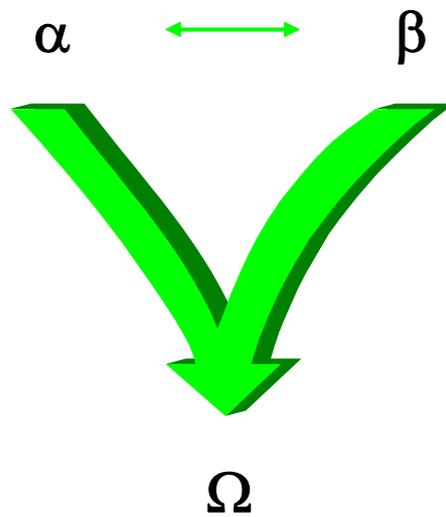


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Science and Mathematics Education Centre
For the Doctor of Philosophy**

**BEYOND PARADIGMS IN THE PROCESSES
OF SCIENTIFIC INQUIRY**

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May 2006

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university. To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.

In memory of my father
Dennis Francis Colbourne
And my mother
Betty Victoria Colbourne

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INTRODUCTION

We are born into this world with many potentialities. If all goes as expected, we shall learn to communicate through symbolic systems such as language and number. We shall develop many emotions, from hatred to love, anger to joy. We shall grow from helpless, entirely dependent beings to fully independent adults. We shall be enculturated into the mores and norms of our families, social groups and societies. We may well learn to interact with others through games and sport. If we are fortunate we may also develop talents for art or music, mathematics or theoretical science.

There are currently nearly seven billion human beings in the world, and we are all individuals, unique and irreplaceable. From the moment the zygote implants into the uterine wall the individual journey has begun. Thus, even monozygotic siblings are not identical, for although life experiences for each individual may sometimes be similar they are never exactly the same.

The nature of the journey of life has occupied the thoughts of human beings since the beginning of the philosophical record. Our oldest written artefacts, such as the Old Testament, the Talmud, the Bhagavad-Gita and the Epic of Gilgamesh, are concerned with exploring the reasons for and the nature of our existence. The writings of the ancient Greek philosophers, from the earliest records, demonstrate the same concerns. Today, the processes of inquiry may be seen to arise out of the same needs for explanation for and control of the journey of life. The same questions that have occupied the minds of men and women throughout recorded history are the same ones that occupy us today – who are we, where do we come from, why are we here and where are we going?

There are many aspects of human beings that mark us out as fundamentally different from the other living beings that share the planet with us. These include our use of symbolic communication, humour, the development of laws, the formulation of organised sport and games, artistic endeavour, the use of fire, and the organisation of societies and civilisations. Perhaps the most distinctive of all, though, is our drive to question our existence and to formulate answers for the questions we raise. Some of the other higher mammals appear to have some concept of death – the elephants and the apes, for example – and some use tools, communicate in various ways, create

artefacts and form family units, but we are the only ones that have formulated intricate and profound philosophies to explain the mystery of our lives and the ending of those lives. Our conception of a self separate from others and the inevitability of a personal death has required explanation throughout recorded history.

Some individuals certainly claim to have a knowledge of a personal existence before birth – apparent memories of previous lives, and so on – and the majority of the world’s population belong to religions that teach of the existence of individual souls, or spirits, that transcend the life of the physical body. There are also individuals that claim to be able to communicate with the spirit world – that is, psychics and mediums. The general experience, however, is very much that of two closed and impenetrable doors: one early in childhood before which we have no memory and no experience of self, and one at death beyond which a belief in any continued existence requires a leap of faith – it is not experientially directly accessible to us. The need of human beings to create explanations for unknowns such as these may be one of our defining characteristics.

As human beings we appear to universally need an explanation for the phenomena that surround us, that are within us and that we ourselves represent. Thus, a personal injury caused by a falling stone may be attributed to malicious spirits, to a spell cast by an enemy or to chance. Similarly, our personal consciousness may be attributed to a Creator, to ancestral spirits or to natural selection. Our explanations arise out of our personal milieu – the enculturation we have experienced, for example. Even though the drive to question and explain phenomena inevitably leads to the questioning of our inherited beliefs and cultural assumptions, it is nevertheless the case that we overwhelmingly adopt the attitudes and mores of the groups we grow up in. Thus, by far the greater majority of individuals that grow up in a Muslim culture will remain Muslim, and those that grow up in a Christian culture will remain Christian, for example. Revolutions in thinking and belief do arise – after all, all religions have their genesis at some period in history – but once that revolutionary change becomes the orthodoxy, enculturation of the proceeding generations into the prevailing belief patterns is again the norm. We can and do re-invent ourselves as thinking beings, but always in relationship to where we have come from and what we have been. We do not become other than we are or wipe clean the slate of

experience. Rather, we re-interpret our experiences and come to new conclusions about the causes of those experiences. In religious terms, we may become *converted* from one set of belief patterns to another.

Changing beliefs or ideas is therefore a paradoxical process for us. On the one hand, we are immersed in and enculturated into the mores and beliefs of our families, groups and societies. On the other, we have inherited the questioning mind, the need to find personal answers to the both the facts and mysteries of our existence. We are indeed the *inquiring hominid* rather than a naked ape. Of course, some individuals question more than others and may change more quickly or more profoundly. Nevertheless, it is the case that as a species the forming of beliefs and the questioning of those beliefs is at the forefront of our intellectual lives from the most mundane everyday concerns to the most fundamental metaphysical concepts.

This thesis is concerned with the process of belief formation and change in one specific area of human endeavour – scientific inquiry – and the paradigms that underpin that process. I will argue that scientific inquiry is driven by the same need for explanation that gives rise to all forms of human inquiry. I will further argue that the perceptual and intellectual processes that form and guide scientific inquiry are no different from those active in any other form of inquiry. I will detail the assumptions, or beliefs, that underlie and give form to our scientific endeavours, both historically and currently, and the fundamental impact those assumptions have on what phenomena we choose to explore, how we explore those phenomena and how we interpret what we find. The purpose of this thesis is to undertake an historical and conceptual analysis of the emergence and development of the dominant scientific paradigms in the Western tradition.

The importance of the central concern of this thesis lies not in an undermining or devaluing of the scientific methods we have inherited, although a debunking of some of the most cherished assumptions about the processes of scientific inquiry is a corollary. Rather, the focus is with the individual – each one of us – as an integral part of these processes. The explicit challenge that arises out of an exploration of the processes of scientific inquiry is to our own beliefs and assumptions. Why do we believe what we believe? What do we assume when we conduct scientific research? Do we assume personal objectivity? If we do, on what basis? Even a cursory examination of the scientific literature demonstrates that these questions are almost

never acknowledged and certainly have yet to be effectively addressed. A more detailed examination of the reasons for this historical blind spot demonstrates that this comfortable intellectual inheritance may no longer be either accepted or supported. Advances in many fields, but particularly in quantum physics, the complexity sciences and in postmodernism, leave the inquiring mind with no alternative but to inquire into itself if it is to retain validity and pertinency.

It is one of the truisms of our age that we are subjected to an increasing rate of cultural and technological change. It is the case, of course, that in the universe we are a part of there is only change – nothing is eternal or unchanging. Human beings, no matter how conservative or untroubled by world affairs some of us may be, experience change every moment of every day. At the very least our bodies age moment by moment. We also are immersed in a pattern of existential moments that have the potential to change our attitudes, values and beliefs – literally ‘change our minds’. The larger societies we create, made up as they are from individual human beings, are also subject to continual change. This is as true for the scientific community as any other. The pursuit of science is continually reforming itself against a backdrop of changing epistemological and ontological parameters of one kind and another. Whether this may be considered progress is another matter, for that is a value judgement that may be argued on many levels. Certainly, however, the processes of scientific inquiry are open to increasing question at this point in history because of the historical imperatives that have led us to the where we are. The time for again changing, for modifying, our view of the business of doing science has arrived and was always inevitable.

The question, then, is not whether we need to accept change in the processes of doing science – change is inevitable whether we like it or not. The real test is how we accommodate those changes. If, as I shall argue, a new paradigm is emerging in relation to the pursuit of scientific inquiry, what does that mean for scientific theorists and practitioners? My position will be that the changes this time around are so profound that each individual will be faced with questioning the bases, the assumptions, that are the foundation of all processes of scientific inquiry.

In this thesis I shall utilise the metaphor of a journey. Indeed, every thesis may be likened to a journey – a passage through a subject that occupies a specific length or dimension. The writing of the thesis is a journey of exploration and exposition for

the candidate, as it is in a different way for the reader. Certainly, the journey has a beginning, a middle and an end. Sometimes journeys can take us to new and unexpected places; sometimes they may return us home but with new insights and viewpoints. We may even take a journey in our imagination without ever moving from our chairs. More importantly, the processes of change may also be seen as a journey. A sense of movement – of changing from one place to another – is central to my view of the historical adjustments that are occurring in the processes of scientific inquiry.¹ Furthermore, as it is the experiences we have on the journey that give it its distinctive nature, I shall be orchestrating the various stages of this particular journey in specific ways. Thus, for example, coincident with an exploration of the importance of discourse in the processes of scientific inquiry, I shall use various discursive techniques for particular effect throughout the thesis. The rationale for this is to involve the reader in experiences that parallel the theme and content of the thesis and thus illustrate and support the central arguments. These techniques shall include exposition, narrative, philosophical reasoning, thought experiments and a series of perceptual tasks which are intended to challenge specific preconceptions the reader may have (and therefore for which I apologise beforehand if this does not apply to you). For the same reasons the first person will be utilised throughout the thesis and the reader directly addressed in a number of instances to reinforce the discursive roles that both of us play in this journey.

Essentially, this thesis will make no claim to knowledge, either epistemological or ontological, to the extent that knowledge is perceived as both contextual and subjective. For example, Plato's texts are examined in Chapter One. Thus, the assumption is that Plato's texts have an extant reality – that is, I “know” (or allow the assumption) that they exist, as the reader must also if the examination is to have meaning. However, my interpretations of those texts are, by definition, subjective and my explanations are embedded in the context of the theme of the thesis. What I “know” about the meaning and importance of those texts cannot necessarily be

¹ And therefore for a similar reason to that expressed by David Bohm (1980): “...thought itself is in an actual process of movement. That is to say, one can feel a sense of flow in the movement of matter in general.” (p. ix)

considered to reflect knowledge beyond these limits². We can certainly agree or disagree on or debate my interpretations, though. As will be examined at length in this thesis, it is this *discursive* process and the shared interpretations of meaning that may or may not come out of them that are significant from my point of view.³ What I do claim is a set of important and I would hold crucial perceptual and intellectual insights into how and why we develop and change the forms of knowledge that we might be considered to have. It is thus an exploration and exposition of techniques, parameters or preconditions we might – and I will argue should – apply to the pursuit of scientific inquiry. In relation to this argument, I will explore at length the rationales for a multi-dimensional approach to the processes of scientific inquiry across all disciplines.

There is a well-known vignette that may be used here to illustrate this point. Four men were walking through the Australian outback. It had grown very dark, but they pressed on as they were close to a billabong (or waterhole) that had caves they might rest in for the remainder of the night and trees that would shade them from the fierce sun during the day. All of a sudden, the men encountered an object. They called out to one another in the darkness. The first man said, “It’s a snake. It’s long and thin and wriggles around.” The second man disagreed. “No, it’s much too big and thick for a snake. It’s a creeper of some kind.” The third man held a different opinion. “There are four large, straight tree trunks here. We’re amongst a group of trees.” “What are you talking about?” the fourth man cried. “This is the entrance to a cave. I can feel the roof.” At that point, the clouds rolled away from the moon and its light revealed a surprised and surprising elephant. The moral of the story being of course that we often perceive what we expect to perceive unless we are willing to approach experiences from differing viewpoints.

The journey within the internal world of this thesis will begin with a series of wars – in this case the *Science Wars* – with an analysis of their history from ancient Greece to the present. This is particularly relevant to considerations of the works of the major proponents of the dominant, or classical, scientific paradigm we have

² Richard Tarnas expressed this dichotomy as follows in an interview with Jack London (2006): “How we approach reality is defined by the kinds of assumptions we have about that reality, and that, in turn, shapes reality and feeds it back to us. The subject and object are deeply implicated in each other,” (p.3)

³ David Bohm (in Factor 1985) referred to this process as “...a pool of common meaning which is capable of constant development and change.” (p. 175)

inherited – Plato, Aristotle, Descartes and Newton. The importance of the complexity sciences are then explored in relation to the range of perceptions we might bring to the processes of scientific inquiry. I will argue that a new paradigm has arisen out of concurrent advances in the complexity sciences and the postmodernist movement that is conceptually both opposed to and opposed by the classical paradigm. Two important examples of reactive measures from scientists to both attack the new paradigm and to protect the modern or classical paradigm are examined. Also, the rationales for the adoption of the new paradigm are analysed at length, together with some consequences for research. The next stage of the journey examines five central dimensions of the human processes of inquiry and their impact on our relationship with the world: the formation of beliefs, the creative process, perceptions, metaphysics and communication. In each case the problematic nature of the concept of the objective observer is emphasised. Following this, we will visit four illustrative examples of where a monoparadigmatic approach to the processes of scientific inquiry has, I will argue, led to a clear mis-identification of the phenomenon studied in each case. I have called this effect *paradigmatic blindness*. The penultimate stop introduces the concepts of the *superparadigm* and the *metaparadigm*. This Chapter details the theoretical models for what I see as the history of scientific inquiry as well as presenting a model for an emerging, new and dominant paradigm. Finally, the thesis shall arrive back where it started and illustrate the theme and central arguments in relation to the experiences encountered along the way. It seems clear that scientific inquiry shall be profoundly changed by the emergence of ideological plurality in what I have termed the metaparadigm.

One of the personal lessons I have taken from this journey is to be highly circumspect with regard to claims of certainty. It seems to me that no matter how well informed we might be, or what level of expertise we might have, we shall only ever be able to perceive a fraction of the metaphorical elephant encountered above. We are finite beings with limits to our abilities and faculties. Furthermore, the tools available to us, both conceptual and physical, make any full identification of the fraction of the whole we might perceive highly problematic. Indeed, this must be considered evidently so as otherwise there would be few disagreements between us – the answers to our questions would be clear and unambiguous. However, that is clearly not the case. Our history as an inquiring species has been, and continues to

be, overwhelmingly contentious. Being *right*, therefore, in a universalist sense, is not something I would claim. Certainly, the arguments I shall put forward in this thesis are subjectively right for me – they answer, both affectively and intellectually, the questions I have posed in relation to our quest for understanding. On the other hand, that does not mean that those answers are right for you, or indeed anybody else. What they do represent, though, is an opportunity and a method for exploring our relationship with both our internal and external realities. And that, I believe, is as important as any other pursuit we might involve ourselves in whatever answers we finally arrive at.

Nevertheless, the bit of the elephant I can feel is, I am keenly aware, only a portion of the whole and, when the moon comes out, I may find that it is a creeper after all. For that reason, there are some lighter moments in this thesis – although they are entirely relevant to the theme and arguments. Also, one of the propositions I shall advance is that continuous re-evaluation of our beliefs and assumptions from all perspectives is both inevitable and requisite as a profound paradigm change impacts on all aspects of our processes of inquiry.

Bon voyage.

CHAPTER ONE

THE SCIENCE WARS

“All scientific truths are necessarily and universally true and deal with the general not the particular. Human knowledge of these scientific truths is based on repeated sense experiences which reason allows a universal to form in the mind.”

Aristotle; Posterior Analytics⁴.

“What our mind grasps is in truth nothing reliable, but something subject to change according to the state of the body and that which comes up against it.”

Democritus; [B9]⁵

Thomas Kuhn introduced the concept of the scientific paradigm in nineteen sixty-two. Kuhn was concerned with changes in theoretical frameworks following the acquisition of information, or knowledge, that led to the replacement of one theory with another. He used the examples of a change from a geocentric to a heliocentric view of the solar system following the work of Copernicus, and the rejection of the concept of phlogiston after the discovery of oxygen by Lavoisier. In both these cases, the change in the relevant theories led to a reevaluation of a range of causes for phenomena. Kuhn referred to these changes as *revolutions*, or paradigm changes.

...scientific revolutions are here taken to be those non-cumulative developmental episodes in which an older paradigm is replaced in whole or in part by an incompatible new one. (1962)

For Kuhn, therefore, one scientific paradigm was always replaced, wholly or in part, by another – two paradigms could not coexist. Further, a paradigm could not by definition be the provenance of an individual, but rather a community – in this case, either the whole scientific community or a significant portion of it. Kuhn was therefore highlighting the essential role that collective beliefs, or accepted conventions of thought, play in the formation of scientific paradigms. In the examples cited above, the beliefs in an earth-centred solar system and that flames were an element were replaced or superseded. In Kuhn’s terms, these *revolutions* in scientific thought represented paradigmatic shifts from one set of theoretical

⁴ In “Quotable Quotes” <http://www.creatorix.com.au/philosophy/t02/t02b.html>

⁵ Quoted in <http://web.mit.edu/wedgewood/www/teaching/ancient97/protogoras.html>

frameworks to another. In both cases, the old and the new theories could not coexist as accepted or conventional scientific wisdom for they contradicted one another.

Kuhn went on to extend this concept to the conventions of thought and action that generically guide scientific activity at any point in history. This definition of the paradigm refers to what may be considered scientific and what not, what methodologies are accepted, and what are legitimate problems to be explored as well as what solutions may be tended. As Kuhn put it: “In learning a paradigm the scientist acquires theory, methods, and standards together, usually in an inextricable mixture.” (1962). This form of the scientific paradigm is therefore cultural in origin and is learnt by association with others in the scientific community, together with the products of their work. It is this second definition of the scientific paradigm that I am primarily concerned with in this thesis.

This Chapter will explore the emergence of what I see to be as the dominant scientific paradigm - or convention for scientific inquiry - in the western tradition, referred to variously as classical, modern, determinist, reductionist or positivist. Although some commentators draw distinctions between these sub-groupings, I will be using these terms interchangeably. I will argue that all may be grouped together under the umbrella of the one distinct paradigm that had its genesis in first century BCE Athens. Also, I will begin the process of highlighting the paradox in the classical paradigm that is undermining its dominance, and discuss a competitor – the postmodern paradigm.

The Competing Paradigms

It is the case that until very recently scientific inquiry had, since the development of ‘modern’ methodologies in the seventeenth century (Nadeau and Kafatos, 1999; Pigliucci, 2000), acquired an instantly recognisable language and form. Research projects hypothesised, analysed and concluded; articles or papers proposed, analysed and concluded. The use of references, quotes and bibliographies was a given, the use of the third person expected (Breuer et al 2002) – as was the use of the English language. The writing styles and topics might be legion, but the form remained relatively constant.

The last few decades of the twentieth century, however, have seen the emergence of challengers to this hegemony⁶. Writers and commentators have questioned the accepted conventions and developed new forms (Foucault, 1970 and 1972; Kincheloe, 1997). Both the postmodernist focus on the subjectivity of our interpretation of phenomena and the new complexity sciences are two faces of this sea change in theory and research practices. However, before moving on to a consideration of these changes, or indeed before they can be fully understood, it is important to review the work of the originators of the modern scientific method: Plato, Aristotle, René Descartes and Isaac Newton. It is the case that the principles expounded by Plato and Aristotle - and the rationales put forward for them - are identical to those adopted by Descartes and Newton over two millennia later. Furthermore, the same paradoxes inherent in the worldview encapsulated by the classical paradigm are explicitly recognised by Plato, Descartes and Newton. Each of these individuals approached attempts to resolve these paradoxes in differing ways, but they nevertheless remain identical in form. The longevity of these paradoxes may be attributed, I will argue in this thesis, to the fact that they represent fundamental and probably permanent dimensions of all forms of human inquiry, including the scientific. An exploration of their history is highly informative, for it not only clearly indicates why we have developed the classical scientific paradigm, but also why its supremacy may be open to challenge.

Plato and Aristotle

The Past is a foreign country. People do things differently there.

The Go Between, J.P. Hartley.

Over the last decade in particular we have been experiencing a new phase of a very old debate – a debate that can be traced back at least to the Athenian philosopher Plato in the fourth century BCE. In *Protagoras*, Plato (380 BCE) presented the

⁶ Antonio Gramsci's (1985) conception of "common sense" is of interest here: "Common sense is not something rigid or stationary, but is in continuous transformation, becoming enriched with scientific notions and philosophical opinions that have entered into common circulation. 'Common sense' is the folklore of philosophy and stands midway between folklore proper (folklore as it is normally understood) and the philosophy, science and economics of the scientists. Common sense creates the folklore of the future, a relatively rigidified phase of popular knowledge in a given time and place." (p. 421). The emergence of a changing set of meanings attached to concepts of scientific/philosophical discourse, not just in popular culture as described here, but also in the "folklore" of science - or the notions and opinions held by scientists about science - are a central theme of this thesis.

philosophers Protagoras and Socrates as opponents in a debate over the efficacy of their approaches to philosophy. On the one hand Protagoras was a self-professed sophist who built his arguments on an initial premise. Socrates utilised a debating technique that trapped the adversary in logical contradictions. Plato presented Socrates as the eventual winner of the interchange, but in fact the debate is well and truly alive nearly two and a half millennia later.

Protagoras argued against the concept of an objective truth. He proposed that all phenomena were perceived subjectively.

Of all things the measure is Man, of the things that are, that they are, and of the things that are not, that they are not. (c460 BCE; quoted in Hyland, 1973)

Plato, on the other hand, argued that there existed ideal forms that had a separate existence from the perceiver.

In my opinion, the ideas are, as it were, patterns fixed in nature, and other things are like them, and resemblances of them - what is meant by the participation of other things in the ideas, is really assimilation to them. (Parmenides, 373 BCE).

Plato proposed that these fixed idealistic forms had been created by a supreme being – a god. Protagoras questioned the very existence of gods.

About the gods, I am not able to know whether they exist or do not exist, nor what they are like in form; for the factors preventing knowledge are many: the obscurity of the subject, and the shortness of human life. (c460 BCE; quoted in Hyland, 1973).

Protagoras can therefore be seen as the archetypical sceptic questioning the assumptions and the beliefs of his age. Plato, on the other hand, supported the dominant theological paradigm of his society – a belief in a supreme god and a pantheon of gods and a perfection of form beyond the material world. For Plato, the philosopher's role was to attain an understanding of these idealistic forms.

Let us suppose that philosophical minds always love knowledge of a sort which shows them the eternal nature not varying from generation and corruption. (The Republic, 360 BCE).

Plato also detailed how philosophical reasoning could achieve this goal. Importantly for later commentators on the processes of scientific inquiry, Plato prefigured both the Cartesian and the opposing postmodern assumptions: that, on the one hand, truth may be attained through the application of reason in a series of logical steps, but that also, paradoxically, this process is both self-contained and circular, bounded by the nature of discourse.

And when I speak of the other division of the intelligible, you will understand me to speak of that other sort of knowledge which reason herself attains by the power of dialectic, using the hypotheses not as first principles, but only as hypotheses - that is to say, as steps and points of departure into a world which is above hypotheses, in order that she may soar beyond them to the first principle of the whole; and clinging to this and then to that which depends on this, by successive steps she descends again without the aid of any sensible object, from ideas, through ideas, and in ideas she ends. (The Republic, 360 BCE).

Just ten years later, Aristotle proposed a refinement to Plato's approach to scientific inquiry that was to have such an impact on the development of science that it still drives the dominant paradigm today. Aristotle believed in reducing phenomena to first principles and building an understanding on the base elements of those phenomena. In this, he preceded Descartes and Newton – both of whom proposed the same model - by over two thousand years.

When the objects of an inquiry, in any department, have principles, conditions, or elements, it is through acquaintance with these that knowledge, that is to say scientific knowledge, is attained. For we do not think that we know a thing until we are

acquainted with its primary conditions or first principles, and have carried our analysis as far as its simplest elements. Plainly therefore in the science of Nature, as in other branches of study, our first task will be to try to determine what relates to its principles. (Physics, 350 BCE)

Thus Protagoras was defeated and silenced by history and the paradigm for scientific inquiry set until the second half of the twentieth century when the nature of discourse again became central to the debate. Then, suddenly, the ghosts of Protagoras' ideas were resurrected by the postmodernists and his sophistry again troubled the adherents to the Platonic ideals – the positivistic scientists of our age. In the mid nineteen-nineties the old enmities erupted into open conflict as a small flood of texts and articles criticising, respectively, positivism and postmodernism and their adherents were written and published. This phenomenon came to be known as *The Science Wars*.

To understand the genesis of this outbreak of hostilities it is necessary to move forward two thousand years to seventeenth century Europe. However, before analysing the scientific philosophies of Descartes and Newton it is important to note that Plato struggled with the paradoxes in his position throughout his writings. Thus, he would illustrate an example of an abstract reality as follows:

I may illustrate my meaning in this way, said Parmenides: A master has a slave; now there is nothing absolute in the relation between them, which is simply a relation of one man to another. But there is also an idea of mastership in the abstract, which is relative to the idea of slavery in the abstract. These natures have nothing to do with us, nor we with them; they are concerned with themselves only, and we with ourselves. (Parmenides, 373 BCE)

And follow this immediately with an apology to subjectivity:

And will not knowledge-I mean absolute knowledge-answer to absolute truth?

Certainly.

And each kind of absolute knowledge will answer to each kind of absolute being?

Yes.

But the knowledge which we have, will answer to the truth which we have; and again, each kind of knowledge which we have, will be a knowledge of each kind of being which we have?

Certainly.

But the ideas themselves, as you admit, we have not, and cannot have?

No, we cannot.

And the absolute natures or kinds are known severally by the absolute idea of knowledge?

Yes.

And we have not got the idea of knowledge?

No.

Then none of the ideas are known to us, because we have no share in absolute knowledge?

I suppose not.

Then the nature of the beautiful in itself, and of the good in itself, and all other ideas which we suppose to exist absolutely, are unknown to us?

It would seem so.

(Parmenides, 373 BCE)

For Plato, the abstract world of ideals was inaccessible to human beings. Nevertheless, this world was an article of faith for Plato, and for him this knowledge was self-evident.

And are not those who are verily and indeed wanting in the knowledge of the true being of each thing, and who have in their souls no clear pattern, and are unable as with a painter's eye to look at the absolute truth and to that original to repair, and having perfect vision of the other world to order the laws about beauty, goodness, justice in this, if not already ordered, and to guard and

preserve the order of them - are not such persons, I ask, simply blind? (The Republic, 360 BCE)

Plato never resolved this impasse and left it as a legacy for both Descartes and Newton. Indeed, both the latter scientists adopted the Platonic ideal complete with its inherent fallacy and utilised exactly the same metaphysical argument to support their positions. However, both scientists chose to ignore Plato's relativistic arguments – the concept that knowledge and truth are subjective.

...you cannot rightly call anything by any name, such as great or small, heavy or light, for the great will be small and the heavy light - there is no single thing or quality, but out of motion and change and admixture all things are becoming relatively to one another, which "becoming" is by us incorrectly called being, but is really becoming, for nothing ever is, but all things are becoming. (Theaetetus, 360 BCE)

Further, Plato did consider the subjectivity of the process of perception which is central to any subsequent postmodern argument for the subjectivity of the processes of discourse.

Socrates. Then now apply his doctrine to perception, my good friend, and first of all to vision; that which you call white colour is not in your eyes, and is not a distinct thing which exists out of them. And you must not assign any place to it: for if it had position it would be, and be at rest, and there would be no process of becoming.

Theaetetus. Then what is colour?

Soc. Let us carry the principle which has just been affirmed, that nothing is self-existent, and then we shall see that white, black, and every other colour, arises out of the eye meeting the appropriate motion, and that what we call a colour is in each case neither the active nor the passive element, but something which passes between them, and is peculiar to each percipient;

are you quite certain that the several colours appear to a dog or to any animal whatever as they appear to you?

Theaet. Far from it.

Soc. Or that anything appears the same to you as to another man? Are you so profoundly convinced of this? Rather would it not be true that it never appears exactly the same to you, because you are never exactly the same?

Theaet. The latter.

Soc. And if that with which I compare myself in size, or which I apprehend by touch, were great or white or hot, it could not become different by mere contact with another unless it actually changed; nor again, if the comparing or apprehending subject were great or white or hot, could this, when unchanged from within become changed by any approximation or affection of any other thing. The fact is that in our ordinary way of speaking we allow ourselves to be driven into most ridiculous and wonderful contradictions, as Protagoras and all who take his line of argument would remark. (Theaetetus, 360 BCE)

Thus, Plato fully understood the subjective nature of knowledge but made a metaphysical appeal to the abstract, unproven and unprovable concept of the ideal form. Descartes and Newton, however, chose to endorse the latter and ignore the former.

René Descartes

The philosopher and mathematician René Descartes was born in 1596 in Touraine, France. His influence on the course of scientific inquiry has been perhaps greater than any other individual before or since. Descartes both formulated the empiricist approach to research and established mathematics as the medium through which research should be undertaken. It may therefore be said that the modern principles of scientific inquiry originated with Descartes.

Right from the beginning, Descartes (1637) clearly identified the motivation for his methodology:

...as soon as I had acquired some general notions respecting physics, and beginning to make trial of them in various particular difficulties, had observed how far they can carry us, and how much they differ from the principles that have been employed up to the present time, I believed that I could not keep them concealed without sinning grievously against the law by which we are bound to promote, as far as in us lies, the general good of mankind. For by them I perceived it to be possible to arrive at knowledge highly useful in life; and in room of the speculative philosophy usually taught in the schools, to discover a practical, by means of which, knowing the force and action of fire, water, air the stars, the heavens, and all the other bodies that surround us, as distinctly as we know the various crafts of our artisans, we might also apply them in the same way to all the uses to which they are adapted, and thus render ourselves the lords and possessors of nature.

Descartes stated intention was the “general good of mankind”, or as he perceived it, to become “the lords and possessors of nature”. An understanding of physical phenomena would lead to an ability to manipulate and therefore control them⁷.

Importantly, Descartes argued for the deployment of reason, or the intellect, in the exploration of the physical environment. He drew a crucial distinction between imagined and objective phenomena and laid the groundwork for the application of deductive reasoning to the establishment of objective “truths”. For this pursuit, he articulated three principles:

The first was never to accept anything for true which I did not clearly know to be such; that is to say, carefully to avoid precipitancy and prejudice, and to comprise nothing more in

⁷ An interesting variation on this drive to control phenomena has emerged in recent research into complexity and that is a series of attempts to predict and control chaotic systems in the processes of destabilisation or change. Such attempts may be seen as an application of the linear paradigm to non-linear systems. Not surprisingly, research by Casaubon (2002) indicates the low probability of success for these attempts.

my judgement than what was presented to my mind so clearly and distinctly as to exclude all ground of doubt.

The second, to divide each of the difficulties under examination into as many parts as possible, and as might be necessary for its adequate solution.

The third, to conduct my thoughts in such order that, by commencing with objects the simplest and easiest to know, I might ascend by little and little, and, as it were, step by step, to the knowledge of the more complex; assigning in thought a certain order even to those objects which in their own nature do not stand in a relation of antecedence and sequence. (1637)

The importance of these principles to the development of Western scientific inquiry cannot be overstated. The concepts of veracity testing, the examination of phenomena through their constituent elements, the construction of theoretical frameworks of the whole based on an understanding of the parts, and the proposition of the objective observer are all presumed here just as they are by positivists today. Descartes' great contributions to the evolution of industrial and post-industrial civilisation were the formulation of, and justification for, the concept of man the controller of nature and the establishment of the practical and paradigmatic tools that could be used to achieve that control. Virtually all scientific inquiry up until the end of the twentieth century explicitly owes its provenance to Descartes' principles.

The proposition that mind is separate from the body – or could have a separate existence from the body - was maintained by Descartes throughout his works. His rationale for this included a referral to God the “perfect being” who had required this facility in humankind. The divine nature of this gift was, for Descartes, central for how could a perfect being create imperfection? For Descartes, it followed that if mind was God given, then it could used to identify truth.

...as I observed that in the words I think, therefore I am, there is nothing at all which gives me assurance of their truth beyond this, that I see very clearly that in order to think it is necessary to exist, I concluded that I might take, as a general rule, the

principle, that all the things which we very clearly and distinctly conceive are true...(from the Veitch, 1901, translation).

This proposition has been at the heart of the reductionist perspective: we are rational and objective beings who may, through the force of intellect, and the application of positivist theoretical and research frameworks, discover all truths. Descartes has been both praised and vilified for his views, but that he did not immediately identify the paradoxes inherent in them has often been ignored.

...however, that there is some difficulty in rightly determining the objects which we distinctly conceive. (Veitch translation, 1901)

And also:

...if there be still persons who are not sufficiently persuaded of the existence of God and of the soul, by the reasons I have adduced, I am desirous that they should know that all the other propositions, of the truth of which they deem themselves perhaps more assured, as that we have a body, and that there exist stars and an earth, and such like, are less certain; for, although we have a moral assurance of these things, which is so strong that there is an appearance of extravagance in doubting of their existence, yet at the same time no one, unless his intellect is impaired, can deny, when the question relates to a metaphysical certitude, that there is sufficient reason to exclude entire assurance, in the observation that when asleep we can in the same way imagine ourselves possessed of another body and that we see other stars and another earth, when there is nothing of the kind. For how do we know that the thoughts which occur in dreaming are false rather than those other which we experience when awake, since the former are often not less vivid and distinct than the latter? (Veitch translation, 1901)

Thus, we may be the arbiters of truth but it is difficult to justify our objectivity. Similarly, experiences that are patently “untrue”, as in dreams, may appear to us to be vivid and real. Descartes’ scepticism, or doubts, over this issue exasperated many other philosophers who followed him, including David Hume. In his *Enquiry Concerning Human Understanding* (1748) Hume noted,

The Cartesian doubt, therefore, were it ever possible to be attained by any human creature (as it plainly is not) would be entirely incurable; and no reasoning could ever bring us to a state of assurance and conviction upon any subject. (p. 172)

However, despite Hume’s protestations Descartes had identified a crucial dilemma for which he had no answer beyond an appeal to the divine nature of God. He thus established this assumption as a statement of faith masquerading as a statement of “truth”.

And in the little I have said I think I have summed up all that I really know, or at least all that up to this time I was aware I knew. Now, as I am endeavoring to extend my knowledge more widely, I will use circumspection, and consider with care whether I can still discover in myself anything further which I have not yet hitherto observed. I am certain that I am a thinking thing; but do I not therefore likewise know what is required to render me certain of a truth? In this first knowledge, doubtless, there is nothing that gives me assurance of its truth except the clear and distinct perception of what I affirm, which would not indeed be sufficient to give me the assurance that what I say is true, if it could ever happen that anything I thus clearly and distinctly perceived should prove false; and accordingly it seems to me that I may now take as a general rule, that all that is very clearly and distinctly apprehended (conceived) is true. (Veitch translation, 1901).

What Descartes believes is true or false is bounded only by his own belief, or perception, that it is true or false. Descartes never resolved the “difficulties” of his position. Indeed, the very same concerns are at the heart of the current debate over the efficacy of the modern and postmodern paradigms – the objective/subjective paradox. In this, Descartes foreshadowed the postmodern position by over three hundred and fifty years.

Nevertheless I before received and admitted many things as wholly certain and manifest, which yet I afterward found to be doubtful. What, then, were those? They were the earth, the sky, the stars, and all the other objects which I was in the habit of perceiving by the senses. But what was it that I clearly [and distinctly] perceived in them? Nothing more than that the ideas and the thoughts of those objects were presented to my mind. And even now I do not deny that these ideas are found in my mind. But there was yet another thing which I affirmed, and which, from having been accustomed to believe it, I thought I clearly perceived, although, in truth, I did not perceive it at all; I mean the existence of objects external to me, from which those ideas proceeded, and to which they had a perfect resemblance; and it was here I was mistaken, or if I judged correctly, this assuredly was not to be traced to any knowledge I possessed...(Veitch translation, 1901).

His “objective” perceptions were “nothing more than that the ideas and the thoughts of those objects (that) were presented to my mind”, and our certainties about external phenomena can be entirely fallacious. Descartes could only assert that his perceptions had a “perfect resemblance” to external phenomena because God created both himself and all other phenomena. The logical absurdity in this position may be clear to the more secular thinkers of the twenty-first century, but they were part of the metaphysical conventions of Descartes’ time. Indeed, their adoption may well have been pragmatic as well. The power of the Church reached into every aspect of scientific life – Galileo, for example, was forced to recant during the time Descartes was writing his treatises. An appeal to the perfection of God and God as

the creator of all, including human knowledge, was de rigeur for intellectuals in Europe in the seventeenth century. Nevertheless, the same logical paradox underlies the current assumption that the positivist model for scientific inquiry is self-evidently “objective” and can therefore by definition reveal the “truth”, for the problematic nature of the subjective scientist remains. I would argue that this is a crucial observation in the context of the modern/postmodern divisions that are being experienced in the scientific community, and it will be explored at length in this thesis. Descartes could invoke the aid of God in this debate. Most scientists now do not or are not required to by a politically powerful Church. Rather, there is an appeal to the self-evident nature of these processes of inquiry and their products. It is precisely the fallacy in this assumption that the postmodernists have attacked.

Rene Descartes codified (the) philosophical idea of the importance, the uniqueness of the human mind that led to a widespread dualism in the actual approach to understanding the world. It is but a short step from the idea of mind-body dualism to man-cosmos dualism, and the distinction between subjective and objective knowledge. (Bradbury, 1998, p. 2)

Exactly fifty years later Isaac Newton published another and equally important exposition of the Platonic ideal.

Newton: the Fallible Genius

The clean serene equations of Newton’s physics were just not reachable from the messiness of biology until the idea grew that the messiness might merely be statistical noise masking an ideal process or parameter, much as measurement error or noise in physics masks the true value. Such a Platonic view of living things...is instantly commensurate with the essentially platonic physics of Newton...This sort of experimental biology depends utterly on the use of mathematical statistics, and on the mindset that goes with it...From there, in the early years of this (twentieth) century, it moved across to the ‘experimental’ social sciences. (Bradbury, 1998, p.4)

A review of Isaac Newton's *Principia*, his seminal work on research methodology, is revealing in any analysis of scientific paradigms. In the *Principia*, Newton constructs an elegant, logical sequence such that if the first premise is accepted all others that follow must also be allowed. For example, if it is accepted that the motions of falling bodies may be perfectly represented and predicted by geometric models, then Newton's extrapolation to the bodies in the solar system must also be allowed – for the assumption has been accepted that the model is “perfect” or exact. However, a fundamental issue arises if the initial premise is incorrect. If there are even minor variations in measurements of falling bodies then the assertion that their motion may be described utilising geometric models with perfect accuracy is fallacious. As will be discussed later⁸, this has proved to be the case. Thus, Newton may be said to be describing an imaginary and idealised model for exploring phenomena and therefore also an idealised conception of all phenomena. Newton was indeed aware of this issue, but dismissed it as an equipment problem. The following is an excerpt from Newton's description of his colliding pendulum experiments:

Thus trying the thing with pendulums of ten feet, in unequal as well as equal bodies, and making the bodies to concur after a descent through large spaces, as of 8, 12, or 16 feet, I found always, without an error of 3 inches, that when the bodies concurred together directly, equal changes towards the contrary parts were produced in their motions, and, of consequence, that the action and reaction were always equal....By the congress and collision of bodies, the quantity of motion, collected from the sum of the motions directed towards the same way, or from the difference of those that were directed towards contrary ways, was ever changed. For the error of an inch or two in measures may be easily ascribed to the difficulty of executing everything with accuracy. It was not easy to let go the two pendulums so exactly together that the bodies should impinge one upon the other in the lowermost place...nor to mark the

⁸ See the discussion on pendulums, page 50.

places...to which the bodies ascended after congress. Nay, and some errors, too, might have happened from the unequal density of the parts of the pendulous bodies themselves, and from the irregularity of the texture proceeding from other causes. (1687)

The assumption is that if the experimental conditions could be perfectly controlled, then the results would perfectly obey geometric principles. In this Newton has claimed the same position later developed by Laplace (1825) – that finer control and finer measurements will allow more accurate descriptions and an increasingly greater understanding of the whole until a perfect understanding is achieved. As is clear, however, the same conceptual paradox applies - this is an ideal that can never be achieved, as there will always be an error factor, no matter by how much it may be diminished. Thus, the models based on the premise can never be “proved” to be universal descriptions of phenomena. This assertion is a leap of faith – a belief – and not necessarily a self-evident law that may be applied to the processes of scientific inquiry.

Further, Newton was postulating in his hypotheses a system that utilised perfectly spherical bodies with consistent density and reflexivity. In fact, no such bodies can possibly exist. There will always be variations in density, composition and elasticity no matter how controlled their production might be. Such structures do not exist in nature - and even if they did, or we could manufacture them, advances in quantum mechanics indicate that it may not be automatically assumed that these perfect bodies would obey Newton’s laws even then. Rather, at the atomic and sub-atomic levels there can be no such thing as certainty (Heisenberg, 1959).

Again, Newton was aware of the problem of idealisation, but again dismissed it.

But if the bodies are either not spherical, or, moving in different right lines, impinge obliquely one upon the other, and their motions after reflexion are required, in those cases we are first to determine the position of the plane that touches the concurring bodies in the point of concourse; the. The motion of each body.....is to be resolved into two, one perpendicular to that plane, and the other parallel to it. This done, because the bodies act upon each other in the direction of a line

perpendicular to this plane, the parallel motions are to be retained the same after reflexion as before; and to the perpendicular motions we are to assign equal changes towards the contrary parts; in such manner that the sum of the conspiring and the difference of the contrary motions may remain the same as before. From such kind of reflexions also sometimes arise the circular motions of bodies about their own centres. But these are cases which I do not consider in what follows; and it would be too tedious to demonstrate every particular that relates to this subject. (1687)

Newton's assumption here is that apparent inconsistencies in measurement would be resolved if enough "tedious" effort were put into the experimental method. However, this remains an unsupported hypothesis. Indeed, rather than "tedious" we may now have to insert "impossible" for, as shall be detailed in the next Chapter, the complexity sciences have demonstrated that most dynamic systems do not conform to Newton's linear laws of motion. Many phenomena interact in ways that defy prediction. Furthermore, it has become clear that identifying the elements of a phenomenon does not necessarily lead to an understanding of the whole. A good example here is the weather. Every aspect of a weather system can be identified and measured and still leave us unable to predict what that system is going to do⁹. Similarly, the fact that highly complex phenomena arise from the interactions of simpler systems – atoms from particles, molecules from atoms, living systems from molecules, consciousness from life, and so on – is not consistent with Newton's premise¹⁰.

