow even better fitting results. The problem, although Kuhn tends to see this as a characteristic rather than a problem, with this sort of scientific activity is that, if an ill-fitting piece appears it will often be discarded as wrong: the choice is

either this or to reject the puzzle - the paradigm - as wrong. So ill-fitting research will be perceived as a failure on the part of the scientist rather than the paradigm itself.

So "normal science" is research founded on established paradigms, indeed Kuhn goes so far as to say that "There is no such thing as research in the absence of any paradigms" and that "To reject a paradigm without simultaneously substituting another is to reject science itself" (Kuhn 1962, p79).

However the historian of science knows that there have been revolutions, processes by which a paradigm is replaced by another. Such a process and the activities around such a process is what Kuhn calls "extraordinary science". In the processes of "normal science", anomalies or inconsistencies may be dismissed or put aside in the belief that improved methods of application will show a way to fit these pieces into the puzzle, so far as possible inconsistencies will be accommodated. However if an anomaly has persisted and is generally recognised as problematic, increasing attention will be paid to it by increasingly eminent scientists and "many of them may come to view its resolution as *the* subject matter of their discipline" (Kuhn 1962, p83, original emphasis). With increased attention and varied attempts to accommodate anomaly, "A proliferation of versions of a theory" will abound which "is a very usual symptom of a crisis" (Kuhn 1962, p70). "Through this proliferation of divergent articulations (...), the rules of normal science become increasingly blurred. Though there is still a paradigm, few practitioners prove to be entirely agreed about what it is..." (Kuhn 1962, p83). So, if there are persistent unresolved anomalies, and many minor alterations are made to a paradigm the rules for "normal research" are "loosened". Kuhn identifies three possible outcomes of such a situation, where either:

> ...normal science ultimately proves able to handle the crisis-provoking problem despite the despair of those who have seen it as the end of an existing paradigm. On other occasions the problem resists even apparently radical new approaches. Then scientists may concluded that no solution will be forthcoming in the present state of their field. The problem is labelled and set aside for a future generation with more developed tools. Or... a crisis may end with the emergence of a new candidate for a paradigm and with the ensuing battle for its acceptance. (Kuhn 1962, p83).

Now, there will be a period of overlap between the old and new paradigms where some problems are resolved by each but once the transition is complete there will be a

whole new framework within which to handle date, what Kuhn calls "picking up the other end of the stick" (Kuhn 1962, p8). Paradigm shifts such as this offer a whole new way of viewing the world, a new perspective from which there is no going back, indeed "... the historian of science may be tempted to exclaim that when paradigms change, the world itself changes with them" (Kuhn 1962, p111). In this extraordinary process, in the early stages of which scientists are almost randomly searching, making speculation and trying them out, philosophy has a role and a debate over fundamentals once again occurs, whereas in the activity of "normal science" such questions are off limits. Kuhn argues that it is often the young or those new to a field, those with a different perspective, who will identify anomaly as counter instance and be instrumental in initiating a period of "extraordinary science".

The processes of "extraordinary science" expose the truth claims of science and, as Kuhn concurs, reveal the subjectivity of the scientist. However, the processes of "normal science" serve to obscure these realisations primarily through the revisionist nature of text books. For, once a new paradigm is accepted, science resumes normal activity and central to this process is the rewriting of textbooks. With the acceptance of a paradigm the role of the scientist is not to reassert the basis laws but to substantiate these laws in further detail or new applications, the job of explaining the paradigm, its basic rules and methods, to the student or layman, falls to the textbook. So after a paradigm shift the textbooks need to be rewritten and in this process textbooks "inevitably disguise not only the role but the very existence of the revolutions that produced them. Textbooks then begin by truncating the scientist's sense of his discipline's history and then proceed to supply a substitute for what they have eliminated" (Kuhn 1962, p137). It is by this process, which is made possible by the technologies of print capitalism, that science appears as cumulative, revolutions are rendered invisible and it is not made clear that the questions of today are not the same as the questions of yesterday. In this way science is presented as a linear progression toward truth and the subjective element is underplayed, and importantly, by not dwelling on those previous paradigms that were once accepted as fact - as science - but have since been proved wrong, normal science validates its relationship to "fact" or "truth".

Kuhn's analysis is interesting on many levels and, if accepted, lays out conditions by which to identify periods of crisis - a profusion of different theories, the asking of bigger, philosophical questions - which could prove useful in showing the contemporary period to be one that has entered revolution, yet his analysis is also open to criticism. A critical take on Kuhn, rather than restricting the impact of his theory, actually allows a good insight into what Newtonian or classical science represented and aimed to achieve. For when Kuhn says that without the consensual paradigm there is no science, he shows himself to be speaking of only one aspect of scientific activity, it is suggested here that when Kuhn says science, he actually means classical science, a closed, introspective science that is not characteristic either of scientific activity before Newton, or perhaps typical of all aspects of contemporary science.

So although Kuhn is critical, as a historian of science, of the revisionary nature of textbooks, and while he recognises the conservative nature of "normal science" where "Perhaps the most striking feature of the normal research problems... is how little they aim to produce major novelties" (Kuhn 1962, p35). He is able to accept such a situation because he views it as enabling of "progress". He understands the crises that develop out of "normal science" as bringing about a progressive revolutionary change internally, he does not see such changes as being part of a larger cultural or social picture but as intrinsic to the nature of "normal" scientific activity. While agreeing that external factors may affect the timing of the acceptance of a paradigm shift he does not view these as causal influences. In his opinion it is the very removal of the researcher from the distractions of the outside world that allows him or her success. Kuhn's perspective is firmly sited within traditional science, for example, by not expanding on the cultural environment within which Newton's theories were taken up as science, he is, it could be argued taking a very classically scientific view of what science is.

A useful aspect of Kuhn's analysis, is the idea that accordant with a paradigm shift is an irreversible change in the way the world is viewed, however his reluctance to expand on the cultural and social influences upon science rather limits the depth of this insight. Is it not more likely that the reason a paradigm shift occurs is because the world itself is changing, or is ready for change? He views this as a unidirectional shift: science changes the world view, rather than an interaction: science operates as part of

the world view. In a contemporary context but in direct criticism of Kuhn, Prigogine and Stengers ask:

> how can we consider as accidental that the rediscovery of time in physics is occurring at a time of extreme acceleration in human history? Cultural context cannot be the complete answer, but it cannot be denied either. We have to incorporate the complex relations between 'internal' and 'external' determinations of the production of scientific concepts. (Prigogine and Stengers 1984, p309).

They would agree that the science Kuhn speaks of as if it were all science, is only an aspect of what science is:

> Scientific activity best corresponds to Kuhn's view when it is considered in the context of the contemporary university, in which research and the training of future researchers is combined. Kuhn's analysis, if it is taken as a description of science in general, leading to conclusions about what knowledge must be, can be reduced to a new psychosocial version of the positivist conception of scientific development, namely, the tendency to increasing specialization and compartmentalization: the identification of 'normal' scientific behaviour with that of the 'serious', 'silent' researcher who wastes no time on 'general' questions about the overall significance of his research but sticks to specialized problems: and the essential independence of scientific developments from cultural, economic, and social problems. (Prigogine and Stengers 1984, p307).

Prigogine and Stengers disagree with Kuhn's assertion that the driving force of science is its conservative nature, rather than seeing scientific transformation as a crisis, after which, once a new language has been found, science settles back down to unquestioning acceptance of paradigms, they choose to focus on the continuities, these may not be immediately apparent, but although hidden, still continuities. Kuhn explains the fact that a discovery will often be made by a number of scientists at the same time as a tribute to the effectiveness of science as an evolutionary system: "The very fact that a significant scientific novelty so often emerges simultaneously from several laboratories is an index both to the strongly traditional nature of normal science and to the completeness with which that traditional pursuit prepares the way for its own change" (Kuhn 1962, p65). He fails to address the fact that scientists work as part of a social, cultural and economic environment which affects the questions they ask.

In relation to Kuhn's analysis, three interpretations of contemporary science can be made. When Prigogine and Stengers assert:

> The past one hundred years have been marked by several crises that correspond closely to the description given by Kuhn - none of which were sought by scientists. Examples are the discovery of the instability of elementary particles, or of the

> evolving universe. However, the recent history of science is also characterized by a series of problems that are the consequences of deliberate and lucid questions asked by scientists who knew that the questions had both scientific and philosophical aspects. Thus scientists are not *doomed* to behave like 'hypnon'! (Prigogine and Stengers 1984, p309, original emphasis).

This might mean, as above, that Kuhn's analysis is applicable only to certain aspects of scientific activity, particularly teaching, or it might mean, as already suggested, that the sort of science that Kuhn speaks of is classical science and that contemporary science in some way differs to this - has changed, or it might mean that Kuhn's analysis is entirely correct but that we are in a period of "extraordinary science" where scientists are asking questions, philosophical questions and looking at the larger picture.

Prigogine and Stengers assert that Newtonian models are still useful and important but they are usefully applicable to closed systems where chance does not have a role; "traditional science in the Age of the Machine tended to emphasise stability, order, uniformity and equilibrium", their book aims to show "how the still valid, though much limited claims of Newtonianism might fit compatibly into a larger scientific image of reality. It argues that the old 'universal' laws are not universal at all, but apply only to local regions of reality. And these happen to be the regions to which science has devoted the most effort" (Toffler 1984, xiv). It is argued here that such an analysis is also applicable to Kuhn's interpretation of the operations of science; that it is useful in thinking about aspects of scientific activity, but that it is grounded within a traditional idea of science, and that contemporary science in some way differs to this. Indeed, Stephen Hawking says that a classical theory is one that "does not take account of the uncertainty principle of quantum mechanics..." (Hawking 1988, p60-61) showing contemporary science to have a different theoretical basis to that of classical science, and Kuhn himself does not take account of the uncertainty principle.

Another theme of Kuhn's work which is compatible with the philosophy of classical science, is that of the scientist as operating most successfully when removed from the distractions of the everyday world. Since Plato there has been the idea that emotions are a hindrance to knowing, and this certainly would concur with Kuhn's idea, for although he understands the subjectivity of the scientist, indeed offers an insight into

this, he regrets the futility of returning to a "realm in which experience is again stable for once and for all" (Kuhn 1962, p125):

> But is sensory experience fixed and neutral?... The epistemological viewpoint that has most often guided Western Philosophy for three centuries dictates an immediate an equivocal, Yes! In the absence of a developed alternative, I find it impossible to relinquish entirely this viewpoint. Yet it is no longer functions effectively, and theattempts to make it do so through the introduction of a neutral language of observations now seem to me to be hopeless. (Kuhn 1962, p125).

Kuhn explains that paradigms define the way the world is perceived, it seems as well as the various paradigms that operate as science, there are laws and methods that pertain to science as a discipline. One of the tenets ofclassical science is a belief in scientific objectivity as diametrically opposed to the non-rational and the subjective - that which is not science. The recognition of the subjective nature of science and the appearance of brilliant science form Einstein, who "put the observer back in the system " (Toffler 1984, xiv) has somewhat altered this situation. The laws of classical science are based on the constancy of time; "With the rise of modernity time faced another split; between historical time and scientific time. With the development of precise clocks, time became a scientific concept which could be defined independent of the stars and planets. Newton's mechanistic, linear, context-independent concept of time became the foundation of all science until Einstein's theory of relativity in a way restored the mystical conception of the continuity between space and time" (Heller 1996, p79).

It is then possible to identify a distinction between the underlying themes of classical science, primarily constancy and stability, and the basics of twentieth century science, where largely due to Einstein the world has come to viewed as fundamentally unpredictable and changing, and central to this is the concept of time as relative and as non-reversible.

> The quest of classical science is in itself an illustration of the dichotomy that runs throughout the history of Western thought. Only the immutable world of ideas was traditionally recognized as 'illuminated by the sun of the intelligible' to use Plato's expression. In the same sense, only eternal laws were seen to express scientific rationality. Temporality was looked down upon as an illusion.. This is no longer true today... We find ourselves in a world in which reversibility and determinism apply only to limiting, simple causes, while irreversibility and randomness are the rules. (Prigogone and Stengers 1984 p7-8).

4.4 CONCLUSION.

This chapter has shown the ways in which spatial tools and methods have been employed to describe a newly spatial world. In this process the body has been displaced by the word and truth and knowledge have become associated with vision and objectivity. These can be understood as an expansion of the practices that were outlined in Chapter Two as emerging in the period of the Enlightenment, a period of spatial transformation.

The subject of this project is the body, the corporeal sensual living here and now body, however this chapter has been primarily about language and has aimed to illustrate the dominance language has come to have in our expression and understanding of the corporeal body, we have no recourse to an alternative explanation, which is why the limits of language in terms of its models and words, are so definitive of the limits within which we can articulate experience. Although Freud talks of a residual 'Oceanic' feeling (Freud 1957), and Cixous claims to remember/know an experience prior to the restrictions of language, the terms within which any such experience can be articulated is once again delimited by contemporary language, it turns out that the future has provided a technology in which these ways of knowing the world are at home. It is suggested here that a more promising route to expression of corporeal experience can be found by looking at the new models and metaphors shown to us by new science and technologies, this will be one of the aims of the following two chapters. However, science and technology not only offer new models, it will also be shown that they are instrumental in changing our knowledge of space and time and our experience of space and time. So as well as offering the possibility of a new language to describe our corporeal experience, science and technology also facilitates a new spatial and temporal experience which requires description and articulation.

CHAPTER FOUR.

TWENTIETH CENTURY SCIENCE.