This is not to say that Newton's laws and scientific methods are not appropriate tools for the exploration of many phenomena. On the contrary, they are profound both in their utility and in the impact they have had on the world we inhabit. It is the case that many phenomena exhibit, on average, linear properties at the macro level. Pendulums have already been discussed, and the same may be said of many other

⁹ See Chapter 4 for a more detailed examination of this point.

¹⁰ And indeed engender a questioning of some of the basic premises of the western scientific tradition: "Inevitably such questions led to the question of why many systems appear to defy the second law of thermodynamics. Why does entropy not increase in living systems? And why do clouds of interstellar gas condense into stars?" (Green and Newth, 2001).

systems where the descriptions developed involve primarily mathematical measurement - velocity, time, temperature, direction and so on. Thus, the melting and freezing points of elements at various pressures can be measured with a high degree of accuracy, as can chemical reactions, which allow the consistent creation of the materials we use in our industries, buildings, power stations and vehicles. The application of Newton's basic premise has led to the creation of both the industrial and post-industrial states. However, many phenomena exhibit non-linear properties at the micro level – pendulums again, heart rhythms, planetary orbits – and others never exhibit linear properties at any level including weather systems, the rise and fall of populations, stock market movements, the flow of fluids, and the movement of gas molecules (Gleick, 1987). Newton's approach to research into and descriptions of phenomena may therefore be seen to be useful and pertinent in some systems and within certain limits. It cannot, on the other hand, be considered a universal prescription for all research methodologies in all circumstances and for all phenomena, as Newton claimed. Explorations into phenomena that do not conform to Newton's idealised conception of the universe – whether or not through some averaging effect at the macro level – have required the development of a new paradigm and new tools. As will be discussed in Chapter Two, these advances have arisen out of quantum mechanics, the complexity sciences and postmodernism.

Indeed, it is worth noting here that I believe Newton would have applauded these initiatives. Below is his fourth, and last, rule for scientific inquiry (or “reasoning in philosophy”).

In experimental philosophy we are to look upon propositions collected by general induction from phænomena as accurately or very nearly true, notwithstanding any contrary hypotheses that may be imagined, till such time as other phænomena occur, by which they may either be made more accurate, or liable to exceptions. (1687)

Therefore, if it is the case that the “other phænomena” have occurred and the exceptions identified, we must follow Newton's admonishment in his note to the fourth rule:

This rule we must follow, that the argument of induction may not be evaded by hypotheses. (1687)

And, where appropriate, adopt new methodologies and theoretical frameworks. It is these initiatives and their consequences for the processes of scientific inquiry that will be explored throughout this thesis.

Newton's genius was to formulate and articulate a research methodology that would change his world and lead inevitably to the world we know. Furthermore, that methodology may always be relevant to some phenomena in some circumstances. However, Newton, like all men and women, was subject to his personal and his society's preconceptions. As with Descartes, who Newton acknowledges in the *Principia*, the conception of the perfect God was at the centre of his thinking. This is no more clearly demonstrated than in this passage:

This most beautiful system of the sun, planets, and comets, could only proceed from the counsel and dominion of an intelligent and powerful Being. And if the fixed stars are the centres of other like systems, these, being formed by the like wise counsel, must be all subject to the dominion of One; especially since the light of the fixed stars is of the same nature with the light of the sun, and from every system light passes into all the other systems: and lest the systems of the fixed stars should, by their gravity, fall on each other mutually, he hath placed those systems at immense distances one from another. (1687)

The "beautiful system", perfect and perfectly described by mathematics, must be the creation of God. Everything is arranged in perfection through the will of God. We now know, of course, that the stars are not fixed, that planets, stars, solar systems and galaxies frequently collide, and that, towards the centres of the galaxies, the stellar separations are not astronomically great. The nature of Newton's faith dictated his vision of existence and the development of his "universal" rules for science.

Newton's third rule states that:

The qualities of bodies, which admit neither intension nor remission of degrees, and which are found to belong to all bodies within the reach of our experiments, are to be esteemed the universal qualities of all bodies whatsoever. (1687)

It is in an unquestioning adherence to this rule that many commentators have committed Newton's logical error of ascribing, or "universalising", the qualities of one system to those of another. The major and most pertinent example here is the assumption that methodologies developed in the natural sciences may be applied to the social sciences. As will be detailed later in this thesis, linear methodologies are almost always inappropriate for the exploration of social phenomena. Thus, "observations" or measurements of phenomena cannot necessarily be universalised to include all phenomena, as Newton contended. This may be demonstrated through an examination of an extract from Newton's notes to his third rule.

...that the divided but contiguous particles of bodies may be separated from one another, is matter of observation; and, in the particles that remain undivided, our minds are able to distinguish yet lesser parts, as is mathematically demonstrated. But whether the parts so distinguished, and not yet divided, may, by the powers of Nature, be actually divided and separated from one another, we cannot certainly determine. Yet, had we the proof of but one experiment that any undivided particle, in breaking a hard and solid body, offered a division, we might by virtue of this rule conclude that the undivided as well as the divided particles may be divided and actually separated to infinity. (1687)

This proposition, while logically coherent, always leads to a logical absurdity. One experiment does not constitute proof of all cases. Neither does it follow that because a body may be broken in half that it may be divided an infinite number of times. The thought experiment put forward here certainly supports the thesis that bodies may be divided successively into smaller parts. It cannot, however, support

the proposal that this division has no limits. It is precisely the problems of limitation and universality that Newton fails to address in the Principia, choosing instead – as did Descartes before him - the metaphor of the perfect creator.

Unlike many postmodern commentators, I will not argue here that the problem with the classic paradigm for scientific inquiry is the lack of an inter-causal connection between theory and research and an external reality. On the contrary, as actors in the universe we inhabit we have a direct and immediate impact on both ourselves and all the bodies or phenomena we may reach with our hands or with the tools we have created. Thus, research into ballistics is likely to produce an efficient weapon with which we may reach out and interdict the lives of others. Similarly, research into the efficacy of drugs for the treatment of disease may well lead to medical advances and the more effective treatment of our illnesses. In any field in which measurement is the key to understanding phenomena and in the construction of artefacts, the physical creations of our civilisations, Newton's methodology may therefore always be one of the most pertinent and significant approaches to doing science. This is just as true of the exploration of the larger environment of our universe – through particle physics and astronomy, for example – as it is of the smaller environment of our planet, including our homes and workplaces. Few commentators would argue that trees, rocks, guns, cars and buildings have no extrinsic reality. Virtually no one would argue that a fall from a window or kicking a rock with a bare foot would not cause pain and damage to our bodies which is both real and measurable. Rather, the issue lies with the presumed correspondence between the paradigm, the underlying philosophy, and phenomena. Thus, an assumption that the classical methodology for scientific inquiry has a correspondence with the structure and nature of the universe is as unsupported today as it was in ancient Greece and in seventeenth century Europe. That it is an effective strategy is clearly the case – our world has been utterly changed by the scientific and engineering processes that have arisen directly out of the methodology postulated by Descartes and articulated by Newton. That linear methodologies can be used to effectively explore and describe complex and non-linear phenomena, however, remains an article of faith with no grounds for optimism in the foreseeable future.

Plato, Descartes and Newton were religious men who idealised the perfect creator and, in a leap of faith, assumed a perfected universe. Furthermore, all three assumed

that their intellectual tools for pursuing scientific inquiry were God given and therefore also perfect – or at least capable of perfection. Linear and reductionist models for research were assumed to be the way to explore phenomena because, as Newton declared in the Principia, it was held that God prefers the simple solution.

...for Nature is pleased with simplicity, and affects not the pomp of superfluous causes. (1787)

Aristotle's influence is apparent here: not only may phenomena be reduced to their simplest elements, but the world is also a simple place that may be explored using simple methodologies. In many ways, the greatest surprise that arises out of an analysis of the history of the classical paradigm is that it survived so long as a coherent and uncontested conceptual framework, contrasted as it had to be against the incredible complexity and messiness of the world and the living systems that inhabit it. The world is not a simple place – it is irreducibly complicated. Yet, this idealistic vision of simplicity has driven the dominant scientific paradigm for two and a half thousand years¹¹.

The classical, or modern, paradigm for scientific inquiry thus presupposes both a simple and a simplistic view of phenomena. However, the situation became complicated, both literally and figuratively, with the emergence of quantum mechanics in the early twentieth century.

¹¹ The significance of the inertia exhibited by belief systems and its importance in the formation and maintenance of paradigms is explored in Chapter 5.

CHAPTER TWO

QUANTUM MECHANICS, COMPLEXITY AND POSTMODERNISM

Considerations of complex phenomena have been extant since Plato. However, the particular focus on complexity as a new science may be traced to the emergence of quantum mechanics in the nineteen twenties and thirties. Before then, the Newtonian paradigm was paramount – measurement was the key to understanding the universe; cause and effect were directly linked and linear in nature; mathematics was the medium of expression (or even the language of God as some scientists, including Newton, contended); and complete and accurate prediction of future events depended only on our ability to accurately describe the past.

Quantum physicists changed that comfortable vision of existence. Niels Bohr (1949) and Werner Heisenberg (1959) in particular debated the efficacy of this paradigm. Almost overnight the concept of an orderly, measurable and predictable universe was shaken to its core. The term “uncertainty” became ubiquitous; electrons could act as particles or waves and at the same time; the position or velocity of sub-atomic particles could be ascertained, but not both at once; an electron in an atom occupied a cloud of potentiality not one position or orbit – in fact, could possibly exist anywhere in the known universe. The conception of an atom as a mini solar system with its orderly electrons spinning neatly around the nucleus so recently established by Ernest Rutherford (1911) was gone. This universe was “anti-intuitive”; it did not make logical sense.

Albert Einstein and Niels Bohr conducted a long and ultimately unresolved debate on the paradoxes presented by quantum mechanics (Nadeau and Kafatos, 1999). On the one side Bohr would present theoretical frameworks to support his position, and Einstein would attempt to debunk them through a series of notable thought experiments (Bohr, 1949). Long after the death of both protagonists, that debate is still current. Although quantum mechanics is accepted almost universally by theoretical physicists as a viable descriptor of matter and energy, the methodologies we may use to explore the universe and our place in it are a matter of considerable debate. The universe has turned out to be a much more complex place than Isaac

Newton ever imagined and the tools we need to describe it are just as difficult to conceptualise, create and utilise.

The establishment of a concept of the universe as complex rather than linear and mechanistic very soon had an effect on scientists and commentators from fields far removed from physics. A paradigm shift occurred that changed perceptions of phenomena across the whole scientific spectrum, including the so-called soft sciences – education, social science, economics, psychology and so on. From the nineteen-fifties onwards theorists and practitioners began to consider their fields of interest through a different lens. Instead of looking for simple cause and effect relationships, complex interactions were perceived. The genie was out of the bottle and scientific inquiry would never be able to force it back in again (Cohen, 1985). Sechrest and Figueredo (1993) describe this shift graphically and picturesquely as follows:

...researchers were mentally prepared by the dominant Newtonian paradigm of social science for a bold exploration of the icy depths of interplanetary space. Instead, they found themselves completely unprepared for the tropical nightmare of a Darwinian jungle: A steaming hell, where everything is alive and keenly aware of you, most things are venomous and poisonous or otherwise dangerous, and nothing waits passively to be acted upon by an external force. (p. 648).

Just as importantly, the concept of a logical and objective rationality as a tool for developing descriptors of phenomena was brought under question. The very basis of the classical scientific paradigm of inquiry was undermined by the anti-intuitive nature of elementary particles and complex systems. The conceptual tools that had served the dominant paradigm so well for millennia seemed impotent in these contexts. It seemed that many phenomena, far from being simple and describable by simple tools, were in fact so complex that they might always defy our attempts to control or predict them (Waldrop, 1982; Gleick, 1987).

Inevitably, all aspects of the processes of inquiry came under question as the effects of the emergence of this new paradigm impacted on the scientific community. Crucially, the paradox of the subjective observer originally identified by Plato over

two millennia before was rediscovered in the nineteen-sixties and seventies and again became the focus of attention. Within a decade a new and powerful intellectual movement emerged that is becoming the major vehicle for the expression of the new paradigm. Driven mostly by left-wing European intellectuals, this movement became known as postmodernism and it is fundamentally changing the way many scientists are approaching both theory and research. As will be explored in some detail later in this thesis, the issue of the subjective observer cannot easily be dismissed. For that reason, many postmodern commentators and theorists have abandoned the assumption that research or inquiry can have any objective basis at all.

Postmodernists reject the idea that humanity perfects itself through the power of rational thought. Universals such as “truth” do not exist. (Tierney, 1997, p. 127)

And other scientists have openly come out of the subjectivist closet.

In their everyday scientific life almost all (experienced) researchers...“know” about the impact of personal and situational influences on their research work and its results. “Officially” and in publications these influences are usually covered up – they are treated as defaults that are to be avoided. (Breuer et al 2002, p. 1)

This change was not, and is not, universal. Rather, there are now two powerful paradigms at work in the scientific community and the tension between them has led some commentators to identify an “internal crisis of science” (Foster, 1998, p. 2). On the one hand, “classical” methodologies for scientific inquiry continue. Thus, replicable research projects investigate phenomena, statistical analyses of findings are undertaken and hypotheses proved or disproved on an agreed balance of probabilities. On the other hand, the new complexity sciences and the postmodernists have reversed this focus. Phenomena are being studied as wholes rather than a collection of parts, the examination of the interaction between variables has replaced the focus on the individual variables themselves and the context in

which these interactions take place (both culturally and individually) is considered an integral aspect of the process of inquiry. Furthermore, the major medium through which scientific inquiry is expressed – language - has become a central concern to many postmodernist researchers. The key issue here is that if “knowledge” and “truth” are subjective, then the expressed viewpoints, the *narratives*, of individuals are not only more important than what may be considered as redundant “objective” observations, but are in fact, by definition, the only valid observations that may be made. Roy Pugh (2000) has succinctly expressed this discursive and contextual approach to postmodern research:

...it proposes the designing of a tale that that invites the reader or partner in conversation or learning into the play of intelligence. It invites her to bring her intuition into the acting of play, to grasp the meaning in the subtle dimensions between the overlapping lines of language and metaphor that tell of traditions, interpretations and transformations. It appeals to the perceptive ability of her mind to see kinships in the weaving of narratives and to hear the messages of the tale and enrich its interpretations. (p. 263)

Within this approach, then, there is not one objective truth that may be accessed through the application of linear or reductionist methodologies, but almost an infinity of subjective truths, bounded only by the number of viewpoints held by human beings.

The move from a simple to a complex model of reality is clear – a paradigmatic shift in worldview that has led complexity scientists and postmodernists to see the universe as a very different place to that perceived by the scientists who preceded them. It needs to be noted here that each of these two sub-groups approach phenomena in entirely different ways for different reasons and with different conclusions. Indeed, I am sure that many members of each would object to the fact that I have grouped them together in this way. Nevertheless, the essential point to be made here is that it is the same fundamental change in perception that has led both

communities¹² to where they are in exploring the universe, whether or not the methodologies differ – and that is the recognition, implicitly or otherwise, of the apparently irreducible complexity of that universe. The postmodernist movement and quantum mechanics have taken this process on to the further extreme of immersing the scientist within these infinitely complex phenomena - as seeing the individual as inseparable from the phenomena being explored.

Gillot and Kumar (1998) see in the emergence of alternative approaches to scientific inquiry a “retreat from reason” (p. 140) and have mounted a spirited apology for the Newtonian paradigm. Much as Laplace (1825) contended nearly two centuries ago, Gillot and Kumar argue that a further clarification of information and processes will re-establish the prominence of the classical paradigm – that all we need is more reductionist application to the understanding of phenomena. For reasons I am elucidating in this thesis, this proposition is failing for the same reason that Laplace’s original theorem has failed – it is a simplistic and ultimately unattainable scientific goal. Rather, as Bradbury (1998) points out, the emergence of differing approaches to scientific inquiry may be viewed as an advance to reason.

What...both (experimental biology and social science) missed is that complexity matters. By concentrating on the search for the supposed underlying simplicity of the world, by reducing the manifest complexity of the observed whole into more manageable, simpler, and more fundamental parts, these two expeditions followed an essentially Renaissance path to a knowledge of man. They were deaf to Darwin’s call that the richness and diversity of life is the stuff of life itself. (p. 4)

Indeed, the emergence of a scientific paradigm that revolutionises research must surely be seen as very much part of the on-going development of scientific endeavour, as Alexander Styhre (2002) has noted:

¹² This is not to suggest that the postmodern community is homogenous – far from it. Alternative schools of thought are as numerous under the banner of postmodernism as they are within the positivist scientific community. I am concerned here with the paradigmatic bases for each rather than exploring the differing products of those paradigms. A more extensive analysis of the pluralist nature of the two scientific paradigms is contained in Chapter 8.

What is sacrificed in the affirmation of complexity theory is the ability to make linear predictions, but what is safeguarded is the authority of scientific research. (P.3)

Furthermore, as shall be detailed in this thesis, there are many opportunities presented to researchers and commentators to extend and enrich scientific inquiry through the emergence of this new paradigm. Certainly, just because systems and the tools needed to explore them may be considered complex rather than simple, this does not mean that inquiring into them is unscientific.

The approach of complex systems theory...is ineffably scientific. It is not some woolly, 'anything goes since everything is relative' belief system. While it does say there may not be simple answers to the way the world is, it does not say any answer is as good as any other. While it does say that we may not yet have the right answers, it also says that many answers – nonscientific answers – are just plain wrong. On all those issues it is as one with traditional science. It fully acknowledges its scientific patrimony. (Bradbury, 1998, p.5)

As has been noted previously, the classical paradigm implicitly avoids or ignores the variation from the ideal model or phenomenon – it presupposes, in effect, a process of inquiry that averages out observations or measurements. Thus, as Edward Green (2002) states, an essential element of the actual behaviour of the universe is disregarded:

...one's greatest enemy in the effort to reject the null hypothesis is error variance that defies all efforts at control. In the naive faith of determinism, one could always rationalize that if control were only more complete, residual variance would eventually vanish. (P.7)

Complexity in all its richness indicates that it is in this variance, or the "noise" as it is often called, that the most profound lessons for scientific inquiry may be found –

precisely the phenomenon that the classical paradigm insists has no value. The power that assumptions and/or conventions have to channel thought and activity is starkly highlighted here. The dominant paradigm contained as an article of faith Newton's belief that divergences from the ideal, linear model were an equipment problem and therefore could be ignored. Indeed, it is the classical paradigm that still dominates the enculturation of individuals who enter the natural sciences.

...in educating new physicists the first thing that we teach them is still good old Newtonian mechanics, and they never forget how to think in Newtonian terms, even after they learn about Einstein's theory of relativity. (Weinberg, 1998)¹³

As a consequence, the dynamic behaviours of complex systems remained invisible until an opposing paradigm changed the way phenomena were perceived. From that point on, complex systems, far from remaining invisible, were suddenly identified everywhere. From its inception in the nineteen-fifties, the science of complex systems has burgeoned to such an extent that it is becoming established as a major component of the processes of scientific inquiry. Further, as is being explored in this thesis, a focus on these phenomena has been and is being instrumental in the rejection or modification of the classical paradigm by many scientists and the development of new descriptions for our world and our place within it.

Few physics handbooks treat nonlinear oscillations in spite of the fact that they are more frequently encountered in the real world. The linear oscillations are a limiting case of nonlinear oscillations and they appear when the deviations from the equilibrium position are small. Linear systems are ideal models and their mathematical analysis is simple and the solutions are explicit. If the input is multiplied by a factor the output is multiplied by the same factor. These results are no longer valid for nonlinear systems. (Grosu 2000, p. 1)

¹³ Weinberg was using this statement as an attack on Thomas Kuhn's concept of paradigm change. However, as demonstrated here, the statement can be seen to support the premise rather than undermine it.

Indeed, an analysis of an apparently simple game of sport can graphically illustrate how new perspectives can lead to more thorough and effective descriptors of phenomena. Furthermore, an everyday or even mundane example such as that explored here raises the question as to what phenomena now may be considered to remain that can be effectively described by only utilising the classical linear, deterministic model. This issue, focussing as it does on the potential for applying different perspectives to the processes of scientific inquiry, will be a major concern within this thesis.

Cricket – A Lesson in Complexity

As the Australian team has just won the cricket world cup at the time of writing, and I am writing this thesis in Australia, I feel we should spend a session at the cricket. As will become apparent, however, this is definitely a working visit.

Cricket is a game that was invented in England, perhaps as early as the thirteenth century. In its modern form, it consists of two teams of eleven players. It is usually played on a round or oval field, or ground, with the outer edge of this ground being called the boundary. The ground is grass covered, with the grass cut short. One team places all eleven players on the ground, and is called the fielding side, and the other just two players at a time. These two players, referred to as batsmen in the male version of the game, are furnished with a specially shaped wooden club apiece, called a bat. In the centre, or close to the centre of the ground, is marked out a rectangular area called the pitch or wicket. At the either end and in the centre of the longer dimension of the pitch are placed three wooden sticks, called stumps, with their ends driven into the ground so that they stand upright. The distance between the two sets of stumps is always set at twenty-two yards. Each trio of stumps is arranged horizontal to the long axis of the pitch and exactly opposite the other. The three stumps are arranged close together as well so that in each case two smaller sticks called bails may be laid in line across the tops, resting in shallow grooves. The assembly of stumps and bails is also referred to as a wicket. White lines are marked out on the pitch and in front of and parallel to the stumps. Each of these lines is referred to as the crease. As the ground is usually about eighty metres across, the diagram on the next page is not to scale. The grass on the cricket pitch is mown down very low and the whole pitch is rolled with heavy equipment to achieve as even a surface as possible.

The one other essential piece of equipment in this game is the ball. The ball is round and is small enough to be held comfortably in one hand. It is constructed out of a hard cork, or cork-like, material covered with leather. The leather covering is tightly sewn on in two semi-hemispherical halves. The join between these two halves forms a straight, raised seam about two centimetres wide.

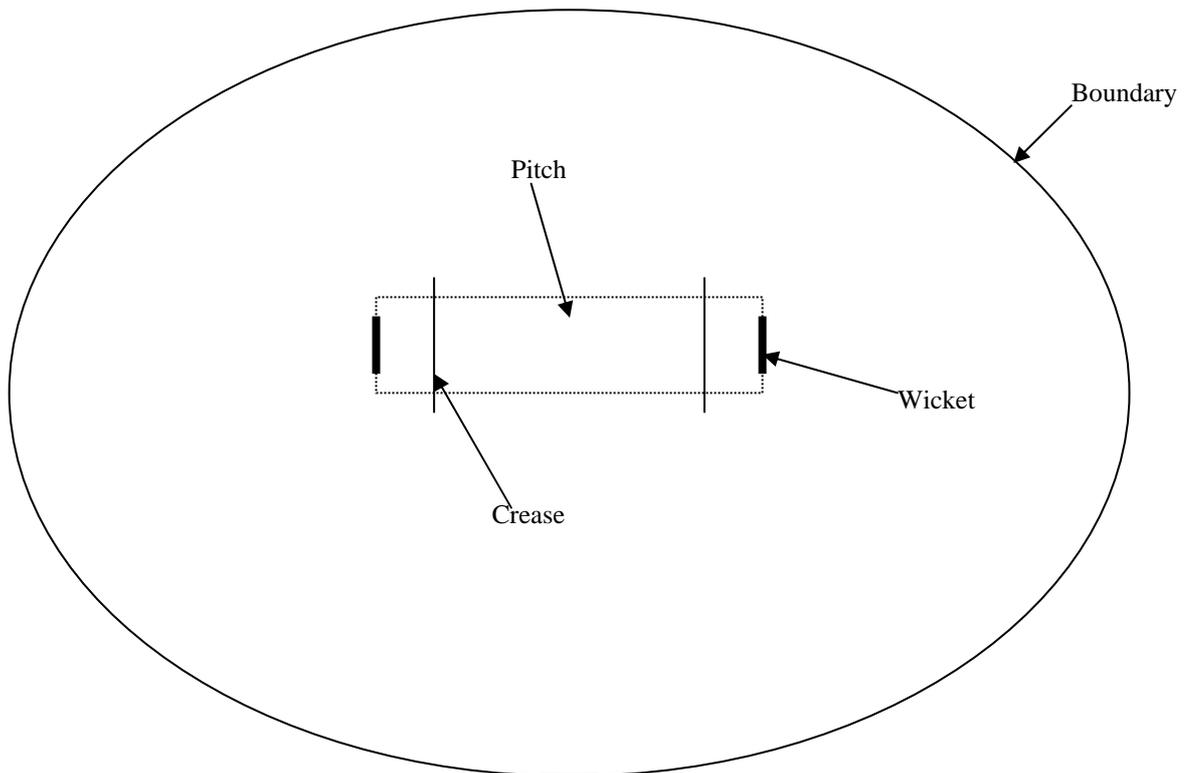


Figure 1: The Cricket Ground

In cricket, one of the batsmen stands at or about the line of one of the creases and in front of the relevant wicket. One of the fielding side, designated the bowler, then throws, or bowls, the ball towards the batsman using a special overarm action. The bowler must release, or deliver, the ball from behind the opposite crease. The bowler is allowed to run towards this crease to gain momentum for the delivery. The batsman attempts to hit the ball with the bat – this is called a shot. The batting side builds up a total through various scoring shots. The bowlers are rotated every six bowls, or balls as they are called, and alternatively bowl from the each end of the pitch. Importantly, and unlike baseball for example, the bowlers are not allowed to aim directly at the batsmen anywhere above the waist without the ball bouncing on the pitch first. In practice, and for reasons that will become apparent, almost every ball is bounced on the pitch before reaching the batsman.

As everyone who has ever played in or watched a game of cricket knows, the ball does strange things. It swings and dips through the air, it jags both ways off the pitch, and it swings either way after it has pitched, or hit the ground, as well. The batsman has to constantly be on his guard against these movements, and conversely the bowler is constantly trying to enhance this unpredictability through various differences in his bowling action.

These elements of the game are crucial as the fielding or bowling side is attempting to remove all of the opposition's batsmen. There are various ways of removing, or dismissing, these batsmen but the most important two are to bowl and catch them. A batsman is bowled when the ball, as a result of being bowled at him, hits his wicket and removes at least one of the bails. The batsman is deemed caught when a member of the fielding side catches a shot off the bat before the ball subsequently touches the ground.

To attempt to confuse or deceive the batsman through the movement of the ball is therefore central to the game. If the ball moved in a predictable line or arc each time it was bowled then the batsman would be much more likely to hit it with his bat and score highly. However, even slight deviations can lead to miscalculations and the more probable misdirection of a shot to a waiting fielder. Larger deviations can lead to a miss altogether and the higher possibility of bowling the batsman by hitting the wicket.

An examination of the physical processes and forces involved demonstrates exactly how complex the movement of the ball in fact is. First, the ball is not a perfect sphere. Indeed, even if an attempt had been made to create a perfectly round and smooth ball, there still would have been minor imperfections and variations. In the case of the cricket ball, however, the raised seam with its stitching patterns forms a distinct ridge on the surface. The seam interacts with the air as it passes through the intervening space between bowler and batsman and the ball can swing and dip alarmingly depending on the skill of the bowler as well as the humidity, the air pressure, the direction and speed of the wind and the smoothness of the ball's surface. In relation to the latter variable, it is important to note that each game starts with a new and highly polished ball. As the game proceeds the ball becomes scuffed and worn unevenly across its surface. Further, the bowling side will often attempt to keep one side of this ball more highly polished than the other through rubbing it

against various parts of their clothing. The differential between the shiny and dull sides of an older ball can lead to significantly more exaggerated movements.

Similarly, when the ball hits the ground, or pitches, after being delivered by the bowler it can land on the seam and thus be diverted laterally either way, or be caused to bounce more or less highly than expected.

The potential for complexity thus becomes apparent. Not only is the movement of the ball through the air dependent on all the variabilities of ball construction and atmospheric conditions but also the speed, release point and bowling action related to each delivery as well. Indeed, some bowlers also impart spin to the ball of differing degrees of speed and angle to the direction of flight that causes further complications for the batsman. None of these variables will ever repeat themselves exactly the same way twice. The bowler will impart many minor and some major differences to the movement of the ball through how, where, when and at what speed he releases it. The weather conditions will vary from moment to moment – air pressure, wind direction and variability, air temperature and humidity levels and so on. Each ball is unique with minor variations in composition and construction. Furthermore, the ball is in a constant process of wear that will produce other changes to the parameters of the system that can neither be predicted nor controlled with any accuracy. When the ball hits the ground further variables come into play. The consistency and elasticity of the pitch will vary, as will the grass cover, and this will effect the bounce of the ball. Cracks open up on a cricket pitch as a game proceeds and add a further imponderable, for it is impossible to predict when, where and in what direction these cracks will manifest themselves or how deep or wide they will be. The ball sometimes deflects off the edges of these cracks and can change direction markedly. The ball also gets softer as the game proceeds and therefore this adds another variable. Finally, the pitch itself wears through the actions of the bowlers and batsmen moving upon it giving the bowlers another unpredictable variable that is exploited later in a game.

The game of cricket is therefore an example of complexity at the macro level. No two deliveries will ever be identical. Indeed, every single variable on its own defies prediction. When the interactions of all these variables are considered it can be seen that this simple game contains within it a prime example of complexity in action.

Because we do live in a universe in which complex interactions are the norm, games like cricket have developed to the enjoyment of both players and audiences. It is important to note here that a universe that followed idealistic Newtonian linear principles would only produce a game that was predictable, unchanging and ultimately boring. Instead, we live in a world that is constantly surprising and novel. Clearly, it is difficult to conceive of a real world system that the same comments may not be made of to a greater or lesser extent¹⁴. In Cricket, the emergent complexity of the system is obvious at a macro level to the extent that each of us may be aware of it utilising only our natural and unaided senses. The same would be true of most games where a ball is subject to the vagaries of atmospheric conditions and/or the surfaces on which it bounces or rolls. Similarly, the growth and function of plants, animals and people are subject to many interacting variables – genetics, nutrition, illness, environment and so on. Each plant, animal and person is therefore unique¹⁵. Indeed, as previously noted, even monozygotic twins raised in the same household are not really identical, for differences in placement in the womb and in life experiences cause divergence in physical and psychological function (Robertson, 1987).

In many systems the differences – the products of the complexity of the interactions between variables – are less obvious and may only become apparent when very fine measurements are taken. Examples here include pendulums¹⁶ and the movements of the planets (Lecar et al, 2001). Both show stochastic variations in movement at micro levels. It is only our conventions of measurement of both systems that assume smooth and unchanging periods and trajectories.

Whether complexity in dynamic systems may be observed at the macro or micro levels, though, it is clear that it is, without exception, an inherent feature of all dynamic systems. It is certainly relevant to ignore that complexity in cases where fine measurements are not considered important. For example, at the levels of

¹⁴ A point also made by Donahue (2002).

¹⁵ As David Green (1994) points out, every biological system exhibits complex, emergent behaviour.

¹⁶ See page 50.

accuracy normally required for driving a clock, a pendulum may be considered to describe the ideal arc detailed by Newton in 1687. Similarly, the variations from the elliptic in the orbits of the planets are too small to cause concern when calculating the trajectory of space vehicles launched from Earth to intercept them. Nevertheless, the variations do exist and they do not obey linear laws. Further, in many systems the level of complexity is sufficiently large to be observed with our unaided senses and to have a potent effect on our interactions with those phenomena. In the game of cricket and in studying weather systems or human populations, for example, we ignore complexity at our peril.

It is clear from the widespread adoption of new methodologies that the new paradigm is here to stay. Since the early nineteen-nineties, new approaches to the study of phenomena have burgeoned to such an extent that texts and projects related to the subject topics have increased exponentially. Texts on chaos for managers, for example, can be bought in local bookshops, school children write essays on the subject, periodicals specifically directed towards the subject flourish, and research projects embedding postmodern and narrative principles are becoming accepted by the larger scientific community. In 1995 a search on the Internet identified three centres in the world that focussed on complexity research and related issues and a limited number of papers (Colbourne, 1995). That same search in 2002 produced literally hundreds of thousands of titles.

Chaos theory, interactive dynamics, non-linear dynamics, complex systems theory, bifurcation, divergence, emergence, nonequilibrium thermodynamics, dissipative structures, self-organisation, catastrophe theory – many terms have been applied to the field that may be referred to under the umbrella term complexity. Although each sub-heading involves the consideration of a different, albeit overlapping feature of dynamic systems the common thread running through all is the rejection of the classical Newtonian paradigm. Furthermore, Heisenberg claimed as early as 1965 that:

Science no longer confronts nature as an objective observer, but sees itself as an actor in this interplay between man and nature.

(p. 446)

Similarly, the postmodern view,

...talks about meaning, not about truth. It talks about how discourses define phenomena, not about how phenomena are described by discourses. It always wants to know what people do to make sense of what we ordinarily call an object or phenomenon. It situates meaning-making practices and the systems of semiotic resources deployed in those practices in the domain of the social, the cultural. Indeed, it sees social and cultural systems exactly as systems of such practices, systems of doings, and not systems of doers per se.

(Lemke, 1994, p. 6)

In both worldviews, therefore, one of the key concepts is the active role that the commentator or the participant takes in this process of assigning meaning to experience or phenomena. Importantly, in neither case – albeit for very different reasons - is the paradigm of the objective observer – or the concept of an ideal description extraneous to the observer – considered either necessarily possible or desirable. For example, the postmodernist position is that the individual interprets experience through the medium of language, which in itself is replete with cultural and situational metaphors (Hoke, 1995). The concern, therefore, is as much with the processes of discourse as the objects of that discourse. Furthermore, it is becoming apparent that discourse itself is a complex system that will require specialist nonlinear tools to revisit in attempts at exploration and explanation (Dooley et al, 2003). Our processes of discourse as a key factor may therefore not be excluded in considerations of the ways we inquire into the universe, for no matter what paradigm we might adopt, we cannot avoid utilising discursive methodologies – mathematics, language and computer programming, for example. On the other hand, Heisenberg's position is that our observations influence, or even change the nature, of the phenomena we are observing and therefore that scientists are mediators and not simply observers. The combination of these two perspectives places the focus on the individual scientist as a subjective and affective parameter in all processes of scientific inquiry. It is this conceptual challenge more than any other that is undermining the primacy of the classical paradigm.

To explore why this change in perception represents such a potent challenge to the dominant paradigm requires a detailed examination of a number of aspects of our processes of inquiry. As I have already indicated, this is not a simple phenomenon. In itself, it presents as a complex system, demanding a focus on some of humanity's most intractable concepts – truth, reality, objectivity – and some of our least understood intellectual processes – belief formation, creativity, perception and discourse. The next three Chapters will examine these phenomena from various perspectives, in each case approaching the topics multilaterally rather than sequentially so that what I believe to be their essential features are highlighted. Indeed, I feel this *nonlinear* conceptual journey is well worth while for not only does it allow a more thorough understanding of all these phenomena, but it also clearly indicates a possible solution to the apparently irreconcilable differences between the classical and postmodern paradigms. In the next Chapter, and concurrent with this exposition, I will further detail the structure and form of the rest of this thesis. Indeed, as I shall clarify, I have chosen particular approaches to the latter two dimensions of this thesis in response to the emergence of the new paradigm.

CHAPTER THREE

DISCOURSE, JOURNEYS AND UNIVERSALISM

I must confess that a man is guilty of unpardonable arrogance who concludes, because an argument has escaped his own investigation, that therefore it does not really exist.

(David Hume, 1748, p. 41)

Just as the modern paradigm for scientific inquiry rendered the variances from the perfect or ideal conception of phenomena invisible, so too was the one element that is common to all scientific processes no matter what the paradigm, the subject or the methodology – the discursive medium. The invisibility of this crucial dimension of all scientific endeavour was guaranteed by the adoption of the concept of the objective observer. It is the case that if the scientist is exploring and describing objective universal truths then the discursive medium is relatively unimportant. After all, although the form of the description may make it difficult for others to access the truths – poorly written explanations or sloppy mathematical calculations, for example – it is nevertheless the case that the underlying truths, being truths, are by definition constant – they are unaffected by the medium. Within the classical paradigm, therefore, the focus is much more on the outcome – the applicability of the theory or agreement with the discovery – than the language or mathematical processes the scientist may have utilised. Certainly, errors or shortcomings in statistical or mathematical processes may put into question the validity of the identified outcome, but a host of ‘mistakes’ of this kind may be made without in any way affecting a belief in the objective existence of a phenomenon. Indeed, this has happened countless times in the history of science. For example, a belief in the objective reality that the planets orbit the sun was not altered one iota by the discovery that these orbits were elliptical rather than circular or by the recent revelation that these ellipses demonstrate chaotic variances. Thus, the discursive medium or mediums utilised remain the least important aspect of scientific inquiry encompassed by the classical paradigm.

However, if truth is conceived as an outcome that can only be achieved through a medium of discourse – as both Plato and Aristotle indeed believed – then the medium itself becomes absolutely central to the whole process of scientific inquiry. This worldview transforms discourse from an invisible by-product of inquiry into a foundation stone. It becomes a starkly visible element of the process. The postmodernist commentators (notably Foucault, 1970, 1972, 1980, Derrida, 1966 and Lacan, 1977) are keenly aware of this fundamental aspect of the new paradigm and have explored its consequences at length. As previously noted, one extreme of this conceptual shift is to identify all truths as relative and subjective. Either way, discourse is established as both the medium utilised in and the location of inquiry. Its nature and functions become critical areas of concern.

A thesis is in effect an example of this issue in microcosm. On the one hand, it could be assumed that objective universal truths are being referred to or explored – the laws of nature, and so on – and thus whether what is being stated is considered true or false becomes a major issue. Another aspect of this approach would be a consideration of whether or not the thesis is well referenced and therefore whether its arguments could be considered well founded. The established conventions of thesis writing could apply – a structure that includes an introduction, a delineation of the theme and a conclusion. An index and a bibliography would also be expected. On the other hand, if the medium is also considered the message, then the mini-world of the thesis may be structured in any number of less conventional and potentially more creative ways. At one extreme, the novel form could be considered appropriate as it certainly can encompass within it experiences and insights that may be considered profound. In this latter case, references and bibliographies may both be considered unnecessary.

One of my major contentions in this thesis will be that we now have two equally valid paradigms for scientific inquiry – the modern and the postmodern. Furthermore, I shall argue that each of these paradigms, and the methodological conventions that are attached to them, offer us a range of choices over what to use, when and in what circumstances. For these reasons, this thesis will utilise elements of both conventions. Thus, the structure conforms to the classical convention: it is meant to be read linearly and is referenced. It is not a work of fiction and the ideas within it are presented and explored through a number of well recognised processes of philosophical discourse. However, I have also included five narratives that may

be loosely described as works of creative writing. The contents of these pieces, their form and their location within the linear flow of the thesis are intended to emphasise particular sub-themes and arguments. They are there for effect. They are part of the *message* which is also the concern and conclusion of the thesis. The extent to which I have blended the two conventions here simply reflects my assessment of their relative value to the extrapolation of the theme in the mini-world of this thesis. In other words, the thesis is intended to be one miniature example of the consequences of the conclusions I shall draw as to the future development of the processes of scientific inquiry.

A Journey Started

In the introduction to this thesis, I proposed that we take a journey together. In this journey, I will be addressing a central question: *what format, structure or paradigm is appropriate in the processes of scientific inquiry?*

In working towards an answer for this question, I will argue that understanding, or analysing, the intentions of the author is as essential to our critical response to scientific inquiry as the veracity, however we judge that, of the content. I will further emphasise that an examination of the writer or researcher's unstated or unacknowledged assumptions is an essential element of that critical response.

I thus opened with the concept of a journey to set the overall expectation: we are going somewhere; there is some end point in view; we shall notice/comment on the landscape on the way. There is an overt attempt by myself to pre-prepare your response, intellectually, to the purpose, structure and content of this thesis. The reason for this is to further the parallel with the nature of the topic as I see it. I will assert that all inquiry, including scientific inquiry, is circular in nature. That is, there are always assumptions which front-end the philosophy, the research or the topic of the inquiry. For example, I am assuming that we have a shared semantic understanding so that a bridge of communication may be opened between us. These assumptions are usually unstated – or at least many of them are. Like the Russian doll or an onion, layers of assumptions may be peeled back, or uncovered, in a Leplacean reductionist pursuit which in itself would assume that such a method of inquiry is worthwhile. On the other hand, one might assume that this linear process was pointless and refuse to name any assumptions at all, as some postmodernists have done. Either way, I would assert, the argument is a circular one that leads us

back to, or does not allow us to depart from, the topic - or perhaps the intention of the writer or researcher. In this sense, the process of discourse ensures that we will arrive back where we started from. This conceptual cycle is important in an analysis of the significance of *form* and *medium* in the discursive process and will be examined more fully later in the thesis.

The assumptions or conventions embedded in a paradigm are powerful. This may be illustrated as follows. As has been detailed in the previous two Chapters, Newtonian physics assumes that the universe may be measured and predicted – the “clockwork” concept that has largely driven scientific inquiry since Newton’s experimental model became the accepted paradigm (McAndrew, 1997; Matthews et al, 1999). Thus, for example, the action of a pendulum may be measured over time and its behaviour predicted from the mathematical analysis of the results. This has been such an accepted, untested assumption that generations of school children all over the world have repeated these experiments and graphed up identical results demonstrating the predictability of the pendulum. However, the argument was entirely circular – the assumption predicated the results - for when the assumptions change, the results also change. As discussed, the newer science of complex systems theory suggests that perhaps all systems, and certainly dynamic systems, do not conform to the Newtonian paradigm. Rather, the assumption is that the parameters that drive such systems interact in unpredictable and non-linear ways. Thus, a pendulum will only appear to conform to linear mathematical models at the macro level – at finer measurements the variations in movement would be expected to be unpredictable or *chaotic*. This is precisely the finding of researchers who have revisited the pendulum with this particular paradigm in mind. (Smale 1980; D’Humieres et al 1982; Tritton, 1986; Stewart 1989)¹⁷.

It may be certainly be argued that virtually all of Western scientific endeavour since Newton has been powered by the positivist paradigm: nature is controllable; there are definitive answers to all possible inquiries; there is a theory for every possible phenomenon (for example the “theory of everything” discussed by Stephen Hawking, 1998); all phenomena may be described mathematically; statistics mirrors real-time phenomena; all phenomena are predictable given sufficient information; the

¹⁷ More recent research by Grosu (2000) into both linear and nonlinear oscillations of forced pendulums and Munteanu et al (2002) into chaotic oscillations of double pendulums is of interest here also.

universe is an ordered place that obeys predictable laws; and so on. Like children in the classroom, therefore, we have looked for predictability, for order and for control – and, overwhelmingly, we have found all of those things¹⁸. Indeed, so powerful has this paradigm been that attempts to justify it, or even acknowledge it, were almost entirely absent from the scientific literature up to the nineteen-nineties when the paradigm came under serious question by commentators and researchers from a number of fields. Paul Grobstein (1997) has expressed the central dichotomy of this position as follows:

...“Newtonian” ideas seem so obvious as to be not worth mentioning, to say nothing of questioning. Because they are so? Or because our brains contain them as built in assumptions? Or because science and our culture have in the recent past found it productive to proceed believing them to be so, whether they actually are or not? One or both of the last two explanations is likely to be correct, because the first is not.