> I remember someone at one of our parties talking about partical/wave duality. After a while Jakob said: 'Perhaps it's just that when light is up against the wall it's forced to choose.' Everyone laughed, listen to the layman talk about physics! But I knew what Jakob meant... Then Jakob said; 'Perhaps the electron is neither particle or wave but something else instead, much less simple - a dissonance - like grief ...'. (Michaels 1998, p211).

4.1 INTRODUCTION.

The last chapter took a route through language and metaphor to illustrate the power of scientific discourse on understandings of the body; this section will develop some of those ideas by showing that new science demands new models for imagining the world. It will also reintroduce the dominant theme of the second chapter, that a period of transformation in systems of knowledge can be triggered by spatial and temporal alterations. Contemporary science will be shown to be significantly different from classical science, and an essential feature of this distinction will be seen to be an altered conception of space and time. Showing the contemporary period to be defined by altered parameters of space and time is a primary indication that we have again entered a period of intense transformation, and it is suggested that alterations to understandings of the body will be intrinsic to this.

A fundamental shift in science, would itself be evidence of new input into our system of knowledge but also contemporary models of science are shown to require a new level of imagination in order to be believed or understood; they cannot be visually confirmed like the models of classical science. It has been demonstrated that the visual association with knowledge contributed to the severance of body and mind which was completed by Cartesian philosophy (see p66); how might an altered sensory definition of knowledge impact understandings of body and mind? Oral culture is

suited to an understanding of time as process, visual culture describes an extended now and makes a claim to atemporality and so objectivity. (Keller and Grontkowski 1996, p200) Twentieth century science however is revealing to us new spatial and temporal perspectives which appear to require more imaginative/conceptual tools for explanation. As Stephen Hawking says: "It is impossible to imagine a four-dimensional space. I personally find it hard enough to visualize a three-dimensional space!" (Hawking 1988, p24). Similarly, attempting to imagine quantum activity or wave particle duality or the expanse of the universe demands that you suspend belief and actually try *not* to visualize the concept. Twentieth century science tells us that things operate differently at a very small or large scale so, from a human perspective, which falls in the middle between the smallest and the largest - both in terms of our size and in terms of the age of humanity - these phenomenon cannot be viewed. Instead we rely increasingly on analogies, partial analogies; because we can not fully imagine, for example, quantum activity - there is nothing like it that we can see with our eyes - we can only say that aspects of quantum phenomena might, sometimes, be comparable to a model we already have.

> Everything in science is about models and predictions, about finding ways to get a picture in your head about how the universe works,... The further we get from the ordinary world of everyday life, whether towards the very small scale or towards the very large scale, the more we have to rely on analogies: an atom is, under certain circumstances, 'like' a billiard ball; a black hole is, in some sense, 'like' a dent in a trampoline. (Gribbin 1998, p7).

In this sense understandings of contemporary science are limited by the appropriateness of available analogies. This has been explored in the first chapter where technologies of communication and the processes of globalisation were examined, for new technologies are a prime source for new analogies; the power of cartography in the development of a language for Enlightenment thinking and the mechanistic understandings of the world in Classical Science have already testified to this. Contemporary science is differentiated from Classical science in that its models are not presented as real or complete, but *as* models: "Even if it *does* agree with experiment, that does not mean that a model is 'right' in the sense of being some

eternal, universal Deep Truth about the nature of things being studied" (Gribbin 1998, p5).

This chapter will work towards an understanding of the challenges to our conception of space and time, and so of our place in the world, that are presented to us by contemporary science. In so doing a marked departure from the parameters of Enlightenment and classical scientific discourse will be identified. When Kuhn explains the paradigm in science he is usually referring to quite specific aspects of science, and often a paradigm shift will only affect a group of interested people, but he also identifies paradigm shifts that have had led to a common change in world view.

> In its extrascientific consequences ..., the Copernican theory is not typical: few scientific theories have played so large a role in non-scientific thought. But neither is it unique. In the nineteenth century Darwin's theory of evolution raised similar extrascientific questions. In our own century, Einstein's relativity theories and Freud's psychoanalytical theories provide centers for controversies from which may emerge further radical reorientations of Western thought. (Kuhn 1957, p4).

Copernicus (see p60) and psychoanalysis (see p69/70) are referred to elsewhere, the changes that interest this section begin with Einstein and proceed to outline, at a layman's level, the developments and implications of his theories in order to work toward an explanation of what is different about contemporary understandings of space and time.

4.2 EINSTEIN AND BEYOND.

Einstein (1879 - 1955) was prolific and influential in many fields but his main theories might be summarised as these: a mathematical explanation for Brownian movement of molecules, an explanation of photoelectric activity - photons, the theory of relativity and the relation of mass to energy. The development of these has led to the most important realisations of the twentieth century: quantum theory, an expanding, entropic universe and the irreversibility of time, none of which Einstein was able to fully accept. Einstein's personal responses to these developments are worth including in this initial explanation; resonant with those of Copernicus, the conflicts that Einstein

experienced between science and belief are illustrative of the antagonisms between old and new world views.

The theory of relativity is often illustrated by imagining the expanding surface of a balloon as it is blown up. I am reliant here on Gribbin's (1998) clarity of explanation. Imagine the balloon's surface is covered with paint spots, each spot representative of a galaxy, as the balloon expands the spots become further apart,

> *not* because the paint is moving across the surface of the balloon, but because the skin of the balloon (space-time) is stretching,... If the balloon expands so that the distance between two neighbouring spots doubles in size, then the distance between every pair of spots doubles in size. Choosing any spot on the balloon to measure from, a spot that was 1 cm away will now be 2 cm away (seeming to have moved by 1 cm), a spot that was 2 cm away will now be 4 cm away (seeming to have moved twice as fast), and so on. The further away a spot is the faster it will seem to be moving... (Gribbin 1998, p236, original emphasis).

This explanation, like Darwinian evolution, is, once pointed out, easy enough to understand, indeed appears immediately to make sense, however to conceive of such a theory requires a leap of imagination, an extraordinary mind. The implications of this theory on accepted notions of time and space are multiple. The experience of the expanding balloon demands a located observer so leading to a concept of time as subjective, but it is also this theory that allows us to understand the universe as expanding and so, as having had a beginning - for if the expansion is run in reverse, "the entire visible universe must have emerged from a mathematical point - a singularity - at a definite time in the past" (Gribbin 1998, p236). The theory of relativity also shows that there is no centre to the universe, nor an external vantage point from which the universe can be viewed, which rather undermines the classical conception of the centrality and authority of humanity, and the theory also tell us that time is not reversible: if the universe has emerged from a singularity and has since been expanding, and is entropic - losing energy , the arrow of time points forward only. This idea alongside quantum theory, which tells us that the activity and timing of future events cannot be accurately predicted, describes a world that is fundamentally disordered and random, concepts in opposition to the tenets of classical science. Together these ideas, which will be discussed below, contribute to alterations of scale

as dramatic as those of the Enlightenment but this time the alterations are temporal as well as spatial.

Firstly then, the implications of time as subjective to the located observer will be examined. Einstein definitively separated the realm of the scientist from that of dreary everyday life, concurring with Kuhn's view that a scientist operates most successfully when removed from mundane distractions: "...one of the strongest motives that lead men to art and science is flight from everyday life with its painful harshness and wretched dreariness, and from the fetters of one's own shifting desires. A person with a finer sensibility is driven to escape from personal existence and to the world of objective observing and understanding" (Einstein 1918 cited in Prigogine and Stengers 1984, p20). However, in the theory of relativity an observation demands a located individual to observe it. This is because, unlike the theories of Newton, which

> ...did not assume that the observer was a 'physical being.' Objective description was defined precisely as the absence of any reference to its author", the theory of relativity, which is "based on a constraint that applies only to physically localized observers, to beings who can be in only one place at a time and not everywhere at once, gives this physics a 'human' quality. (Prigogine and Stengers 1984, p218).

In this way the scientist is relocated in the ordinary world.

General relativity explains space/time as curved, and time as slowed down near a massive body like the earth (Hawking 1988, p32), the acceptance of this demands the abandonment of the idea of absolute time. (1)

Newton's laws of motion put an end to the idea of absolute position in space. The theory of relativity gets rid of absolute time. Consider a pair of twins. Suppose that one twin goes to live on the top of a mountain while the other stays at sea level. The first twin would age faster than the second. Thus, if they met again, one would be older than the other. In this case, the difference in ages would be very

(1) It is exceptionally difficult for Westerner's to abandon the idea of absolute time and so to overcome the paradox. For other cultures there is no paradox, as Ardener suggests by using Sarah Skar's work which gives a: " fascinating example of a whole popular culture in which no clear boundary is placed between abstract time and space. Among the Matapuquio of Peru one term (*pacha)* is employed to embrace both concepts... In the practical daily world of the Matapuquio, the intertwining of space and time is exemplified by the difference between the tops of the mountains where crops take a long time to mature, and the lower slopes where the maturation of plants is quicker. The passage of time and the place of space are thus intimately linked" (Ardener 1993, p15).

> small, but it would be much larger if one of the twins went for a long trip in a spaceship at nearly the speed of light. When he returned, he would be much younger than the one who stayed on Earth. This is known as the twins paradox, but it is a paradox only if one has the idea of absolute time at the back of one's mind. In the theory of relativity there is no unique absolute time, but instead each individual has his own personal measure of time that depends on where he is and how he is moving. (Hawking 1988, p33).

The next challenge presented by the theory of relativity is that, if developed, it explains the universe as expanding which, when taken alongside the uncertainty principle, (which will be explained in relation to quantum theory below), might seem to describe our universe as fundamentally random and chaotic.

> The uncertainty principle had profound implications for the way in which we view the world. Even after more than fifty years they have not been fully appreciated by many philosophers, ... The uncertainty principle signalled an end to Laplace's (2) dream of a theory of science, a model of the universe that would be completely deterministic: one certainly cannot predict future events exactly if one cannot even measure the present state of the universe exactly. (Hawking 1984, p55).

Newton had believed that a divinely constructed universe would be fundamentally stable and unchanging, and "Although it was out of fashion from the mid 19th century onwards to include God in scientific statements, the feeling that there was something sublimely rational and sacred about an unchanging universe ... had by no means disappeared" (Ferguson 1999, p183). So when theories of an expanding universe were proposed many, including Einstein himself, were resistant to the idea. Twentieth century science had relinquished the idea of a created universe, however a universe that had a beginning also seemed to require a creator (Ferguson 1999, p183). But Einstein's reservations seem to be art of a more traditional Scientific belief in constancy: his theories are by Hawking's definition classical, in that they do "not take account of the uncertainty principle" (Hawking 1988, p60). Einstein said that "To admit to such a possibility seems senseless" (Ferguson 1999, p184) and to counter this possibility, he conceived of a "cosmological constant" which limited his theory so as to render the universe unchanging, this he was later to call "the biggest blunder of my life" (Ferguson 1999, p184).

(2) Pierre Laplace, (1749-1827) was a French mathematician and astronomer who was interested in perturbations in gravitational fields these, he concluded, were negligible, thus asserting the stability and permanence of the solar system.

As mentioned above, the located observer in an expanding universe has no external vantage point by which to gain a complete, objective view. Ferguson argues that the only way in which we can see an edge of the universe or perceive the universe in entirety is by looking backwards: "Paradoxically, living in an expanding universe means that there is a direction in which we *can* peer and see something different, perhaps even see an 'edge'. That direction is the past. What's more, in any space direction we look, we look towards the origin of the universe, for *any* direction is towards the past" (Ferguson 1999, p187-188, original emphasis). This idea will be picked up later when it is argued that although at first these theories might seem to point only towards disorder, randomness and dislocation, there does seem to be a balance between the forces that interest contemporary science and also, in Prigogine and Stengers' work, emerging evidence of order.

Einstein's theory of relativity led to Hawking's and Penrose's work which "implied that the universe must have a beginning and, possibly, an end" (Hawking 1988, p34), in which case the universe is not unchanging and so time is not irreversible. Also the second law of thermodynamics states that the universe is losing energy, winding down away from organisation and toward disorder, and these concepts, in interaction with quantum theory, will be developed into a discussion about order and disorder, determinism and chance.

So, this expanding universe, combined with the second law of thermodynamics, describes a world in which time is irreversible and the future fundamentally unpredictable. Classical science with its foundations in reason, had removed time from the equation and hence been able to assert the permanence and universality of its laws:

> In the world model constructed by Newton and his followers, time was an afterthought. A moment, whether in the present, past or future, was assumed to be exactly like any other moment. The endless cycling of the planets - indeed, the operations of a clock or simple machine - can, in principle, go either backward or forward in time without altering the basics of the system... [when] the second law of thermodynamics was proclaimed, time suddenly became a central concern. For, according to the Second Law, there is an inescapable loss of energy in the universe. And, if the world machine is really running down ... Then it follows that one moment is no longer exactly like the last. You cannot run the universe backward to make up for entropy. (Toffler 1984, xix).

Einstein, although it was his work that had put time back into the equation, was unable to accommodate the idea of irreversibility. He could equate such a concept with "lived" or "philosophical" time but not with science; for him "the intelligible was identified with the immutable". His friend Besso "kept asking the same questions: What is irreversibility: What is its relationship with the laws of physics? And untiringly Einstein would answer ...: irreversibility is merely an illusion produced by 'improbable' initial conditions" (Prigogine and Stengers 1983, p293-294). So Einstein was concurring with the classically scientific view that phenomenological time, the experience of time, is something beyond the remit of science, Prigogine and Stengers quote the philosopher Rudolf Carnap:

> Once Einstein said that the problem of the Now worried him seriously. He explained that the experience of the Now means something special for man, something essentially different from the past and the future, but that this important difference does not and cannot occur within physics. That this experience cannot be grasped by science seemed to him a matter of painful but inevitable resignation... Einstein thought that these scientific descriptions cannot possibly satisfy our human needs; that there is something essential about the Now which is just outside of the realm of science. (Prigogine and Stengers 1984, p214).