(p. 1).

Indeed, I shall argue in this thesis that in a monoparadigmatic system the workings of that paradigm are generally rendered conceptually invisible. Thus, the classical processes of scientific inquiry were based on conventions that neither needed to be acknowledged nor recognised – they were the way things were done. However, when an opposing paradigm emerges – as it has in this case – the rationales for the utilisation of both paradigms are brought into focus. This is not to suggest that this process is deterministic, of course. Conventions are often questioned by individuals, and this has certainly been the case with the processes of scientific inquiry as well. However, as long as the conventions remain dominant then processes and rationales are not necessarily highlighted or acknowledged.

Understanding the assumptions inherent in any paradigmatic position is therefore necessary if the rationales for any process of scientific inquiry are to be made explicit. In the same way, the journey in this thesis has begun with a set of

¹⁸ Or as Alfred Wallace (1855) put it: "We are like children looking at a complicated machine of the reasons of whose construction they are ignorant, and like them we constantly impute as *causes* what is really *effect* in our vain attempts to explain what we will not confess that we cannot understand."

assumptions – my assumptions as the writer. Some of those assumptions I have already described above. However, for reasons that will be detailed as we progress, the reader may need to consider at this point that I could be unaware of many of those assumptions, or may have simply forgotten them. Further, I may lie about those assumptions as well for purposes I am not willing to reveal. As shall be discussed shortly, that is not necessarily an issue in either the production or the reception of a piece of scientific discourse. Nevertheless, I will assert at this point that the end of the journey will be to arrive where we started – with my assumptions central to the conclusion or the denouement of the thesis. Indeed, this self-fulfilling cycle, I will argue, is an inherent feature of all scientific discourse. In relation to this thesis, because they are self-justifying the arguments in this thesis can be considered no more *true*, therefore, than any other arguments, philosophies or points of view – unless, that is, you accept, tacitly or otherwise, the assumptions imbedded within them. To put it another way, I will argue that all discourse and inquiry is subjective in nature, or at least has an unavoidable subjective element within it, and is therefore dependent on two separate yet interacting elements – the assumptions (or assumed paradigms) of the writer and the assumptions of the reader. As William Tierney (1997) has put it:

...individuals have a significant part in the creation of the reality that surrounds them, but they do not have a literally deterministic role. That is, the social, cultural, and historical contexts in which individuals are embedded play an important role in the creation and substantiation of what individuals come to define as reality. (P.129)

The particular journey I have involved you in here thus has as its end point a reflection on the assumptions inherent in the construction of – and reader's reaction to - an academic thesis, and the structure of this thesis further reflects what I perceive to be the fundamental parameters that define that process. For reasons I will justify in due course, this discourse will therefore be both the medium and the message. The point I would make here is that I believe this has in fact always been the case, whatever the discourse, whatever the subject of that discourse and whatever medium has been utilised. The use of any medium – a language, mathematics, a computer

program – has attached to it a set of unavoidable assumptions about the nature and purpose of discourse that impacts on both the producer and the consumer of that discourse. These assumptions are subsumed in the conventions, or the dominant paradigm, of the day. I shall argue that it is only when that paradigm is under challenge that these underlying and definitive parameters are highlighted and their efficacy questioned. In other words, it is at times of paradigm change, as we are experiencing currently, that the *forms* of scientific discourse become more diverse as the conventions that underpin them are questioned and adjusted. Indeed, it is one of the major tenets of this thesis that in times of paradigm change the assumptions that are inherent in the way we conduct the processes of scientific inquiry become explicit rather than implicit. Thus, a conscious choice over or between forms becomes an issue in the processes of discourse. I have therefore adopted a few unconventional discursive devices in this thesis – at least in relation to scientific inquiry - to emphasise this point.

I should re-emphasise here that although the classical paradigm is extensively critiqued in this thesis, I do not suggest that it is invalid. On the contrary, the Newtonian scientific model has created the world we know – it has given us modern medicine and space travel, televisions and pop-up toasters, motor vehicles and computers. Furthermore, the mathematics used to send space ships to Mars, to design skyscrapers and oil refineries, could be carried out by pre-tertiary high school students and would be entirely familiar to Newton. Predictable and repeatable results are the keystone to the world we have created since the industrial revolution. After all, if we could not be reasonably sure that our buildings would stay up, or our bridges or our power lines, we would not bother to build them at all. If we could not predict with reasonable accuracy the trajectory of a space vehicle, we would not launch it. Above all the Newtonian model for scientific endeavour is *useful*. It gets results. For that reason, this thesis will not question the utility of the modern paradigm or even its pre-eminence. Rather, the conclusion that it should be the *only* way to conduct scientific inquiry is the concern here.

Nevertheless, as Stephen Jay Gould (2002) noted after a particularly vociferous critical attack on his work, any questioning of an established paradigm may receive a strong reaction from true believers in the way that scepticism towards belief systems often does. Similarly, adoptees of new belief systems may sometimes proselytise vehemently for their point of view – a point made in relation to postmodernism by

Clive Beck (1993). Here, the debate between those who are ‘for’ and ‘against’ the classical scientific method of inquiry has been informative. This debate has occupied many forums – chaos theory, game theory, complex systems theory, some aspects of quantum mechanics, fluid mechanics, computer modelling, postmodernism, hermeneutics. Many proponents of the various non-Newtonian paradigms have attacked the classical method as unrepresentative of real systems – that is, an imposed, theoretical and ultimately baseless model of existence – and with some justification, as has already been discussed. The various descriptions of complex systems, the argument goes, mirror the true interactive nature of phenomena – non-linear and, most of all, unpredictable. As noted previously, a good example here is the weather. Weather systems were the first to be subjected to non-linear computer modelling. The results were models that more accurately mirrored actual weather patterns – changeable, unpredictable and subject to sudden fluctuations¹⁹.

The counter-argument against the new paradigms often centres around two issues: utility and veracity. Chaos and complexity research has produced some fascinating insights into dynamic systems and even some stunningly beautiful new phenomena, such as the Mandelbrot sets (Mandelbrot, 1977), but not as yet, it is argued, anything particularly utilitarian²⁰ (Horgan, 1996). Also, research that focuses on unpredictability and non-repeatability is seen as highly suspect by many commentators – if a research result cannot be repeated then how can the veracity of the theory or the research method be ascertained?²¹ To further reflection on this debate it is useful at this point to make reference to some absurdist filmmaking.

Monty Python and the Pursuit of Truth

Those familiar with the Monty Python film *The Life of Brian* will recall the scene where Brian is mistaken for the Messiah after speaking to a crowd at a market. In an act of desperation, Brian had pretended to be some sort of wise man in an attempt to

¹⁹ A more complete discussion of this topic is included in Chapter 4.

²⁰ Although Manus Donahue (2002) has reported on two: a revolutionary washing machine and a new type of bubble machine. Neither of these is likely to change the world significantly.

²¹ Carol Cleland (2002) has comprehensively explored this issue with particular reference to research methodologies.

avoid being arrested by a Roman Army patrol. Joining other speakers, he makes up a clearly meaningless discourse and pontificates to the listeners until the patrol passes by. Brian has indeed been lying. However, the listeners are there to hear wise men impart insights about existence – they are there to hear truths. When Brian leaves, the crowd follows calling out for him to reveal more. Soon he is running through the town with dozens of people running after him. In his flight he drops a gourd and loses one of his sandals. Members of the crowd immediately seize these artefacts and form into two groups – the followers of the gourd and the followers of the sandal. A later scene shows these two groups in a heated argument with each other over the veracity of their callings – with the members of one group all carrying gourds and the members of the other all wearing only one sandal. Brian eventually gives them the best advice he could: “You don’t have to follow anyone,” he declares, “you can make up your own minds.” Sadly, no one takes his advice.

Within the comic world of the film, this is both amusing and entertaining. As Vibeke Boolsen (2002) has pointed out, however, in the world of scientific inquiry it is neither. People’s integrity is being impugned and their reputations attacked²². The arguments mounted on both sides of the debate have often been vociferous and emotional. On one side the pragmatic positivists have waved their gourds around and on the other the passionate postmodernists have limped about with only one shoe. Perhaps Brian’s advice needs to be reiterated with a rider – not only make up your own minds, but let others make up theirs as well.

The depth of feeling experienced, indeed the vitriol expressed, in this debate can be illustrated with two examples. Also, an analysis of both these attempts to debunk the opposition highlights the underlying tensions over form and medium that now are characterising the processes of scientific inquiry.

²² As per this statement by Norman Levitt (2002): “...much of the humanities/social sciences wing of academia has in large measure ceased to be correlated with precise thinking, or command of evidence, or even fundamental intellectual honesty” (p. 1), and Andrew Murphie’s (2002) reference to Sokal’s fake postmodern paper (analysed here) as “...a rather sad little hoax” (p. 1). See also “Science Wars or Science Derision?” by Michael Harris (1997) and Carl Dassbach’s (1995) vitriolic attack on Nicholas Fox.

Lies and Reality: Sokal's Hoax

There are many natural scientists, and especially physicists, who continue to reject the notion that the disciplines concerned with social and cultural criticism can have anything to contribute, except perhaps peripherally, to their research. Still less are they receptive to the idea that the very foundations of their worldview must be revised or rebuilt in the light of such criticism. Rather, they cling to the dogma imposed by the long post-Enlightenment hegemony over the Western intellectual outlook, which can be summarized briefly as follows: that there exists an external world, whose properties are independent of any individual human being and indeed of humanity as a whole; that these properties are encoded in "eternal" physical laws; and that human beings can obtain reliable, albeit imperfect and tentative, knowledge of these laws by hewing to the "objective" procedures and epistemological strictures prescribed by the (so-called) scientific method.

But deep conceptual shifts within twentieth-century science have undermined this Cartesian-Newtonian metaphysics; revisionist studies in the history and philosophy of science have cast further doubt on its credibility; and, most recently, feminist and poststructuralist critiques have demystified the substantive content of mainstream Western scientific practice, revealing the ideology of domination concealed behind the façade of "objectivity". It has thus become increasingly apparent that physical "reality", no less than social "reality", is at bottom a social and linguistic construct; that scientific "knowledge", far from being objective, reflects and encodes the dominant ideologies and power relations of the culture that produced it; that the truth claims of science are inherently theory-laden and self-referential; and consequently, that the discourse of the scientific community, for all its undeniable value, cannot assert a privileged epistemological status with respect to counter-

hegemonic narratives emanating from dissident or marginalized communities. (Sokal, 1996).

This is the introduction to Alan Sokal's paper *Transgressing the Boundaries: Towards a Transformative Hermeneutics of Quantum Gravity* which was published in *Social Text* #46/47 in 1996. Sokal goes on to mount an interesting argument in support of inter-disciplinary research and the postmodern paradigm of the subjective nature of experience. He quotes Werner Heisenberg and Niels Bohr, Jacques Lacan and Jacques Derrida and disputes the efficacy of the classical paradigm for scientific inquiry. He makes a number of broad stroke statements that might be considered unsupported and some technical claims that appear incorrect, but it appears on the surface to be a statement of position and/or belief. Only occasionally does a hint of something else show through, as in these final sentences:

Finally, chaos theory -- which provides our deepest insights into the ubiquitous yet mysterious phenomenon of nonlinearity -- will be central to all future mathematics. And yet, these images of the future mathematics must remain but the haziest glimmer: for, alongside these three young branches in the tree of science, there will arise new trunks and branches -- entire new theoretical frameworks -- of which we, with our present ideological blinders, cannot yet even conceive.

Fairly ingenuous, one might think, for a professor of physics at New York University, but nevertheless a reasonable point of view if you except the premise imbedded in the statement. The problem was that Sokal wrote this as a fake paper – it was never intended, so Sokal asserted later, to be serious at all.

For some years I've been troubled by an apparent decline in the standards of intellectual rigor in certain precincts of the American academic humanities. But I'm a mere physicist: if I find myself unable to make head or tail of *jouissance* and *différance*, perhaps that just reflects my own inadequacy.

So, to test the prevailing intellectual standards, I decided to try a modest (though admittedly uncontrolled) experiment:

Would a leading North American journal of cultural studies -- whose editorial collective includes such luminaries as Fredric Jameson and Andrew Ross -- publish an article liberally salted with nonsense if (a) it sounded good and (b) it flattered the editors' ideological preconceptions?

The answer, unfortunately, is yes. (Sokal, 1996b)

Indeed, the paper was intended to highlight the postmodern “absurdity” that Sokal feels has pervaded scientific inquiry.

While my method was satirical, my motivation is utterly serious. What concerns me is the proliferation, not just of nonsense and sloppy thinking *per se*, but of a particular kind of nonsense and sloppy thinking: one that denies the existence of objective realities, or (when challenged) admits their existence but downplays their practical relevance. (Sokal, 1996b)

Sokal also goes on to state:

Of course, I'm not oblivious to the ethical issues involved in my rather unorthodox experiment. Professional communities operate largely on trust; deception undercuts that trust. (Sokal, 1996b)

One reaction to Sokal's “experiment” is to explore the author's own stated intentions in writing the paper – a debunking of the postmodern paradigm – and to question one's own assumptions in relation to scientific inquiry, as Sokal suggests. However, its significance is much greater than that.

Putting aside for the moment any consideration of the validity or otherwise of Sokal's position on postmodernism, the focus may be turned on the role that scientific papers play in the processes of discourse between individual scientists. This is a quote from Bruce Robbins, one of the editors of *Social Text*, in response to Sokal.

But we thought Sokal had a real argument, and we still do. Allow me to quote Paul Horgan, senior writer at *Scientific American*, summarizing in the July 16 *New York Times*: Sokal, Horgan says, "proposed that superstring theory might help liberate science from dependence on the concept of objective truth." Professor Sokal later announced that the article had been a hoax, intended to expose the hollowness of postmodernism. In fact, however, superstring theory is exactly the kind of science that subverts conventional notions of truth." (1996)

Sokal's arguments were intended to be untrue. However, they may nevertheless raise genuine affective responses in the reader. Lies may be "true" to the extent that others may receive them as being so. Similarly, intended lies may turn out, unintentionally, to be the truth after all. The statement that they are untrue therefore makes no difference at all to the validity of the response – unless you hold to the assumption that there is an external and objective reality that, a priori, demonstrates the truth of all statements however and wherever they are made.

Sokal's error is not to argue for the positivist and against the postmodern paradigm – after all, his point of view is held by many and the arguments for and against contribute to the overall debate – but that he holds to the untenable position that his beliefs are self-evidently true while those of others who contradict him are self-evidently false. In doing so, he falls neatly into the classical trap – the belief that personal "truths" are also universal ones.

This is not to denigrate the processes of scientific inquiry that Sokal defends so passionately. Contrary to Sokal's assertions, very few postmodern writers or researchers would hold to the view that there is no "external reality". Further, it is widely accepted that many phenomena obey linear laws, at least at the macro level. Certainly, it is an acceptable proposition to hold that we may test our descriptions of universe against observation and the judgement of our peers. However, it is completely untenable to maintain that our processes of discourse, or their products, are objective or value free. As Wark McKenzie (2002) has pointed out:

Can one imagine a knowledge, for example, that exists without language or controlled observation? The answer is no. All knowledge is socially constructed, in other words. (p. 2)

The words we use in our descriptions of our experience and environment are value-laden, cultural artefacts. They are also contextual and situational. Thus, Sokal's hoax paper may be considered "valid" by readers for any number of reasons²³: agreement with the premise; acceptance of another's views (even if disagreed with, for example); respect for an authority figure's position (in this case, a professor of physics); an assumption that scientists tell the truth as they see it; and so on. Indeed, the knowledge that this paper was a hoax does not necessarily change our response to it – it may still be considered a "valid" contribution to the current debate on the nature of "reality".

Sokal may therefore be seen to have inadvertently supported the paradigm he so detests – the postmodern assumption that our approach to meaning, to describing our world, is inherently subjective²⁴. If this was not the case, then Sokal's paper would have been seen as a hoax by all – it would have been self-evidently "untrue". This is clearly not the case and thus Sokal will have to continue to argue his point of view in the midst of debate and paradigmatic plurality. Further, Sokal's (1996b) explanation for his hoax is no more and no less than his narrative – his personal story. Within it he shares information about his political and social background and expresses his feelings about the subject. There is little evidence of the objective scientist here.

An argument Sokal could have more effectively mounted from his position was that the classical paradigm for scientific inquiry is better suited to some fields than the postmodern. Thus, for example, explorations within the natural sciences – or physics – may well respond more positively to linear conceptual frameworks and linear research methodologies. The social sciences, on the other hand, are generally badly served by this model. Social behaviour obeys what appear to be emergent and chaotic principles and may best be explored utilising non-linear methodology. Also,

²³ Steve Fuller (2003) also makes this point: "...the first mistake the editors made was to grant Sokal the authority to speak on behalf of his text and thereby accept the verdict that they had indeed been hoaxed. Instead, they should have stuck to the postmodernist tenet of not privileging the author's intention when conferring meaning on a text. Since the author is only one of many possible voices that constrains how the text "speaks," ultimately the text's meaning is determined by the community of readers that the text attracts."

²⁴ A point also made by Wark McKenzie (2002).

language and the study of language may be seen as fundamental to the social sciences for two reasons: it is the major discursive medium used within social groupings, and it is also the major discursive medium – the methodology – that is used for explorations of societies within the processes of scientific inquiry. It may therefore be argued that postmodern methodologies are not only better suited to the social sciences, but are requisite (Denzin and Lincoln, 1998). To put it another way, we may be able to map the universe utilising positivistic models, but to know what an individual experiences within a social setting it is necessary to listen to his or her narrative.

Universalist arguments for and against any particular paradigm for scientific inquiry may therefore be misplaced. It is the case that inquiry is both contextual and situational. Thus, one of the major tasks that researchers and theorists now face is to clarify their own assumptions and prejudices and move beyond unsupportable statements of belief. Rather, the debate, or the “science war” as it is being referred to, between supporters of the classical and postmodern paradigms could be seen as a family disagreement – all are members of the same scientific quest to explore the same universe. Sometimes the explorations may be considered widely separated in form and intent, sometimes they may overlap, as is the case at present with the complexity and social sciences. Nevertheless, any respect given to – say – a physicist because of his or her expertise and knowledge in the natural sciences surely demands that the same level of respect be shown the social scientist and his or her work in the highly subjective and volatile environment of human groupings and visa versa – a point emphasised by Dinshaw K. Dadachanyi (1998) in a comment on the science wars debate.

If there is any conclusion we can draw from all this, it is that **science** is not practiced in idealized situations, insulated from social influences, but neither can scientific knowledge be cast in purely relativistic terms. And whichever side we may be on in the debate about how **science** is done, we need humility in recognizing our limitations, and honesty, openness, and mutual respect as we explore the complexities of nature and formulate our understanding of reality. (p. 172)

Indeed, any other position is not only elitist and arrogant, but betrays a deep ignorance of the quality and the nature of the processes of inquiry being followed in each other's fields²⁵. The only substantive differences between the two scientific communities may be the tools and the discursive conventions utilised.

The second example from the literature on this division between positivists and postmodernists involves some clever computer programming and an Australian academic with a wicked sense of humour.

Alice in Wonderland: the Postmodernism Generator

For the purposes of illustration I have reproduced a short paper in its entirety below, including the references.

Modernism and the semanticist paradigm of discourse

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1. Consensuses of failure

The main theme of the works of Smith is the absurdity, and eventually the genre, of prematerial society. In a sense, Sargeant^[1] suggests that we have to choose between subdialectic narrative and capitalist pretextual theory. Derrida uses the term 'modernism' to denote a self-supporting whole.

"Reality is part of the absurdity of sexuality," says Sontag. Therefore, the subject is interpolated into a semanticist paradigm of discourse that includes art as a totality. Lyotard uses the term 'modernism' to denote the defining characteristic, and some would say the rubicon, of conceptual society.

In a sense, Bataille promotes the use of subdialectic capitalism to modify and analyse class. If the capitalist paradigm of discourse holds, we have to choose between modernism and posttextual dematerialism.

²⁵ Robert M. Young (2000) makes the same point, referring to the 'stupid divide' (p. 1) that currently separates the natural and social sciences.

Thus, Lyotard uses the term 'cultural nihilism' to denote not narrative as such, but subnarrative. Sargeant[2] states that we have to choose between the semanticist paradigm of discourse and capitalist socialism.

In a sense, the primary theme of Bailey's[3] analysis of the substructuralist paradigm of consensus is the role of the artist as writer. The premise of subdialectic capitalism implies that sexual identity has intrinsic meaning.

2. Smith and the semanticist paradigm of discourse

In the works of Smith, a predominant concept is the concept of modern consciousness. But any number of deappropriations concerning a neocultural whole exist. Debord's essay on modernism suggests that language is capable of truth, given that semiotic discourse is invalid.

"Art is dead," says Marx. Thus, the characteristic theme of the works of Smith is the role of the reader as participant. Debord suggests the use of subdialectic capitalism to deconstruct capitalism.

"Class is part of the paradigm of reality," says Foucault; however, according to Tilton[4], it is not so much class that is part of the paradigm of reality, but rather the economy, and subsequent rubicon, of class.

However, in *Gravity's Rainbow*, Pynchon analyses the precapitalist paradigm of narrative; in *V*, however, he denies subdialectic capitalism. A number of narratives concerning the semanticist paradigm of discourse may be discovered.

If one examines modernism, one is faced with a choice: either accept subdialectic capitalism or conclude that consciousness may be used to exploit the Other. It could be said that the premise of the semanticist paradigm of discourse states that the collective is intrinsically responsible for the status quo. If subdialectic capitalism holds, we have to choose between the semanticist paradigm of discourse and conceptualist deconstruction.

In a sense, the subject is contextualised into a subtextual paradigm of reality that includes language as a totality. D'Erlette[5] implies that we have to choose between modernism and capitalist appropriation.

It could be said that an abundance of narratives concerning not discourse, but prediscourse exist. Baudrillard promotes the use of subdialectic capitalism to challenge society.

In a sense, the primary theme of Humphrey's[6] analysis of modernism is a self-sufficient paradox. Lyotard uses the term 'Sartreist absurdity' to denote the common ground between art and sexual identity.

Therefore, the semanticist paradigm of discourse states that expression is created by the collective unconscious. The subject is interpolated into a modernism that includes truth as a totality.

Thus, the main theme of the works of Pynchon is the role of the observer as artist. A number of narratives concerning the semanticist paradigm of discourse may be found.

3. Modernism and conceptual theory

"Class is unattainable," says Sontag; however, according to Reicher[7] , it is not so much class that is unattainable, but rather the absurdity of class. It could be said that if conceptual theory holds, we have to choose between the semanticist paradigm of discourse and the postdialectic paradigm of narrative. The subject is contextualised into a patriarchal materialism that includes sexuality as a paradox.

However, Cameron[8] implies that we have to choose between modernism and the neoconstructivist paradigm of discourse. Lyotard uses the term 'conceptual theory' to denote the difference between society and consciousness

But the defining characteristic, and eventually the dialectic, of modernism prevalent in Burroughs's *The Last Words of Dutch Schultz* is also evident in *Nova Express*. The characteristic theme of McElwaine's[9] essay on the semanticist paradigm of discourse is the role of the poet as participant. In a sense, if pretextual libertarianism holds, we have to choose between conceptual theory and dialectic conceptualism. Derrida uses the term 'neomaterialist narrative' to denote the genre, and subsequent meaninglessness, of capitalist society.

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1. Sargeant, M. ed. (1973) *Semiotic Discourses: Modernism in the works of Joyce*. Loompanics
 2. Sargeant, E. U. W. (1998) *Feminism, modernism and the postsemiotic paradigm of context*. Panic Button Books

3. Bailey, K. ed. (1982) *The Failure of Reality: Modernism in the works of McLaren*. University of Michigan Press
4. Tilton, S. W. (1995) *The semanticist paradigm of discourse in the works of Pynchon*. Yale University Press
5. d'Erlette, J. P. D. ed. (1980) *Deconstructing Modernism: The semanticist paradigm of discourse and modernism*. And/Or Press
6. Humphrey, Y. P. (1993) *Modernism and the semanticist paradigm of discourse*. University of North Carolina Press
7. Reicher, F. ed. (1971) *Reading Sartre: Modernism in the works of Burroughs*. Loompanics
8. Cameron, J. V. (1984) *Modernism in the works of Gaiman*. Panic Button Books
9. McElwaine, M. H. B. ed. (1973) *The Iron Sky: The semanticist paradigm of discourse and modernism*. University of Michigan Press

The *Postmodernist Generator* was written by Andrew Bulhak of the Department of Computer Science, Monash University, Australia, as “a system for generating random text from recursive grammars” (2002). That is, the texts are randomly produced by computer and are entirely fictional. Further, each time a text is produced it is unique. The example above was generated by myself on 30 October 2002 over the Internet. Bulhak states,

Recursive transition networks are an abstraction related to context-free grammars and finite-state automata. It is possible, to generate random, meaningless and yet realistic-looking text in genres defined using recursive transition networks, often with quite amusing results. One genre in which this has been accomplished is that of academic papers on postmodernism. (1996)

Indeed, the parody of some postmodern discursive papers is painfully appropriate - loosely structured and unsupported statements with no apparent denouement.

However, the papers produced are hauntingly familiar for a completely separate reason – they utilise the conventional from, referencing and so on, that one would

expect in a scientific treatise. One feels that they *should* make sense: that if only one tried harder the meaning would emerge. That it never will does not take away that affective response to the discourse we are presented with. It may be very poor writing, but is recognisable as an attempt at discourse. In this case, it has been generated by computer software written by a human being. Equally poor pieces of writing are occasionally produced by university students.

This piece of barbed whimsy by Andrew Bulhak highlights a vital consideration for producers and consumers of scientific papers: the form is not the essential feature of the paper. It may be that a scientific paper is beautifully crafted and meticulously referenced, but be vacuous and meaningless nevertheless. Similarly, a paper may be badly constructed and written, unreferenced and emotive, but contain profound and significant insights. Thus, for example, the carefully constructed and logically sequenced papers of quantum physicist Niels Bohr and the complex, sprawling and subjective papers of postmodernist philosopher Jacques Derrida can be considered equally important and valid in their own fields. It may well depend on the subject, the context and the conventional expectation.

The debate between the two sides, however, is far from resolved. Over the last decade the arguments and counter arguments have impacted on every field of scientific inquiry. The current unease and uncertainty in relation to the future of scientific inquiry has been neatly summed up by Eve et al (1997):

We have been tempted to argue in the past that our previous mathematics gave us the wisdom, perhaps even the “right”, to engage in social and physical engineering. While these are worthy goals and indubitably worth pursuing, chaos reminds us that we cannot always be sure that the feedback effects of such changes will be predictable in a specific sort of way. If we stumble into a set of dynamics unknowingly that is chaotic, we cannot anticipate emergent properties and phenomenon (sic) that are not deductible by extrapolations from earlier data or conditions. (P.280)

If we cannot predict the outcomes of our interventions, then what processes can we involve ourselves in with any confidence? The question thus remains: how can

this impasse be resolved? What methodologies are appropriate for the exploration of the universe we inhabit? Attacks on the postmodern paradigm such as the ones by Sokal and Bulhak detailed above have made the situation more not less complicated. On the other hand, postmodern commentators have undermined the very assumptions on which the classical paradigm is founded. I would argue that there really is no alternative but to focus on first principles: to examine the nature of the realities we experience and assess the efficacy of the tools we may use to explore those realities.

The Scientists' Heaven

Fred had worked as a scientist all his adult life. He had moved around a bit, starting as a research chemist and then becoming an educator. It had been an interesting life, full of surprises and some successes.

Eventually, however, he suffered the fate of most scientists and grew old and died. He was met by Saint Peter at the pearly gates. Peter opened up a huge ledger and carefully studied an entry. He pointed his finger at Fred. "It seems that the good you have done has outweighed the bad – just. You can enter heaven. By the way, the theories you came up with were all wrong. You'll learn a lot up here."

Peter took Fred on a tour of heaven – the harp factory on one side, the halo production facility on another. Eventually, they came to the section of heaven reserved for scientists. Just about everybody seemed to be there – Plato and Aristotle declaiming to Protagoras and the other sophists, Einstein and Bohr still arguing away. It looked like a fun place.

Further on, Saint Peter motioned Fred to be quiet. Nobody else seemed to be around this part of scientist's heaven. They came to a very high, circular wall that obviously enclosed a group of people – muffled voices could be heard. Following Saint Peter's lead Fred tiptoed past this wall. Soon, they came to another high, circular wall identical to the first. Again, voices could be heard and again they tiptoed past until they were out of earshot.

Fred looked back the way they had come. "Excuse me, Saint Peter, I don't mean to be inquisitive, but who were those people back there and why were we being so quiet?"

Saint Peter shook his head. "Don't worry, behind one wall we've put all the postmodernists and behind the other all the positivists. Each of them thinks they're the only ones up here."

CHAPTER FOUR

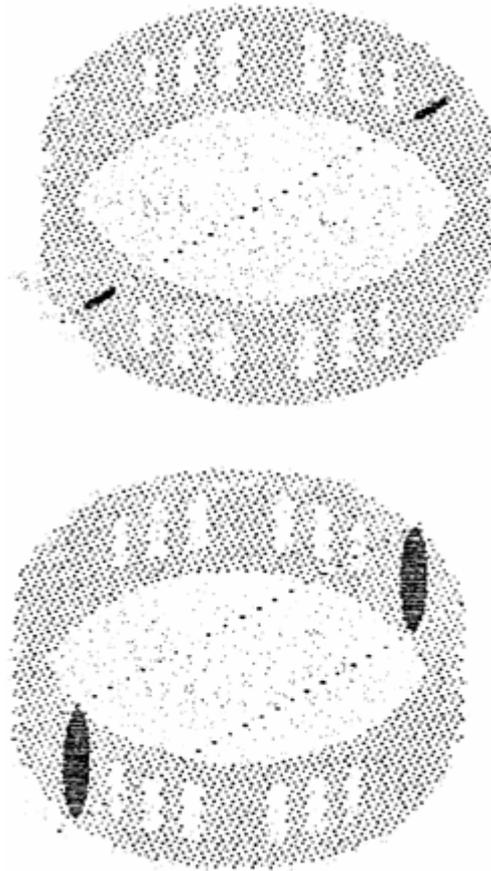
THE PROBLEMS OF DIMENSIONALITY

Imagine a one-dimensional world – an infinitely thin layer of reality. As inhabitants of this world, we perceive objects only as straight lines, shrinking and growing in length. Often, these lines shrink to nothing and disappear, only to re-appear seemingly magically further along our infinitely thin horizon (see Figure 2, page 70). As intelligent creatures we have formulated theories to explain these phenomena. A particularly imaginative approach postulates a second dimension beyond the one we can perceive. This second dimension, it is argued, would allow objects to change in length in our one-dimensional world as a larger or smaller cross-sectional edge becomes available to our perceptions. Objects would then disappear when they passed completely “above” or “below” our perceptual horizon. Similarly, these same objects could re-appear elsewhere having travelled in time through the second dimension.

In time a whole genre of speculative writing might grow up around this theory. Authors would grapple with the complexities of two dimensions, attempting to give the readers a mental picture of what life must be like for its inhabitants. However, it would take a particular leap of imagination to envisage what it would be like for two or three-dimensional creatures to experience phenomena in three, four, five, six or more dimensions.

Two-dimensional creatures, for example, would perceive an interesting range of polymorphic shapes, constantly changing configuration as the cross-sectional plane reflected the movement of the object through a third or higher dimension. Again, the object would seem to appear and disappear as it moved in and out of the cross-sectional plane that represented the two dimensional creatures’ views of it (see Figure 2, page 70), with some objects reducing to a point or the ubiquitous line occasionally. Furthermore, some of these lines would not be straight, as they always are in one-dimensional world, but rather would wander around in a way impossible for one-dimensional creatures to grasp, except mathematically. (A similar comparison of two and three dimensional views of mappings, or graphical

representations, of strange attractors identified in some chaotic systems can be found in Shaw, 1981).



Reproduced from Colbourne (1995)

Figure 2: Dimensions: a one-dimensional (top) and two-dimensional view of the same three-dimensional ring. The dotted lines represent the field of perception and the heavy black configurations the actual shapes perceived. In each of these cases, the viewers see two apparently separate yet similar shapes, the full configuration remaining hidden from them.

Three-dimensional creatures, however, would not be able to perceive a cross-section of an object, but rather its external configuration. These creatures would have an experience of depth, which would allow the phenomena of parallax and perspective to be perceived. Here, objects would seem to disappear and appear as they moved behind other three-dimensional objects. Importantly, as with the creatures in the lower dimensions, these inhabitants would only be able to envisage the phenomena of their world in direct relation to the number of dimensions available to their senses. For them, cause and effect would appear to be linear in nature – push an object and it moves in that direction; turn an object round and the other side

becomes available. However, the real problems for three-dimensional creatures begin when they confront complex, multi-dimensional phenomena.

Human beings, operating as we do in three dimensions, enjoy a conception of existence, which is far richer and more complex than anything that can be experienced by the one and two-dimensional creatures pictured above. Nevertheless, we too miss out on a universe of experiences that are not available to our limited perceptions (see also Edward Green's 2002 reflection on dimensionality and superstring theory). This can be illustrated by a further consideration of that most ubiquitous of phenomena – the weather.

Predicting the weather is a universal pastime – satellites and statistics; bones cast on the earth. My grandmother read tealeaves. In summer the temperature rises and in the winter it falls, on average. However, exactly how much that rise and fall will be year to year has proved impossible to predict. The situation has been further complicated by apparently random fluctuations in temperature patterns – frosts in the warm months and balmy days in winter. Ocean currents occasionally reverse for a season resulting in drought where there has been plenty and drowning otherwise arid land. Modern computer models of weather systems operate on a grid of points about eighty kilometers apart. However,

....suppose the earth could be covered with sensors spaced one foot apart, rising at one foot intervals all the way to the top of the atmosphere. Suppose every sensor gives perfectly accurate readings of temperature, pressure, humidity, and any other quantity a meteorologist would want. Precisely at noon an infinitely powerful computer takes all the data and calculates what will happen at 12:01, then 12:02, then 12:03...

The computer will still be unable to predict whether Princeton, New Jersey, will have sun or rain on a day one month away. (Gleick, 1987, p.21)

I have argued that we have been *predisposed* to approach phenomena utilising a linear methodology because of the dominance of the classical paradigm for scientific inquiry. Furthermore, as detailed above, the principles underlying complex systems

inquiry may be considered counter-intuitive for three-dimensional beings such as ourselves. Indeed, accurate predictions concerning the behaviour of complex systems are beyond our capabilities for two reasons. Firstly, we cannot perceive all the affective dimensions that impact on the system – the links between cause and effect are hidden from us in precisely the same way that the second and third dimensions are hidden from our imaginary companions above. Secondly, complex systems do not obey linear laws. Descriptions of cause and effect are not precise sciences and understanding a phenomenon today does not necessarily allow us to predict its behaviour tomorrow.

This observation has profound consequences for inquiries into human behaviour.

Jane's Ten Seconds

Human behaviour has proven impossible to predict with any certainty - as educational research has consistently demonstrated since its inception. This failure of educational research to deliver the insights and tools to guarantee effective outcomes has been commented upon by many practitioners, including Joe Kincheloe (1997):

Positivistic research has contributed neither to the clarification of educational problems or the formulation of solutions to them.
(p. 100)

Why this is the case after the investment of incalculable effort on the behalf of individuals and governments can be demonstrated through changing the focus on the learner as an object being acted upon by external forces – teaching methods, and so on – to that of an individual who interacts dynamically with the environment and all the forces that interplay therein. A classroom, for example, seems to be a relatively simple thing to describe – a rectangular box, usually, with people inside engaged in some sort of teacher-learner interaction. Now let us focus on one of the pupils in one of these classrooms. Jane is ten years old and is sitting three rows back. She has proved to be a likeable if unremarkable student, neither causing the teacher undue concern nor standing out as a pupil. The teacher would reasonably expect that Jane would proceed with her schooling in much the same way as in the past - she would

be satisfactory but not outstanding. However, the teacher is aware that he cannot predict with certainty that this will be so. There are so many aspects of Jane's experience and development unavailable to him. Jane may have inherited the genes that predispose her to schizophrenia and may thus become ill in her teens or early twenties. On the other hand, Jane may well have these genes and never exhibit schizophrenic behaviour. Similarly, Jane may experience a traumatic episode that permanently affects her ability to interact with others. Or she may be one of those fortunate children that bounce back from adversity seemingly unscarred. As the teacher studies Jane he recalls the famous Einstein report card with its failure in mathematics. Could Jane be a potential theoretical physicist? Unlikely, but possible. The teacher is also aware that although there is some correlation between school grades and professional occupational success, there is very little between school grades and business success. The literacy levels of the parents, whether first born or not, socio-economic status of the family of orientation, genotype, experiential learning patterns, right or left hemisphere dominance, the amount of free lead in the environment, introverted and extroverted personality traits, height, attractiveness, IQ, leadership qualities – all have been demonstrated, in some studies, to have a negative or positive correlation with school and life outcomes (Robertson, 1987; Coon, 1989). Unfortunately, experience of all the positive dimensions does not guarantee success and happiness. Similarly, experience of all the negative ones does not condemn the individual to a life of failure and unhappiness. The multifaceted richness of the totality of Jane's existence is simply inaccessible to us. Mere three-dimensional creatures, we peer at outcomes at any particular time and our attempts at explanation are, to quote T.S. Eliot, "...only hints and guesses, hints followed by guesses..." (The Four Quartets, 1969) as we strive to perceive a four-dimensional phenomenon through three-dimensional eyes. Neither we nor the most sophisticated computer can predict with certainty what Jane will do in ten seconds let alone in ten or twenty years. Overall, with her teacher, we will just have to wait and see. Furthermore, this model proposes Jane as a dynamic and affective dimension in all the processes which involve her and with which she is involved. Thus, as Kincheloe (1997) has pointed out, her education must be considered much more than just observation and measurement.

...an embrace of reason accompanied by the exclusion of the affective, the emotional aspects of learning and knowing, forces us to focus on the least important aspects of the educational process – aspects which are inevitably the most measurable. (p. 87)

Indeed, what can be measured may well be the least important information we can gain about Jane's past, present and future.

Linear Research Design in Non-linear Systems

I have suggested that research has generally been ineffective in allowing an understanding of the parameters of human existence – effective descriptors of Jane's past, for example, or effective predictors of her future. A brief analysis of research methodology can demonstrate why this has been the case.

A basic linear design model for educational research can be represented as follows (Campbell and Stanley, 1963):

$$\begin{array}{cccc} \mathbf{R} & \mathbf{0}_1 & \mathbf{X} & \mathbf{0}_2 \\ \hline \mathbf{R} & \mathbf{0}_3 & & \mathbf{0}_4 \end{array}$$

Where two groups are randomly assigned (**R**) and one is given a treatment (**X**) while the other, untreated, is used as a control. Observations or measurements of the experimental group at **0₁** and **0₂**, before and after the treatment, are compared statistically with observations of the control group at **0₃** and **0₄**. Traditionally, the treatment might be a reading programme or a mathematical teaching method, for example. The observations might therefore be concerned, in these cases, with reading levels or mathematical ability. To take the first example, it may well be found that the introduction of a particular reading scheme leads to a significant increase in reading levels in the members of the experimental group. One might therefore assume, with some justification, that this particular reading scheme was effective and introduce it into the school. However, what cannot be assumed is that such a scheme will always be successful with every student or with every class. Indeed, it cannot even be assumed that the same scheme would succeed with the

same group of students in apparently identical circumstances. Furthermore, there may well be “outriders” – students who apparently defy the trend and experience a fall in reading levels, for example – that the statistical analysis fails to highlight.

The shortcoming in this approach to research is that it focuses on one or two dimensions of a complex system and often for only short periods of time. A useful analogy lies in the two-dimensional world postulated above. A research design of this kind illustrates cross-sections of, or slices through, an aspect of a multi-dimensional system at particular moments in time. Such cross-sections will certainly give useful information and insights into such systems. What they cannot do is give predictability as to outcomes from group to group, from individual to individual, or over time. The bulk of the action is hidden from us in the multi-dimensionality of the factors affecting the development and behaviour of human beings. Thus, the decision to ignore or wish away the complex nature of social development may be likened to an insistence on the concept of a flat earth - it has some interesting features but you have to ignore the horizon.

As Yaneer Bar-Yam (1997) has pointed out, statistical analyses represent a process in which complex systems are presented as simple: it is a process of averaging out variations so that a linear relationship may be proposed.

The origin of simplicity is an averaging over the fast microscopic dynamics on the time scale of macroscopic observations (the ergodic theorem) and an averaging over microscopic spatial variations. The averaging can be performed theoretically using an ensemble representation of the physical system that assumes all microscopic states are realised. Using this as an assumption, a statistical treatment of microscopic states describes the macroscopic behaviour of systems. (P. 16)

Further insights may be gained into this basic problem in research methodologies through the exploration of a proposed conceptual model.

Chaos Theory

Chaos theory initially developed from analyses of turbulent systems, with weather patterns being one of the earliest in the nineteen-fifties. When it became apparent

that computer modelling using linear equations produced only stasis – repeated, predictable patterns with no parallel in reality – Edward Lorenz developed a program that used non-linear equations (Lorenz, 1979). Non-linear equations change at each calculation, unlike linear equations which retain their initial form, and for the first time a computer model produced outcomes that mirrored actual weather systems – similarities in patterns that never quite repeated themselves no matter how long the programs were run (see the Sparrow, 1986, analysis of the Lorenz equations). Lorenz developed the original program in 1960. Over the intervening fifty years models have been developed for fluid mechanics, the movement of economic indicators, the ebb and flow of animal and plant populations, the movements of the galaxies, the formation of ice crystals and the distribution of leaves on trees, amongst others. The important common denominator in all these systems is that they are not random in nature but nevertheless defy prediction. There is an order, but that order is complex and never repeats itself in exactly the same way twice.

Crucial to any consideration of a complex, multi-dimensional system is the fact that if a phenomenon is not “chaotic” in the literal sense, then that phenomenon must conform to embedded parameters that drive the system. We may not be able to perceive them, or perhaps have not yet created mathematical models for them, but they must be there (Tritton, 1986). If they were not, there would be no order at all, complex or otherwise, and no similarities apparent in the multi-varied patterning of that phenomenon. For example, each ice crystal is unique, but each one is instantly recognisable as an ice crystal and the formation of each will have followed the same physical laws. In any complex system there will be several of these parameters acting at once, and perhaps dozens (Lorenz eventually constructed twelve non-linear equations for his weather model). They act as “attractors” (Ruelle, 1980), directing the phenomenon, channelling it within certain limits and along recognisable paths. Because the relationships between these attractors and the systems they affect are non-linear, those systems never settle down to an identical series of patterns or to stasis, but ring an infinite number of changes around a finite series of themes (Takens, 1981). A rose is always recognisable as a rose, but, as the Little Prince knew, each rose is unique in all the world (Antoine de Sainte-Exupery, 1959).

Human behaviours are certainly complex and unpredictable, but they are not necessarily random in nature. Human beings develop in similar ways, have similar

aspirations and fears, form similar social groups at the micro and macro level, and create similar cultural products all over the world. Thus, human development and behaviours, too, must conform to a finite number of non-linear parameters, which define their limits and their characteristics (Warren et al, 1998, have put forward a similar argument). The actual form those behaviours take will vary as widely as snowflakes in a blizzard, but they will nevertheless remain variations on a distinct number of themes. Some of the attractors that influence human behaviour will be genetic in origin, others cultural, but whatever the full range turn out to be it remains the case that attempts to understand that behaviour, to see beyond the limits of the dimensions currently available to us, will require more than a simple linear approach to inquiry. Indeed, as one of the characteristics of non-linear systems is that every attractor interacts with every other attractor in constantly varying ways (Stewart, 1989), a multi-dimensional approach to behavioural research will be the most useful in reaching an understanding of those behaviours. At the very least, such an approach predicates a range of observations that reflect the influences of a number of attractors, thus avoiding to an extent what I would term the linear fallacy – that a complex system may be understood by taking a two-dimensional cross-section through it at any particular point in time.

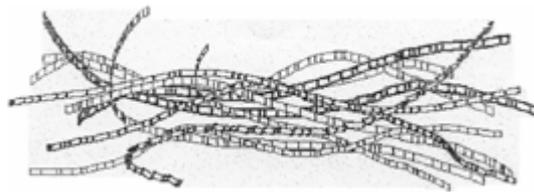
A useful analogy here can be taken from Gestalt theory on human personality – the concept that the whole is more than the sum of its parts. The reductionist approach to behavioural research attempts to pare down actions and motivations for actions into their constituent parts. The implicit assumption is that an understanding of the base elements, the strands that make up the system, will allow a conceptual understanding of the whole. This can be called the wire rope theory of behaviour: the constituent strands, once identified, will be seen to form a cohesive and recognisable form which can be used as a universal descriptor and predictor of human behaviour (see Figure 3, page 79). However, this model is three-dimensional and linear whereas human behaviours can be described in four dimensions, and perhaps many more. The ‘strands’ of this imaginary rope can be taken to exist, of course, because they are simply metaphors for the parameters that underpin human behaviour. The key to an accurate mental image of the form they may be said to create lies in an understanding of how these parameters interact (the fourth

dimension in this model)²⁶. If these parameters are non-linear in nature, then each strand will interact with every other strand in varying and unpredictable ways. They will also vary in thickness, or influence, at any point in time. New strands will appear as new parameters impact on the system and old ones will apparently re-appear and disappear as their influence waxes and wanes. The resultant form is not one that would be welcome in any hardware shop – tangled and misshapen, bent and twisted, with strands entering and leaving at odd intervals. Furthermore, what we are picturing here is the history of one person through an unspecified span of time – Jane’s, perhaps, during one school day (see Figure 3, page 79). Any other child will have his or her own history which may be similar to Jane’s, but never configured in the same way, and the further apart the two histories are – in time or cultural origin, for example – the less alike the two will be. Yet, if the models for all of humanity could be projected before us we would nevertheless recognise each one as unmistakably human histories, no matter what the differences might be. A consideration of the micro and macro forms of this model is also informative. Jane’s model is composed of a number of parameters, or attractors, that define the particular non-linearity of her history. However, each of these parameters might themselves be made up of many separate strands. For example, her genetic inheritance would have to be considered as a powerful, or highly influential, attractor. Yet, this genetic inheritance will have many elements to it, sometimes acting in concert, sometimes not, so that, again, a multi-dimensional and non-linear model emerges. Similarly, each person can be said to form separate strands in a human grouping – a peer group, a class, a family, a community, a society, and so on. At this macro level, each individual history may be said to have the potential to act as a parameter, or attractor, influencing human history in the wider sphere, with some people having more influence than others at different times, thus creating a further chaotic system. The resulting matrix, reaching through the four dimensions that this model can encompass – and reflecting dimensions beyond these that it cannot – would fill all of the space available to it in an infinitely complex pattern of separate yet mutually influential strands from the most fine at the micro level to the most massive at the

²⁶ For the importance of the fourth dimension, or the application of the fourth power law, to all biological systems see Hunter (2003). The model that is described utilises fractality (or complex systems scaling) and is very similar to the one proposed here. The essential elements are three dimensional phenomena operating in four dimensional environments.

macro. There would be repeated volumes of space that demonstrated self-similarity, thus betraying the attractors embedded in the system, but never in the whole history of its passage through time would the matrix exactly duplicate itself at any level within it or from any perspective.

Figure 3: The Hardware Shop: would you buy this wire rope? A representation of the multi-dimensional and non-linear parameters underpinning Jane's behaviour during one school day.



Or would you be tempted by this one. An idealised, linear and deterministic model of the factors underlying human behaviour.

Reproduced from Colbourne (1995)



Importantly, this model leads directly to a number of considerations for behavioural research methodology that may be briefly explored here.

Think Locally

What happens with this group of people in this situation may not be repeatable elsewhere with others or in different circumstances.

Focus on the Differences

The extent to which observations of behaviours do not correlate may be much more significant than their correlations. It is as much in the rich diversity of responses to any given situation that an understanding of human behaviours may be found.

The Experimenter as Participant

Non-linear, chaotic systems are sensitive to the least stimulus (Kauffman 1993; Dimitrov et al 1996; Green, 1998). Any experiment therefore becomes a disturbance, which ripples through the whole system – a stone thrown into a multi-dimensional pond. The system is changed permanently and in unpredictable ways by any attempted intervention. Even the introduction of an observer will probably have a significant impact. The important point here is that it is unnecessary, and probably impossible, to isolate the experimenter from the system being studied. Rather, it becomes more relevant to consider the experimenter as participant – at the design stage, during the experiment itself and during the analysis of results (Heisenberg, 1964).

Validity is Ubiquitous

Personal reflections, case studies, anecdotal comments, diaries, casual observations – all of these assume particular importance if the underlying parameters for human behaviour are accepted as non-linear (Kincheloe, 1997). A useful analogy is an imaginary dust box. A handful of fine dust is inserted into a closed box inside of which the air is maintained in a state of turbulence. Quickly, the dust particles are whirled around inside the box, filling every part of it, but never evenly. Eddies and whorls are formed and disappear as the particles, obeying non-linear laws, move in unpredictable ways through their small world. Each of these particles has a story to tell, from its own unique experiences, from its own unique perspective, at any particular point in time. Similarly, through experiencing the phenomenon, being embedded in it, people have unique and important observations to make on their particular situation from their particular perspective. Even erroneous observations have something to tell us about that individual's subjective experience of the multi-dimensionality of existence and can therefore lead to a greater understanding of the parameters that underpin that experience. In other words, research that is subjective

and anecdotal may have just as much to tell us as that which follows the classical experimental methodology described above, and perhaps more. (Russell Standish, 2001, has completed an interesting analysis of complexity and subjectivity which is useful here).

Process Not Prediction

Finally, given that human behaviour is non-linear and dynamic in nature, there can be no one approach to behavioural research methodology (Adcock and Collier 2001, Trochim 2000b, Swepson 1998, Becker 2003, Jones 2002, Cupchick 2001). As Kincheloe (1997) has pointed out:

One discipline or paradigm is not adequate to the task of understanding the network of the intricate and ambiguous human relationships, which make up a classroom. Researchers need a multi-dimensional set of research strategies to understand such classroom interactions and the relationship between the classroom and the deep structures of the larger society. (p.101)

Thus research that focuses on continuous process reactivity, both in relation to locality and over time, may well lead to more effective descriptors and therefore more effective outcomes or initiatives in fields such as education and social engineering (Russell and Kelly 2002, Knuuttila 2002).

Significantly, a multi-paradigmatic approach to research is now supported by scientists from many disciplines, including medicine (Bowen 1996, Casebeer and Verhoef 1997), economics and psychology (Trochim 2002), market research (Davies 2000), educational study (Thomas 2003), psychotherapy (Nau 1995) and social research (Jones 1997, Kelle 2001). Further, a growing number of projects have been overtly utilising methodologies from both the modern and postmodern approaches to gain a greater understanding of the phenomena under study (see particularly the overviews of research by Nau, 1995, and Casebeer and Verhoef, 1997).

Beyond Pragmatism

Importantly, one of the foci that the postmodernist position has given us is a return to the ethics or beliefs that may underpin scientific research. Three questions have driven this focus: Why do this research? Why do this research in this way? And, what form should be used to describe that research? For postmodernist researchers these are not just intellectual questions:

...it is particularly important to pay careful attention to inner ways of knowing, to somatic and affective layers, so that we might consciously work on the evolution of our story. While inner ways of knowing cannot be the sole source of knowledge, they are a major source of knowledge. We must therefore acknowledge, and do so publicly, that the formulation of a different story is not exclusively an intellectual affair. (Heshusius and Ballard, 1996, p.15)

Thus, our choice over what particular research project to develop may be guided as much by an inner sense of rightness of choice as any apparently objective set of criteria. Heshusius and Ballard (1996) explain this as follows:

By somatic and affective modes of knowing.....we refer to direct modes of knowing, to actual locations of primary knowledge, to primary sources of information. We are expressing the belief that forms of discourse need to be welcomed that no longer reflect the forced separation of what has become to be seen as interior and exterior modes of knowing. (P.14)

It may be, for example, that the choice for the direction of our research might take into account our deepest beliefs on ecology, education or socio/political concerns. The question may be what do we need to know to improve that ecosystem, educational process or community rather than simply seek to describe what we believe is already there. Similarly, the way in which we conduct that research may involve us intimately in the research – as participants in the topic being investigated

– rather than observers of it. Further, we may choose to utilise narrative processes to report on the research because, somatically and affectively, it makes sense for us to do so in this particular situation with these particular subjects:

Our concern here is with the major paradigmatic shift from a mechanistically conceived epistemology that relies on a rationality of method, which abstracts and quantifies the human experience, to an interpretive and qualitative epistemology in which knowledge is seen to be constructed from our capacity to directly create and grasp meaning and connections in life. (Heshusius and Ballard, 1996, p.16)

Interestingly, many researchers are now publishing their narratives in relation to the adoption of this new paradigm. For some this has represented a “eureka” moment – a reflection of a sudden shift in belief patterns – and for others a more gradual shift from one paradigm to another:

I knew that the sense of division, that chasm between what I believed in and how I thought about research, was over. Something that had felt wrong for a long time now felt resolved; the seismic plates had shifted and settled... (Ballard, 1996, p.30)

My journey towards becoming an interpretist...no doubt has very personal roots. In tracing the nature of this journey, I know I have made both conscious and unconscious choices about what is important in my life. (Gallagher, 1996, p.38)

I slowly came to realise what my gut had been trying to tell me for years: that there was an intrinsic problem with current modes of conceptualizing the world and defining ways to study it....I had been skirting the edges of a paradigm shift, whereas I should have been joining a revolution. (Guba, 1996, p.46)

I suddenly saw what it means to understand paradigms as ways of constructing knowledge in all that we do. Finally, I had arrived at that point where, in both theory and practice, the reductionistic-behaviouristic worldview was no longer a successful picture of human behaviour for me. (Israelite, 1996, p.60)

The message that these narratives have for the broader considerations of research is that affective responses to our activities are an integral function of our work. We are emotional/intellectual beings who respond to phenomena on many levels. Attempts to remove, or deny, these dimensions in favour of some objective postulant are naive at best. It is certainly poor science, as the concept of the objective observer is not currently supported by any of the evidences available to us.

However, it is also the case that all the above individuals, and many others, express the conviction that, for them, the new paradigm represents a sea change – no longer will they pursue reductionist models. Nieta Israelite (1996) goes on to make this comment:

I realized that I could never again think of subjecting deaf children to measurement and quantification in support of the deficit model. Nor would I engage in research informed by the positivist paradigm any longer. My colleague and I lived in two different worlds. (P.60)

I believe here that Ms Israelite and many other postmodern researchers have fallen into the same trap that ensnared the positivists before them. To hold to one paradigm, one set of assumptions, about research methodologies, is to deny the very processes that have led to the adoption of the new – the somatic and affective dimensions of change and decision making. Thus, the adoption or retention of a postivistic worldview is just as valid for, say, Killott and Kumar discussed elsewhere in this thesis as the position detailed by Heshusius and Ballard. We are involved in a series of discourses, and the tools we may use to further those discursive processes may take many forms.

I would therefore change the focus from an argument over the rightness, or wrongness, of the competing paradigms to an overview of the lessons they have to teach us about the way we construct theory and conduct research. Paradigms are powerful. They are the often unconscious belief systems that direct our thoughts and actions. For two and a half centuries, the Newtonian paradigm for research was almost unchallenged – it was tacitly assumed that it was the ‘way’ to do science. However, recent discoveries in quantum mechanics and the complexity sciences have demonstrated that the classical paradigm is not *the* way but *a* way of doing science. Concurrently, differing models have emerged for conducting research, and particularly those embodying hermeneutic, narrative and emergent principles. These new methodologies do not represent a retreat from reason or, in some way, an attack on the efficacy of the processes of conducting scientific inquiry. On the contrary, they represent new tools and new insights. On the other hand, they are not, as many observers have attempted to assert, the only way to do science any more than the classical methodologies may be so considered. Rather, they are opportunities for choice, for new approaches and for novel outcomes.

The new methodologies have focussed attention on the researcher – or the theorist – as an affective dimension in the processes of discourse. Thus, questions as to the assumptions underpinning these discourses become paramount. Any theoretical or research position will have a paradigm or set of assumptions embedded within it. It is, therefore, becoming of increasing importance as the writer to explicitly recognise those assumptions in constructing the discourse. Indeed, as Jelinek et al (1998) have pointed out, these assumptions may well underpin the very choice of terms, or technical words, utilised in any discourse. Similarly, as readers we have a responsibility to analyse and recognise our own preconceptions and assumptions in developing or framing our responses to the form and content of the discourses presented to us. It may simply not be enough to disregard a discursive process because it arises out of a paradigm we do not support, or utilises a methodology we would not use ourselves. On further reflection, it may be realised that this approach in relation to this topic by this person in this situation is perfectly reasonable. Certainly, we may decide that it is entirely unreasonable – and that is fine as long as we have assured ourselves that our assessment is not driven by assumptions we have failed to acknowledge.

It may therefore be argued that the paradigm shift we are experiencing in scientific inquiry is less about methodologies than form. If the position detailed in this thesis is accepted, then a revision of the format of scientific discourse is a corollary. For example, it may follow that a recognition of a pluralistic worldview of inquiry requires that the paradigms underpinning those processes be explicitly detailed by the proposer. Thus, a statement, or series of statements, clarifying the paradigmatic position(s) of the proposer may well become as accepted an element in scientific discourse as hypotheses are now. In other words, to borrow from the complexity sciences, this may be the adopted paradigm that represents the settling around a new attractor of the chaotic processes that are currently characterising scientific discourse.

Central to the position advocated here, then, is the concept of choice. We may be driven by our assumptions and paradigms without serious reflection or we may bring to consciousness those same assumptions and make decisions on purpose, content and form from a more informed and potentially justifiable position. Thus, we may decide on a classical research model for one project and a holistic model for another. Essentially, our choices can be informed by our understanding, at both the affective and intellectual levels, of the subject, the intention and the potential outcomes. Given our new insights into the processes of inquiry I would argue that any other approach must be considered ad hoc and less rigorous.

Serendipity: Beyond Rationalism

We do not deny the reality of an external world, but only suggest that numerous possible explanations exist and that chance events can be made serendipitous if the event provides the opportunity for story-building. In this way, story telling is a means, not an end. We use stories in much the same way as researchers might use an illustrative case decorating a statistical study. Our stories are intended as supportive evidence for the paper's conclusions and, it is hoped, permit the reader to experience an abbreviated version of the *verstehen* and inference processes of the researcher. (Fine and Deegan, 1996, p.5)

I am not sure where stories start, but they have to start somewhere. It is certain that each of us is searching for something – happiness, success, a home. It is also true that we only have a limited number of years in which to chase our dreams. We shall grow old and die, or suffer illness or accident that will end our personal stories. Growing older tends to focus the mind.

I grew up in the mining valleys of South Wales, the land of song, *How Green Was My Valley*, rugby football and Tom Jones. It was a land of contrasts. The valleys were deep industrial wastelands, black with rubbish from the mines, yet fringed with a green halo of hills that looked down on the tattered communities below. The people were poor, the bottom of the industrial hierarchy, living in grim terraced houses on dank and ugly streets. And yet music was everywhere - the soaring of voices in harmony in the homes, the schools, the pubs, the chapels. Every small community had its choir: the miners, the shopkeepers and the unemployed singing together with *hwyl* and passion, with beauty to move the soul.

As a boy I would climb the steep paths up Mynyddislwyn, the poet Islwyn's mountain. The terraces at last gave way to fields bordered by endless stone walls, encompassing short, tough grasses cropped by the hardy Welsh sheep. Up there, the wind whipped across the eyes and mouth, clean and fresh, and the valley seemed so far away down in the greyness. My favourite spot was right on top. Only three structures stood there, in the crook of two roads that met in the middle of nowhere.

There was a pub, which was banned to me being a child, a ninth century church, where I had been baptised, and a bronze-age burial mound. All three of these were mysterious to my eyes. The pub with its thick, stone walls and studded door, the church with its high, stained-glass windows, brown with dust and weather, and the huge mound reaching for the sky. On good days I would climb the mound, disturbing the few sheep that nibbled the grass flat like hair on an old man's head, and lie spreadeagled on the very top. Up there, the sky spun and whirled and I knew that anything was possible and that the world was waiting for me to find it if I could but escape the prison of my days there in nineteen fifty-seven.

Childhood was a round of bitter, endless winters and warm, endless summers that all ended nevertheless, each blending into the other, with the summer holidays and Christmas the highlights. Snow was magical, blanketing the harsh, black landscape with cathedrals of glittering architecture, softening the edges and stopping the traffic. The snowball fights were serious, with the bad boys putting stones or pieces of ice in the middle to sting and hurt. Our breath would freeze on our hoods and scarves and we would return to our homes with their glowing coal fires worn out and happy at the ends of the afternoons. If the evenings were still and dry, we would all meet up again in the dark after tea and do the rounds, singing the old carols for copper and silver coins. The young voices would soar, clear and high in the harmonies, and the singers, us with our eyes closed, lost in the song. At each house the people would stand at an open doorway in the cold until two or three carols had been finished and only then would they press their precious coins on us, hard won and freely given, while we sang another carol for them in gratitude.

Childhood ended when I was sixteen. I was too stunned to cry, though my mother cried enough tears for all of us. Aberfan Primary School, just seven miles away, had been buried when a coal waste tip had slipped, millions of tons of coal slurry and rubble moving like a living thing down the valley slope. Children and teachers were missing. The people of the valleys streamed to Aberfan to dig with shovels and hands, long lines of men with buckets snaking across the broken hillside. For days and nights the digging went on unending, the school slowly emerging, black against the black waste around it. But there were no stories of heroism and survival. They were all gone, snuffed out in a moment as the slurry filled their world, the children with their arms over their heads, the teachers with their arms out flung, vainly trying

to protect their pupils. The count went up as the poor bodies were removed and carried down to the waiting ambulances, so many of them small and huddled, the scene eerily quiet: seventy, ninety, one hundred and ten, one hundred and twenty. My enduring memory of Aberfan after that day is silence – no children’s voices, no laughter, no singing. For the people of Aberfan, this was beyond a disaster; a whole generation of children had been killed. For the people of South Wales, it was another episode in a long history of industrial and social exploitation and degradation. Three years later I packed a duffle bag and my guitar and left the valleys forever.

Having abandoned the lifeboat of home and struck out into the oceans of the world I discovered that I had no idea where I was going or what I was doing. I was certainly *travelling*, but to what purpose I just didn’t have a clue. For two years I worked in a wholesale warehouse in Cardiff, the capital of Wales, and lived in a tiny, third story flat next to a busy train goods yard that worked unceasingly day and night 365 days a year. One of the gifts I received from my time there was the ability to sleep through anything.

A personal inventory made bleak reading. No money or resources; few abilities and little knowledge; a thick accent and poor interpersonal skills. It didn’t look good. Interests? Well, I loved music and could sing and play the guitar. Not well enough to make a living, I judged. I also loved literature, as did many Welsh people, and read voraciously. My parents had been left a cupboard full of books by a great aunt and I had read every one of them. What a world of imagination and ideas! From the classics to thrillers and detective stories: Charles Dickens rubbed shoulders with Rider Haggard and Daphne Du Maurier. There was also a beautifully illustrated bible that was a joy to hold and read. I loved poetry too and often revisited the visions of Longfellow, Wordsworth, Byron and Keats. Research into entrance requirements soon told me that I wouldn’t get into a university. However, I knew after all that anything was possible and discovered that I could get into the Bedford College of Education – a College that offered a scholarship into Cambridge University. I applied and was accepted.

This was the first year that Bedford had enrolled male students – up until then it had been females only. The authorities did their best to maintain decorum and order between the sexes, but it was a lost cause. The residential blocks soon became centres for experimentation in everything, and particularly relationships and

recreational drugs. Pregnancies were inevitable and many a future was decided in that first mixed-sex year. Much to my surprise, I found myself a father and married at twenty-one.

I was a serious young person, much too concerned with matters of the mind. That was not the case with everyone, though. Bedford had one street that had over a thousand houses in it, reaching like an arrow from the college site to the centre of the town. Walking down that street at dusk was surreal as living rooms with lights on but curtains open revealed never ending variations on the same theme – pictures on the walls from the same stores, the same furniture, the same programmes flickering on the TV screens. Also ubiquitous were the garden gnomes. Almost every other garden had them in various poses, shapes and sizes. The most gnomes were reserved for one particular front yard. This yard at least was unusual in that there was not one living thing to be seen in it. Every square inch was covered with green painted concrete, gnomes strategically placed. One memorable night a group of students collected every gnome from every garden on the street and placed them all in the green concrete front yard. The owners were greeted by over three hundred of these creatures the following morning, apparently in discussion groups. The photograph made the national newspapers but none of us broke under the resultant interrogation by the local police.

Nevertheless, as a student group we also worked hard in every area from our studies to an involvement in the arts. Academically the standard was high and the opera society was renowned for its productions. *Dido and Aeneas* was the highlight while I was there (I was in the chorus). I too was diligent in my studies and received, puzzlingly, both As and Ds. A discussion with the person awarding me the failures, the head of English, sorted me out. I was advised that people like myself should aim at what was possible – a bare pass. After all, I was told, look where I had come from? I should be grateful for the opportunity to get a qualification. Afterwards, if I managed to scrape through, I should return to Wales and work in a school somewhere.

Happily, this bit of advice did not have the intended result. I considered it the best motivational talk I had ever received. I worked harder and managed to hand pieces of work required by the head of English to other lecturers for separate assignments as well. After a series of C minuses from him and As from other lecturers for the same

pieces of work, I had made my point. My overall averages went up and my goals were thereafter taken seriously. I was very fortunate, won a scholarship into Cambridge University and eventually completed my first degree there. I did note that I was the only successful student at Bedford College that year that was not congratulated by the head of English.

The head of English's reaction to my work was a revelation to me. It was clear that an individual could perceive exactly what they expected, or wanted, to perceive, no matter what the evidence might be. Subjectivity played a fundamental role in processes of judgement, and people's prejudices, or assumptions, were crucial in presupposing any outcomes or results. Indeed, I had observed this process working in reverse for me as well, for after I had gained a reputation for good work my grades remained consistently high whether I honestly felt the assignments deserved it or not. This lesson in the subjective/objective paradox in human processes of inquiry was never to leave me.

However, I had also received a sharp lesson in racial and class discrimination and this too stayed with me. After receiving my degree in nineteen seventy-three, I looked beyond the United Kingdom. I felt no affinity with the social structures there. I would keep travelling. In time I was offered two-year contracts in both Saudi Arabia and Tasmania, the island State of Australia. My wife Patricia had successfully gained her Teacher's Certificate at Bedford and had also been offered work in both places. One day, while we were trying to make a decision, she looked at me and shrugged. I took a ten pence piece out of my pocket and tossed it: heads for Hobart, tails for Riyadh. The coin spun through the air, glittering in the morning sun coming through the lounge room window. It hit the floor, twirled round and stopped. Heads. Tasmania it was. Chance and opportunity had defined the next twenty years of our lives, years that included success and failure, illness, accident and recovery and divorce, grief, loss and new relationships – the usual mixed bag for most lives.

So it was during one long, dusty afternoon in the University of Tasmania Library in 1993 while reading through a series of research papers on teacher effectiveness that it suddenly struck me – no matter how many papers were read on a particular subject in the topic I was researching - behavioural sciences - the actual addition to a global understanding of that subject was little. It was as if each paper was a tiny,

feeble globe illuminating one portion of an infinitely large room. What was more, the information revealed by one paper often contradicted that illuminated by another – the research findings were not always duplicated in replication studies, for example. Now, if behavioural research could be modelled on the dominant paradigm found in the physical sciences, this should not be so. Each research project should ideally reveal part of a path between total ignorance and full understanding with the latter being achieved when all the intermediate steps had been explored. Indeed, until the advent of quantum mechanics all phenomena had generally been considered to be linear in nature and therefore understandable in this way. However, it seemed clear that human behaviour had never fitted into this model in the first place. This left me in a quandary. If human behaviours did not obey linear laws, what principles did they follow? I remember feeling unsettled and disturbed. It seemed that I was in the process of discarding the only paradigm for scientific inquiry I had ever known.

I thought back to the first time I had engaged in a doctoral programme, in this University in 1980. After one year I had pulled out and gave as the reason personal issues. Looking back now I realised that really I had begun to doubt the process even then. I had been working in the Special Education Department on research into the links between teacher personality characteristics and student learning. It was reasonably straightforward: an empirical study utilising well-established processes for statistical analysis. Without doubt, I would have discovered significant correlations and could have written the doctoral dissertation. Unfortunately, after a year of work I just could no longer see the point of this sort of research – what utility it could possibly have.

Part of my retreat from purely empirical research had been founded in my experiences with a particular young person, whom I shall call Jeffrey. Jeffrey was ten years old and autistic. The University at the time was running some programmes for autistic children, and I had been asked to participate. The basic principle behind the work was the application of highly structured, reinforced activities targeting specific learning difficulties. None of the autistic children involved, including Jeffrey, seemed to be making much progress under this regime, but at least somebody was trying to do something with these young people, and the parents were more than grateful. However, Jeffrey changed all this for me. Jeffrey was hyperactive, always squirming or leaping about or throwing things - he was never

still. It was impossible to get his attention for more than a moment and therefore impossible to apply any learning programme. Being an experienced teacher of remedial and special children, I realised quickly that this was not going to work and another approach had to be tried. Immediately outside the room I worked in with Jeffrey was a playing field. Jeffrey liked to get out onto that field and run. After two or three abortive sessions attempting to settle him back into the teaching room I decided that I would bow to the inevitable and allow him to burn off some energy. So he and I ran around that playing field until Jeffrey had had enough.

Jeffrey was also obsessive about feet – everybody's feet. He would attempt to take off people's shoes and socks as well as his own, and his parents had warned me about this behaviour. After our run, Jeffrey took his shoes and sock off and then mine. And then we had our best learning session so far. We used language and number and communicated well for ten to fifteen minutes. Jeffrey had orchestrated a breakthrough.

At the beginning of each session following that, Jeffrey would lead me outside and we would run around that playing field for twenty minutes to half an hour. Then we would sit on the grass wherever we happened to stop, off would come the shoes and socks and the processes of communication and learning would begin utilising whatever items might be at hand – leaves, twigs, patterns in the grass, buildings and pathways, whatever was in my pockets. Jeffrey was responding more than he had ever done before.

However, none of the activities that Jeffrey and I were involving ourselves in were part of the learning programme that had been developed for autistic children. They could therefore at that time neither be effectively recorded nor included in any assessment of the programme. In a sense, our activities did not exist, successful or not. Further, what I was doing was ad hoc and unstructured and therefore did not fit into the paradigm of the day – the concept of controlled, pre-planned and sequential learning tasks. Whatever I was doing, it was not what I was there for. Eventually, I withdrew from the programme and soon thereafter from the doctorate. I had lost faith in the efficacy of the empirical research model and went back to teaching.

Jeffrey had taught me something significant, though. There was a crucial difference between content centred and individual centred programmes. Jeffrey wasn't interested in, and was never going to respond to, content based programmes.

He did know, however, what he wanted and needed. None of the rest of us involved knew what we were doing no matter how experienced or qualified we might have been. He did, though, and showed me in no uncertain terms. He needed a programme that arose out of his personal milieu – that met his individual needs. Furthermore, Jeffrey was totally unimpressed by attempts at sequencing his learning tasks. His intuitive and unstructured leaps from topic to topic and task to task demonstrated no apparent pattern or series of connections. There was no structure to what we were doing, but there was plenty of purpose and meaning. The really important dynamic was in the interaction between the two of us – the learning relationship that had developed. Indeed, what Jeffrey had insisted upon was what most teachers now attempt to deliver every day with their pupils – an individually based programme. My regret from that time is that I had neither the resources nor the opportunity to fully develop an individual programme for Jeffrey and the other autistic children involved.

The lesson Jeffrey had taught me often informed my teaching and my thinking and it was there too in the late nineteen-eighties when I rediscovered quantum mechanics. I realised then that the intellectual tools to overcome the barriers I perceived to my involvement in the processes of scientific inquiry had been there all along. What I had to do was think outside the square – to find more applicable ways to interpret and describe the world as I perceived and experienced it. The concept of uncertainty would not leave my consciousness. I knew this was important at some deeper level, but was not clear yet in what way. But I was excited – I was progressing again and eventually decided that I could re-enter the world of higher education. I did some masters units in the early nineteen-nineties and began to read widely into chaos theory and complex systems theory in general. Gradually, the lights went on and for the first time the room I had glimpsed so dimly over the years became more fully lit: I knew I had the paradigm to effectively continue the processes of inquiry that had meaning to me as an educator and researcher. Phenomena in the social sciences did not obey linear laws at all. Rather, it was characterised by conceptual frameworks akin to those current in the complexity sciences – emergence, non-predictability and interactive dynamics. In 1995 I wrote a new proposal for a doctoral dissertation embodying my recently acquired understandings and submitted it to the University. It was rejected! It was suggested

that I take it to the U.S.A. where some groundbreaking research was being conducted at the time through the Santa Fe Institute, or to my alma mater Cambridge University. Whatever I did with the proposal, it was clear that it was not welcome in Tasmania at that time. I was disheartened and began to doubt the validity of the insights I felt I had gained. I also had things to do and children from a second marriage to raise and so I shelved the idea.

However, I had not finished the journey I had started as a child on the great bronze aged burial mound on Mynyddislwyn in South Wales forty years before, and in 1999 one of my children asked me a question that changed, in a moment, the direction I was going. Rowen was nine at the time. He always was an individual who thought laterally – he would tend to see aspects of experience that I missed. More importantly than this, though, was the fact that he articulated his concerns in question form. Thus, he would ask what time was, why the sky was blue and why people died, and so on – and like all fathers, I would answer his queries as best I could. Then one day he asked, “Why is a tree?” I was stunned. Something had been triggered in my mind at a very deep level. I struggled through a long and inconclusive answer, but the repercussions went on in my consciousness for days. I kept returning to the question in my mind. Why is a tree? Why is this question so important? During the following weekend while playing a backyard cricket game with Rowen and his brother Bryn some answers did come into my consciousness. It seemed suddenly clear to me that it was the act of asking the question as much as the question itself that was significant. Furthermore, it was clear that words had power – the conjunction of these four words had led to a reconstruction of the conceptual parameters of the processes of inquiry that I had been developing. The intense *individuality* of this experience struck me. It also seemed to me that the question was ultimately unanswerable without recourse to some sort of statement of belief – some overt acceptance of a set of personal assumptions. The importance of this in relation to any process of inquiry struck me with painful clarity, for nothing now could be taken for granted. I would have to start again. Rowen’s question had completed an unlooked for circle for me - I had a fortuitous paradigm and a format and I now I would need to ask the questions that would lead me in the direction I felt I wished to go.

CHAPTER FIVE

HUMAN ABILITIES, HUMAN FRAILTIES

Scientific inquiry is a process. Furthermore, it is a process carried out by human beings. Thus, our endeavours as scientists are bounded and constrained by our limitations as human beings. Those limitations come in three major forms: physical, intellectual and emotional. Many physical limitations we can overcome through our technology. However, others are not amenable to that solution. Similarly, we can enhance our intellectual functions through the use of computers. But, yet again, some aspects of our intellectual lives are, at least currently, beyond any computer. Finally, our emotional lives are ours alone – there is no technology that can take on that burden.

This Chapter will explore the key elements of these limitations in relation to the theme of this thesis. These include the formation of beliefs, our perceptions, creativity, our need to be right, representation, our pursuit of truth and our vehicles for discourse. Crucially, each of these dimensions has a direct and profound effect on every aspect of our processes of inquiry. An analysis of these dimensions, both individually and in terms of their impact on us in total, is central to an understanding of the problematic nature of the concept of the objective observer.

Believing Is Seeing

O woe! What do I do now, where do I go now?

Death has devoured my body,

Death dwells in my body,

Wherever I go, wherever I look, there stands Death!

The Epic of Gilgamesh.

Why do we ascribe meaning to anything? Why do we look for reasons for the existence of phenomena? Why is it so important to us to find explanations for the universe we inhabit and our place within it? Why have we created religion, philosophy and science? The probable answers to these questions are significant in any exploration of the process of human inquiry for their genesis emphatically

highlights the subjective nature of its end products – the ideas, theories and beliefs that are our cultural heritage. To begin to access those answers it is necessary to travel back into our past as a species. Importantly, the emergence of an ability to formulate beliefs may be a very recent event.

It is entirely possible, for example, to imagine a human species that does not have the drive to theorise and to explain. Such a species might well live at one with the natural environment, simply existing within it without question, foraging and gathering much as the great apes do now. We may never know whether chimpanzees and gorillas reflect on their environment and seek meaning for their existence, but internal philosophical discourse is certainly not required for the lifestyle these animals lead. The foods that they eat grow or exist without any intellectual consideration on their part. Water to drink falls from the sky and is found in streams and rivers without any need for explanation for the phenomena. These things just are.

Thus, it is plausible to consider a time when our own ancestors lived as the great apes do now, subsiding off the environment and embedded within that environment as completely as all wild animals are. Devoid of language and all but the simplest artefacts, those ancestors would have occupied a world of sensation in the moment – the present – where memory of what has passed and considerations of what may come are tied to the demands for survival, procreation and interaction with the group. Interestingly, in many ways this state of mind is similar to the nirvana postulated by the Buddhists where regret for the past and fear of the future are transcended so that the enlightened individual may live in the present, at one with the existential world. I will return to that observation later.

Certainly, hominids may well have lived in this way for millions of years. The term "hominid" is used to describe all members of the human family since the most recent common ancestor of apes and humans. That common ancestor may probably be dated at between 5 and 10 million years ago (Lewin, 1987). The oldest current hominid fossil, *Sahelanthropus tchadensis*, has been dated at between 6 and 7 million years (Brunet et al 2002, Wood 2002) and the latest and oldest fossil discovery of what was probably a bipedal hominid, *Orrorin tugenensis*, has been dated at about 6 million years (Senut et al 2001). There is no way of knowing whether or not these particular hominids are antecedents of homo sapiens, but almost

certainly beings very much like them were our direct ancestors. From that point 6 or 7 million years ago, hominids underwent a number of evolutionary changes. Species came and went with skeletal and cranium size changes that, in general, more and more closely prefigured modern humans.

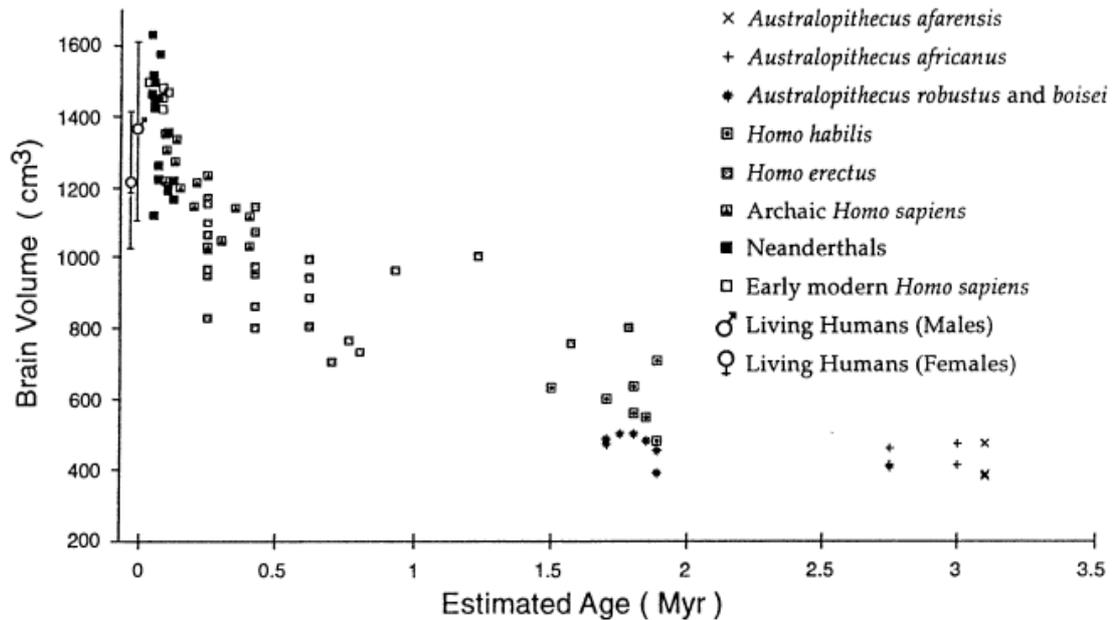


FIG. 4. Brain size (in cm³) plotted against time (Myr) for specimens attributed to Hominidae.

Reproduced from Foley (2003)

Of the hominids that may be considered our direct ancestors, *Homo habilis* lived between 1.5 and 2.4 million years ago and is the first hominid for which the use of tools is evidenced. *Homo habilis* had a brain size roughly half that of modern humans. *Homo erectus* lived between 300 000 and 1.8 million years ago, had a brain size about three-quarters of that of modern humans and probably used fire. Modern humans, *Homo sapiens sapiens*, appeared about 120 000 years ago.

Our ancestors, from the earliest following the divergence from the common ancestor with the apes to modern humans, can therefore be traced in the fossil record over a period of at least 6 million years. To gain an appreciation of the length of time that represents consider that 6 million years is about 300 000 human generations. If we lined up one member of each of those generations from *Sahelanthropus tchadensis* to *Homo sapiens sapiens* the line would stretch unbroken across Europe and Russia from Lisbon to Moscow. In geological time this represents only a moment, but in human history it is a very long time indeed. As a comparative

example, all of recorded human history would only occupy about 250 generations. These individuals lined up would not even get out of Lisbon city centre.

In almost all that time there is no evidence that suggests any living pattern beyond that of subsistence living. The tools produced by *Homo habilis* and *Homo erectus*, for example, were used entirely for butchering and digging. Indeed, with certain improvements of shaping and utility, the same may be said of the tools of *Homo sapiens* until very recently. However, about 40 000 to 50 000 years ago a sudden exponential increase in the complexity, diversity and utilisation of tools occurred (Stringer and Gamble, 1993; Mithen, 1996) – a period in human evolution referred to by anthropologist Nick Potts (2001) as “the mind’s big bang”²⁷. Over the next 20 000 to 30 000 years our ancestors also developed art and music, settlements and buildings, weaving and needlework, and probably religion as well. Incredibly, human beings had by 50 000 years ago spread throughout Africa, Asia, Europe and Australia, yet this explosion of symbolic activity appears to have occurred virtually simultaneously throughout the whole human population. This occurrence therefore does not seem to fit any of our current models for evolutionary change (Carruthers, 2002). These models require changes to occur within a small group in a restricted locality and the subsequent gradual replacement of the superseded species. Possible alternative models for evolutionary change are discussed in Chapter 6.

For hundreds of thousands of generations, then, our ancestors lived much as the great apes do now, subsiding off the land without any evidence of artefacts beyond some stone tools and digging implements. To put it another way, for 99.2% of our history as bipedal hominids we have left no evidence of a lifestyle substantially different from that of the great apes. Indeed, our nearest living relative the chimpanzee²⁸ uses both rocks and sticks as tools today (Goodall, 1970). Later hominids went beyond that and shaped stone tools for butchering animals, but the use of tools to create symbolic forms such as paintings and carvings is very recent indeed. It was at that point about 50 000 years ago that human beings developed a new relationship with their environment. It may be that it was at that time that our ancestors began to reflect on their existence and sought answers to the questions that

²⁷ Nick Potts is the Director of the Human Origins Program at the National Museum of Natural History in the Smithsonian Institution.

²⁸ Recent research by Wildman et al (2003) indicates that chimpanzees and humans share 99.4% of their DNA. Humans and chimpanzees had a common ancestor between 5 and 7 million years ago.

arose. As Terrence Deacon (1997) has pointed out, this development marked us as fundamentally different from all other living things.