In this way Einstein agrees with Kuhn's belief that in the "normal" processes of science, philosophy and seemingly abstract questions have no place. The domain of science as Einstein understood it is changing;, philosophical and ethical questions have re-entered the arena of science, and science is now tackling some of the questions that were once the realm of philosophy, which in Kuhn's analysis (see Chapter Three) would be an indication that we are in a period of "extraordinary" science.

It was suggested above that a balance can often be found between the forces of the contemporary world and although the arrow of time points to increased entropy and so increased disorder, there is another aspect of time which pulls in quite a different direction. Entropy suggests the break down of order in our universe, "as energy leaked out of the system, its ability to sustain organized structures weakened, and these, in turn, broke down into less organized, hence more random elements" (Toffler 1984, xx). Which would seem to lead to a view of the world where all the tenets of classical science are uprooted, where "most of reality, instead of being orderly , stable. and equilibral, is seething and bubbling with change, disorder and process" (Toffler

1984, xv). Yet while entropy is a winding down of the system of order, in direct contrast evolutionary time explains a system that is increasingly complex: "Evolution proceeds from simple to complex, from 'lower' to 'higher' forms of life, from undifferentiated structures to differentiated structures. And, from a human point of view, all this is quite optimistic. The universe gets 'better' organized as it ages..." (Toffler 1984, xx). (4)

In examining the forces of globalisation it can be shown that, very often ,one force, which may seem to have a negative impact on the world, can be seen to be countered by another with a more positive effect. When quantum theory is examined a balance of negative and positive energies will be seen ,but before developing this Prigogine's and Stengers' reinterpretation of the second law of thermodynamics which suggests that "Under certain conditions, entropy itself becomes the progenitor of order" (Toffler 1998, xxi) will be examined.

The best way to illustrate order arising out of disorder is to use Prigogine's and Stengers' own example as described by Alvin Toffler:

> "Imagine a million white ping-pong balls mixed with a million black ones, bouncing around chaotically in a tank with glass windows in it. Most of the time, the mass seen though the window would appear to be gray, but now and then, at irregular moments, the sample seen through the glass might seem black or white, depending on the distribution of the balls at that moment in the vicinity of the window. Now imagine that suddenly the window goes all white then all black, the all white again, and on and on, changing its color completely at fixed intervals - like a clock ticking. By all the traditional rules, this should not happen at all. Yet, if we leave ping-pong behind and look at molecules in certain chemical reactions, we find that precisely such a self-organization and ordering can and does occur ..." (Toffler, 1984, xvi).

The observations of Prigogine and Stengers have led them to assert an interdependency between chance and determinism. They identify three possible states for a system: equilibrium, far from equilibrium and near equilibrium, and within these systems are subsystems "which are continually 'fluctuating' "(Toffler 1984, xv-xvi).

(4) This description of the tendencies of evolution is generalised, the processes of evolution do not exclusively tend toward increased complication or towards "higher" forms of life.

> At times, a single fluctuation or a combination of them may become so powerful, ..., that it shatters the preexisting organization. At this revolutionary moment - the authors call it a 'singular moment' or a 'bifurcation point' - it is inherently impossible to determine in advance which direction change will take: whether the system will disintegrate into 'chaos' or leap to a more differentiated, higher level of 'order'... (Toffler 1984, xv).

Prigogine and Stengers suggest that at these singular moments chance plays a part, we can not predict this, and then subsequently determinism takes over until another "bifurcation point" is met. "At this point ..., it is inherently impossible to determine in advance the next state of the system. Chance nudges what remains of the system down a new path of development. And once that path is chosen (from among many), determinism takes over again..." (Toffler 1984, xxiii). There is then order, but it cannot be predicted and, unlike the order of classical science, it is not imposed upon the world, but is the self ordering of the world, and in this self ordering both chance and determinism have an equal part to play.

Moving on now to theories of quantum activity. Quantum activity is concerned with what happens at the smallest level however, because the universe, in the big bang theory, has itself emerged from an atomic point, quantum theory also helps us to understand things on the largest scale.

> The big question, in philosophy and religion as well as science, is why the Universe should exist at all - why is there something rather than nothing? ...Einstein taught us that mass is a highly concentrated form of stored energy. But Einstein also taught us that gravitation (warped space-time) is a form of energy - and the bizarre thing is that a gravitational field actually stores *negative* energy. It is quite likely that all of the mass energy in the Universe is precisely cancelled out by all of its gravitational energy. The Universe may be nothing more - or less than the ultimate quantum fluctuation. (Gribbin 1998, p242).

In atomic theory, an atom will have, or seek, a balance of negative and positive energy in the form of electrons, protons and neutrons and Gribbin has suggested above that the universe itself seems to have a balance of energy. Before proceeding with this a basic understanding of quantum uncertainty needs to be reached.

Quantum theory emerged from the study of radiation of electromagnetic waves from hot bodies which led Max Planck to hypothesise that "light, X rays, and other waves

could not be emitted at an arbitrary rate, but only in certain packets called quanta. Moreover, each quantum had a certain amount of energy that was greater the higher the frequency of the waves, so at a high enough frequency the emission of a single quantum would require more energy than was available. Thus the radiation at high frequencies would be reduced and so the rate at which the body lost energy would be finite" (Hawking 1988, p54). This resolved an anomaly in held theory which seemed to suggest that the energy radiated by hot bodies would be infinite, however it also presented a further problem, this time for determinism, when Heisenberg suggested the uncertainty principle in 1926 (Hawking 1988, p54). This stated that "the more accurately you try to measure the position of the particle, the less accurately you can measure its speed, and vice versa" (Hawking 1988, p55). So "particles no longer had separate, well-defined positions and velocities that could not be observed. Instead, they had a quantum state, which was a combination of position and velocity" (Hawking 1988, p55), and this state could not be accurately measured.

The nuclei of atoms are held together by quarks, specifically by a quark-antiquark pair known as a meson, these quarks emerge from nothing to make mesons, by borrowing energy. They will exist for a length of time correspondent to the amount of energy they have, the more energy the shorter the life, and then disappear, giving their energy back to the vacuum. The amount of energy and hence the length of existence of mesons is not precisely quantifiable at this level, nor can the timing of the creation of mesons be predicted, this is an other example of quantum uncertainty (Gribbin 1998, p63).