Though we share the same earth with millions of kinds of living creatures, we also live in a world that no other species has access to. We inhabit a world full of abstractions, impossibilities, and paradoxes. We alone brood about what didn't happen, and spend a large part of each day musing about the way things could have been if events had transpired differently. And we alone ponder what it will be like not to be. In what other species could individuals ever be troubled by the fact that they do not recall the way things were before they were born and will not know what will occur after they die? (p. 1)

Why did so profound a change take place? Why did we develop from clever animals to self-conscious beings? Non-metaphysical theories struggle to explain the emergence of consciousness. Such a facility is not required for evolutionary survival, nor indeed does it necessarily provide an advantage for the species. Non-conscious species have existed virtually unchanged for hundreds of millions of years – the crocodiles and the coelacanth, for example. Some bacteria have existed in similar forms since the inception of life three and a half billion years ago. Consciousness is the latest addition to the pantheon of abilities that have emerged through evolution. There is no guarantee that it shall demonstrate longevity. That consciousness, however we might attempt to define it, does exist and did emerge at some point in our recent past seems clear. Why it did at present remains a mystery. It may be that consciousness is a by-product of our large brains, or perhaps of the way our brains are organised. There are creatures with larger brains than ours inhabiting the world with us today – the cetaceans and the elephants – but they do not exhibit evidence of symbolic processing. An extinct human species, *Homo neanderthalensis*, had a larger brain than ours and was the first to bury its dead about 100 000 years ago. However, the neanderthals created only functional tools – for stabbing, cutting, scraping, pounding and so on - and they died out about 30 000 years ago. It was left to our species to create a universe of symbols and ideas, including art, writing, mathematics, philosophy, religion and science. For reasons beyond our current knowledge, it is *Homo sapiens sapiens* that became self-aware

and entered the internal world of beliefs and theories. Nevertheless, however and whenever consciousness arose, it has left human beings with a deep need to explain all aspects of existence²⁹. The eternal questions remain: what is the universe, where has it come from, why does it exist and where is it going? These questions are just as important to us today as they were to the ancient Greek philosophers and no doubt also were to our Palaeolithic ancestors. We have different tools available to us today to explore those questions – nuclear accelerators, electron microscopes, radio telescopes and computers, for example – but it is probable that the intellectual gifts at our disposal are no more advanced than they were 20 000 years ago³⁰. We ask questions and we seek answers. Depending on our cultural heritage and/or our level of knowledge, those answers may be theistic, scientific, mythical or supernatural. Indeed, our individual answers may include all of these categories. Thus, we may utilise an accepted scientific methodology to explore phenomena, yet hold to a belief in God, identify with a mythical culture such as the Celts – which never existed as a cohesive peoples - and talk about good and bad luck.

Our minds are generators of meaning, as James Alcock (1995) has also noted.

It is because our brains and nervous systems constitute a belief-generating machine engine that (it) produces beliefs without any particular respect for what is real and true and what is not. This belief engine selects information from the environment, shapes it and combines it with information from memory, and produces beliefs that are generally consistent with beliefs already held. This system is as capable of generating fallacious beliefs as it is of generating beliefs that are in line with truth. (p. 1)

Thus, without necessarily any conscious effort on our part, we generate reasons for the phenomena that surround us and that we are part of. Nevertheless, as Harlan Miller (1994) has pointed out, many of the questions we ask have no clear solutions, or at the very least the phenomena we observe are impenetrable by the tools and

²⁹ Charles Peirce (1877) referred to this need as “the irritation of doubt” and went on to state that: “Doubt...stimulates us to inquiry until it is destroyed.” (p. 4).

³⁰ Or indeed wherever we go in the world: “There isn’t ten cents worth of difference between the Kalahari bushman and the Oxford don.” (Gazzaniga, 2003, p. 1)

abilities that we have at our disposal. Thus, for example, the question *where did the universe come from* has generated a host of metaphysical and scientific theories, many of which cannot be entirely discounted. It is equally plausible, given our inability to observe the phenomenon, that the universe arose out of an act of creation by God, for example, as it is that it spontaneously came into existence as a quantum fluctuation in a vacuum. On which side of the fence one might come down on may well depend, as Alcock implies, on one's culture and background. Importantly, remaining on the fence is still an act of belief. The responses *I don't know* or *I'm not sure* are in fact relational answers that presuppose that there is a correct decision. I have yet to hear or read a response to this question that suggests that there is no answer. The same may be observed of all questions that require an element of belief in the formulation of an answer. *Is there a God* or *Is there life after death* elicits responses of *Yes*, *No* or *I don't know*. Thus, unlike the apes or our hominid ancestors, we do not live in the moment. Indeed, it is hardly surprising that many transcendental philosophies – such as Buddhism – teach a state of being that parallels a return to the in-the-moment existence of other living beings as well as that of our own pre-human ancestors. Only by laying aside considerations of purpose and meaning can we escape the burdens of the inquiring mind – regrets about yesterday and concerns for tomorrow, for example. However, as a species we seek answers and create beliefs, theories and philosophies to support those answers. The need for explanations for phenomena, I would argue, is one of the deepest human drives.

The central point here is that if the reasons behind the answers to our questions are not unambiguous or beyond doubt within our own frame of reference then we shall create those reasons. For example, a shooting star to most people today signifies the passage of a piece of space rock through our atmosphere. To peoples who did not possess our tools for validating this interpretation, a shooting star has signified the anger of the gods or a supernatural portent. Similarly, it is generally agreed now that the sun is a star around which all the planets in our solar system travel, and our moon is a satellite of the Earth. Again, previous generations have held an opposing geocentric conception of the solar system.

Thus, reasons and meaning are always attributed to phenomena. All phenomena are explained within the context and knowledge of the peoples of the time. Nothing is left without an explanation. Explanations, of course, change with time and levels

of understanding, but explanations there will be. As human beings, we are incapable of not forming explanations for all that we perceive or believe that we perceive.

Because virtually no single reason may be attributed to a phenomenon without question or debate, the answers that human beings create for the existence of any phenomenon will vary almost as widely as culture, education and predisposition allow. This is particularly, but not exclusively, true of phenomena that are not amenable to empirical investigation. Thus, religions, and subdivisions within religions, are both legion and inevitable. Similarly, philosophical considerations of the nature of truth splintered into divisions in ancient Greece and have remained problematic to this day. Exactly the same may be said of political, social, educational, economic or scientific belief systems. Our answers are therefore not so much encapsulations of truth or reality but explanatory exercises that may or may not have any objective basis. Human beings need to find answers – or reasons or explanations - and shall create an answer of some sort for that phenomenon, in that place and at that time whether or not there is any supporting evidence. In other words, the need for explanation precedes and supersedes any need for objectivity or detachment.

A Beginning

Of every tree of the garden thou mayst freely eat: But of the tree of knowledge of good and evil, thou shalt not eat of it: for in that day thou shalt surely die.

Genesis 2: 16-17.

Any consideration of the reasons for the human drive to ascribe meaning is purely suppositional, but inevitable in this context – I am a member of the human species and therefore will search for reasons that appeal to me whether they may be considered “reasonable” to others or not. With that rider in place, I would propose a thought-scape. Please note that the “first” in this case may in reality have occupied several or even many successive generations and/or involved a number of individuals. Also, I have for the moment put aside the question of the emergence of language, in all probability a necessity in the development of introspective, self-aware thought processing³¹.

³¹ An informative overview of hominid models may be found in Shupp (2003).

Imagine you are the first truly conscious human being. As you grow from infancy to adulthood, you observe the members of your troupe. The troupe scavenges for food as well as hunts animals for their meat. Life is demanding – a hand to mouth existence. With skill, you and your fellow human beings fashion stone, wood and bone tools to assist in accessing sustenance. Fire is used to warm the nights and keep the predators at bay. The people eat, sleep, procreate and groom as a group. Each day is almost identical to the one before. Except for the excitement of a hunting session, the inconvenience of bad weather or an occasional skirmish with a large predator, life proceeds as it apparently always has done. The people live in the timeless moment, without any discernible reflection on their lives or the world around them. Indeed, the people have lived this way for at least one and a half million years, or 75 000 generations.

However, you are different. For you, two phenomena stand out and have caused long hours of cogitation by the campfire at night as those around you busied themselves with the tasks and activities of the evening, the children tumbling and playing, the adults squabbling over scraps or mating rights. You have watched humans being born and you have watched them die. You have seen childhood friends that you spent happy hours with fall to predators, the light in their eyes extinguished. You have seen elders age, sicken and die, their bodies scattered by scavengers or decomposing amongst the rocks. You have seen the newborn develop into children and then adults, each one so individual - some serious, some flippant, some fast, some slow.

As you reflect on the fate of those who have died, you realise that you will die as well. In a moment death may strike, or it may take a while, but accident, illness or age will kill you. You as a unique individual will be gone for good. The troupe will continue, but with no reference to you. Death does not seem to bother your fellow troupe members too much. Certainly, there is some evidence of mourning – mothers carrying the bodies of dead infants around for a day or two, or individuals sitting beside or grooming the body of a particularly favoured friend for a while. But soon the bodies are left and life moves on. Silently, you stare at the fire and think about the cycle of birth, life and death. Where do we come from and where do we go? Is there any reason or purpose to our existence, or is this all there is? As a conscious individual and the first human to be born with a drive to formulate explanations for

phenomena, after a while you do come up with some answers. However, what those first answers actually were is not relevant to this discussion, so we shall leave the thought-scape at that point.

Whenever our ancestors did become self-aware, and whether or not that process was gradual or a rapid evolutionary change, I propose that the questions above will have occurred to them and answers – explanations or explanatory stories - will have been formulated³². In essence, we are no different from the first self-aware *Homo sapiens sapiens* pictured here. Each individual enters into an accommodation with these questions in some form or other. We seek some sort of explanation for our births, our deaths and the fact of our existence. The answers we arrive at are as individual as we are and vary in scope and detail, but each of us owns explanations of some sort, from atheistic or scientific-rational to religious or mythological or humanistic. Assigning meaning to our individual and collective lives is a central element to the human drive for explanatory analysis. Non-conscious beings cannot be aware of personal mortality nor reflect upon its mysteries; self-aware beings cannot avoid it. I would argue that this reality is one of the root motivations for the processes of inquiry we have evolved as a species.

The development of language in human history is an essential parameter to consider at this point for although language may or may not have been necessary for the formulation of conscious thought, it is indisputably essential for the cultural transferal of ideas and beliefs from individual to individual and between generations. The formation and use of tools does not necessarily require this facility – as has been demonstrated by studies of chimpanzees (Goodall, 1970; Mercader et al, 2002³³) – but a conceptual framework that attempts to explain hypothetical constructs dies with the individual unless a complex, advanced and culturally shared language is in existence. It is highly probable that a language that embodies abstract concepts took many generations to fully evolve, for not only are the individuals within that culture required to have the facility for reflective self-awareness, but also must develop

³² A view also held by Pat Hutcheon (2001): “It is possible that only explanations of this nature [that is, beliefs] could have assuaged the fear of death encountered by humans once imagination and memory and self-consciousness had evolved, and connections could be made between the deaths of other living beings and their own inevitable fates.” (p. 5)

³³ Interestingly, Julio Mercader and his team have excavated chimpanzee stone tools believed to be five million years old. Unlike human tools, these have remained unchanged from that time to those used by chimpanzees in the present.

shared associative meanings attached to each concept that may well require repeated conversational interactions between individuals over time and in space.

However, once the shared concepts and the requisite vocabulary are established beliefs and ideas, unlike their progenitors, essentially become immortal. There will be changes and developments, of course, but no longer can abstractions die with the individual – the memories and minds of those in succeeding generations will transport the beliefs and mores of the culture through the millennia. Shared language, and the concepts embedded within it, also allows an accumulation of knowledge and facilitates the transfer of complex skills. Language must surely be seen as essential for the development of any social group organisation beyond that observed amongst the apes. It is difficult to see how settlements, families, horticulture and animal husbandry could exist without language.

Abstract thinking and language may therefore have developed concurrently, and may well be a function of each other. Certainly, the profound changes in social organisation that occurred about 50 000 years ago suggest the emergence of language, or at least a language facility beyond the merely functional such as that which may have developed previously to enable efficient hunting practices³⁴. We became fully human when we developed self-awareness, invented language and evolved the drive to question our existence. Without all three of these gifts we would in all probability have remained clever animals – bipedal hominids embedded in, and part of, the natural environment. Terrence Deacon (1997) has highlighted this division between ourselves and the rest of the animal population of our planet:

We think differently from all other creatures on earth, and we can share those thoughts with one another in ways that no other species even approaches. In comparison, the rest of our biology is almost incidental. Hundreds of millions of years of evolution have produced hundreds of thousands of species with brains, and tens of thousands with complex behavioral, perceptual, and learning abilities. Only one of these has ever wondered about its place in the world, because only one evolved the ability to do so. (p. 1)

³⁴ Peter Carruthers (2002) has come to a similar conclusion.

Two of the three key elements I have listed above are inherited abilities and the third, crucially, is an artefact. We may inherit the ability to be self-aware and the drive for explanatory analysis, but language is learnt. We are certainly born with the physical and intellectual potentialities to acquire language, but the development of language beyond the babbling stage requires enculturation. Each infant child, if they are to develop language, must be immersed in a culture in which language is used. Children raised by animals, for example, do not develop language (Coon, 1989).

It is a truism to state that all human artefacts are human creations, but this is a fundamental observation in this context. Language is as much of an artefact as a hammer or a motor vehicle – if and when the last hammer is destroyed and the last word spoken, neither the object that was the hammer nor the spoken word will thenceforward retain any form of existence whatsoever. They will literally have ceased to exist. Thus, the concepts, ideas, beliefs and mores embedded in and expressed through language are artefacts created by human beings in and through human culture. Contrary to Plato's assertion, we do not have to assume the intervention of gods nor the existence of ideal forms to justify our philosophies - whether or not these phenomena actually exist - self-awareness, the drive for explanatory analysis and language mediated by human culture are sufficient in and of themselves.

Since that time when hominids ceased to be clever animals and became fully human, probably about 50 000 years ago, human beings have created all the artefacts that distinguish our societies. Some of those artefacts have a physical existence – all the tools, machines, implements and utensils that we utilise in our homes and industries – and some are conceptual – our beliefs and theories. We have tended to group our beliefs under certain headings: religious, political and scientific, for example. However, these distinctions are cultural conventions and do not necessarily confer an inherent superiority on any of these categories. This can be illustrated as follows. A belief in the existence of God and in the second law of thermodynamics would both cease to exist if all human beings were destroyed tomorrow. This would be the case *even if both, either or neither of the propositions are objectively true*. Beliefs are created by human beings, whereas God or entropy may not be. To put it another way, the human belief in the existence of the sun would end with the death of the last human, but not necessarily the sun itself.

Scientific theories and beliefs thus have no more objective reality than any other systems of belief. They, too, would cease to exist with the passing of the last human being. We may be able to justify our scientific beliefs by reference to various agreed conventions, but like all belief systems they will be continually subject to pluralism, challenge and change. I would therefore contend that there is and can never be a single and unified system of scientific beliefs any more than there can be in religion or politics³⁵. Beliefs are cultural products and have no objective existence. Our beliefs about phenomena are not the phenomena themselves.

Furthermore, each of us throughout our lives is enculturated into the belief systems of our cultures, our social groups and our families. Because we are a species that generates both questions about and explanations for the phenomena we encounter, we will also modify, discard and re-formulate those belief systems. Each of us, therefore, represents a dynamic node of abstract conceptualisation, constantly shifting and adapting, within a culture or cultures that are also dynamic and changing. The overall pattern therefore is one of almost infinite complexity. Some individuals are more effective generators of novel interpretations than others and may have a profound effect on cultural conceptual artefacts – great scientists, artists, philosophers and politicians, for example. Nevertheless, each of us is an active participant in this process of dynamic enculturation, at once interpreting, adapting and passing on this ever-changing pageant of ideas and beliefs.

Within this scenario any argument that a particular belief system should or must have dominance is questionable. Beliefs, by their nature, are changing artefacts that may or may not be held by the majority of people in a culture at any one time. Some beliefs prove to have longevity and may last decades, centuries or even millennia. A belief in a God or gods, for example, has been extant in human cultures for thousands of years. Other beliefs may spring into being, spread quickly and just as quickly be discarded. The panic caused in the United States by the Orsen Wells radio broadcast of the War of the Worlds is a classical example of the latter where tens of thousands of people briefly believed that the country was being invaded by aliens.

Scientific beliefs, by definition, are also artefacts and are also subject to the processes of cultural pluralism and change. Scientific methods of validation have evolved that may be considered a reasonable process to support or refute those

³⁵ A position also taken by Sperry (1993).

beliefs, but they are no more or less human conceptual creations than, for example, those arising from religious contemplations. What is considered validation, or “proof”, is at the heart of this issue. Thus, it is frequently possible to construct empirical and replicable experiments to test the efficacy of scientific theories in the physical sciences, but the existence of God or an afterlife has thus far proved not to be amenable to these methodologies. It is also the case that the non-physical sciences are difficult to explore utilising empirical methods. Palaeontology, for example, may draw on research and technologies from physical sciences – geology, carbon dating, climatology and so on – but the resultant conclusions concerning the history and evolution of a species can be considered no more than informed supposition. The situation is even more complicated in the social sciences, for there are no fossil records to study and no technologies available to analyse historical social phenomena. Rather, social science history is recorded or related by individuals who have their own motivations, theories and beliefs that both guide and channel them. Thus, what is ‘real’ or ‘true’ about social phenomena and the people involved in them can never with confidence be ascertained. It is hardly surprising that the further the science is from hard-core empirically explorable physical phenomena the more diverse and divergent the theories created are, and the more heated and divisive the debates over them. This division between the physical, or natural, and the social sciences is an important one in the context of the topic of scientific inquiry and I shall explore it more fully as this thesis proceeds.

I have suggested that the human drive for explanatory analysis precedes considerations of an objective reality. I have further suggested that explanations for most phenomena are not amenable to objective validation anyway, by whatever methods may be found acceptable. Just as importantly, even the almost universally accepted theories established through the physical sciences, are accorded virtually mythical qualities by both scientists and non-scientists alike. The belief in the double helix structure of DNA is an example. Discovered in 1953 by James Watson and Francis Crick, most individuals could give a description of what it looks like, what it is and where it occurs. On the other hand, only a very small number of individuals have actually carried out research to investigate this phenomenon. Indeed, very few scientists could claim either the expertise or the knowledge to initiate such research. The scientific community, together with the larger

community, has acquired a belief in the structure of DNA through enculturation, just as most in western cultures acquire a belief in God, democracy or capitalism. Believing what others contend without entering into a process of personal verification is an act of faith not factual or objective observation.

Furthermore, modern scientific research is highly specialised. Few individuals would work across more than one discipline, and no scientist would claim expertise in all. Further, each discipline is sub-divided into many strata and areas of specialisation. Thus, the majority of all research and the findings of that research are taken on faith by the scientific community at large. Probably most of the world's scientists believe that earth moves around the sun. However, very few people will have conducted the simple research project to verify this belief, or have travelled into space to observe the phenomenon for themselves. Most of us have learnt this theory as a cultural artefact without any attempt to verify it for ourselves. This is not to say that the sun is not at the centre of the solar system. However, believing in something does not necessarily mean it is true or that it is false. It does mean that the belief exists.

Almost universally amongst scientists the belief precedes the research, and indeed must do so. Research projects are designed to explore phenomena the scientist has previously identified, in ways that are preordained by the scientist and in an attempt to verify pre-formulated questions. Research is, by definition, planned, structured and ordered. Research, therefore, overwhelmingly finds what the scientist expects to find and verifies what the scientist specifically set out to establish.

...scientific observations are “theory-laden” and subject to bias from many sources. We see what we are looking for, we categorize our experience and perceive our environment within the limits of the conceptual frameworks we bring with us to the laboratory, to the classroom, to the market. We see what we look for, and we can only see what we are ready for. (Miller 1994, p. 2)

This is not to say that unexpected discoveries are not made all the time in science. The discovery of penicillin and radium are two classic examples. However, such discoveries are often fortuitous accidents. As Kuhn (1962) has pointed out:

Normal science, which is cumulative, owes its success to the ability of scientists regularly to select problems that can be solved with conceptual and instrumental techniques close to those already in existence.

Kuhn also goes on to suggest that this process forms a significant barrier to scientific advancement.

That is why an excessive concern with useful problems, regardless of their relation to existing knowledge and technique, can so easily inhibit scientific development. (1962)

In other words, the conventional paradigm for scientific inquiry reinforces itself through usage of methodologies that usually do not challenge the status quo, either conceptually or epistemologically.

(This) class of phenomena consists of those whose nature is indicated by existing paradigms but whose details can be understood only through further theory articulation. These are the phenomena to which scientists direct their research much of the time, but that research aims at the articulation of existing paradigms rather than at the invention of new ones. (Kuhn, 1962)

Research is theory driven or, to put it another way, arises out of the beliefs of the scientist. Thus, a researcher who believes in natural selection, for example, will design a project to find evidence of that process. Alternatively, a creation scientist will design a project to find no evidence of natural selection. Whether or not you hold one approach to be good science and the other bad, I contend, will depend entirely on your belief system.

The formation of beliefs, then, is a defining characteristic of our species and, as far as we know, of our species alone. Furthermore, in evolutionary terms, this is a brand new development that is still in the experimental stage, and therefore it may or

may not have survival value in the long run. Nevertheless, without this ability the world we have created would be inconceivable – without it we would probably still be clever hominids, subsiding within and on the environment and indistinguishable from it. Beliefs also, however, impose conceptual frameworks on our perceptions of existence that have a tenuous and problematic relationship with external truths or realities, however they may be defined. We are generators of beliefs, creating them for all the phenomena we encounter, both within and without ourselves, imaginary or real. The formation of beliefs always precedes and subsumes considerations of objective truth.

The significance of these observations for the processes of scientific inquiry we have developed lies in its focus on the links between subjective and objective realities in the individual scientist. It is the case that the assumption that the processes of science inquiry entered into by scientists are by definition objective must be discarded. This is not to say these processes may not achieve an acceptable level of objectivity to meet the evidential requirements of the larger scientific community; that is a separate question. What it does mean is that the assumption of objectivity cannot be automatically ceded to any scientific process or paradigm. In other words, the onus for justifying the assumptions or beliefs embedded in any process of scientific inquiry are placed firmly with the individual scientist or scientists involved. The comfort of Plato's idealistic connection between thought and truth has finally been removed by the modern-postmodern debate and has been replaced by an energetic and fundamentally discursive process whose outcome is yet to be determined.

The Perceptual Double Barrier – Dualism Revisited

Human scientific beliefs may be artefacts and therefore subject to all the malleabilities of any theoretical system, but there are also significant physical/perceptual barriers between our inquiring minds and the phenomena of the extant universe that make our relationship with the external world both complex and problematic.

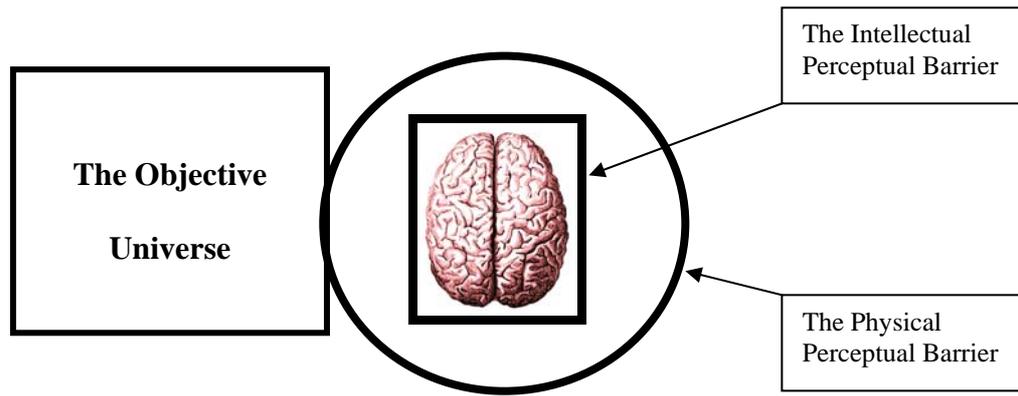


Figure 5: The double barrier between mind and matter.

Let us assume for the moment that the physical universe does have an objective existence and is not a coherent illusion created by a supreme being with an unknown purpose³⁶. Let us assume that if we all ceased to exist tomorrow, then the universe would not – it is separate from and does not depend upon our perception of it. If that is the case, we are both part of that universe – as much a part as the planets, the stars, the nebulae and the galaxies – and separated from it. On the one hand, our physical bodies are made of the same fundamental particles as all matter, formed into atoms and molecules. On the other, the processes by which we perceive the universe, including indeed our own bodies as part of that universe, place an impenetrable double barrier between our minds and that universe. Firstly, we rely on distinctive physical pathways for our only perceptions of that universe – we call them senses. Thus, energy waves and friction act on our physical receptors and signals are transmitted via networks of nerves to various areas of our brains where an impression of the extant physical world creates an experience for the mind – a sense of touch, sight, sound or smell. Of that process of transportation between the physical realm and the mind we have no experience whatsoever. The phenomena occur without any volition on our part and we do not possess a sense that ‘feels’ the passage of the impulses through our nerve fibres. Everything we experience through our senses occurs within our brains, and our minds - however they may be conceived – are conscious of the end product, the firing of the neurons that create the sensations for

³⁶ Not that this necessarily makes any difference: “If there is no way of telling whether there is an external world, it makes no practical difference whether there is one or not. Assuming that there is not, scientists still have their observations and can still formulate theories about the relationships among observations, theories that may have predictive power about future observations. That is all science is about.” (Burdett, 2002, p. 2) Peter Lloyd (1994) has also made the same point.

us to experience. We are thus always and forever locked within the confines of our skulls, experiencing the illusion of touch, smell, sight and hearing in a mini-universe that is devoid of tactility, odour, light and sound. Our minds have no direct contact with the physical universe but rather we are aware of the response of a tiny portion of that universe – our brains – to electrical and chemical signals triggered in response to the body’s remote sensing system. This is a defining factor of our experience of the external world that the seventeenth century English philosopher Thomas Hobbes was entirely aware of. These are his four explanatory points on the “conception” of objects:

- (1) That the subject wherein colour and image are inherent, is not the object or the thing seen.
- (2) That that is nothing without us really which we call an image or colour.
- (3) That the said image or colour is but an apparition unto us of that motion, agitation, or alteration, which the object worketh in the brain or spirits, or some internal substance of the head.
- (4) That as in conception by vision, so also in the conceptions that arise from other senses, the subject of their inherence is not the object, but the sentient. (1640)

The first barrier to our experience of any objective reality we are part of is therefore a physical one – it is the very body we inhabit and which mediates sensation for us.³⁷ Furthermore, the senses that create what appears to us as an incredibly rich experiential world of smells, sights sounds and touch are in themselves highly limited faculties. Many animals have a sense of smell that is a million times as sensitive as ours. Bats and dolphins have sonar. Eagles have much more acute vision than we do, and goldfish can see into both the infra red and the ultraviolet. Wonderful as it is, our world of sensation is a highly restricted one.

³⁷ This position coincides with Francisco Varela, Thompson and Rosch’s (1991) argument that knowledge coevolves with the knower and not as an outside, objective representation. Varela et al go on to propose that this knowledge is a function of the whole cellular organism that is the human individual rather than any one subset of it as I have suggested here.

Secondly, any processing system must interpret the data received so that meaning can be inferred. A face has to be recognised as a face; the call of a bird as birdsong. Our brains interpret the raw data – the nerve impulses – and create sense and order. Without this processing system there would be no perception of a coherent external reality, a point also made by Dan Sperber (1997). This is starkly highlighted by people in whom this process has been damaged in some way and who hear colours and see sounds, for example, or who suffer from hallucinations.

This process is therefore the second barrier to our perception of the universe, for the process is an interpretive one and requires both something to interpret experiences against, for comparative purposes, and through, for the assignment of meaning.³⁸ This latter issue may be illustrated with two linked examples. Picture yourself watching a sunrise. The horizon lightens and eventually the sun rises above it. Morning has arrived. In this case, photons have impacted on your retinas and nerve impulses have been decoded or interpreted to represent the experience of a sunrise. Further, being a twenty-first century person, you perceive the movement of the sun to represent the spinning of a roughly spherical earth in space around a hydrogen-burning star. Thus, the horizon you see is for you the curved edge of our round planet.

Now transport yourself back into the body and mind of an individual in medieval Europe who is observing a sunrise there. Again, the architecture of this person's brain will create the experience of a sunrise. However, what she sees is a heavenly sphere circling the earth. Moreover, the horizon for her is the edge of the earth over which the unwary explorer is likely to fall. For both yourself and our medieval acquaintance, it is not the objective reality that imparts meaning to the experience but the belief system. For human beings, believing is seeing.

³⁸ David Bohm and F. David Peat (1987) have discussed the related concepts of selection and collection under the heading of “category formation” (p.112).

This phenomenon of the subjectivity of human perception has been graphically illustrated in a number of recent research projects on the unreliability of eyewitness reports. Consistently, individuals will report seeing activities that did not happen or people who were not there (Bizzell et al 2000; Wright, Gail and Justice 2000; Poole and Lindsay 2001; Haber and Haber 2001; Wright, Loftus and Hall 2001). It has been estimated that currently 5000 people are incarcerated in the Unites States of America on the sworn and incorrect testimony of eyewitnesses.

The physical limitations of our perceptual systems combined with the interpretive functions of the brain make these errors inevitable. We shall tend to ‘see’ what we are predisposed to see and will probably be convinced that our interpretation represents the only ‘objective’ reality.

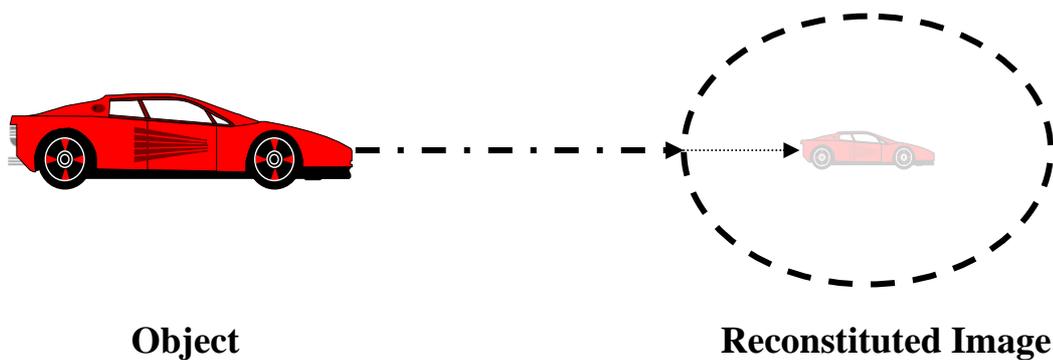


Figure 6: The Interpretive Mind. An object acts as a stimulus on our sense receptors and signals are sent to the brain. The brain then reconstitutes an impression of the object. We thus do not “see” the object but rather its reconstituted image. That image may be poorly or wrongly realised because of the limitations of our perceptual systems and the processes of interpretation we impose on the image. For example, we may decide that the red car parked next door is, as usual, our neighbour’s Ford when it is in fact a visitor’s Toyota. We have “seen” what we expected to see.

Our relationship with the universe is therefore both second hand and problematic. Our minds, however they may be defined, do not and can never directly perceive the ‘objective’ universe. We certainly construct interpretations and representations of that universe – or at least parts of it – but those phenomena are not the universe itself, as David Hume noted over two hundred and fifty years ago.

...nothing can ever be present to the mind but an image or perception, and that the senses are only the inlets, through which these images are conveyed, without being able to produce any immediate intercourse between the mind and the object.

(1748, p. 174)

Scientific research, therefore, may be conceived of as a vehicle for moving our perceptions and beliefs closer to an accurate description of objective phenomena – or as Simon Blackburn (1999) has put it: “Science...contains within itself the devices for correcting the illusions of science” (p. 232). Also, scientific theories are tested against observation, or research, and may be discarded or modified accordingly. The process of science may be seen as a codified attempt to align the reconstituted, internal conception of the universe, and its recorded descriptions in writing and mathematics, with the objective extant universe³⁹. (In terms of the hypothetical example in Figure 6 above, a further examination of the car in question may reveal what make it is and to whom it belongs.) This is similar to Karl Popper’s (1966) conception of the process of scientific inquiry. Popper also identified the problematic nature of this process:

...the concept of truth plays mainly the role of a regulative idea. It helps us in our search for truth that we know there is something like truth or correspondence. It does not give us the means of finding truth, or of being sure that we have found it even if we have found it. (p 28)

Science therefore, in general, as Popper asserts, overtly addresses the problems of subjectivity and perceptual plurality in human inquiry through both its methodologies and an evolved process of peer review⁴⁰. Popper (1953) referred to this process as *falsificationism* - that is, the applicability of scientific theories is assessed against how inaccurate they are rather than how accurate. To take the example in Figure 6 again, it is an identification of the inaccuracies of the ‘theory’

³⁹ Clive Beck (1993) has expressed a similar view: “Knowledge is the product of an *interaction* between our ideas about the world and our experience of the world.” (p. 3)

⁴⁰ Or as Willard Quine (1951) put it, “...our statements about the external world face the tribunal of sense experience not individually but only as a corporate body.” (p. 36)

concerning the neighbour's car that would lead to adjustments and not any confirmation of its accuracy. This system is by far the most effective yet developed for establishing descriptions of the physical properties of phenomena, devising technologies to manipulate those phenomena and creating physical outcomes. The system may be just as much belief driven as any other human endeavour and always open to the inconsistencies that are inherent in the human perceptual system, but a process of critical analysis, or belief modification, is inherently part of it. Thus, neither the effectiveness of science in forming and sustaining our technological society nor its role in developing relevant representational theoretical structures is questioned here. What is questioned is the objectivity of these processes, both in their inception and their execution, and the extent to which they may be applied to phenomena. Robert Maxwell Young (2000) has expressed this as follows:

...science, technology and medicine – far from being value neutral – are the *embodiments of values* in theories, things and therapies, in facts and artefacts, in procedures and programs. I also believe that all facts are theory-laden, all theories are value-laden and all values occur within an ideology or worldview. (p. 2)

Furthermore, the consequences of a misplaced belief in the objectivity and universality of any scientific process are profound. Chapter 6 will explore classic examples from differing fields of scientific endeavour where hidden and unacknowledged belief systems have subverted and therefore, I will argue, put into question the conclusions of the scientists involved.

Cartesian Dualism

At this point I should acknowledge that the second perceptual barrier I have identified above is a re-statement of “dualism” first proposed by Plato and established as a principle of human psychology in the Western scientific tradition by Descartes. This view of human personality suggests that mind and body are not only separate, but can also exist separately from each other. Descartes (1649) believed that the mind and the body were composed of different substances that interacted

through the pineal gland. Other theorists, and in particular Malebranche (1674) and Leibnitz (1696), developed variations on this concept, but for all three men God was an essential element of their hypotheses, either as the creator of mind, or as the medium through which the mind and body interacted. Eventually, the concept of dualism was replaced by that of “monism” – or the belief that mind and body were aspects of the one phenomenon, initially introduced by Spinoza (1677). Although Spinoza saw God as the unitary force in this model, the view of human beings as *machines* (La Mettrie, 1749) soon became central to this hypothesis, and came to focus on the mind as being a product of chemical or neurological processes in the brain (Wozniak, 1992). This latter form of the model denied the metaphysical aspect of dualism and became the orthodoxy as theistic explanations for phenomena became less accepted by scientists. These rationalist theories remained current until well into the nineteen-eighties when both Roger Sperry (1987) and Michael Gazzaniga (1993) reopened the debate. The basic premise of both neurobiologists was that we *experience* mind as separate from body and that, therefore, they may be considered conceptually separate. Further, both support Descartes’ *interactionist* model that assumes a mutually influential relationship between mind and body.

Scientific theory has become squared finally with the impression of common experience; we do in fact use the mind to initiate and control physical actions.

(Sperry, 1987, p. 166)

However, both Gazzaniga and Sperry, and later Searle (1999), also supported a monist view of consciousness that saw this phenomenon as an emergent property of the functioning of the brain – a view compatible with complex systems theory. That is, mind and body (or the brain in this case) might be experientially separate, but nonetheless are part of the same phenomenon – the biological entity that is the human brain⁴¹.

The model I have proposed, therefore, takes this one step further. In the *Interactive Mind* above, Sperry, Gazzaniga and Searle’s concept of the experientially separate mind is assumed – that is, mind and body may be experienced as separate

⁴¹ John Dewey was ahead of his time here and discussed a similar model in *Democracy and Education* (1916).

but may not be able to exist without each other. However, the dimension of the affective/subjective observer that I have proposed profoundly alters the outcomes that might be considered to arise from the functioning of this model. For example, Descartes' model presumes not only God as *agent*, but also that mind can objectively observe body – or, in its universalist form, all matter. Thus, all that is separate from mind becomes an object to be observed and used (see Figure 7, p.120). Descartes' combination of the two concepts of the separation of mind and matter and the objective observer entails objectifying all that is non-mind. For Descartes, mind is God created and God given and, because God is incapable of error, mind can objectively observe God's creation – the extant universe. As detailed in Chapter 1, Descartes explicitly expressed this view of man the controller of the natural world in the *Meditations*.

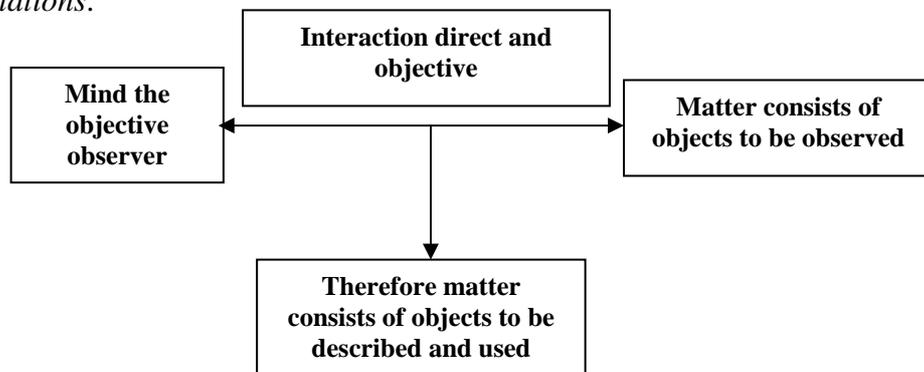


Figure 7: Cartesian Dualism

However, if the objective dimension is removed, the consequence is very different.

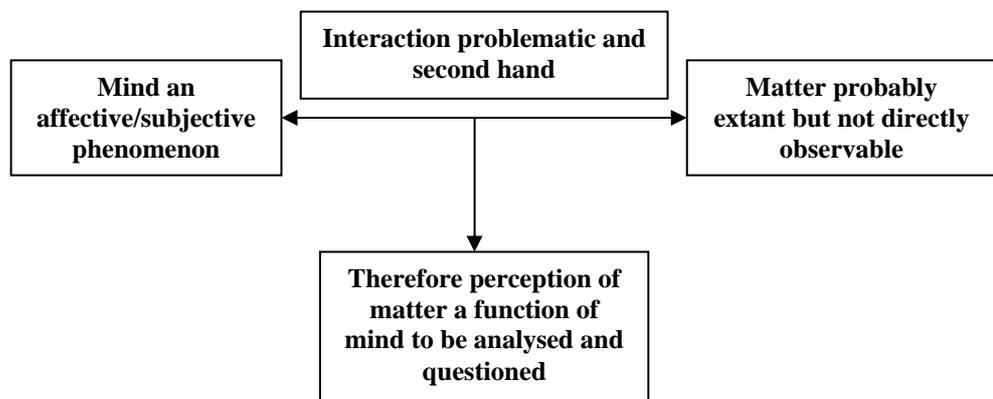


Figure 8: Postmodernist Monism

In this case, no direct relationship between mind and matter is assumed. Rather, the physical media and the perceptual and intellectual processes through which mind pursues and interprets a relationship with matter are assumed to be problematic and possibly objectively impenetrable. Thus, the focus is removed from an objectified universe to an affective/subjective interface between mind and matter. In this model, the conception of the extant universe as an object to be manipulated is removed at least one dimension, and unless the objective/subjective paradox is resolved, may indeed continue to be excluded from it.

The consequences for the Descartes worldview are profound. Far from a God given ability and right to control the rest of nature, a consideration of the rationales for any interventions becomes an issue. In other words, the features of the relationship between the inquiring mind and the universe can be seen to put into question all motivations and justifications for actions that impact on that universe. Essentially, the concept of the subjective observer places ethical and moral considerations at the heart of the debate on human activities, and that must be particularly true of science and technology as such overwhelmingly potent forms of those activities. Roger Sperry (1987b) has come to the same conclusion.

Instead of maintaining the traditional separation of science and values, cognitive theory says the two come together in brain function. If we are correct in saying that our conscious mental values not only arise from, but also influence brain processing, then it becomes possible to integrate values with the physical world on a scientific rather than supernatural basis.....On these new terms, science no longer upholds a value-empty existence, in which everything, including the human mind, is driven entirely by strictly physical forces of the most elemental kind.
(p. 3)

In this thesis I have emphasised *choice* as an affective element in the processes of scientific inquiry. The emergence of a recent form of monism, which I have called *postmodernist monism*, again highlights this crucial dimension of the current debate over paradigmatic change. The assumption that the scientist is in some way

transformed into an objective agent – some sort of machine, in fact – for analysing phenomena, is not supported by this model. Rather, the conception of the scientist as an affective agent exploring his or her relationship with the universe seems unavoidable and I will return to this point later in the thesis.

The Inertia of Beliefs

In the first two sections of this Chapter I explored possible reasons why we as a species formulate beliefs at all. Certainly, it is entirely plausible to imagine a human species that does not have any beliefs whatsoever – perhaps, as discussed, our hominid ancestors are examples. I have suggested that beliefs are an inevitable consequence of the inquiring mind – of a mind that can formulate questions. Other commentators have gone further than this and argued that beliefs have survival value.

Survival, for our primitive ancestors, may well have been furthered by a propensity to explain their experience in terms that would provide a sense of security and the emotional comfort and satisfaction flowing from it....It is possible that only explanations of this nature could have assuaged the fear of death encountered by humans once imagination and memory and self-consciousness had evolved, and connections could be made between the deaths of other living things and their own inevitable fates....It's possible that those who held fast to such truths – and to their own important role in the nature of things on which these truths were predicated – would have acted with greater confidence and been more willing to assume the risks associated with hunting and fighting off marauding neighbours than were those who cowered within their literal caves overcome by the insecurity and fear that their situation probably warranted. (Hutcheon, 2001, p. 5/6)

Under either model, or a combination of the two, beliefs can be seen as artefacts to assuage a need for meaning. Scientific beliefs are included in this definition.

Some of our favorite stories in the history of science, such as Kekule's famous "Eureka" episode⁴², feature dramatic journeys to compelling explanations. In these scenarios, the explanation "felt right". This sense of understanding is causally potent. It can be so comforting that explanation stops when this feeling is experienced.....this sense of satisfaction is confidence that one enjoys an accurate description of the underlying causal factors sufficient (under the circumstances) to bring about the phenomenon we are examining. But confidence is, notoriously, not an indicator of truth. (Trout 2002, p. 213)

As Stephen Jay Gould noted in one of his last papers: "As ordinary human beings with egos and arrogances, scientists love to be right." (2002, p. 8) And so the feeling of rightness, the belief, can become a 'truth' to be proclaimed and defended.⁴³ Furthermore, it has long been recognised that being undecided produces an unease – a dis-ease – that also needs addressing.

Doubt is an uneasy and dissatisfied state from which we struggle to free ourselves and pass into the state of belief; while the latter is a calm and satisfactory state which we do not wish to avoid, or to change to a belief in anything else. On the contrary, we cling tenaciously, not merely to believing, but to believing just what we do believe. (Peirce 1877, p. 4)

Thus we may not only inevitably form beliefs in answer to questions about our existence arising out of our intellectual inheritance, but we may also need beliefs to resolve states of psychological uncertainty perhaps originating in evolutionary imperatives such as those postulated by Hutcheon (2001). Trout (2002) describes the sense of relief experienced in formulating an explanation or belief as follows:

⁴² Kekule visualised a model for the structure of molecules in a daydream.

⁴³ On this, David Bohm and Mark Edwards (1991) argue "...we often find that we cannot easily give up the tendency to hold rigidly to patterns of thought built up over a long time...This stance implies that under no circumstances whatsoever can we allow ourselves to give up certain things or change them." (p. 15)

An explanation pleasantly discharges that feeling of intellectual unease. But unity and consistency with background knowledge is a poor substitute for accuracy and truth, as the litany of false but unifying and consistent theories in the history of science should warn. (p. 216)

Thus, as Charles Peirce (1877) suggested, there would therefore be an incentive to enter false states of belief as well as a disincentive to re-entering states of uncertainty – that is, doubting and changing our beliefs. In other words, being sure is a pleasant feeling – it makes us feel good, or at least removes the irritant of doubt – but any link to an objective truth or reality must be considered tenuous⁴⁴. Further, we may tend to hold onto our beliefs past their use by date. Trout (2002) goes on to make this point as follows:

The fact is, our history is littered with inaccurate explanations we confidently thought were obviously true: the explanation for mental illness in terms of demonic possession, the humoral theory of illness, and so on. The sense of understanding would be epistemically idle phenomenology were it not so poisonous a combination of seduction and unreliability. It actually does harm, sometimes making us squeamish about accepting true claims that we don't personally understand, and more often operating in the opposite direction, causing us to overconfidently accept false claims because they have a kind of anecdotal or theoretical charm. (p. 225)

It is possible to take this even further still. As discussed earlier in this thesis, if the feeling of 'rightness' includes a belief in a central and unifying paradigm for scientific inquiry that implicitly encompasses a linear cause-and-effect model (that is, the positivist paradigm) then a simpler rather than a more multi-dimensional

⁴⁴ Charles Peirce went on to propose the "scientific", or positivist, method as the only way out of the conundrum of subjectivity that belief formation presents. Thus I agree with his analysis of belief, but not his conclusion.

worldview is a consequence. However, simplicity is not always a virtue, as John Dupré (2002) has pointed out:

Simplicity has often been suggested as a virtue of scientific theories or scientific explanation.....But this is also a domain in which the simple all too often merges into the simplistic.....As theologians have long been aware, one path to simplicity is unity. Some philosophers and scientists still maintain that there is only one fundamental law of nature. Everything else is just details. (Recalling the parallel with theology, there is just one true God, and the devil is in the details.) (p. S284)

Thus, we need beliefs and cannot avoid forming them. However, once formed those beliefs have resilience and can direct our thinking processes, and therefore in many cases our actions, in direct and profound ways⁴⁵. It is my contention that an insistence on one particular paradigm for the processes of scientific inquiry – whatever that paradigm may be – is an example of both the intellectual/psychological imperative for believe formation and the inertia that established beliefs may be considered to display in human beings.

It is difficult to see, however, how the mono-paradigmatic approach may be maintained if the model for the *Cycle of Inquiry* presented here is accepted, for all paradigms then become legitimate phenomena for exploration and utilisation. Furthermore, there are very good reasons to move beyond the classical paradigm if a pursuit of truth is truly to be retained as a central concern of scientific endeavour, as John Dewey fully recognised sixty years before the postmodernist movement again highlighted the issue:

...while, indeed, empirical observations and records furnish the raw or crude material of scientific knowledge, yet the empirical method affords no way of discriminating between

⁴⁵ Koehler's (1993) research is of interest here. "A laboratory experiment using advanced graduate students in the sciences...and an experimental survey of practicing scientists on opposite sides of a controversial issue...revealed agreement effects. Research reports that agreed with scientists' prior beliefs were judged to be of higher quality than those that disagreed...the agreement effect was larger among scientists who held strong prior beliefs."

right and wrong conclusions. Hence it is responsible for a multitude of *false* beliefs. (1910, p. 147)

As emphasised here, false scientific beliefs are both inevitable and legion. As human beings we cannot avoid forming beliefs, whether or not we have the information or tools, perceptual or otherwise, to objectively verify those beliefs. We are also highly likely to hold those beliefs as ‘true’ and therefore opposing beliefs as ‘false’ without necessarily any direct evidential support. Finally, changing those beliefs is problematic and therefore they may well display unsupported longevity. The major consequence of this analysis for the individual is, I would argue, an emphasis on the need for an examination of the assumptions underpinning personal scientific beliefs, including any paradigms that may have been adopted through enculturation or some other means⁴⁶. It may well be that the scientific beliefs we hold are either incorrect, or as Dewey went on to emphasise, even when they are correct this may be “almost a matter of good luck as of method.” (1910, p. 147) The fundamental question now to be asked if we claim epistemological outcomes from our processes of scientific inquiry is: “How can we be sure?” The problematic nature of our belief and perceptual systems makes considering this question both inevitable and essential.

We are indeed generators of meaning – creating beliefs is a defining feature of human beings. Also, belief formation is a process that is as automatic for us as breathing. An analysis of that process raises further issues in relation to the debate on paradigm plurality in scientific inquiry.

Creativity and Science

The human mind, in its never-ending change, is like the moving water of a river, or the burning flame of a candle; like an ape, it is forever jumping about, not ceasing for even a moment.

The Teaching of Buddha.

Human beings are involved in acts of creation every moment of every day. Thoughts, emotions and impressions arise out of the inexhaustible well of the mind both while we are awake and when we sleep. Unlike machines, we are never turned

⁴⁶ A position also taken by Benz and Shapiro (1998).

off at some switch or are on stand-by. Unless we suffer irreparable damage to our higher functions or we die, our minds are forever active. All human beings are creators, originators, producing unique sequences of thoughts, words or ideas as a natural function of our existence. Some individuals are exceptionally talented and may be recognised for their creations – writers, musicians, artists, philosophers, scientists and so on – but every person creates their lives anew moment to moment and never exactly repeats any sequence of thoughts or actions twice in a lifetime. Indeed, as Sabelli and Abouzeid (2003) have noted, creativity shows all the hallmarks of a complex system and may well be most effectively explored through tools specifically designed to investigate dynamic systems. Also, human creativity is both apparent and, by definition, a necessity in all processes of inquiry, as Baaquie and Heng (2002) have noted, and is therefore important in the context of scientific inquiry.

The exercise of human creativity and intelligence is essential in the production of all forms of human knowledge. Human creativity is indispensable for the creation, acquisition, application and expansion of human knowledge. Carrying out a critique of existing knowledge, breaking the boundaries of predominant paradigms and charting out hitherto unknown domains is the essence of critical thinking, and forms the underlying template of human creativity in all spheres of human knowledge. (Baaquie and Heng, p. 1)

Creative ability is nothing special in the plant and animal world, of course. Even the lowest form of life will adapt to its environment, producing novel behaviours in response to changing environments. The ability to be a creator is an inherent function of living organisms. From the simplest to the most complex, living systems have adapted to every conceivable environment on this planet.

The difference for human beings, and perhaps some of the other more highly developed animals such as the cetaceans and the apes, is one of degree. As Peter Carruthers (2002) has noted, our creative abilities surely must be considered one of our most striking features. For reasons that are not yet clear, we have developed large brains and have become self-aware. As a result, not only are we creators, but

we can choose between our creations, whether those be artefacts, conceptual systems or behaviours⁴⁷, and have moved into a new realm of self-directed adaptation to and of our environment. In essence, we have created a self-sustaining feedback loop that is both the origin and the target of our creations. Thus, we can actively and consciously remodel ourselves and the world we live in and may well, in due course, move out into the larger universe and remodel that too.

The process involved in this constant stream of creative energy is still a mystery to us. We can propose models from studies of what we experience during the process, but there is no agreement as to the nature or the detail of that process. Indeed, there is only one constant amongst models proposed by commentators on the creative process and that is that it has a non-conscious element. Wallas (1926) referred to a period of “incubation”; Rossman (1931) “invention”; Osborne (1953) “incubation” again; Koberg and Bagnall (1981) “ideation”; Bohm and Peat (1987) and Prigogine and Stengers (1984) both referred to the “unconscious”; Barron (1988) “gestation”; Bandrowski (1985) “creative leaps”; Fritz (1991) “vision”; and Parnes (1992) “idea finding”⁴⁸.

A basic model may be seen to have three components. There is an input that may take the form of a question, a problem, a change in circumstances or environment, or some similar stimulus that engenders a response from the individual. That stimulus is consciously experienced in that the individual is aware of it experientially either as a process of thought or sensory input.

Similarly, the product of the creative process, whether it be an idea or an action, is consciously experienced by the creator. That is, an idea is by definition one that exists in the conscious mind and an action is under conscious voluntary direction. However, the act of creation is non-conscious. From the input of the stimulus to the emergence of the product is unknown territory. Something happens in our minds that we are not consciously privy to. It is a function of our humanity and we do it all the time, but we do not know how we do it.

⁴⁷ John Dewey (1910) made a similar point nearly a century ago: “When dominated by the past, by custom and routine, (experience) is often opposed to the reasonable, the thoughtful. But experience also includes the reflection that sets us free from the limiting influence of sense, appetite, and tradition.” (p. 156)

⁴⁸ In this analysis I have drawn on the work of Paul Plsek (1996) in that it directed me to the majority of the models discussed. However, I am sure Mr. Plsek would not support the conclusions I have drawn here as they differ from his in both content and emphasis.

A diagrammatic model for the creative process is therefore by necessity simplistic:

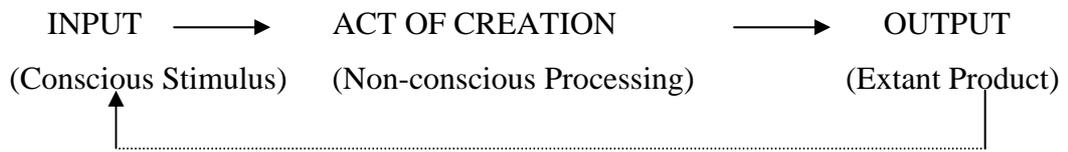


Figure 9: the Creative Process

Where the output can, and often does, then become a further stimulus that leads to another creative response, and so on. Certainly, it is clear that some sort of processing of input against stored information is being carried out by our non-conscious minds. In our everyday responses to stimuli that processing can appear virtually instantaneous – as in vocalising a response in a conversation, for example. Furthermore, we are sometimes aware that a solution is being gestated as we nearly, but not quite, grasp an idea or thought that is approaching the edge of our consciousness or just fail to access a word that is “on the tip of our tongues”. However, the nature of the processing we can only infer from the product, for an experience of it is inaccessible to us for exactly the same reason that we are unaware of our autonomic bodily processes – both are always non-conscious.

It needs to be noted here that all models of creativity emphasise that the process may be aided or engendered by controlling both the inputs and the environment. Thus Wallas refers to “preparation”; Rossman to “observation” and “analysis”; Osborne to “orientation”, “preparation” and “analysis”; Koberg and Bagnall to “analysis” and “definition”; Barron to “conception”; Bandrowski to “analysis”; Fritz to “conception”; Bohm and Peat to “dialogue”⁴⁹; Prigogine and Stengers to “critical sense”; and Parnes to “fact finding”. An evaluation of the product is also a common element. However, the essentially non-conscious nature of the actual generation of the creative product is either explicitly or implicitly embedded in the models. We can increase or develop our creativity, even learn to control it to a certain extent, but how we actually do it remains unknown.

⁴⁹ Bohm and others have developed a detailed practical model for the development of creative dialogue. See Bohm, Factor and Garrett (1991).

This is a crucial observation in any analysis of the products of the human mind, including those in the field of science. Theories, ideas and concepts are rarely, if ever, the result of conscious, logical processes. On the contrary, their genesis lies in insights, intuitions and flashes of inspiration that are the end products of primarily non-conscious processing. Einstein, for example, often told the story that his moments of insight that led to the theory of relativity came unbidden while he was shaving. Similarly, creative artists often talk about the “gift” of creation as something separate from themselves: and so it is - from their conscious selves.

Into this unknown and unknowable blank space of non-conscious processing we may therefore project any causal factor that might seem to us to be likely. Thus, if we have a strong religious faith we may see our acts of creation as divinely inspired. This is precisely what Plato, Descartes and Newton concluded. On the other hand, if we have divorced faith from the scientific process we may conclude, for example, that the human non-conscious mind acts as a biological supercomputer, parallel processing information and producing multiple outputs. Further, if we perceive this processing as entirely internal and individual we may then conclude that it is subjective in nature and has no direct relationship either with anybody else’s subjective reality or with an external reality. Indeed, all three interpretations, or some combination of them, must currently be considered equally plausible for we do not at present have the understanding or knowledge to fully dismiss any of them. It is the case, for example, that the metaphysical solution is simply less fashionable now than it was in the seventeenth century, not necessarily less accurate.

It is therefore hardly surprising that the same debate that occupied Protagoras and Socrates is still unresolved today. The part of our minds that produces our streams of thoughts, ideas, theories and hypotheses is, and always has been, inaccessible. Plato, Descartes, Einstein, Sokal, Foucault and indeed you and I have faced the same unknown within ourselves and have found or will find our own explanations for it. Indeed, it is more than probable that the same debate will occupy philosophers and scientists in another two and a half thousand years as the non-conscious mind remains beyond the reach of the conscious self.

Human creativity is truly an incredible gift. It has allowed us to create art, literature and music. It has allowed us to create civilisations and all the social and technological artefacts that make our twenty-first century world so distinctive. It also allows us to create novel responses that guide our everyday activities.

Nevertheless, it is a process that we can neither effectively observe nor describe, except in terms of its outcomes. However we do come up with the ideas and solutions that characterise our processes of scientific inquiry, we cannot look into our minds and perceive whether or not that outcome was the result of affective or objective parameters, for the act of creativity is impenetrable to us. Furthermore, any feeling of “rightness” or “fit” we might experience following the creation of, for example, a hypothesis, may or may not have any other justification than our own subjective and individual non-conscious processes. We can certainly measure or assess our hypotheses against our observations of phenomena (however problematic those in themselves might be), but we cannot claim that our creations are self-evidently “true” for the evidence is inaccessible to us.

Again, this further underlines the uncertainty that is characterising the concept of the objective observer. The interactions between our perceptual systems and the creative generator of beliefs that each of us has inherited are complex and problematic. A direct link between our observations and an extant reality can no longer be assumed.

The process of the creation of beliefs is further complicated by another enduring characteristic of human beings – universalisation.

Being Right

Everyone’s wrong except thee and me, and I’m not sure about thee.

English saying

I have already explored some of the reasons why a feeling of ‘rightness’ is such a powerful factor in human intellectual activity, but there is another important aspect of this predisposition, and that is: why is it that so often each of us is so sure our personal truths are universal ones? For example, I am sure I am right about the current paradigm shift; I am sure my descriptors of its provenance and status are accurate. On the other hand, I am also sure that my personal truths are subjective – yes, even this latter belief! Unfortunately, there seems to be a bit of a problem here, a logical paradox that recedes into the distance in a never ending cycle of affirmations and denials. An examination of this paradox has significant implications for considerations of the formation and influence of paradigms.

Religious beliefs are intensely interesting in this context. A belief in God precludes a disbelief. This is an either/or position. Thus, if I believe in God I must hold that your disbelief in God is wrong – untrue – and visa versa. After all, either God exists or does not exist, and – either way – as far as I am concerned my belief is right and everyone that disagrees with me is wrong, including you. Whether I believe or disbelieve (just another form of belief, of course), I still universalise my belief or, to put it another way, it is the *universality* of the belief that takes precedence, not the content of that belief. Indeed, in this model whether God exists or does not exist is entirely irrelevant.

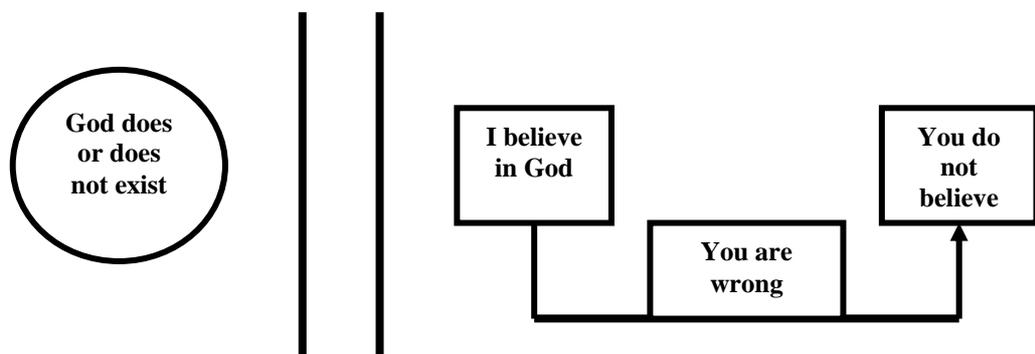


Figure. 10: The Theocratic Universality Paradox

Now, if we cover the circle – or remove it altogether - then nothing else in this model alters. The existence or non-existence of God has no impact on the affective dimension between you and I. The arrow goes in one direction – in this case from me to you – as I judge and condemn your point of view. There is no connection between the perpetrator and the fact or non-fact of God’s existence. From your standpoint, of course, the arrow would reverse, pointing its condemning finger at me. God, however, does not get a look in either way.

Very few scientists would argue that their truths, or beliefs, were immune from scrutiny or correction. The business of science, after all, is presumed to be a quest for clarity and understanding. Thus, peer review is an essential element in the processes of scientific inquiry. Theoretical structures, or scientific beliefs, change over time as more information becomes available or other theories are developed that more closely match observation. Or at least, that is the idealistic conception. However, let us reconsider the above model with a scientific belief at its centre.

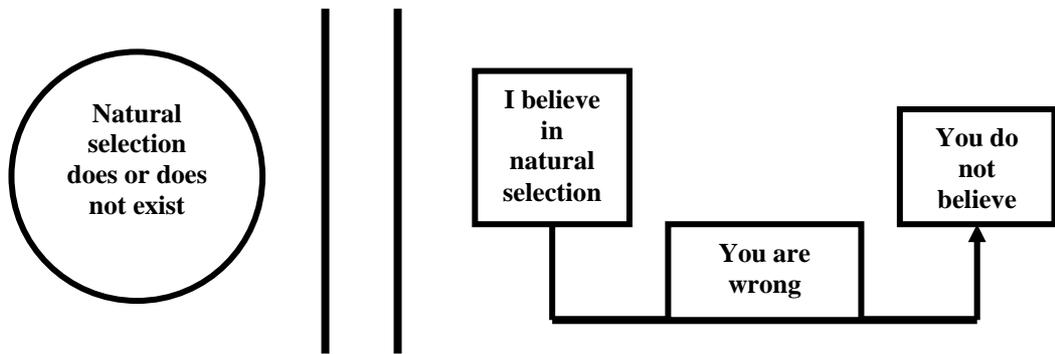


Figure 11: The Scientific Universality Paradox

And one more pertinent one.

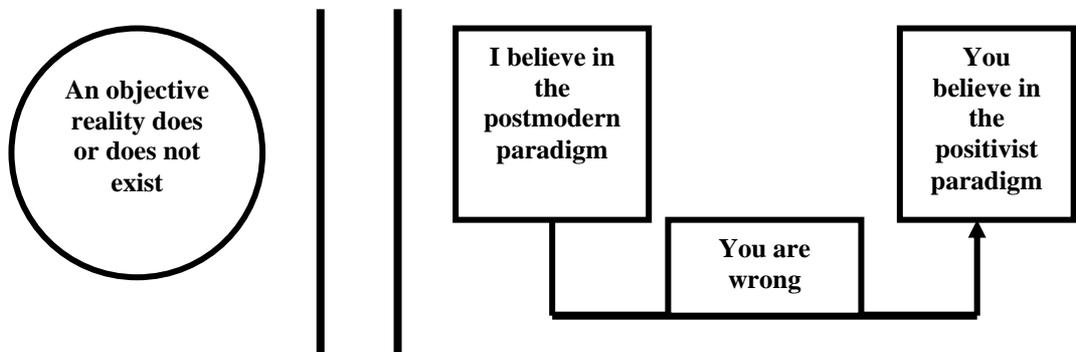


Figure. 12: The Paradigmatic Universality Paradox

In neither of these cases, or indeed any cases that may be substituted for them, does the actual existence or non-existence of the phenomenon in question have any bearing on the relative positions of each believer and non-believer. Scientific beliefs are therefore conceptually identical to all other beliefs. Being objectively right about, say, the speed of light, is not a requirement for an individual to hold his or her beliefs as true, and therefore those who hold contrary beliefs as wrong. The essential factor is the holding of a belief – whatever that may be – not whether it may be considered a true or untrue belief by others, nor whether the belief may be subjected to any number of regimes of veracity testing by others either. A good example here is the creationist belief in the origin of the species. Most scientists discount it for a number of reasons, both theoretical and evidential. Nevertheless, those who hold creationist beliefs are sure that these scientists are wrong.

The answer to the question *who is right*, therefore, is always to a certain extent relativistic. Until all objective truths are available, or revealed to us, without division

or dissension – that is they are self-evidently true – who may be considered right or wrong depends on the beliefs of each individual.

And this may be the reason why scientific beliefs are so hotly contested and the arguments so vitriolic between scientists themselves. Science is in the business of seeking truth⁵⁰, however that may be defined. As demonstrated above, if a scientist believes that a fact has been established or a theory supported by evidence – that is, is evidently true - he or she is likely to believe that all those who dismiss the conclusions are wrong. It is but a small step after that to presume that these opponents are less rational, less professional, less well informed, or less intelligent. Now, in some cases all the latter assumptions may be objectively true but, as demonstrated here, being right about the characteristics of others is not necessarily requisite in forming beliefs about them. Human beings, by definition, simply tend to believe that their beliefs are right and that opposing beliefs are therefore wrong.

To return to the personal paradox identified at the beginning of this section: my beliefs in the trueness of my observations on paradigms and in the subjectivity of my scientific beliefs remain incompatible as long as I universalise the former. If, however, I am willing to accept that my feelings of rightness are the result of internal affective processes, then that feeling of being right – of having an insight into the true nature of a phenomenon – becomes a personal rather than universal truth. I may indeed be objectively right in my observations, but that is not required for me to believe that I am right. In this sense, I can “claim to know” or claim knowledge of or insight into a phenomenon, without claiming knowledge for or on behalf of others.

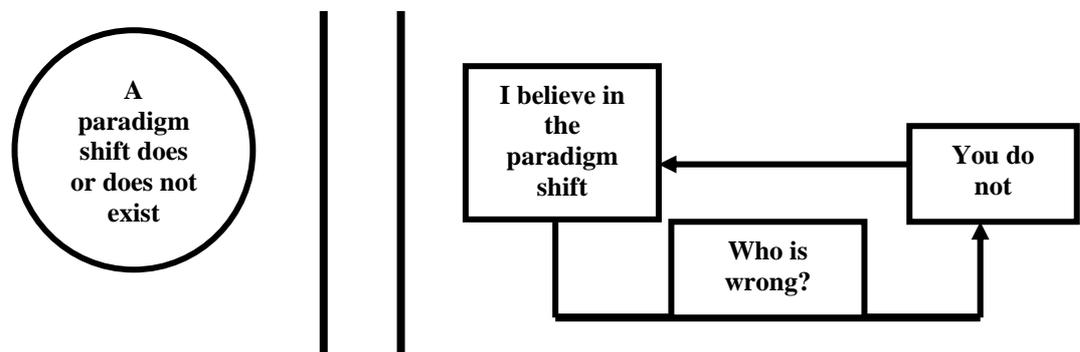


Figure 13: The Discursive Circle.

⁵⁰ Or at least that is what is presumed within the dominant paradigm.

In this model, we are involved in a discursive process rather than a fundamentalist universalisation of belief. Whether I am right or wrong is not self-evidently true. Therefore, my opinions are always open to discussion, criticism and challenge. During this discursive process the links between my position and a range of observations – the evidences – may be examined. However, and just as importantly, the nature of what may be considered evidence as well as what may be considered objective reality also become essential subjects for exploration. The question *how can we know* in this context, as well as the related questions *how have we come to know* and *on what grounds can we justify our claims to know*, cannot be examined otherwise.

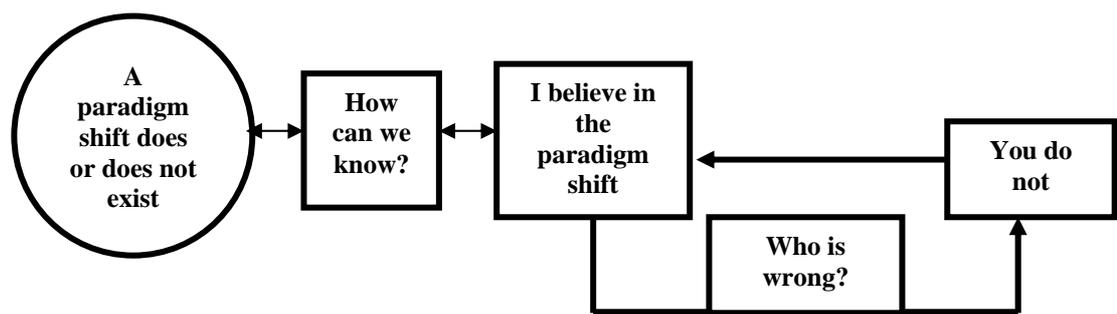


Figure 14: The Cycle of Inquiry

Similarly, the nature of discourse itself is also highlighted as the vehicle for these processes. The answers to the questions asked may prove difficult to ascertain, but asking them is now unavoidable.

In many ways, this is a restatement of one of the basic tenets of the processes of scientific inquiry that have been extant since Aristotle – that science is a process of discovery, challenge and change. Nevertheless, scientists remain human beings and are subject to the same intellectual processes as all others. One of those processes is the conversion of personal into universal truths. Indeed, science overwhelmingly continues to be characterised by universalistic statements and arguments from its community members.

Universalisation, perceptual paradox and the ubiquity of belief creation are all essential features of our processes of inquiry. *Representation* is another element of this enduring and complex system that was identified over three hundred years ago and is just as relevant to today's discussions on the power of the paradigm.

Representation

...we must remember and acknowledge that there be in our minds continually certain images or conceptions of the things without us, insomuch that if a man could be alive, and all the rest of the world annihilated, he should nevertheless retain the image thereof, and of all those things which he had before seen and perceived in it; every man by his own experience knowing that the absence or destruction of things once imagined, doth not cause the absence or destruction of the imagination itself. This imagery and representations of the qualities of things without us is that we call our cognition, imagination, ideas, notice, conception, or knowledge of them. (Thomas Hobbes, 1640).

This is a fundamental dimension of the processes of inquiry that must be addressed in any comprehensive analysis of the paradigm shift detailed in this thesis and may be highlighted by a simple task. Study Figure 15 on the next page and make a judgement on which is the best tree. Take your time over this and consider as many criteria and approaches to the task as possible.

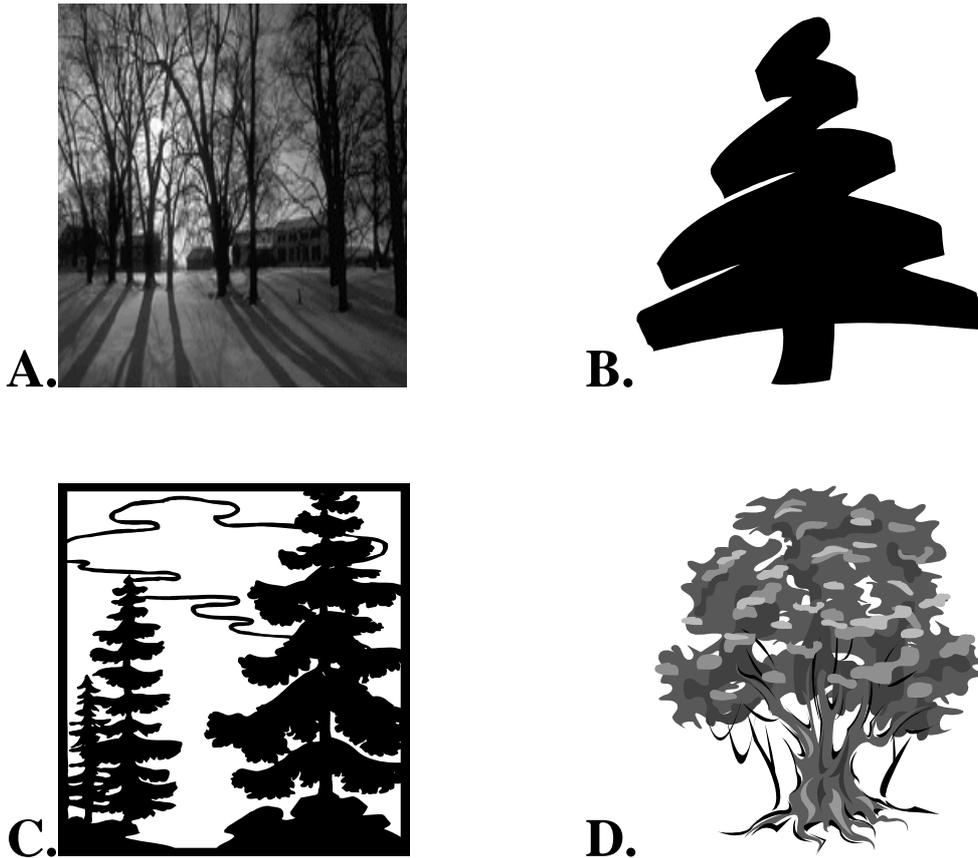


Figure 15: Which is the Best Tree?

Different readers may come to differing conclusions for a variety of reasons – personal preference, aesthetic values, accuracy and so on. Some of the reasons for the decision may be considered entirely subjective, others more objective. It would be possible to do a statistical analysis of preferences amongst readers and, with a sufficiently large sample, it would be possible to postulate about larger communities and their probable preferences as well.

However, there is another and conceptually completely different response to this task. It could be decided that the task is meaningless for, in fact, what you were presented with was a page with some black and white printing upon it. That is not a tree. There may be some agreement on the issue of printed features intended to portray some shared conceptualisation of the representations of a tree, but it is not and never can be a tree.

Morrison (1991) refers to the tendency to equate representations with phenomena as the “fallacy...of confusing the model with reality” (p. 270) and goes on to state that “this has happened again and again in the history of science and mathematics”.

Indeed, all our mathematical models are simply representations, agreed interpretations of descriptions that we might apply to phenomena – they are not and can never be the phenomena themselves no matter how “accurate” or “realistic” we might consider them to be. Similarly, no matter how much validity we might attach to a theoretical framework and no matter how many times we might “test” this framework against an agreed set of criteria, it remains the case that it does not in some indefinable way become the phenomenon we are observing. The universe and our descriptions of it remain separate in exactly the same way that a map of the world can never become the world itself.

The importance of this observation is that there can never be a “right” way of describing anything. There may be conventions agreed on by many, if not a majority of observers. There may even be a very high agreement between observers on the representational value of any particular model. However, whatever the phenomenon might be, it remains unchanged by our descriptions of it whether or not they may be considered in some more or less subjective way reasonable symbolic representations. This is true for the competing paradigms outlined in this thesis; and it is equally true of the varying points of view expressed by commentators for and against them. Neither the descriptions nor the opinions make one jot of difference to the physical reality of our universe. Thus, for example, the weather does not become linear in nature or predictable simply because we utilise reductionist, predictive theories to describe it. Similarly, the non-linear “weather models” now utilised in computers are not, no matter how similar the descriptions may be of the outcomes, the weather itself. Our descriptions therefore – mathematical, computer models and theoretical – are no more than exercises in communication of varying degrees of skill and utility.⁵¹

If this premise is accepted, there are profound implications for the way we conduct scientific inquiry. If we are primarily involved in a process of communication, then the form, purpose and metaphorical parameters of our communication become central subjects for concern. After all, a process of discourse we might enter into in relation to – say - complexity, is driven by the ways we communicate, the assumptions each of us brings to the discourse and our intellectual and emotional investment in that discourse. It is not, however, subject to

⁵¹ A point double Nobel prize winner Ilya Prigogine makes in relation to mathematics: “For me mathematics is only a tool to write down my ideas so that in the long run they can be communicated.” (Interview with Robert B. Tucker, 1983, p. 6)

some miraculous, external process that can turn the discourse into a storm over the Pacific Ocean or into any other physical reality.

The inescapable element of subjectivity in this view of scientific inquiry may be seen, on one level, to strongly support the postmodernist position. Certainly, there is no room here for purely “objective” truths. However, it also undermines it to the extent that all processes of discourse must be considered equally valid if there is no one agreed frame of reference that may be used to choose between them. Thus, the classical paradigm that embodies the concept of the objective observer rejected by postmodernist commentators is just as valid as an avowedly narrative and subjective position. The central question is not whether one approach or another is more valid, but why those discursive processes are taking place in that way, in that context and involving those individuals. As I have emphasised elsewhere in this thesis, the concept of choice between a range of discursive tools is one of the major conclusions to be drawn from an analysis of the processes of scientific inquiry.

Plato and Aristotle were concerned with discursive and scientific processes that would reveal the truths of existence. Descartes and Newton created methodologies that would guide the same quest for over two centuries and also gave to our species the opportunity to develop the technological tools to change the face of our planet. What may be considered “truth” and the methods by which we may explore this concept are indeed still central to the debate on scientific paradigms. The next section analyses the paradoxes inherent in considerations of truth in relation to the processes of scientific inquiry. This analysis begins with one of the hidden assumptions in the classical paradigm – a belief in God.

Truth and the Problem of God

Knowledge. Everyman, I will go with thee, and be thy guide,
In thy most need to go by thy side.
Everyman

If God exists, does it follow that there is an objective reality that human beings can access, understand and describe? If God does not exist, does it follow that there is no objective reality, or that human beings cannot access it any way, or do not have the tools to describe it?

Even a cursory examination of these questions demonstrates the logical complexities inherent in the task of answering them. For example, if God does exist, it does not necessarily follow that there is an objective reality. Furthermore, if God does exist and there is an objective reality, it does not follow that human beings can understand it or, even if we could, then describe it to others.

The converse question is even more interesting. If God does not exist, it still may be that there is an external reality. However, as Immanuel Kant (1790) pointed out over two centuries ago, it does not follow that we can perceive that reality. Similarly, even if we can perceive that reality, we may not be able to describe it to others.

At any point along these sequences the suppositions may be reversed. For example, we may have the tools for describing an external reality, but this does not presume the existence of that reality. Or we may have the abilities to perceive an external reality but that reality may not exist.

As I have outlined, the Newtonian conception of the processes of scientific inquiry presupposes the existence of God. Indeed, God is essential in the process as the originator not only of an objective universe, but also our abilities to both perceive and describe that universe. The Newtonian model may therefore be represented as follows:



Figure16: The Newtonian Model for Scientific Inquiry

Importantly, in this model the existence of God is essential to all four stages. Without the concept of an ideal and perfect creator, the model has no basis for validation for each subsequent stage is contingent on the first. Newton was very

clear about both his subject and his methodology – he was describing God’s universe with God’s tools.

There are therefore significant problems with accepting Newton’s model. Some of us believe in God, and some of us do not. Indeed, many of us really are not sure one way or the other. To presume God’s existence and a series of God given abilities is therefore unacceptable as a universal descriptor of scientific inquiry. It can only be an accurate description for scientists who both believe in God and that human beings have not only been given the abilities to perceive an external reality but also to describe it. It further presumes that God has put in place an external reality for us to perceive and describe. It is unlikely that many twenty-first century scientists would hold fast to all four statements of belief. The Newtonian model is not appropriate.

Postmodern commentators are generally silent on whether or not God exists, although many do suggest that an objective reality probably does. Rather, it is almost universally argued that we neither have the tools to perceive that reality nor to objectively describe it. In general terms, the postmodern model for scientific inquiry may thus be represented as follows:

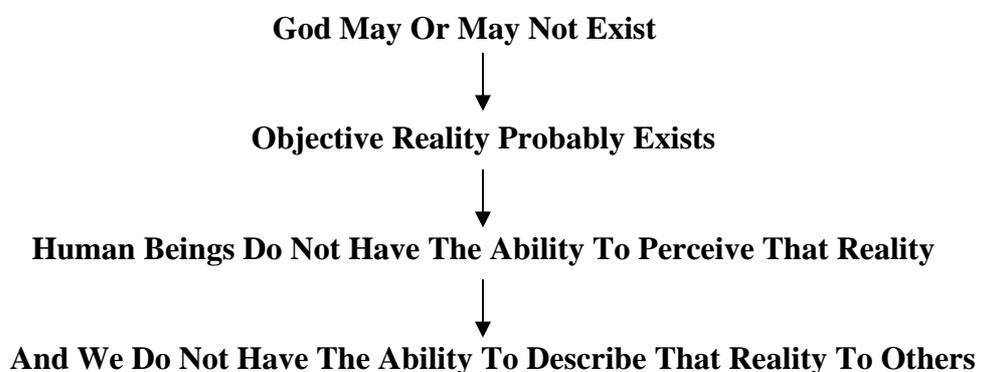


Figure17: The Postmodern Model for Scientific Inquiry

The crucial issues in relation to the current debate over scientific inquiry, therefore, do not centre on the existence of either God or an external reality. Whether God exists or not begs the question over the existence of the universe – the universe may have spontaneously emerged as a quantum fluctuation in a vacuum, for example. Also, very few commentators since George Berkeley (1710) have argued that the universe is an illusion. The empirical evidence supporting the conclusion

that we are imbedded in a universe that has a physical reality seems overwhelming – we always bleed when we are cut, for example, and always burn if we put our fingers in a flame, as David Hume pointed out originally in 1748. Certainly this position – without necessarily being explicitly stated - is now a fundamental assumption of almost all scientific commentators. Rather, the essential debate centres around the processes of perception and discourse and may be encapsulated in two key questions:

Have we the tools to effectively perceive truth and reality?

Have we the tools to effectively share our perceptions with others?

Any attempt to justify positive answers to either of these questions must address both coincidentally, for supporting one does not lead to an automatic acceptance of the other. Thus, for example, the ability to perceive an objective reality – through, say, theory and research – does not presuppose that the tools used to describe and explain those perceptions to others (the symbolic systems of language and mathematics) are either effective or accurate. Neither does it presuppose that we have the abilities to accurately receive and process the perceptions of others. Similarly, even if our processes of discourse are held to be entirely accurate and effective for the sharing of our perceptions, we cannot also automatically conclude that our perceptions are accurate in the first place.

This situation is made very much more complex by considerations of degree. It may be that both or either of our perceptual and discursive tools are only partially effective, or only effective under certain circumstances and within certain limits – that is indeed the position taken in this thesis. If this is the case, establishing the parameters that can accurately describe these processes may be the most difficult task of all. For not only may considerations of the efficacy of scientific paradigms and methodologies be a source of hot debate, but also there is no commonly accepted explanation for interactions in the individual between beliefs and perceptions and the processes of understanding and communication. It is in this latter area that the postmodern movement has contributed most to the debate relating to rationales for models of scientific inquiry.

Most scientists seem to have adopted a hybrid of the Newtonian and the postmodern models. Thus, God may not be a necessary part of the model, but assumptions concerning the existence of an objective reality, of a given ability to

perceive that reality and a given ability to describe it are inherent in the positivist position:



Figure18: The Positivist Model for Scientific Inquiry

Again, this model is conceptually fragile, for its overall efficacy depends upon the individual efficacy of each of the last three stages. If any one of these stages is untrue then the model cannot be accepted as a blueprint for the processes of scientific inquiry. As noted above, an objective reality can exist without a necessary consequent human ability to either perceive or describe it, and visa versa.

Interestingly, a number of writers with a Christian perspective have combined the Newtonian and postmodern models in another way. The subjective nature of experience is central to all postmodern philosophies, whether this be governed by primarily cultural or neurological parameters or a combination of the two. Our beliefs therefore, rather than any objective truth, become the centre of concern. On this basis, many Christian writers have assumed the Newtonian connection between experience and God, but reversed the order of the argument:

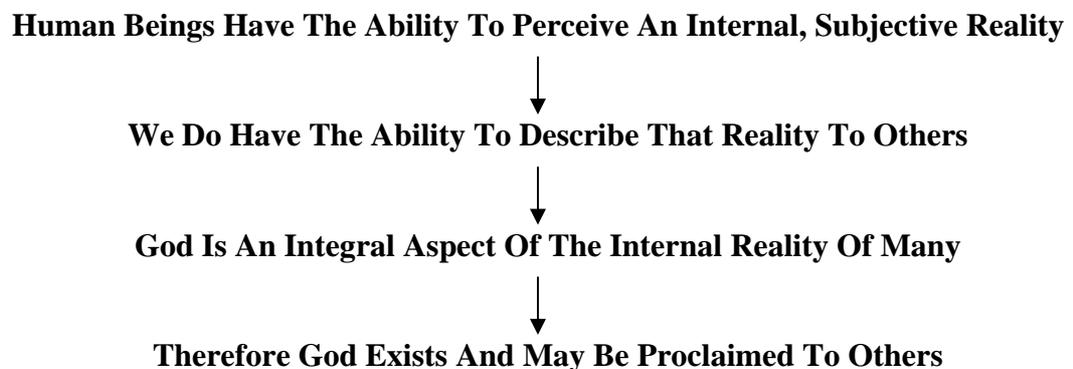


Figure 19: The Positivist Model for Theocratic Inquiry

An analysis of this model is informative in a consideration of the connections between subjective and external realities. For example, whether or not God does in fact exist, this model may be questioned because it presupposes not only that our beliefs reflect an external reality but also that these inner truths may be conveyed – or revealed - to others. As the myriad of human religious beliefs indicate, individuals perceive different gods and/or different faces of God rather than a consistent revelation that is shared by all. Further, there are as many descriptions of faith as there are religious writers. An experience of faith appears to be individual rather than universal. Certainly, the existence of both atheism and agnosticism strongly supports this conclusion. Many human beings, it seems, have experienced the inner reality of the non-existence of God. The importance of this observation in this context is that all three models – and not just the last one - rely on statements of belief. Thus, no one model can be considered any more valid than the others – unless, of course, the individual *believes* in one of them.