So at the quantum level there is activity that not only can not be visualised, but can not be accurately measured or predicted either. Einstein was unable to accept quantum theory as an answer to the workings of the world, he did not fault the theory in itself, but was sure that a more satisfactory encompassing explanation would in time emerge, he simply could not accept that nature is fundamentally unpredictable, random. His position might be compared to Copernicus - caught between two worlds - instrumental in changing the scientific world view - yet unable in terms of belief, which were still grounded in the traditional world view, to reconcile the consequences. "I

hold it true that pure thought can grasp reality, as the ancients dreamed" he said in 1933 (quoted in Banville 1976, p208) and the quantum model of the universe, in particular, was too removed from Einstein's everyday experience of the world, too far from his "grasp of reality" to be held as "true". This is unsurprising for quantum theory is "weird", the models we have of quantum mechanics are removed from our everyday experience, and they refer to things we cannot see, an attempt to understand science at the quantum level, and indeed at the universal level, requires the forgetting of held beliefs.

However, quantum theory, as will be shown, can offer a harmonious cosmic theory where the largest and the smallest are made of the same stuff, and work in the same ways, and where there is a balance of energy in the universe. A cosmic theory was reluctantly given up in the progress towards a classically scientific explanation of the world and yet through science this concept is renewed.

Firstly, it is thought to be because of unpredictable quantum fluctuations that our universe exists at all. Contributing to the idea of a correspondent relationship between life at the smallest level to life on the largest scale, this theory proposes that it is due to quantum fluctuations that occurred during the birth of the universe that the universe is inhabited by galaxies. If it were not for these fluctuations with caused "ripples", the universe would be entirely uniform, neither we, nor our world would exist.

> If the models are correct, without the primordial quantum fluctuation there would have been no Universe at all; and without these secondary quantum fluctuations there would be no people around to puzzle over the origin of the Universe, because everything would have been smooth and uniform, so no stars would have formed. No other model yet devised can explain why the Universe is both very uniform overall (thanks to inflation), but contains exactly the right kind of ripples needed to make galaxies and clusters of galaxies (also thanks to inflation). (Gribbin 1998, p247).

Gribbin also suggests that the balance of energy at the quantum level is reflected in a balance between positive and negative energy in the universe as a whole. He says that the balance may be such that it equals zero, indeed that the universe may be "the ultimate quantum fluctuation":

> Quantum uncertainty, ..., allows "empty space" to be alive with packets of energy that appear out of nothing at all, and disappear within the time limit set by the quantum rules. The less energy involved the more time the 'virtual' energy packet, a quantum fluctuation, can exist before the Universe notices and it has to disappear. Thus a quantum fluctuation which had precisely zero energy overall could, as far as the quantum world is concerned, last for ever! (Gribbin 1998, p244).

Just as Copernicus' theories would lead to changes in the world view so that the conflicts which had dogged his work could be resolved, so Einstein's conflicts were later to be resolved by the development of his own theories:

> This change of perspective is not the result of some arbitrary decision. In physics it was forced upon us by new discoveries no one could have foreseen.... Who would have expected that with the experimental confirmation of an expanding universe we could conceive of the history of the world as a whole? (Prigogine and Stengers 1984, p9).

The new temporal and spatial perspectives by which we are now able to view the history of the universe, the earth, and humans, contributes along with an increased understanding of the impact of human activity upon the earth, to a repositioning of the role of science and the scientist:

> In our postmodern times of global crisis, science cannot abandon matters of ecological disaster such as global warming, pollution and nuclear fall-out. Postmodern science looks at itself as socially and textually constructed and is conscious of the role of the scientist in the whole process of knowledge creation; a space for ethical issues is thereby (re-)opened. (Toumlin 1982 cited in Heller 1996, p75).

In terms of our relationship with our environment, science, which in the seventeenth century had enforced a barrier between the mechanised body and the natural world, has come to show us the interdependency, as a fragile eco-system, of everything on earth. And also, that at a quantum level everything is built from the same blocks; connections are thus re-established with our natural world through science.

> ...because of technological advances, we have been able to see the planet in its entirety, and have become aware of global interdependencies of many kinds. If, in addition, we admit that human societies are in constant change, and that every state of 'being' is but the effect of a temporary historical configuration, we can no longer think the subject, singular or collective, in a vacuum. At the very moment when technology has seemingly acquired mastery over nature, 'nature' returns and is rehistoricized. (Conley 1993, p78).

To return to a point made by Ferguson earlier: if there is a vantage point from where an "edge" to the universe can be viewed, it is by looking back in time, irreversibility does offer an aspect of the world that is unchanging. Although quantum physics demonstrates that the activity of matter at the fundamental level, at the quantum level, is unpredictable, so rendering the future unpredictable, irreversibility offers the past as fixed. The concept of "deep time", the recent realisation that our world has existed for around four billion years, may seem disorienting, it is an amount of time so large it is almost unimaginable, and yet geologists know that the strata of rocks, or deep ice cores, for example, contain a record of climatic changes. This not only allows a means by which to visually and conceptually grasp an understanding of the age of our world - it is *fixed*. So in this way irreversibility does allow a constant. "We think of weather as transient, changeable, and above all, ephemeral; but everywhere nature remembers. Trees, for example, carry the memory of rainfall. In their rings we read ancient weather - storms, sunlight, and temperatures, the growing seasons of centuries. A forest shares a history, which each tree remembers even after it has been felled" (Michaels 1998, p211). Just as in the cells of our bodies, in our DNA, we each carry our own history, a map of our ancestors. Genetic scientists are able to trace a persons racial history back thousands of years by looking at their DNA and matching it to those of ancient peoples, these ideas are important in critical examination of theories which explain the self as entirely culturally constructed, as a blank sheet inscribed by culture (see Chapter One).

4.3 CONCLUSION.

In the previous chapters it has been shown how a cosmic explanation of the world was gradually abandoned due to the seeming incoherence of spatial discoveries. This chapter has shown that contemporary science describes a universe which at many levels is unpredictable and random. Yet out of these discoveries there appears to be a balance between chance and determinism, entropy and evolution, negative and positive energies and between the smallest and largest aspects of the universe. As time re-enters the arena of science so do philosophical questions and ethical issues.

In the last chapter a great deal was said about language and models by which to make sense of the world. In relation to the thesis as a whole this raises important questions. The central hypothesis is that during a period of revolution in knowledge, in concurrence with a revolution in spatial and temporal perspective, the body itself is revolutionised: the meanings of the body in interaction with its environment are changed. The key question then is, does this actually allow a new experience? Is there simply a new framework by which to *express* the feeling of being a body, or does it mean a new *experience* of the body? In this chapter a new world and universal view has been shown to be emerging, which certainly offers us a new model by which to frame and conceive of our corporal experience, and shows this experience as defined by new concepts of space and time. In the first chapter disruptions to our sense of location and new modes of communication, brought about by globalisation and technology, are shown to effect shifts in subjective identity, which establishes that an identifiable change is occurring in the actual experience of the world. This demonstrates a revolution not only in perspective and modes of expression but in the activity of the self in relation to others and the environment. The articulation between these is explored in the following, final chapter.

CHAPTER FIVE.

CONCLUSIONS.

> It's no metaphor to feel the influence of the dead in the world, just as it's no metaphor to hear the radiocarbon chronometer, the Geiger counter amplifying the faint breathing of rock, fifty thousand years old. (Like the faint thump from behind the womb wall.) It is no metaphor to witness the astonishing fidelity of minerals, magnetized, even after hundreds of millions of years, pointing to the magnetic pole, minerals that have never forgotten magma whose cooling off has left them ever desirous. We long for place but place itself longs. (Michaels p53, 1996).

5.1 SUMMARY.

The research question posed in the Introduction was: "If the convergence of new spatio/temporal perspectives with new modes of communication and new scientific/technological models operate in articulation with a new formation of the subject and new ways of understanding and experiencing the body what will be the impact of comparable current developments on the contemporary body?"

By demonstrating that we are in a period of transformation comparable to that of the Enlightenment, it has been shown that changes to our systems of knowledge as radical of those initiated in the earlier period can be expected and it has been demonstrated that this period is useful as a comparative model of the way trends in knowledge become manifest at a corporeal level. Secondly, the project has explored the relations between technologies of communication, spatial and temporal frames, and the languages and models by which we describe and understand the working of the world, as corresponding with shifts in conceptual and perceptual knowledge's of embodied selves/subjects in the world. Finally this project has argued that the theory and methodology by which the above relations are established also permit the identification of qualitative shifts in subjective experiences of the body.

The validity of the research question has been substantiated by demonstrating that in times where there is a significant spatial shift which coincides with technological advances - especially in the areas of communication and media - there is a corresponding shift in subjective identity. This has been discussed in historical and contemporary contexts and has been achieved through a synthesis of the work of others.

In the historical analysis it has been shown that the metaphors and language of an emergent way of knowing the world, in the Enlightenment, were directly transposed onto understandings of the body. This has opened up the argument that current metaphors and language of science and technology will be transposed onto the contemporary body. Digitization, the interface, and the matrix have all been discussed as useful contemporary metaphors for conceptualising the body and connectivity, fluidity and spatio-temporal location have been identified as common new themes to these and other areas: in relation to notions of the cultural, geographic and theoretical.

Shifts in media and communication result in a reconfiguration of the sensory hierarchy: where different senses have authority and so are validated in relation to new media - and thus in relation to structures of knowledge more broadly. Tactility has been identified as the sense that aligns itself most closely with new forms of media and so with "knowing". It has also been argued that the role of the imaginary is heightened in significance in relation to understanding contemporary scientific models, see Chapter Four, and in relation to virtual technologies, see Chapter One. The question this demands is: how might tactility and imagination, when given authority in relation to "knowing", reshape the ways in which we understand our corporeality.

As a development of the above points this work has argued that corporeal knowledge, which was in Enlightenment discourse made distinct from "truth" is, in contemporary thought, more closely associated with knowledge. A dominant theme has been the significance of mapping - the illustrative forms of spatial and spatio-temporal technologies - as a rich source for explanations of subject location, and for bodily metaphors. It has

en been demonstrated that historically the language of cartography has been definitive of emergent structure of knowledge, and of the body as part of this. Given this, NMRI, a ience, a technology and a topography is to be discussed in this chapter as potentially formative of the tendencies of contemporary corporeality.

2 DISCUSSION.

he models of twentieth and twentyfirst Century science departed fundamentally from the nets of Classical Science, corroborating evidence that fundamental ways of knowing the orld have shifted. This shift at its most basic is from the spatial to the spatio-temporal. his shift is inherent also to all new technologies and communications. How do we locate ur own spatio-temporal bodily experience in relation to this change? It has been argued ere that our own physical living body becomes heightened in significance as a point of eference in a fluid, multiple world. It has also been argued that as, part of these ansformations, corporeality and knowledge are no longer oppositional definitions.

he use of metaphor has been key to the Classically Scientific approach or way of inking. Contemporary metaphors are those of flows and exchange, of interactions and onnections, the network. In the models of science and technology, and in the processes f globalisation, boundaries collapse. These ways of understanding the world are nderstood here as also explanatory of bodily existence. If boundaries are being disrupted nen the boundary between interiority and exteriority would also be expected to be isrupted, shifted or confused.

hese are tendencies that this project has demonstrated as significant. Significant because, vhen seen as a wide picture, show altered spatio-temporal frames, altered material xperience of physical location, new modes of communication, new theories of ubjectivity, intense cultural interaction (all elements found present in the period of nlightenment) which contribute toward a new sense of corporeality.

In the Enlightenment the body occupied a defensive position between the newly revealed anatomical interior and the newly "discovered" expanse of the globe. In contemporary terms, the body is conceptualised as occupying a position between the real and virtual worlds and between the quantum and the universal scales. The relationship between the particular and the universal is no longer oppositional then but involved, interactive. Contemporary scientific explains a new unity of matter and these explanations depend overtly on the imagination in order to be understood and, through virtual technology, imaginary realms are opened up which have a consequent impact upon experience in the real world (Poster 1996). How might an increased emphasis on the role of the imaginary together with new qualitative experience, fluid and multiple concepts of subjectivity and a newly validated tactility come together? If it is through imagination and experience that the worlds of the real and the virtual, the quantum and the universal are linked, then the point of convergence for imagination and experience is at the site of the body or, alternatively, the mediator, translator between these realms is the body, the tactile body newly authorised in relation to knowledge.

It is the image that has been the focus of many postmodern theories, image in terms of visual representation - the mediums by which the signs of the postmodern age are communicated - film, advertising, magazines for example and, in a different way, in terms of theories developing from psychoanalysis or theories of the subject, self-image and the interactions of self with culture. This work is not so interested in the image. It is interested in the imagination, the conceptual, in interaction with the sensory, experiencing body. The visual is not excluded from these processes, but, crucially, it is not prioritised. It is the sensory experience opened up by the altered parameters of available conceptual tools that is of concern here. Within these shifted parameters the experience and definitions of the body are less constrained by the visual. As discussed above, seeing is no longer believing, and the solid image before us in the mirror is not enough of an explanation for corporeality, other sensory and imaginary ways of knowing are also required to make sense of a changed and changing environment and new subjectivities.

These alterations are conceptual, metaphorical, subjective and material. As Poster says: "the new technologies install the 'interface', the face between the faces; the face that insists that we remember that we have 'faces', that we have sides that are present at the moment of utterance, that we are not present in any simple or immediate way." (Poster 1996, 196/197).

As contemporary science offers a new unity of matter, and mind/matter distinctions are confused, then a corresponding confusion of the categories of "imagined" and "known" would seem possible, such a confusion would result in a significant refiguration of the ways in which corporeality can be expressed and understood.

6.3 FUNCTIONAL MAGNETIC RESONANCE IMAGING.

The purpose here is to offer just one example of where qualitative evidence for a shift in corporeal experience might be explored. Science, technology and the body all meet in this example, a form of mapping, so it compares well to cartography and anatomy, the examples used in a historical context.