The conclusion that no one model can be considered objectively *true* and therefore the others *false* is not, however, a prescription to discard all three. Rather, it is necessary to explore the lessons that may be learnt from the processes of modelling. Thus, if all models for inquiry entail the adoption of beliefs, or assumptions, then an examination of those beliefs and the rationales for their adoption become important. For example, a belief that positivist research and theory can reveal the nature of an objectively existent universe may be a perfectly reasonable working assumption in relation to many phenomena at the macro level – the movement of planets and the behaviour of crystals, for example. It may, however, be entirely unreasonable in relation to complex and emergent phenomena such as societies and languages. Similarly, the postmodern conclusion that all discourse is subjective in nature and reveals internal and not external processes may be an accurate description of explorations of ideas and meanings, but much less appropriate for the exploration of physical properties such as gravity or the speed of light. Further, the Christian postmodern writers have an important perspective to offer on the nature of belief and its place in the development of Western scientific philosophies.

The essential question is not *which* model is right or true, but *when* it is appropriate to use any or all of them. It would seem more appropriate for medical

research to utilise the classical model, for example, and particularly in relation to empirical studies into the effectiveness of treatments - such processes are more likely to establish the side effects from a new drug regime. On the other hand, considerations of individual involvement in, say, educational processes more probably require narrative techniques to explore the essentially existential nature of that involvement. Similarly, explorations of belief require a reverse model similar to the third above to embody the concept that belief is founded on some form of revelatory experience.

A fourth model may therefore be presented that embodies this principle of *relational choice*. The strength of this model is that it neither assumes the existence or non-existence of an objective reality⁵², including that of God, nor assumes a hierarchical connection between its constituent elements. Rather, all elements are interchangeable in position and importance depending on the context. What it does do is emphasise the contextual nature of the processes of inquiry.

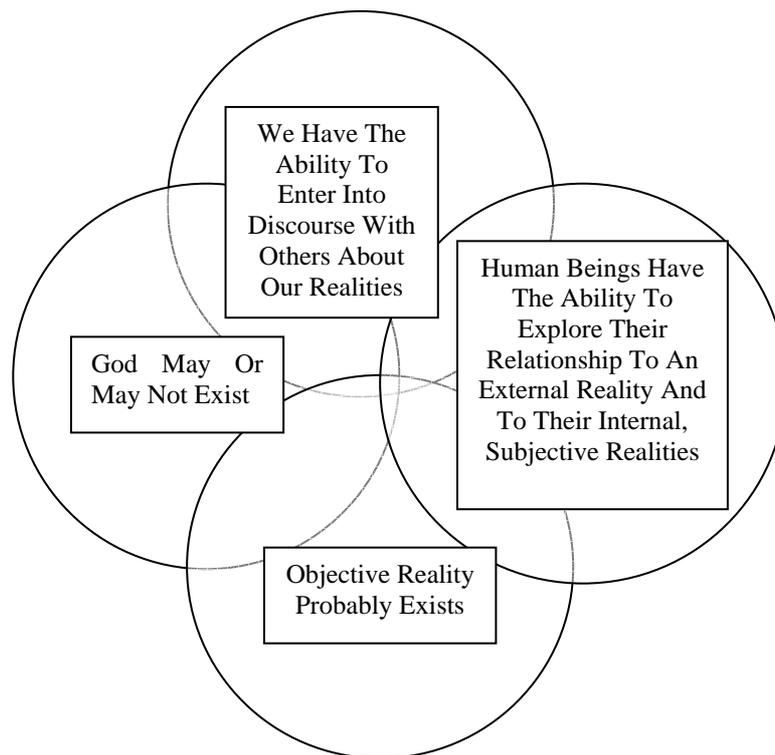


Figure 20: the Contextual Model for Scientific Inquiry

⁵² And on this I concur with Burdett (2002): “The controversy might generate less emotion...if scientists would learn a little epistemology.....The view that the world exists is useful. It helps make sense of experience. But there is actually no conclusive evidence that there exists an external world of which we are each a self-conscious part – a world that would exist whether we were aware of it or not. Logically, it is quite possible that there is nothing but our consciousness (the writer’s anyway), albeit of things that seem to imply an external world.” (p. 2)

Thus, the individual's choices and rationales for those choices become paramount. A simplistic or unquestioning acceptance of any one paradigm is therefore insupportable under this model. To put it another way, the question *why do this in this way in this situation* may need to be considered before any particular line of inquiry may be adopted.

If the relationships we experience with our external and internal realities may be effectively described utilising linear, cause and effect descriptors then there is only one answer to the above question – a re-affirmation of the classical paradigm for scientific inquiry. However, if that paradigm may be challenged by one arising out of the complexity sciences and expressed in postmodernism, as argued here, then the answer is fundamentally changed. The emergence of the postmodern paradigm ensures a pluralistic debate over the assumed epistemological and ontological outcomes of the processes of scientific inquiry and, perhaps most importantly of all, highlights the importance that individual and personal decision-making occupies in every aspect of those processes. I would argue that this is a crucial observation within the context of this thesis and the central role that personal ethical frameworks may be considered to play in all forms of inquiry will later be explored at length.

As human beings, we create beliefs as part and parcel of our processes of inquiry. Many of the issues in relation to that element of these processes are discussed above. However, the medium within and through which all of this activity occurs is discourse. This essential and unavoidable element is also both complex and problematic.

The Academic Tribes and Their Modes of Discourse

One of the tasks we set ourselves...was to take into account the adaptations of the academic tribes to these environmental changes (to higher education): adaptations made sometimes reluctantly, occasionally enthusiastically and often unconsciously. (Becher and Trawler, 2001, p. 9)

Every culture, sub-culture and group has its own vocabulary and its own contextual meaning imbedded in that vocabulary, even where the same language is used, as well as its own social and linguistic practices – in effect a sort of tribal separation, as Becher and Trawler suggest. Thus, the word “cool” had a different meaning for

refrigeration mechanics and hippies in the nineteen-sixties and seventies, for example. There are conventions of usage that betray an individual's enculturation in a society or group, and often the one individual will adopt differing conventions in differing social situations. A barrister who plays rugby is highly likely to use very different linguistic conventions in the club and court rooms.

In the same way, the disciplines in the physical sciences have their own vocabularies and conventions of language usage. Thus, biologists, physicists, chemists and mathematicians all use differing, if overlapping, vocabularies and approach their subjects primarily utilising the conventions of those who have preceded them.

If there are differences between the various physical science disciplines, however, there is currently an even greater gap between the physical sciences as a group and the social sciences. Physical scientists generally assume the classical paradigm for scientific inquiry. Social scientists, on the other hand, increasingly do not. Thus, explorations of physical phenomena are often reductionist and linear with the intention to describe the constituent elements and therefore gain an understanding of the whole. Studies of social groupings and tools (symbolic systems and so on) are characterised more by discourses on context and meaning and utilise narrative and commentary as methodologies. As outlined in Chapter 4, some physical and social scientists are increasingly utilising blended methodologies as an explicit recognition of the efficacy of both paradigmatic approaches. However, as also noted, many of the physical scientists who have taken sides in the *science wars* debate, hold that the classical research method is more rigorous and objective. Certainly, the language used often presupposes this position with the vocabulary and structure following well-established conventions, including the use of the third person.

Social scientists, then, are increasingly utilising language and forms that suggest subjectivity and contextuality. What people experience and how they interpret that experience is considered just as important as any factual description of the physical and social environment. Social studies tend to focus on groupings rather than individual elements. For example, a society is composed of a number of individuals interacting together in numerous and different ways. One individual, therefore, cannot effectively be studied in isolation from his or her group. It makes more sense to study the relationships between the group and the individual, or to study the emergent behaviours of that group as a social entity. Further, the stories or narratives

that the members of these groups have to tell about their experiences and their reflections on experience are integral elements of the processes of inquiry in this discipline. Human beings assign meaning and purpose to experience and re-interpret the world through both symbolic and ontological systems. Thus, the use of the first person is much more prevalent in the social sciences.

Physical scientists do not generally study subjects that can answer back and challenge their interpretations, whereas social scientists do not, in general, study systems that obey linear physical laws. In each case, the nature of the phenomena studied is, to a large extent, dictating the form of both the processes of inquiry and discourse in the two disciplines. Notably in the field of complexity, scientists are utilising conventions borrowed from both fields. Thus, although many studies into complex systems have often followed the classical reductionist model in an attempt to understand first principles and gain predictive capabilities, metaphors are frequently used to illustrate and elaborate on the complexity of the phenomena studied and particularly the existence of emergent behaviours that defy prediction. This adoption of the social scientist's technique of illustration through commentary is not surprising. Social scientists have been dealing with highly complex and emergent behaviours all along and the use of metaphor is a useful and effective tool for encapsulating complicated and difficult conceptual frameworks.

No matter what discipline may be involved or what paradigm assumed or adopted, all attempts at scientific discourse can only occur through symbolic systems. The overwhelming medium utilised is language, and notably the English language. Almost all texts and papers are entirely written. Also used are mathematical explanations in certain circumstances, almost always in conjunction with written explanations. Computer programs are increasingly being used to study certain complex phenomena as well, again accompanied by electronic/written text. All symbolic systems, however, are both a medium for discourse and a barrier to communication. Thus, most scientific discourse would be unavailable to a non-English reader, for example. Similarly, mathematical and programmed discourses would be unavailable to non-mathematicians or non-computer scientists. There are also much more subtle barriers to the processes of discourse, however. Students of the various disciplines will be enculturated differently. Thus, as discussed above, social and physical scientists may well misinterpret each other's attempts at discourse because of the differing inherited language conventions. Further, non-

believers may dismiss a text that assumes a belief in God, for example, as an integral element of the discourse - that is, the content may be dismissed because of the packaging.

Symbolic systems do not have an objective existence separate from the meaning assigned to them by human beings. This is obviously true of language, of course. The word “fish” has a particular meaning in English, but has no meaning at all in other languages that use the same alphabet – French and Italian, for example. However, this is also true of mathematics or any other symbolic system. Take the simple equation:

$$3+4=7$$

This is instantly recognisable to almost everyone who has attended a primary school anywhere in the world. However, the following form of the equation is also accurate if a base of 5 is used:

$$3+4=12$$

And this if the base is 6:

$$3+4=11$$

It simply depends on the conventions we have agreed on or adopted, including those governing the use of the symbols + and =. Similarly, the number symbols, like words, do not have an existence separate from the meaning assigned to them by human beings. For example, in the base ten equation, $3+4=7$, we may ask, three what plus four what equals seven what? The equation has no objective meaning unless we ascribe properties to the number symbols. Thus, we might say three apples plus four apples equals seven apples. This convention is useful indeed for measurement, commerce, trade, scientific formulae and so on, but it is an idealised and convenient symbolic representation of a process of grouping and measurement that has no parallel in the real world. No apple is ever identical to another, for

example, and seven apples grouped together still remain seven separate apples. Thus, one plus one never exactly equals two except in the idealised form $1+1=2$ ⁵³.

All mathematics therefore is an idealised form of symbolic notation. Measurements in equal and exact increments, no matter how small or large those increments may be, assume a quality that the phenomena of our universe do not possess. No object, whether created by humans or occurring in nature, is perfectly smooth or perfectly straight or perfectly curved. The mass of two objects is never exactly equal and the density of solids, gases and liquids is never evenly distributed. Mathematical notation allows us to average out inconsistencies and thus ignore minor – and sometimes major - variations.

For this reason, mathematics is the ideal tool for pursuing classical processes of scientific inquiry, as Isaac Newton fully realised. A paradigm that insists on an idealised and perfect universe requires a tool that ignores the deviations from the perfect curve or the consistent set of measurements. In this imaginary and perfected vision of existence one plus one has to equal two, not very nearly two.

Green and Newth (2001) have highlighted a further problem with this idealistic modelling process.

Traditional science has implicit biases that tend to promote a reductionist approach to problems. One of these biases is the restriction of the term “measurement” to numerical data. This forces scientists, before they even begin to analyze phenomena, to look for ways to reduce a situation to numerical variables that can be measured. But complex structures cannot be captured as numbers, nor can many important properties and behaviours. (p. 8).

That is, the very symbolic tools that are used to explore natural phenomena represent in themselves an implicit assumption about the nature of those phenomena that may be entirely inappropriate.

When social scientists use the symbolic tools of language to describe their work similar problems are encountered. Words may have dictionary definitions, but that

⁵³ Nor is one kilogram ever a fixed weight. The platinum-iridium kilogram reference weight kept in France is mysteriously getting lighter. Currently, there are several projects underway to try and create a more stable reference weight.

does not mean that each human being has exactly the same conception of their use or meaning. Furthermore, words grouped together are intended to reflect conceptual frameworks that others may not understand or may simply misunderstand. In other words the message may be totally misread by the receiver. Even more importantly, words are rarely value neutral. Words are powerful affective catalysts that can evince an emotional reaction from the receiver. Even individual words can lead to significant reactions in the individual – words such as torture, sex, war, abortion and love for example. When words are combined, the effect can be profound, as in the political treatises of Karl Marx, Adolf Hitler, Mahatma Ghandi and Martin Luther King Junior, the novels of Dostoevsky and Joseph Conrad, the plays of Shakespeare and Ibsen, and the poetry of T.S. Eliot and Melarmé. Words can engender many subtle variations of affective meaning and emotional response in each individual and the messages the words might convey are therefore always open to variations in interpretation.

The significance of this observation for a consideration of the processes of scientific inquiry is that a discipline that relies almost entirely on the printed word for both the research and the presentation of that research may be criticised, for entirely cultural reasons, by those who utilise other conventions, as Benz and Shapiro (1998) have noted. For example, disciplines that embed mathematical conventions in these processes are often held to be more objective and rigorous. As I have detailed above, that is not necessarily the case. However, words have never been granted the mystique of representing a perfect and idealised universe. On the contrary, language is seen as imprecise, shifting and interpretive. Newton did not consider words to be the “language” of God, but mathematics. Words have had a bad press.

Many social scientists and all postmodern commentators use nothing but the medium of language to do their research, present their theories and defend their positions. It is little wonder that they are often criticised so heavily by those who have been enculturated into the classical tradition⁵⁴. However, as detailed above, it needs to be firmly established that this latter tradition also utilises a culturally

⁵⁴ And indeed with some justification. Kokol and Podgorelec’s (2000) research into long range power law correlations in human writings is informative here. “Language development and the meaning of human writings generated by that language are both parts of the ‘closed loop’ related through the common phenomena called complexity. Complexity, entropy and information are related - information reduces entropy and enlarges complexity.” (p. 1) Human writings are complex phenomena that are irreducible by linear methodologies.

defined symbolic medium that further imposes an idealised conceptual framework on all research and theory that utilises it. Numbers are no more real life, extrinsic phenomena than words are. Both, on the other hand, are wonderful tools for entering into processes of discourse with one another – to share and reflect on our discoveries and insights.

As in so much else in this debate over the existing forms of scientific discourse and inquiry, the choice of the tool or tools to use can be defined by the subject and context rather than an insupportable idealistic conception of the nature of the universe or our place within it. Thus, the use of mathematical notation would be both necessary and appropriate in the fields of physics and astronomy, for example, where measurement and the predictive power of theoretical frameworks are highly valued. Explorations of meaning, however, or feelings are beyond mathematics. The only medium we have that can even begin these tasks is language. Here multiple interpretations are a strength rather than a shortcoming, and “truth” is considered both subjective and contextual. The concern is more with exploring a multitude of possible answers rather than the one definitive answer – the theories of everything rather than the theory of everything⁵⁵. Indeed, it is highly likely that variations on these discussions will continue as long as we are recognisably human for they define the very nature of the human condition. We can certainly measure the distance to the nearest star, but we can only use language to reflect on what we feel about it.

I have spent some time in this Chapter detailing the problematic nature of the physical and intellectual tools that are available to us in the prosecution of the processes of scientific inquiry. The reason for that is, as I have emphasised, that an insight into these systems is essential for an informed view of both the efficacy of the competing paradigms and the consequences for methodology. It is clear that the relationship we have as a species with the universe that we are a part of is not, and never has been, straightforward. We are finite beings with finite tools and abilities and it has to be within and against these contexts that our processes of inquiry must be assessed. The emergence of the postmodern paradigm has directly highlighted these issues and is changing the ways many scientists are approaching and pursuing

⁵⁵ An approach also supported by John Dupré (2002): “Just as simplicity or simplisticity is naturally connected with unity, so complexity cries out for plurality. The only route to a deeper understanding of ourselves is through radical epistemological pluralism.” (p. 290)

their work. Furthermore, the existence of more than one paradigm explicitly presents us with competing perspectives against which our own work and the work of others may be reviewed. The next Chapter explores four classic examples of monoparadigmatic approaches to scientific inquiry analysed through the multi-dimensional lens that these competing paradigms have created for us. Notably, adjusting the assumptions that underpin each example changes utterly the hypotheses, the potential methodologies and the possible conclusions.

A Religious Story

A philosopher made a pact with the devil. “I want to be the greatest philosopher in the world. Can you show me the secret of the universe?”

The devil nodded. “Well, I can indeed. However, if I do you must give me your soul. Are you willing to do this?”

The philosopher thought it through for a few minutes. A soul didn't seem much use and, anyway, he really didn't believe in the existence of one. And he did want to be the greatest philosopher in the world. Finally, he agreed.

The devil reached forward and tapped the philosopher's forehead. “You now have the ability to perceive all the properties of all the material in the universe. Watch this.” The philosopher saw the devil form a perfectly smooth, perfectly circular disc of metal of even density. With his new abilities, the philosopher knew this was so. The devil then balanced the disc, like a coin on its edge, on a perfectly smooth, flat surface of even density in a consistent gravitational field and then isolated the whole experiment from all external influences. The disc stood there unmoving and, as the philosopher was aware, would stand there for all eternity unless it was disturbed. Moving back a little way, the devil whacked the flat surface with enough force to dislodge the disc. With interest, the philosopher observed the disc fall to the left. With infinite care the devil then replaced the disc in exactly the same spot. With infinite precision, the devil moved back exactly the same distance in exactly the same direction, and with his abilities to perceive the properties of all he saw before him the philosopher knew that this was so. The devil now hit the surface with precisely the same force in precisely the same manner as before. Looking up, the philosopher saw the disc fall to the right.

The devil nodded. “There we go. Your soul please.”

CHAPTER SIX

THE POWER OF PARADIGMS

The Peppered Moth Affair

Biston betularia, or the peppered moth, was the subject of a series of classic experiments by English biologist Bernard Kettlewell (1955, 1956) that seemed at the time to confirm the processes of natural selection detailed by Charles Darwin in *The Origin of the Species* (1859). The peppered moth exists in various shades of grey from a near white to a near black, with individuals normally exhibiting lighter shades interspersed with a speckling of darker scales. It had been noted by Tutt (1896) that darker, or melanic, varieties were replacing lighter ones near heavily industrialised areas. He hypothesised that the lighter varieties were more easily located and predated upon by birds when the moths rested on the dark trunks of trees exposed when industrial pollution killed the lighter coloured lichen that had covered them. It was assumed that natural selection then resulted in a progressive darkening of the population.

Kettlewell's experiments were designed to test Tutt's hypothesis. He first established that the moths were predated upon by birds. He then, through a process of releasing and recapturing moths in polluted and non-polluted woodlands, established that melanic individuals were twice as likely to survive in polluted environments, with the opposite being the case for lighter individuals. He therefore concluded that the theory of evolutionary change, and particularly natural selection, was supported.

Kettlewell's work was widely lauded by biologists and geneticists (Wells, 1999) and his experiments on the peppered moth became, and still are, essential study for biology students as a classic example of natural selection in operation.

However, Kettlewell made two crucial and unfounded assumptions when framing his hypothesis and the research to explore that hypothesis. First, he assumed that evolutionary change was driven by simple cause and effect relationships – in other words, that a simplistic model for natural selection could be observed in nature – and secondly, and most importantly, he also assumed that an empirical research methodology could accurately and effectively be utilised to explore and describe that

process. Kettlewell then went on to complete the paradigmatic circle – he found what he expected to find.

Subsequent research has thrown significant doubt on both Kettlewell's methodologies and his conclusions.

The geographic distribution of melanic peppered moths did not fit the theory: the frequency of melanics was not as high as it should have been in some places, and higher than it should have been in others. Furthermore, melanism is not correlated with lichen cover; in the U.K., it declined before lichens returned to the trees, while in the U.S., it occurred despite the presence of lichens and declined without any perceptible changes in lichen cover. Finally, peppered moths do not normally rest on tree trunks: instead, they normally rest under horizontal branches high in the canopy, not where Kettlewell and his successors had carried out their experiments on selective predation. (Wells, 1999)

Exactly why peppered moth populations exhibit significant changes in pigmentation between generations is not yet clear. Hypotheses include air born pollutants such as sulphur dioxide, genetic drift and thermal melanism (Wells, 1999). Whatever the underlying causes are, however, it is clear that Kettlewell's conclusions are unsupported. Although his experiments clearly demonstrated evolutionary change between generations, both the choice of methodologies to explore the causes for those changes and the conclusions drawn from the empirical results are founded on unproven assumptions.

The essential point to be made here is that if a classical model for scientific inquiry is adopted, then a linear and simplistic model is the corollary. Indeed, if the classical paradigm is considered the way to do science, then Kettlewell's work is to be admired:

Bernard Kettlewell was a good scientist. Even now, almost half a century after his initial experiments, Kettlewell's scientific papers make exciting reading. (Wells, 1999)

Kettlewell conducted his research in an era when the classical paradigm for research methodology was relatively unchallenged. He was simply following the almost universally accepted and expected processes for exploring phenomena. The challenges to this hegemony from the complexity sciences⁵⁶ and postmodernism were yet to come. Nevertheless, it was the beliefs, the assumptions, that Kettlewell carried into his research that informed the hypothesis, structured the research and presupposed the analysis of the results. Kettlewell therefore found what he was looking for – what he believed he would find. As noted previously, however, a belief is an artefact and believing in something at the best only demonstrates the existence of a belief. Beliefs cannot be automatically translated into facts, or truths, about the objective universe external to our minds. Kettlewell got it wrong in this instance not because he was a poor scientist, but because he was enculturated into the norms and mores of his community. He - together with myself and all those who adopted the classical paradigm for research - was misled by a subconscious assumption about the nature of phenomena and how those phenomena might be explored.

However, if phenomena are considered complex both in themselves and in the ways they interact with other phenomena then such an approach must now, with hindsight, be considered poor science. As I have demonstrated, very few, if any, phenomena obey linear laws at anything but the macro level. Dynamic systems, including living systems, do not obey linear laws and simple cause and effect models are therefore misleading and inappropriate.

To date, however, no studies of *Biston betularia* have approached the issue of melanism from the perspectives of complexity theory. The adoption of this opposing paradigm would presuppose that melanism is a complex and emergent process that is driven by a number of interacting parameters. Further, any exploration of those interactions would consider them non-linear and therefore probably irreducible by linear methodologies. Other methodologies would be adopted, including computer modelling utilising non-linear equations. In other words, the tools exist and are

⁵⁶ Although Warren Weaver (1948) had already heralded its birth: “Science must, over the next 50 years, learn to deal with these problems of organized complexity.”

widely used that could move this fascinating debate onwards. All that remains is a change in the presuppositions governing the theory and research.

Wells (1999) has neatly summed up the issue raised by the debate over Kettlewell's work:

The classical story, elegant and appealing though it may be, should no longer be presented as a textbook example of evolution in action. If the purpose of science education is to teach students how to do good science, then instead of re-telling the classical story textbooks would do better to focus on how science revealed its flaws.

In the context of my argument, one of the greatest 'flaws' revealed by a focus on science is the problem of *paradigmatic blindness*, or the often unconscious beliefs and assumptions each of us carries into our work. Bernard Kettlewell had little choice but to do so in his research – at the time there was only one major paradigm in existence that could inform and guide his work. However, the same excuse could not be accepted today. The same series of experiments repeated now with the same hypotheses and methodologies would be highly questionable. Furthermore, the conclusions should certainly be very different as well. Kettlewell's research projects were classics of their time and indeed I studied and appreciated them as well. The point here is not a criticism of Kettlewell, but rather that changes in the assumptions applied to any outcome of the processes of scientific inquiry can change completely the value that may be placed on that outcome and the methodologies utilised which led to that outcome. In Wells' terms, this work may now be considered an example of a flaw in the way science is conducted rather than an example of best practice. Importantly, the paradigmatic tools now exist to ensure that this particular flaw is avoided in the future – but only, of course, if those tools are utilised.

The second example discussed in this thesis concerns the insistence of many commentators to assume a hierarchical conception of human development and behaviour. Notably, the beliefs that drive this set of assumptions have not been tested by research, from a classical perspective or otherwise, and yet have been the accepted orthodoxy for over a century. Also, the influence of one of Aristotle's

assumptions about the nature of the natural world clearly underpins the models discussed, even after two and a half millennia.

Hierarchies of Needs

Be not constrained to do good.

The Prince, Machiavelli.

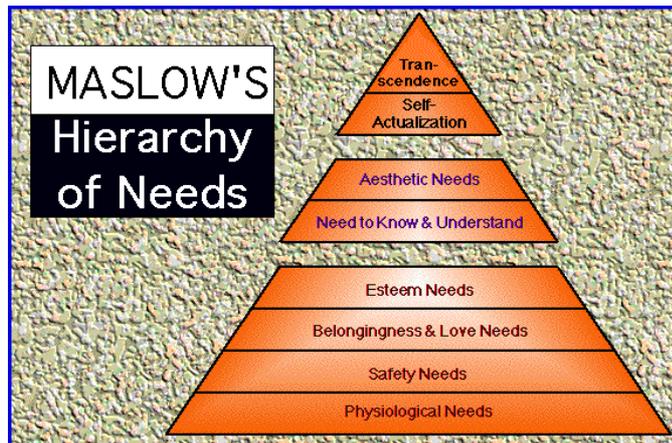


Figure 21: Maslow's Hierarchy (reproduced from *Maslow's Hierarchy of Needs*, William G. Huitt, 2002).

Abraham Maslow (1954, 1971 and 1998 with Lowery) has proposed a hierarchy of human needs reproduced graphically above. It is presented by Maslow as a pyramid to represent his contention that the base needs have to be met before the next level can be addressed. Thus, the needs for sustenance would, generally, precede and preclude the needs for shelter and both would have to be met before the need for belongingness and love could be addressed, and so on up to self-actualisation and transcendence.

Maslow's conception of human needs is therefore, fundamentally, an optimistic one – it presupposes that human beings inherit the propensity for psychological growth and health, and that the end product of that growth is a fully autonomous, self-aware and fulfilled individual. Importantly, Maslow's vision has no place for the darker side of the human personality – anger, greed, envy, violence, competitiveness, fundamentalism, racism and so on. Maslow's model therefore constructs an idealistic conception of human beings in which the fulfilling of lower order needs automatically lead to the accessing of higher order metaphysical ones. Similar hierarchical models postulating a movement from lower order to higher order

needs were produced by William James (1892), Clayton Alderfer (1972) and Eugene Mathes (1981).

However, an adjustment to the primary assumptions imbedded in this framework has a profound effect on the model. For example, a complex, pluralistic model for the emergence of personality and behaviour suggests that hierarchical systems such as Maslow's are just one version of a more complex and less idealistically driven process. Rather, in a sufficiently large population it may be, for example, that virtually every variation of human personality characteristics and patterns of behaviour will be exhibited. Thus, in a pluralistic society the number of individuals who achieve the fulfilment of loving relationships, high self-esteem and transcendent self-knowledge will be relatively low⁵⁷. Further, the meeting of lower order needs such as for food and shelter will not automatically ensure access to any of the other need levels postulated by Maslow, James, Alderfer or Mathes. On the contrary, this opposing model presupposes that some individuals will use the freedom from want that meeting lower order needs presents to engage in self-destructive behaviours, or relationships characterised by manipulation, dominance and power, or crime, or violence towards others in response to less socially acceptable needs than those identified, for example, by Maslow. Freedom from basic wants may give time and space to explore other needs, but the resultant activities may only occasionally enhance belonging and loving, esteem or self-actualisation.

Utilising this less optimistic assumption about human development and behaviour it is therefore possible to construct a very different model of human needs. For example, discarding the assumption that spiritual transcendence and self-actualisation are the primary, or ultimate, goals of human beings immediately removes the justification for a hierarchical structure. Similarly, the inclusion of human needs for what may be defined as anti-social or even self-destructive behaviours rewrites the categories that Maslow and others have constructed. Furthermore, the models put forward by Maslow, James, Alderfer and Mathes are primarily concerned with *universal* human needs – that is needs that all human beings will experience or display progressively as each order of lower needs is met. Again, a pluralistic model discards this assumption in favour of the assertion that

⁵⁷ Maslow came to the same conclusion but for entirely different reasons. He felt that few people achieved their psychological *potential* but would access higher level needs, as he defined them, in propitious circumstances or environments. The Needs Passigram model presented here assumes that few individuals would do so even in the best of circumstances.

different human beings experience differing needs and therefore supports the conclusion that most are non-universal. As Huitt (2002) has noted, only one element of the various ‘universal’ needs put forward by commentators is common to all of them, and that is bonding and relatedness. Huitt also notes Franken’s (2001) comment that “...suggests this lack of accord may be a result of differing philosophies of researchers rather than differences among human beings.” (p. 3).

A detailed consideration of this alternative model has some potentially profound implications for the study of human personality. I have also built my assertion concerning the importance of belief formation into this model.

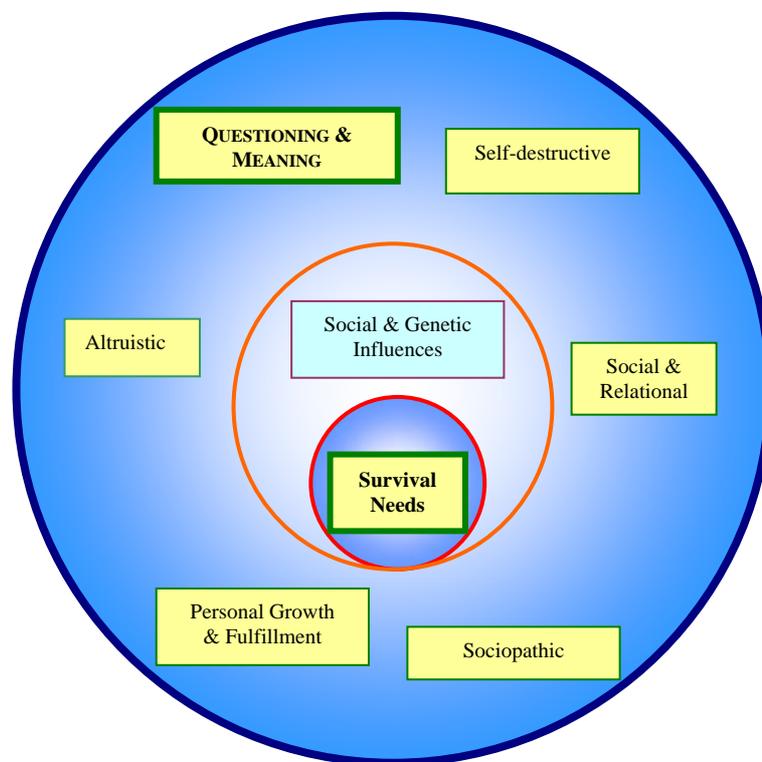


Figure 22: The Needs Passigram.

The Needs Passigram, from the Latin *passim* meaning everywhere or throughout, is flat and circular to indicate that that there is no ascension from one state to another or a hierarchy of needs intended. Survival needs are placed close to the centre because the individual, by definition, could not survive without these being met on a continual basis. Also, survival needs are primarily physiological in

nature, and all others primarily emotional or intellectual⁵⁸, and that is reflected in the separation of the two orders of needs in the Passimagram. Survival needs would include needs for sustenance, shelter and safety. If survival needs are met sufficiently for the individual to function, the emergent and evolving personality traits, motivations, attitudes and behaviours will be mediated by a complex interaction between genetic and social/environmental influences and this process will define the needs expressed. Unlike Maslow's model, the resultant needs can take six general and, with one important exception, equally significant general forms:

Sociopathic

The need to express non-empathetic, anti-social, manipulative or perhaps destructive behaviour towards others. Most theories of human personality (and particularly those of Maslow and fellow American psychologist Carl Rogers, 1959) suggest that the need to indulge in sociopathic behaviour arises out of a failure of socialisation, or organic damage or is a genetically inherited condition. That is, there is something *wrong* with the individuals concerned. While this is an interesting point of view in that it raises questions about what may be considered optimal psychological health, it is equally likely that these characteristics represent variations in human personalities in any given population. In other words, they are 'naturally occurring' to the extent that many individuals who exhibit the characteristics could not be classified as ill or damaged. Indeed, those individuals who may be considered clinically sociopathic would constitute only a small subset of people who experience this needs grouping. Similarly, this classification system does not assume human nature to be inherently selfish or driven by asocial desires, as - notably - did Thomas Hobbes (1640, 1660), English philosopher and contemporary of Rene Descartes, and later Sigmund Freud (1900). Rather, individual human beings are perceived to be variable, 'naturally' experiencing a range of needs and desires that may be considered 'good' or 'evil' depending on personal points of view as well as the mores of the society⁵⁹. As discussed later, this classification system assumes that most human beings experience to a lesser or greater extent needs that may be grouped under all headings.

⁵⁸ With the possible exception of the sub-group of sexual needs. However, the expression of those needs is effectively mediated through emotional and/or intellectual processes.

⁵⁹ A restatement of Bertrand Russell's (1961) doctrine of the subjectivity of values.

Personal Growth and fulfilment

Parallels Maslow's *self-actualisation*. The individual experiences a need to experience fulfilment, self-knowledge or a higher self-esteem. This dimension also includes needs for possessions and entertainment as well as artistic, musical and aesthetic needs, both passive and active.

Self-destructive

The need for addictive behaviour, destructive relationships, self-harm. This is a dimension of human beings extensively explored as a group of activities or behaviours, but not as a group of needs as proposed here. It is afforded a separate category in this model to reflect the assertion that the needs that may be grouped within it are both extensive and common.

Altruistic

The need for selflessness and to work towards others' welfare. Again, this dimension is included as a separate category to reflect the widespread occurrence of needs to help others within human communities.

Social and Relational

The need to be involved in friendships, social groups and sexual relationships. Similar to Maslow's *belonginess and love*, but does not assume the category to reflect a universal human need.

Questioning and Meaning Attribution

Similar, but not equivalent, to Maslow's *need to know and understand*. The individual needs to form opinions and beliefs about phenomena, but those opinions and beliefs are subjective and personal, not necessarily representative of a universal or external reality.

These needs, and the behaviours that may be expressed to fulfil them, are neither mutually exclusive nor hierarchical. Under this model, almost all individuals will experience all six dimensions of needs to a greater or lesser extent concurrently. Also, the relative strength of each need will vary over time. As this is a dynamic model, the categories of needs are mutually influential as well. For example, the expression of sexual needs in one individual may also meet either self-destructive or

personal growth needs, or indeed neither or both, depending on the relative complexity of the links between needs in that individual. The patterns and interactions of the needs experienced will be unique to each person.

Importantly, this model thus supports the conception of human personality as complex, dynamic and even contradictory. One individual, for example, may experience indifference to the suffering of a neighbour, have a high self-esteem, reflect on the meaning of his or her life, be involved in a destructive relationship and offer help to a stranger with no expectation of reward all on the same day. Similarly, it is entirely possible to need a loving and fulfilling relationship and at the same time experience a need to relate to an inappropriate sexual partner - or commit larceny and use some of the money to help others, both in response to apparently contradictory individual needs.

While most people will experience an admix of these groups of needs varying around an undefined middle ground, some individuals will be excessively driven by a single dimension. Thus, highly *altruistic* people may feel a need to devote their lives to working with and for others. Individuals who are highly *sociopathic* may need to predate on others in various ways. Other individuals may experience a need to devote their energies to the goals of *personal growth* through self-help groups, study and so on. Some people will experience a need to apply themselves to such pervasively *self-destructive* behaviours that their lives are threatened or ended. Others will devote themselves to needs for *social* or family relationships to the exclusion of other activities. Finally, some individuals will experience a need to pursue issues of *meaning* so extensively that it becomes a way of life – as theologians, scientists or philosophers, for example.

Similarly, some individuals may experience an absence of one or more of these dimensions of needs. Some people may not feel the need to help others, or manipulate others, or to pursue personal growth, destructive behaviours or any sort of relationship - at the least at some stages in their lives and, in some cases, perhaps permanently.

Thus, as emphasised previously, the relative importance of a need will vary within an individual's lifetime. What may have been extremely important in one phase of a person's life may cease to be important at all in other. An example here is the person who expresses the need for a passionate adherence to a religious creed at one stage but becomes an atheist in a later time, or *visa versa*.

In this model there are only two dimensions of needs that the individual cannot avoid addressing and that therefore may be considered *universal* human needs. The first is survival needs - if he or she is to continue living, that is - and the second is the need to attribute meaning to phenomena. Unless the individual suffers severe neurological damage or is profoundly intellectually retarded, the forming of beliefs or explanations remains an over-riding human need. The relative importance of these two dimensions is indicated in the Needs Passigram by the heavier text-box borders. Further, the beliefs that arise out of the universal need to assign meaning to phenomena can, under exceptional circumstances, subsume all other needs. For example, survival needs can be set aside in response to many different beliefs that result in actions that threaten personal existence. These include a high value assigned to human life that results in risking one's own life to save another's, or a powerful political belief that risks torture or death or an overpowering nihilistic belief that results in suicide. Similarly, needs for self-destructive behaviours may be subsumed, for example, by a strong belief that such behaviours are sinful and are therefore proscribed, and so on. Essentially, whatever needs an individual experiences as a result of physiological requirements or the interaction of genetic and social/environmental influences may be enhanced, negated or ameliorated by the need to evolve a belief system. The relative dominance of this dimension of human needs is emphasised in the Needs Passigram by the use of a bold font.

This is not to suggest that this process is necessarily straightforward or easy for the individual. On the contrary, a struggle between belief systems that arises out of the need to assign meaning and the expression of other sets of needs is held to be a defining characteristic of most individual psychology. Thus, an individual's need for multiple sexual relationships may contravene a belief in the sanctity of marriage, or a shoplifter's need for possessions violate a belief that such actions are immoral. On a more mundane level, the need to lie to save face, avoid embarrassment or to avoid offending an acquaintance may contravene a belief that lying is wrong. Importantly, there would be no internal contradiction in experiencing or expressing any need whatsoever, no matter how destructive or manipulative, unless the individual *believed* there was a problem, moral or otherwise. Thus, for example, a sexual predator may feel quite comfortable with his or her needs if there is no concurrent personal ethical belief system that would reflect on either the desires or the resultant actions. This tension, and/or lack of tension, between needs and beliefs also offers

an explanation for why the acting out of an individual's specific need can be constrained in one situation but not another. A person who experiences a need to inflict physical harm on others, for example, may only act out in situations he or she believes are socially sanctioned, such as contact sports and war.

Although very good arguments may be mounted to support the premise that the fulfilling of some needs is *better* for the individual and/or society than others, the Needs Passigram intentionally avoids embodying value-judgements of this kind. On the one hand, what is destructive for one person may be fulfilling for another. Secondly, what may be considered *good* for people and the societies they live within is a matter of opinion, or belief, and may have little to do with the needs individuals experience or the behaviours they exhibit. Thirdly, and crucially, the Needs Passigram is not an attempt to state what needs *should* be addressed by *healthy* individuals – however that may be defined - but to reflect the plurality of the needs of human individuals in human societies.

Human needs as envisaged in this model, therefore, are malleable, variable and possibly transient. Further, the categories proposed are simply convenient labels based on general conceptual divisions. Certainly, under this classification system a need may only be considered altruistic or sociopathic, for example, if it is defined as such in the context of the mores of the society in which it is expressed. Thus, this model does not necessarily assume that there are universal metaphysical principles against which either the categories or what may be listed under those categories may be referred. Rather, it assumes that human language and the concepts embedded in that language are subjective human creations.

Some human beliefs have demonstrated both resilience and longevity. These have included beliefs in a God or gods, in an afterlife and in the existence of an immortal soul. A belief in hierarchies is another. The *scala naturae*, or *Great Chain of Being*, was a concept that was first suggested by Aristotle in the first century BCE. It was redeveloped in the Middle Ages (see Figure 23) and its presence can be discerned in the assumptions underpinning the theoretical frameworks constructed by Maslow and the others here. The *Great Chain of Being* conceived of creation as a grand pyramid with God at the top, man next, and so on down through the animals and plants. The medieval version placed the heavenly host, the angels, between man and God. The inherent assumption in this model was that mankind was the epitome of earthly creations – was in fact superior to all other living things. This belief stands in stark

contrast to that of many traditional peoples, such as the Australian Aboriginal and Native American people, who see themselves as part of nature as a whole – as part of a cycle rather than a hierarchy of life. For traditional peoples such as these, other living things are to be honoured and respected. The western tradition, however, has inherited the assumptions embedded in the *Great Chain of Being* and approaches the rest of nature as something to be exploited. As noted earlier in this thesis, Descartes specifically stated this in his *Meditations*. Indeed this world-view can be said to have largely driven our science and technology from that time in the seventeenth century until the end of the last century when many postmodernist writers began to challenge both its morality and its logic. The concept of hierarchical superiority, however, is pervasive and the exploitation of our natural resources shows little sign of slowing down. Similar comments may also be made of our social artefacts. We talk of gaining success, climbing the ladder, becoming, developing, growing. Conversely, we also refer to tripping up, falling, sliding down the slippery slope, and so on. The concept that each of us has somewhere to climb up to and/or fall down from, both socially and personally, is an inevitable consequence of the adoption, consciously or otherwise, of a belief in hierarchies.

Similarly, a conception of the human personality as a series of distinct levels ascending from the lowest to the most valued betrays the same assumptions. Indeed, Maslow's highest level is overtly metaphysical, or even spiritual. In essence, a transcendental state, or heaven on earth, that human beings may strive for. The hierarchies of needs may therefore be seen as a combination of Platonic idealism with Aristotelean reductionism. The conventional presuppositions of the classical paradigm are evident in every aspect of their conception and articulation.