I started looking at fMRI purely because it was a striking example of a disruption between concepts of bodily interiority and exteriority, I was not considering it in terms of mapping or in relation to the rest of the project at all. However it became quickly evident that it fitted with all the key areas of interest, that it was a topography, that it was a quantum science, that it was technological, and that it thoroughly disrupted classical notions of science and the body. I will briefly outline how MRI works before discussing the ways in which this could prove to be a useful case study.

"Functional MRI (fMRI) has enabled scientists to look for the first time into the human brain *in vivo*, to literally 'watch it while it works'. This has revealed exciting insights into the spatial and temporal changes underlying a broad range of brain functions, such as how we see, feel, move, understand each other and lay down memories" (Matthews 2002, p1). The brain, like other tissues in the body, is made up of over 70% water. Each hydrogen atom in this water is a tiny magnet. When placed within a very strong magnetic field, these billions and billions of magnets align. When these atoms return to their original position they give off energy which can be detected with a "receiver coil". This allows relative amounts of hydrogen to be measured. The varying water content between the cortex and the white matter of the brain mean that MRI "can be used to provide exquisite details of structure" of the brain (Matthews 2002, p3). (1)

So, MRI allows detailed structural knowledge of the brain and "with the development of functional imaging, we are now able to look inside the brain of humans in 'real time' and appreciate the neural mechanisms *behind* our behaviour, rather than just observing the consequences of these effects" (Matthews 2002, p4). As freshly oxygenated blood gives off a different signal, active areas of the brain can be recognised and mapped, and the flows of activity can be mapped.

This process is allowing analysis of various brain functions and pathologies. For example, memory loss, cognitive learning processes, depression, Alzheimer's, Attention Deficit Hyperactive Disorder, grief in bereavement and addiction. Integral to the imaging of these magnetic forces is computerised analysis.

So fMRI fits as a model with the examples used in the historical analysis, it fits with the key areas of interest identified in Chapter One, it exemplifies the departure from Classical

(1) MRI is widely used as a diagnostic method for all bodily functions, but it is the diagnosis of brain function that is of particular interest here.

Science demonstrated in Chapter Four and is in alignment with the theory because it is interested in flows of activity and it disrupts the most significant distinction, that between bodily interiority and bodily exteriority.

- Its object of study is the living functioning body and brain.
- It is a topography, a form of mapping.
- It is at the forefront of scientific and technological progress.
- It is facilitated by and dependent upon computerised interpretations, digital analysis.
- It uses information taken at the quantum level to inform diagnosis at the corporeal level.
- It facilitates a completely new experience of physical interiority and exteriority.
- It disrupts classical distinctions between body and mind, emotion and reason, science and art.
- It is defined and mapped spatio-temporally and has the capability of operating in real time.

As has been discussed in relation to the Enlightenment, cartography was definitive, in terms of both language and approach, to the structures of knowledge that developed from the explorations of the "new" world and of the anatomical interior. Here it is suggested that contemporary forms of mapping will be equally powerful as indicators of the new ways in which the body will be understood. Looking at this new medical technology the departure from a classically scientific view can, even at this early stage, be identified at every level.

Firstly, science and technology, are utilised here, in a medical context, to study such conditions as depression and grief in bereavement, or to map thinking processes. This thoroughly collapses the classical distinctions between body and mind, emotion and reason and mind and matter. Magnetic Resonance Imaging has been used also to study creativity and artistic impulses in the brain. These regions were not even considered to be within the remit of scientific study in the earlier era. Secondly this technology allows the interior of the body and brain to be witnessed functioning in real time, so confusing classical concepts of the body as an impenetrable boundary between the interior and exterior worlds and

effecting shifts in bodily location. In these ways it is in alignment with the other contemporary phenomena already explored.

The interaction of space and time are central to this process; in terms of the science - quantum physics is inherently a spatio/temporal science, in terms of what it is examining - the spatial and temporal changes in the brain and, in the way it operates - providing spatio/temporal images in real time, via digital interpretation. It is a thoroughly spatio/temporal topography and on this basis alone would be an interesting case study.

FMRI however, links also to imagination and experience. Understanding how the science works is dependent upon imagination, and this science then maps brain functions of various experiences, resulting in the experience of seeing your own brain as it works, which requires another imaginative leap in order to be comprehended as reality. These realms of understanding the world were invalidated by classically scientific thinking, in new science they are fundamental.

If one of the aims of the project is to look for trends in contemporary scientific and technological topographies as strong indicators of the ways in which corporeality might be refigured, then a case study of this new topography has the potential to bring all the key elements into play. What it would appear to reveal without further analysis is a corporeality that is on some levels turned inside out. How might a qualitative analysis of the experiences of patients and practitioners involved in the processes and interpretations of NMRI reveal a newly interpreted body, symbolically and materially? What language and metaphors does this science employ in analysis? How might this help explain the tendencies of corporeal experience?

It is not suggested that an analysis of fMRI will tell us everything we want to know about corporeality. It is suggested that given the power previous technologies of mapping have held in relation to corporeal understandings that this would be one good place to look,

among many, for rich information about the direction of our corporeality, and, most significantly, this topography disrupts notions of corporeal interiority and exteriority.

6.4 CONCLUSIONS.

In the historical analysis it was shown that new approaches to knowledge became definitive of meanings and experiences of corporeality. Further, it was shown that we are in a period of comparable transformation and that it may be illuminating to look at the trends in new structures of knowledge to see how these might inform the potential of corporeal understandings. It was also demonstrated that the particular interactions of space, language and technology in various forms of mapping are a valuable source of information about corporeal understandings. The examination of the contemporary situation found that the periods of analysis were comparable in multiple ways, but that the significant development in all disciplines and arenas today is the dissolution of boundaries, metaphorically, materially and physically; a move towards fluidity, new spatio-temporal location, and connectivity. In part this involves a reconfiguration of the hierarchy of the senses, where tactility and imagination have a new authority in relationship with knowledge. This Conclusion brings together various findings to argue that the indications are that a new experience of corporeality will tend towards these same factors: connectivity, fluidity, particular spatio-temporal location, and has suggested an area of proposed research where qualitative, experiential evidence might be found to demonstrate this - in a new form of medical mapping..

The dualist discourse of the Enlightenment was founded on light and dark, known an unknown, valid and invalid, and the whole approach to corporeality in this era can be seen to grow from these philosophical key stones, the organ best associated with this form of knowledge was the eye. The organ of the contemporary world is the skin, the sense is touch/connection. The identified tendencies have been shown to be significant and prevalent - can they be proven as evident in our qualitative experience? Do the new

models, the new languages, the new material experience of the world allow more than new words, more than new descriptive tools for explaining sensory and psychological experience of the world, more than a new material/physical/symbolic location, more than new cultural freedoms, do they permit a new corporeal experience?

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