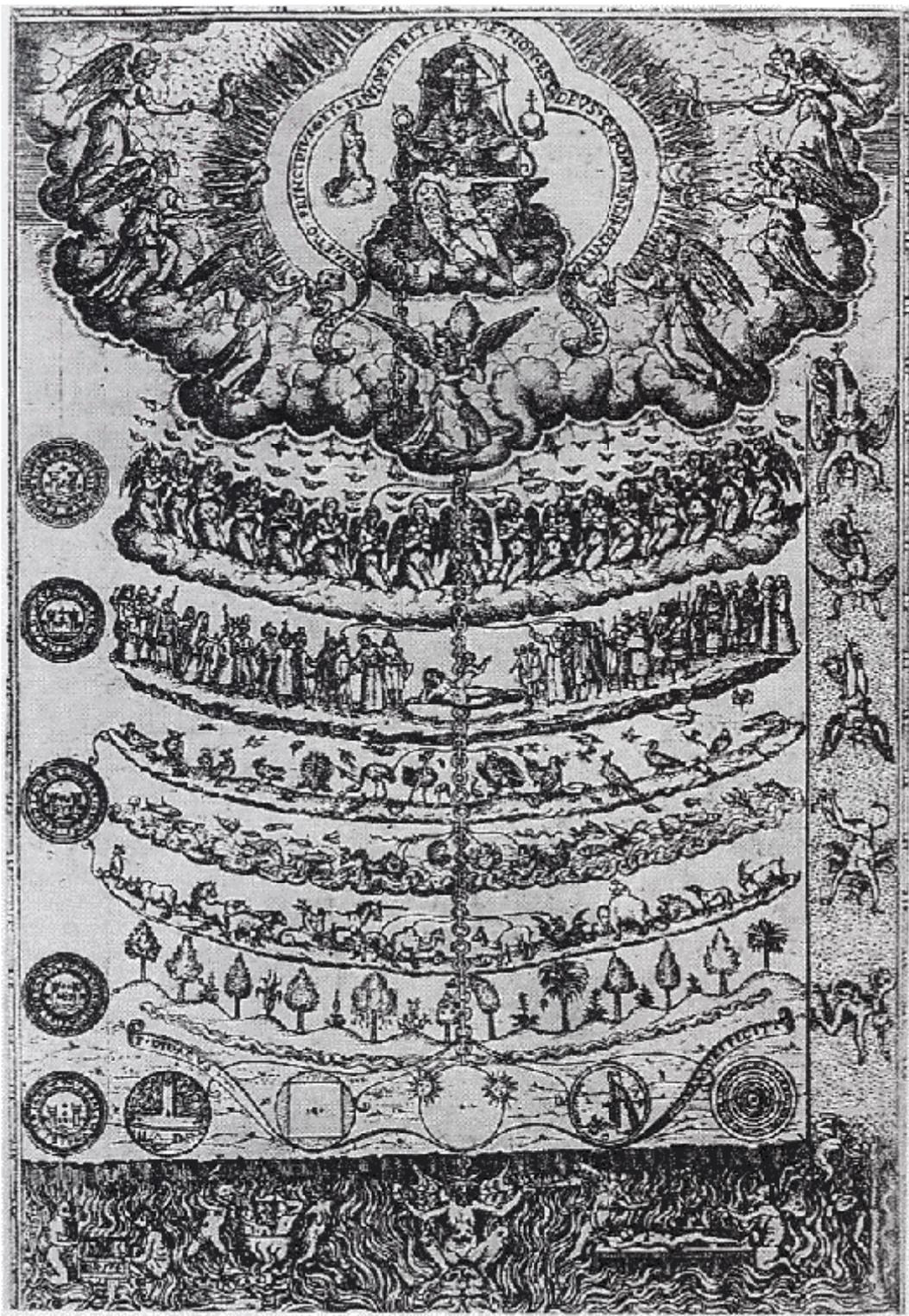
Within the context of this thesis, then, the hierarchies of needs are a prime example of the unstated beliefs or assumptions of the protagonists driving every aspect of the theoretical frameworks and the resultant models. Importantly, change the beliefs, the base assumptions, underpinning the models and they are inevitably and fundamentally altered in both content and structure. Furthermore, there is a significant paradigmatic difference hidden in the approach to the two types of models. On the one hand, the hierarchies presuppose a compartmentalised conception of human needs with one category of needs leading to another – indeed a 'chain' of categories. As noted, this is an embodiment of the classical paradigm for scientific theory and research. The Passigram, on the other hand, presupposes a

complex interaction between elements with no category necessarily either being immutable or dominant. Again, this opposing paradigm has arisen out of the complexity sciences.

Figure 23: Scala Naturae

Reproduced from *Gender, Sex, & Subordination*, Anthony Fletcher

<http://stanford.edu/class/engl174b/chain.html>



At this point, it is an essential observation to note that the paradigm that underpins a particular example of scientific theory or research may remain unacknowledged, as is almost universally the case, or it may be articulated. If the former is the case, it is an act of faith to accept another's beliefs or assumptions without identification and critical analysis. Thus, an at-face acceptance of any piece of scientific theory or research without an assessment of the underpinning paradigmatic assumptions lacks, and always has lacked, one of the fundamental pillars of modern scientific practice – critical analysis. If the paradigm is acknowledged, however, that process of critical analysis may at the very least be applied to the prejudices and beliefs of the protagonists as well as to any methodology or content. As paradigms are immensely influential in any scientific endeavour, as detailed here, it is argued in this thesis that a statement of paradigmatic intent could be viewed as a requirement rather than an option.

The third example included in this thesis concerns the myths and assumptions that have been attached to the concept of human evolution. Again, the assumptions that have driven the theory and research on this topic are not new and indeed have been the accepted orthodoxy for the last two centuries. For the purposes of this thesis I have focussed particularly on the evolution of human language.

Evolution and Language

In the beginning was the Word. St. John 1:1.

As has been noted, modern human beings, *Homo sapiens sapiens*, evolved approximately one hundred and twenty thousand years ago, most probably in Africa. There is strong evidence for a narrow range of common ancestors for we are more genetically homogeneous than almost any other species on the planet (Rogers and Jorde, 1995; Owens and King, 1999; Rosenberg et al, 2002). It is likely, therefore, that every individual human being traces his and her ancestry back to a small population pool, possibly numbered only in the thousands (Rogers and Jorde, 1995; Venter, 2000; Klein, 2003). Our differences are indeed skin deep.

Every human culture exhibits the same behaviours: the formation of family and social groups, cooperative behaviour, the manufacture of tools, food preparation, the sanctioning of behaviour, the creation of music and art and, perhaps most importantly of all, the use of language.

The complexity and utility of our languages mark us out from the other intelligent creatures on this planet. As previously noted, some of these creatures have larger brains than we do and many have developed forms of communication of one kind or another, but human beings have evolved a language system that is unique in its ability to express meaning, emotion and knowledge.

When language developed is uncertain. There is no direct evidence that the human brain has changed significantly in the last one hundred and twenty thousand years and it may be that language was there at the origin of our species – that our immediate progenitors were already using vocalised and symbolic forms of communication before our genesis in Africa. As noted, there is evidence of an exponential increase in the temporal volatility, differential spatial distribution, and spatial relocation of artefacts about fifty thousand years ago (Klein, 2003) that some commentators have ascribed to the emergence of language (Potts, 2001). Whenever language was developed by our ancestors, though, it has certainly been with us for at least tens of thousands of years and probably predated both the formation of settlements and the cultivation of foodstuffs. It is one of our first and greatest creations.

Human languages contain nouns, adjectives and verbs and therefore allow detailed descriptions of all phenomena both within and external to ourselves. The use of tenses allows reflections on the past, statements about the present and dreams about the future. Oral histories and stories have been passed on within cultures for thousands of years, and written language has given us repositories of knowledge and creativity, both printed and electronic, that are effectively infinite.

Language has also allowed us to lie to, manipulate and deceive others. It has allowed us to record our greatest follies, our untested assumptions and our most divisive philosophies. Language is a two-edged sword. This issue will be examined more fully towards the end of this thesis.

Most theories on the origin of language stress the advantages for its development in enhancing cooperation between hunting groups and maintaining the cohesiveness of the tribe or family. Interestingly, research by Robin Dunbar (1996) has demonstrated that two thirds of the content of all conversations is social gossip. Thus, language is assumed to have developed out of social gesticular behaviour as well as vocal utterances similar to those utilised by apes and monkeys today. Eventually, it is assumed, the advantage accruing to those best able to vocalise would

have led to a process of progressive natural selection for those with both the neurological and physical propensities for more and more complex vocalisations. Both vocabulary and grammar is assumed to have emerged through this process.

A more recent development of this Darwinian model suggests that mutations and other genetic changes play a significant part in these processes of evolution (Futuyma, 1998). Alterations to the genotype may occur through interdiction by an outside force – impact by a cosmic ray, for example, or exposure to naturally occurring background radiation – or through errors in replication in the division and recombination of DNA sequences. It is postulated that some of these mutations may be advantageous and give certain individuals an evolutionary edge and thus become established in a population through the processes of natural selection. Disadvantageous mutations would die out through the same mechanism. Those mutations that are neutral in effect may survive as characteristics in some members of a population, but do not become dominant. Examples of the latter might include excessive height or an ability to curl the tongue.

A further mechanism that is often linked to theories of mutation is genetic drift. Isolated populations within a species will experience a gradual divergence from the parent stock until speciation occurs. In some cases that speciation may not include an inability to have offspring with the parent stock, but an absence of mating that would lead to procreation. An example of the latter would be lions and tigers who can produce inter species offspring but normally do not mate.

Also, gene migration is a mechanism by which different species exchange genetic information that may result in speciation. This is common between bacteria, but also happens between some plants and animals. Hybridisation is a form of gene migration.

The emergence of human languages may therefore be characterised as a process that combined fortuitous mutations and perhaps genetic drift - or even gene migration - with the pan-generational forces of natural selection.

Again, however, developments in complexity theory and research into change in complex systems suggest that there is another possible model for this revolutionary development in human abilities. This model resurrects an issue that has given rise to as much vitriol and condemnation as any other in the history of science and for that reason alone it is of intense interest in any exploration of the power of assumptions or paradigms.

It is possible to propose a model that reverses the order of behaviour and mutation. That is, rather than the mutation allowing more complex behaviours or advanced abilities and consequently being genetically advantaged through a process of natural selection, this model proposes that an individual's experiences may cause genetic change that can be passed on to the offspring. This is a re-statement of the so-called *Lamarck heresy*, proposed by French scientist Jean Lamarck (1809). Lamarck believed that repetitive movements in individuals would result in physical changes in offspring.

The bird which is drawn to the water by its need of finding there the prey on which it lives, separates the digits of its feet in trying to strike the water and move about on the surface. The skin which unites these digits at their base acquires the habit of being stretched by these continually repeated separations of the digits; thus in course of time there are formed large webs which unite the digits of ducks, geese, etc. as we actually find them.

It is interesting to observe the result of habit in the peculiar shape and size of the giraffe; this animal, the largest of the mammals, is known to live in the interior of Africa in places where the soil is nearly always arid and barren, so that it is obliged to browse on the leaves of trees and to make constant efforts to reach them. From this habit long maintained in all its race, it has resulted that the animal's fore-legs have become longer than its hind legs, and that its neck is lengthened to such a degree that the giraffe, without standing up on its hind legs, attains a height of six metres (nearly twenty feet). (1809)

Unlike Darwin, who saw the adaptations such as those exhibited in the giraffe as primarily the result of a process of natural selection that favoured animals that could feed on the higher branches, Lamarck believed that these changes occurred because the giraffe's ancestors physically stretched their necks in an attempt to reach feed. This then led to a series of generations being born with longer necks. In genetic terms, this would presuppose a direct modification in the genome as a result of

individual experience and a violation of the Weissmann⁶⁰ barrier, the current orthodoxy that states that the genome is proscribed from experiential influence.

However, it is important to note here that Darwin did not believe that natural selection was the only mechanism that drove speciation. He did believe that it was the most significant factor, but not exclusively so.

I am fully convinced that species are not immutable; but that those belonging to what are called the same genera are lineal descendants of some other and generally extinct species, in the same manner as the acknowledged varieties of any one species are the descendants of that species. Furthermore, I am convinced that Natural Selection has been the main but not exclusive means of modification. (1859)

Darwin also prophetically stated that “much remains obscure, and will long remain obscure” in relation to the origin of species. Darwin and Alfred Russel Wallace, who developed the concept of natural selection separately at about the same time, proposed their theories in opposition to the purely creationist arguments that preceded them – that the differing species had been created separately and in their observed forms as an act of God. Wallace went on to refute Lamarck’s position.

The giraffe did not acquire its long neck by desiring to reach the foliage of the more lofty shrubs and constantly stretching its neck for the purpose, but because any varieties which occurred among its ancestors with a longer neck than usual at once secured a fresh range of pasture over the same ground as their shorter-necked companions, and on the first scarcity of food were thereby enabled to outlive them. (1858)

Darwin, on the other hand, did not dismiss Lamarckism. He included that mechanism as one of the causes of evolutionary change. The italics are mine:

⁶⁰ Named after the geneticist August Wiessmann.

A great stride in the development of the intellect will have followed, as soon as the half-art and half-instinct of language came into use; *for the continued use of language will have reacted on the brain and produced an inherited effect...*(The Descent of Man, 1882)

And (again, the italics are mine),

It is not improbable that *after long practice virtuous tendencies may be inherited.* (The Descent of Man, 1882)

Indeed, Darwin was not only part Lamarckist but also part creationist for, like many before him, he attributed humankind's higher functions to a Creator.

As Europe moved into a more secular age the non-metaphysical theories gained ascendancy. Similarly, Lamarckism was apparently discredited through Wallace and, later, the early Austrian geneticist August Weissmann. However, the creationists never went away, even though they were muted for nearly a century. Interestingly, the creationist voice has now been raised again in the debate on evolution and to some effect – including the inclusion of creationist studies in some educational jurisdictions in the United States of America.

The reason for the longevity of the creationist position is not necessarily the result of blind faith. Neither is the current ascendancy of the Darwin/Wallace hypothesis necessarily the result of irrefutable scientific investigation. It is the case that neither point of view is fully supported by empirical evidence. Creationist beliefs that each species was created whole and complete as we observe them today is not supported by the geological or the fossil record. However, there has never been an observation made of the emergence of a new species through the mechanism of natural selection either. Indeed, the only examples we have of the observation of the emergence of new species in recorded history indicate spontaneous and not gradual speciation – such as the recently discovered York groundsel in the United Kingdom⁶¹.

⁶¹ Discovered by plant evolutionary biologist Richard Abbott and reported in the Times Online, 20/02/2003 <http://www.timesonline.co.uk/article/0,,2-584528,00.html>

Both sets of hypotheses must therefore be considered statements of belief - and not just the creationist position. Neither, at this stage, can be proved nor disproved through reference to research. We can certainly make best guesses based on studies of the fossil record and on rapid intra-species change – for example with experiments on fruit fly populations and the selective breeding of domestic animals. Neither of these latter processes, however, produces speciation, simply changes in species that already exist, and there is little that is natural in these forced selection practices.

As with all phenomena for which there is no clear genesis, the origin of species and intra-species change is subjected to continual and conflicting theoretical propositions. Indeed, as long as there is a significant area of doubt on speciation, it is unlikely that any one position will gain the final ascendancy. The creationists can argue along with Darwin, and quite correctly, that natural selection cannot be considered the only mechanism for the origin of species. The area of uncertainty, doubt, lack of observed causal connection may therefore be filled by reference to a deity. Similarly, Darwinists and neo-Darwinists may claim the high ground of scientific orthodoxy because their positions can, at present, neither be fully supported nor gainsaid by the processes of scientific inquiry. In this case the black hole of uncertainty may be filled by an adherence to an internally consistent and logical theory that allows a veneer of certainty on what has proved to date to be an irreducibly uncertain phenomenon. Green and Newth (2001) have made a similar point in a recent overview of developments in the complexity sciences.

One of the biggest challenges in biology is to understand the complex relationships between genotype, phenotype, and ecological interactions. Although much is known about form and function, the complex manner in which growth changes to produce phenotypic adaptations and variations is largely unknown. (p. 6)

As emphasised previously, although belief systems may give comfort and some answers to difficult and unsettling questions, it does not necessarily follow that those answers are correct or objectively true. Indeed, if the emergence of the complexity sciences have a central lesson for scientists it is that if an answer is simplistic it is almost certainly incorrect.

The working of the classical paradigm for scientific inquiry is not difficult to uncover in the case of current neo-Darwinian evolutionary theory. The classical model always presupposes linear cause and effect relationships between phenomena – a chain of linked causal relationships stretching from the past, through the present and into the future⁶². The pre-eminence of the theory of natural selection, in its various forms, neatly falls into this category. Gradual and small changes are postulated that, in this case, are held to lead to the establishment of new inherited features, behaviours and/or species. So imbedded has this orthodoxy become that it with creationism are the only theories currently taught in schools and universities. Indeed, the battle between the adherents of each of these theories has been and is bitter and vociferous in both the literature and in the courtrooms.

It is often assumed that Darwin was a gradualist – that he postulated small and gradual changes in species through the processes of natural selection. As noted above, however, although he did describe such a mechanism he was careful to acknowledge other mechanisms in species change as well. Studies of the fossil record suggest that Darwin was quite correct to advise caution on this topic. The number of examples that may be considered links between one species and another are extremely rare. The overwhelming picture is of sudden speciation without any evidence of intermediate forms. The process of evolution appears to be a series of uneven steps interspersed with very little or no intra-species change. The palaeontologist and essayist Stephen Jay Gould (1979) has coined the term *punctuated equilibrium* for this process.

The oldest truth of palaeontology proclaimed that the vast majority of species appear fully formed in the fossil record and do not change substantially during the long period of their later existence (average durations for marine invertebrate species may be as high as 5 to 10 million years). In other words geologically abrupt appearance followed by subsequent stability. (Gould 2002, p. 2)

⁶² A listing of the research into the complex nature of biological and behavioural systems by Henmi and Kalish (1998) is useful here: “Both the biological mechanisms of life, and their behavioral manifestations, have been found in many of their aspects to show the properties of nonlinear dynamics, or deterministic chaos.” (p. 1)

Gould went on to include the concept of allopatric isolation in his theory: that is the concept of the splitting of parent species into small, isolated populations.

Without geographic isolation, favorable variants will not accumulate in local populations, for breeding with parental forms is a remarkably efficient way to blur and dilute any change that might otherwise become substantial enough to constitute a new species. Most peripherally isolated populations never become new species; they die out or rejoin the larger parental mass. But as species may have no other common means of origin, even a tiny fraction of isolated populations provide more than enough “raw material” for the genesis of evolutionary novelty. (Gould 2002, p. 4)

The problem of the absence of intermediate forms in the fossil record is still an issue for Gould’s theory too, of course, for it also presupposes small changes that lead to speciation, albeit in isolated populations. Gould’s answer to this objection was to propose two other parameters: relative geological speed and geographic size.

...most peripherally isolated populations are relatively small and undergo their characteristic changes at a rate that translates into geological time as an instant.....Five to ten thousand years may be an eternity in human time, but such an interval represents an earthly instant in almost any geologic situation.....Moreover, peripheral isolates are small in geographic extent and not located in the larger area where parents are living, dying, and contributing their skeletons to the fossil record. (Gould 2002, p. 4)

Therefore this most recent and thus far most complete re-working of the Darwinian model must also open to challenge because the supporting evidence is, as yet, unavailable. Punctuated equilibrium may well be one of the mechanisms that contribute to speciation but it is almost certainly not the only one.

Genetic changes in a species may be inconsequential in the short term in that no overt evidence for change is noted either in the offspring's abilities or physical make-up. However, if intra-species change is characterised by complex interactions between multiple agents, genetic changes may accumulate in a population to the point where significant modification to behaviour or physical structure occurs apparently rapidly or even spontaneously. To re-state Darwin's hypothesis in relation to the development of language, successive individuals and generations may have experienced the advantages in utilising proto-languages together with other genetic changes and these processes may have led to the rapid evolution of language about fifty thousand years ago. As noted in Chapter 5, the evidence at present may well indicate the emergence of higher functions such as language and imagination across the whole of the widely dispersed human population coincidentally. Such a finding, if it is supported by further evidence, would put into question all current neo-Darwinist theories of evolutionary change.

All complex systems are characterised by sudden changes, not gradual ones, as the systems abruptly leave one state and enter another⁶³. That is, the systems become dominated by new *attractors* or parameters. Thus, if evolution is also a complex system, major changes may occur, or even new species emerge, in a relatively short period of time as a new and dominant mutation or other changes emerge and establish themselves in a population. This model therefore proposes that evolution of any species is characterised by lengthier periods of relative stasis, or non-change, interspersed by sudden and rapid intra-species alteration as an accumulation of genetic and other changes reach a threshold level and produce a sudden and significant modification in physical and/or intellectual function. Importantly, this model does offer an explanation for the emergence of new species. Current neo-Darwinian models postulate the thus far unsupported scenario of an emergence of new species through a process of gradual and small changes – a lengthening nose or changes in colour, and so on. However, this model only presupposes populations with, for example, longer noses or different colourings, but not necessarily new species. The emergence of new species may well require other mechanisms from that of natural selection.

⁶³ This point of change, or crisis, is sometimes also aptly called the “edge of chaos” (Green and Newth, 2001, p.4).

***Relative stasis – small and gradual changes through natural selection**

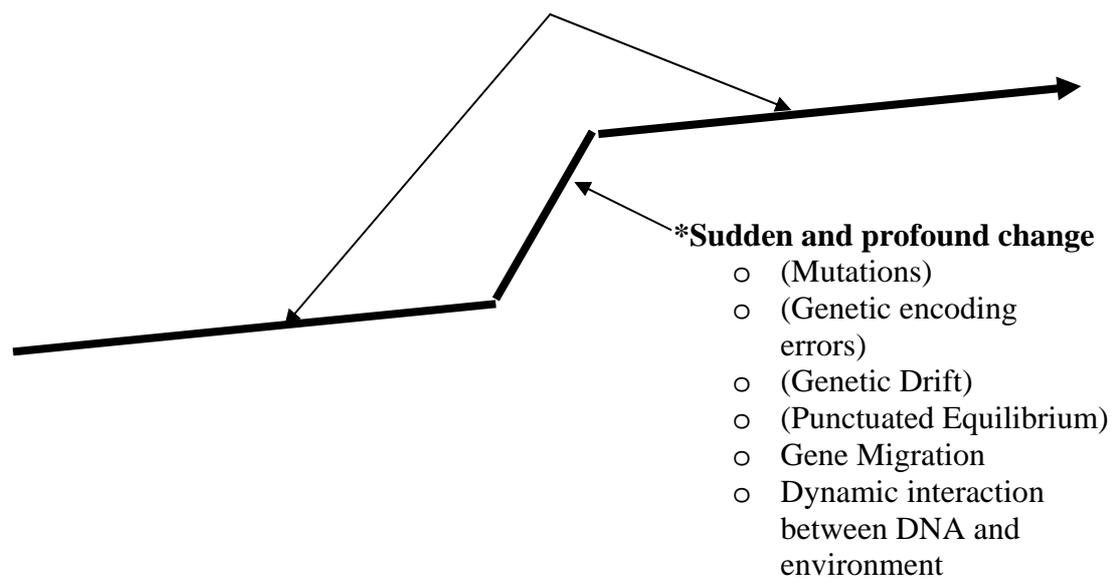


Figure 24: A Dynamic Model For Evolutionary Change

This alternative model, then, suggests that genetic evolution is a complex system driven by a number of interacting parameters or attractors. These parameters may include the processes of natural selection, genetic drift, gene migration, punctuated equilibrium, mutation through external interdiction, mutation through errors in DNA recombination processes and mutation through a dynamic interaction between experiential forces and genotype. Indeed, in relation to the latter it is important to note that all living systems are characterised by dynamic interactions between the environment and the organism. Living systems do not passively wait to be acted upon by their environments, but directly interact with those environments leading to modification and adaptation. It is therefore just as likely that DNA has a dynamic and interactive relationship with its environment as a passive one. The nature of that interactive mechanism may be currently unknown, but the products of it may be apparent in every living system on this planet⁶⁴. Further, both the genetic damage and encoding error models presume genetic change that is entirely random in nature. The chances of producing “good” genetic changes through such mechanisms would

⁶⁴ Dopazo and Perazzo (2002) have recently explored the historical genesis of this concept and put forward possible models to support interactive processes between genotype and environment. Although these models are as yet untested by targeted research and are primarily directed to supporting a neo-Darwinian hypothesis, they do raise important issues in relation to the assumption that individual experience cannot be genetically encoded: “The ability of learning and the later inheritance of acquired behavioral traits may well constitute one of the most effective ways of enhancing natural adaptation.” (p. 5)

be extremely low, if not non-existent. The dynamic model, on the other hand, presumes a responsive causal relationship between environment and genetic change.

Crucially, the first evidences of direct links between individual experience and inheritable changes in the genotype are now becoming available. For example, it has been shown that individual immune system adaptations can be passed on to offspring. That is, the consequent immune system response to an individual's exposure to a pathogen is inherited by the children of that individual. The children do not require exposure to the pathogen to exhibit the response but are born with it (Blanden et al 1998 and Marshall et al 1999). This change in genotype has occurred within one generation and has profound consequences for any consideration of evolutionary change for it raises questions about the extent of the links between individual experience and genetic development. Ted Steele (1998) asserted the following in relation to this discovery:

The evidence we now have in hand is quite unequivocal: etched into the very fabric of our chromosomes are the telltale signs of what we will technically describe as 'soma-to-germline genetic impact events'. The strength and quality of this evidence is now as strong, metaphorically speaking, as our confidence in the origin of craters, the impact sites of cosmic bolides. We thus have clear evidence for what we have termed is 'Lamarck's Signature' written into our genes.

Secondly, gene therapy research by Reaves et al (1999) demonstrated that reduced hypertension in rats induced through a retroviral treatment (that is, the relevant genes were introduced into the rats' cells utilising a specially engineered viral carrier) were inherited by the offspring of those rats. The viral carrier had been injected into the rats' hearts and therefore the presence of the introduced genes in the germ plasm and eventually the offspring, was totally unexpected. This result suggests there may well be mechanisms through which inheritable characteristics emerge within one generation.

Also, recent research by Réale et al (2003) has explored significant advances in breeding times of red squirrels in the South West Yukon, Canada, in response to global warming. The advance of eighteen days in ten years is attributed to phenotypic changes within generations as well as genetic changes among generations. This fascinating finding opens up many possibilities for further research to specifically explore the links between individual experience and genetic change.

Advances in the complexity sciences suggested that links such as these almost certainly did exist and might well be explored through targeted research⁶⁵. It is also highly probable that the dynamic processes that underlie these links will prove to be complex, non-linear and resist prediction.

The potential importance of consciously utilising a variety of paradigms for scientific inquiry is neatly emphasised here. The classical paradigm would presuppose linear causal links between environment and evolutionary change. Thus, a longer neck advantaged the ancestors of the giraffe and through a process of natural selection led in small increments to the animal we see today. The classical paradigm would further presuppose that this mechanism is true for all evolution, both intra-species change and the emergence of new species. This position thus forms a self-justifying loop that assumes both cause and effect without, necessarily, any supporting evidence. Indeed, as has been noted, there is little evidence for the latter assumption in the fossil record. Certainly, species appear to be highly responsive to environmental stimuli and new species seem to emerge relatively suddenly and without the small increments of change dictated by the linear neo-Darwinian model. A model based on the paradigm of emergent complexity, however, presupposes these sudden changes and leads inevitably to a re-assessment of the neo-Darwinian hypotheses.

Nevertheless, whether or not either or neither of these competing sets of theories is supported by further research is not the essential point in the context of this argument. Rather, this analysis underlines that it is primarily in the exploration of differing paradigms that new models emerge. John Dupré (2002) has expressed the importance of this approach as follows:

⁶⁵ Very recent research by Oliver Pergams and Dennis Nyberg (2003) may shed further light on this complex system. It has been demonstrated that mitochondrial DNA mutates more quickly than nuclear genomic sequences and may therefore be one of the mechanisms that allow species to rapidly adapt or change. Nyberg has described the rate of change as “blindingly fast”.

It is considerations such as these that have led the majority of philosophers.....to see evolution not as providing us with some kind of universal law in the style of Newtonian mechanics, but rather as providing a large and open-ended family of models, a tool-kit with which we can hope to get some understanding of the processes involved in particular cases.....The more diverse our tool-kit, the better the chance we have of finding something that may serve the case in hand. (p. 287).

Here, the questions raised, and the possibilities for further research, are significant and pertinent but would not have been identified in an adherence to the classical model. On the other hand, the utilisation of a linear research model may be entirely appropriate to explore the nature of the links between individual experience and genetic change, for example. This demonstrates that paradigm plurality based on contextual and situational analyses is a powerful intellectual tool for establishing parameters for the processes of scientific inquiry. In this context, Stephen Jay Gould, with gentle irony, did indeed identify the problems with utilising only simplistic, classical models for evolutionary change.

There is something immensely beguiling about strict adaptationism the dream of an underpinning simplicity for an enormously complex and various world. If evolution were powered by a single force producing one kind of result, and if life's long and messy history could therefore be explained by extending small and orderly increments of adaptation through the immensity of geological time, then an explanatory simplicity might descend upon evolution's overt richness. (1997, p. 5)

And perhaps much like the impossible game of cricket visualised in Chapter 3, would therefore be predictable and ultimately boring.

The Flight of Archaeoraptor



Figure 25: An Impression of Archaeoraptor.

Reproduced from MISSING LINK BETWEEN DINOSAURS AND BIRDS FOUND IN CHINA
on the Dino Website <http://www.geocities.com/stegob/dinobird.html>

In 1999 a fossil discovery was announced by the National Geographic Magazine in its November edition (Sloan, 1999) that was hailed at the time as one of the most significant in the history of palaeontology. Unearthed in the Liaoning Province of China and bought at an Arizona minerals show in the USA, the fractured pieces of shale seemed to contain the fossil of a missing link between dinosaurs and birds. The fossil exhibited the arms of a primitive bird, and possibly feathers, and the tail of a theropod – a small dinosaur. The fossil was dated at about 125 million years old.

The missing link between the two genres had been sought by palaeontologists since the discovery of the first archaeopteryx fossil in 1860 near Solnhofen in Germany. Archaeopteryx was a primitive bird-like species with feathers that the scientist who named it, Hermann von Meyer, suggested had evolved from a dinosaur. Until archaeoraptor, no evidence of intermediary links between the genres had been discovered.

If this is starting to sound familiar, bear with me, for there is an important observation to be made here in relation to the role that expectations, or the assumptions inherent in a paradigm, play in scientific inquiry.

Within a year, archaeoraptor was shown to be a fake. By an incredible stroke of chance, Chinese palaeontologist Xu Xing obtained what turned out to be the counter slab of part of the archaeoraptor fossil from a farmer and sometime amateur fossil hunter in Liaoning Province. The deposits in the area had been formed in layers that often split apart when removed. Thus a fossil can be split into two complimentary

halves, known as the slab and the counter slab. Xu Xing compared his fossil with pictures of archaeoraptor and realised that the latter must be a composite, for not only were completely different pelvises exhibited on each slab, but also the rear legs bones in the photographs were mirror images of each other – that is, they were yet another slab and counter slab of a single fossil leg arranged in archaeoraptor as if they were separate limbs. His email to the National Geographic's Christopher Sloan was a bombshell. The error was National Geographic's most embarrassing in its 110 year history.

Lewis Simons was commissioned by National Geographic to investigate the error. His (October 2000) report details what he called:

...a tale of misguided secrecy and misplaced confidence, of rampant egos clashing, self-aggrandizement, wishful thinking, naïve assumptions, human error, stubbornness, manipulation, backbiting, lying, corruption, and, most of all, abysmal communication. (p. 1)

He eventually established that archaeoraptor was created by a Chinese farmer from fragments glued together of at least two separate and completely unconnected fossils. Further analyses by Timothy Rowe et al (2003), utilising high-resolution x-ray analysis, has demonstrated how the fake was created, including the use of grouting to hold it together. Archaeoraptor was nothing more than a clever combination of two stone jigsaws.

As it has turned out, neither of the two identifiable fossils that made up the archaeoraptor composite were of species previously known to science. They have now been classified and named as, respectively, a fish-eating bird *Yanornis martini* and a small bipedal meat-eating dinosaur *Microraptor zhaoianus* (Mayell, 2002). However, neither specimen may be considered an intermediary link between dinosaurs and birds.

In relation to the context of this thesis the most important finding to come out of Simon's investigation was that nearly everybody involved, amateurs and expert scientists alike, saw what they expected, or perhaps wanted, to find - a missing link between species presupposed by the neo-Wallace/Darwinian theories of natural selection. After all, if the theories are accurate reflections of a real and measurable

effect in the natural world then such links must exist and finding the relevant fossils may be simply a matter of time. This is not to say that the theories may not prove to be reliable predictors of such discoveries. The important point to be made here is that it was *assumptions* that drove the conclusions. The positivist paradigm, embodied in this case in current theories of speciation, predisposed the result. Indeed, Simon makes the point that without the amazingly unlikely finding of the counter slab by Xu Xing then archaeoraptor may well still be considered one of the most important discoveries in palaeontology. In other words, the story of the finding of archaeoraptor may have been considered an example of the modern scientific method revealing an important truth or fact about the history of our world. As it is, archaeoraptor has existed only for a short time, and then, like Pegasus, has flown only in the imagination.

Applying the same conceptual framework to this example as the previous three, it is therefore possible to establish a competing set of assumptions. If complexity theory offers an alternative to an incremental view of speciation, then missing links of this kind will not be presumed. Rather, it will be expected that they will not generally be found, either because the changes happened relatively quickly, as Stephen Jay Gould proposes, or because the genetic changes are too significant to normally allow intermediate forms of this kind. Thus, a multi-paradigmatic approach would not preclude a missing link but would be much more sceptical of specimens such as the archaeoraptor fossil. Certainly, it is unlikely that National Geographic would have accepted the fake if those involved had adopted an opposing paradigm.

In this Chapter I have detailed four examples of the hidden power of a monoparadigmatic approach to scientific inquiry to channel every aspect of theory and research, from the hypotheses or concept, to the articulation or methodology and to the conclusions or outcomes. Importantly, it is normally only when a second paradigm allows a critical reflection on the first, that fundamental issues regarding the validity of the program, model or theoretical framework are identified. Even the unmasking of the archaeoraptor hoax, due as it was to solid, deductive scientific investigation, would have been problematic without an almost impossibly unlikely chance event. Indeed, without a second paradigm, such an outcome would have been highly unlikely, for an effect I have called *paradigmatic blindness* normally maintains the invisibility of any possible opposing frameworks or models. Thomas

Kuhn (1962) maintained that no scientific inquiry was possible without the existence of a paradigm. I can extend that position here by asserting that effective critical analysis is unlikely without the existence of competing paradigms. It is therefore entirely possible that the destabilisation we are experiencing in the processes of scientific inquiry caused by the emergence of a competing paradigm will engender a renaissance in scientific endeavour. The new perspectives offered through a doubling of the conceptual tools available to us are potentially revolutionary. Already, the complexity sciences and postmodernism are not only opening up new phenomena for investigation, but are also placing our accepted theories and scientific beliefs under intense scrutiny. The opportunities for new discoveries and insights are literally everywhere. We indeed may be fortunate to be able to experience this period in the history of science⁶⁶.

⁶⁶ A sentiment shared by Karin Knorr Cetina (1997) and for similar reasons. She believes that the modern/postmodern debate is in fact emphasising the importance of science and will lead to increased scientific activity.

Once Upon A Time In Copenhagen

Here is a story relayed to me by a friend⁶⁷ that neatly illustrates the potential clash between multiple and single paradigms. She received a version over the Internet in February 2003, author unknown⁶⁸.

The following question was included on a physics examination paper presented for the physics degree at the University of Copenhagen:

“Describe how to determine the height of a skyscraper with a barometer.”

One student answered the question in this way: “Tie a long piece of string to the top of the barometer and lower the barometer from the top of the skyscraper to the ground. The length of the string together with the height of the barometer will give the height of the skyscraper.”

In due course, this answer was failed outright. The student appealed, however, on the grounds that his method was an accurate way of obtaining the answer. The university appointed an independent arbiter to judge the case. The arbiter decided that the method was accurate, as claimed by the student, but did not demonstrate a knowledge of physics. It was decided to give the student six minutes to verbally support his case. A time was arranged and the student was ushered into an office to face the arbiter. For five minutes the student sat there in absolute silence, obviously deep in thought. At this point the arbiter reminded him that time was running out. This was the student’s response:

“You could take the barometer to the top of the skyscraper and drop it over the side. Measuring the time taken to reach the ground would allow the height of the building to be calculated using the formula H equals nought point five g times t squared.

⁶⁷ With thanks to Carol Wever.

⁶⁸ I have tried to validate its contents by scouring the relevant official and unofficial websites without success, so it may well be apocryphal. – but let’s not allow that to get in the way of a good story.

“If the sun was shining, however, the height of the barometer could be measured together with the length of its shadow. Thereupon, by measuring the length of the skyscraper’s shadow, the height could be calculated using proportional arithmetic.

“On the other hand, you could tie a short piece of the string to the barometer and swing it like a pendulum, on the ground and on top of the skyscraper. The height of the building can be calculated through the difference in the gravitational restoring force – T equals two pi square root one over g .

“Then again, if the skyscraper had an external staircase, it would be simpler to walk up this, using the barometer to note how many of its lengths it took to reach the top. The height of the building can then simply be calculated by adding or multiplying.

“You could also use the barometer to measure the air pressure on the ground and on top of the skyscraper. The difference in millibars could be converted into feet to give the height of the building.

“Finally, you could knock on the janitor’s door and offer him the barometer in exchange for his knowledge of the height of the skyscraper.”

The student – so the story goes – was Niels Bohr, the only Danish national thus far to win the Nobel Prize for physics.

CHAPTER SEVEN

REFLECTIONS ON AN EXTERNAL REALITY

Throughout this thesis I have been emphasising the importance of the role that the individual scientist has in the processes of scientific inquiry. Our scientific communities are made up of autonomous individuals with their own life histories, motivations, gifts and failings. As we experience a fundamental paradigmatic change that entails a revision of the role that each of us plays in the discursive process we call science, the fundamental problem of the subjective/objective paradox has once again, after more than two millennia, been thrown into sharp relief. This paradox is at the heart of the debate over the relative merits of the two paradigms we now have to guide our processes of scientific inquiry. This Chapter will offer a summary of the arguments thus far proposed and examine the conceptual parameters of this crucial issue more thoroughly.

I have not proposed in this thesis that there is no reality external to our affective response to stimuli, from whatever source those responses may arise. Rather, the proposition is that we cannot escape, not just from the “prison house” of language as Nietzsche contended, but the temple of our minds and bodies. We cannot by definition be separate from or external to ourselves. Everything we are is no more and no less than we are. The problem, then, in the assumption that we can be objective observers of an external reality is that we may only comment upon our affective responses to stimuli. Those responses are entirely internal in nature – they happen within ourselves. The stimuli may arise from outside our physical bodies, but the experience of them always resides in our perceptions, emotions and senses *as experienced within our own minds*. All experience is mediated within and by ourselves.

As I have noted, our attempts to communicate these affective responses entail some form of agreed symbolic framework. This may include language, written or spoken, or mathematics, or computer programs or gesture. These are shared conventions of meaning and symbol that allow information to be passed from one individual to another. Thus, there can be no a priori assumption that these conventions, human inventions as they are, represent some universal truth or series

of truths. They are constructs. Furthermore, symbols are not neutral. They are powerful stimuli in and of themselves. For example, we respond deeply and emotively to words and combinations of words. It is the case that words are affective triggers that we respond to at very deep levels within our psyches. Words grouped together in meaningful combinations can make us laugh or cry, sexually arouse us or move us to anger. These responses are outside our control. They are automatic.

Any assertion that we may become other than ourselves or create a description of our selves or any other being, object or phenomena that is quarantined from either an affective origin or affective reception is therefore delusory. All forms of communication have attached to them meaning and emotion, both in the creator and the receiver. These affective dimensions are our heritage as human beings – a heritage that at one and the same time frees us to form an affective bridge between ourselves and others and imprisons us within the limitations of our affective personal universes. Every utterance we make – or other symbolic form of communication we enter into – arises from an affective base that no one else can experience and our affective response to another's communication is ours alone – it cannot be experienced by any other being.

Paralleling this conception of an inner process, but not contradicting it, is the assertion that we are not separate from the universe. We are not even immersed in it. We are the universe – we are part of it. We are constructed of the same sub atomic particles as all matter. We are the very phenomena we comment upon as theorists and researchers. We are indivisible from existence and conceptually invisible within it. We cannot step outside the universe to observe it any more than we can step outside ourselves during discourse. It follows, therefore, that not only are we subjective beings but that we are the objects of our own internal affective experiences.

Neither are our descriptions of these subjective and internal processes the processes themselves. They are formulistic interpretations and explanations of both the processes and their products – the ideas, insights, feelings and so on. Furthermore, we present no more than a skeleton, an edited version, of these explanations. The concepts presented at any one time are the product of a lifetime of experiences and reflections on experience and of both unconscious and conscious processing. We can no more express all the elements relevant to this life-long journey of becoming any more than we can remember every step we have taken

since infancy. I would add to this the assertion that the very choices we make on what to express, what to leave out and what modes of expression to utilise are themselves underpinned by affective processes. We are bounded and constrained by the gifts and limitations of the processes of communication.

Naturally, this does not ensure that the products of these processes are “true” or “objective”. Indeed it ensures the opposite. The essential point is that although these products can be subjectively “true” for an individual, each idea or insight may be untrue for others. As discussed, I might come to the realisation that there is no God. You at the same moment may come to the realisation that God exists. Logic would dictate that one of us is wrong. However, such a conclusion misinterprets the processes that have led to such opposing beliefs. In fact, we are each wrong and right. My disbelief in God is true for me – it has arisen out of my affective processes – and your belief is true for you. However, neither point of view, arising as they do out of entirely subjective processes, can be considered an objective description of the nature of the universe.

Fundamentalism therefore may be seen to arise out of the erroneous belief that internal and external “truths” are coexistent. Much has been made by commentators of religious fundamentalism and the consistent attempts by fundamentalist religious groups to persuade others to their beliefs. However, any proselytisation is fundamentalist in nature, including that attached to scientific argument⁶⁹. An insistence on one approach to scientific inquiry is therefore erroneous in the same way that an insistence on one religious belief system is – as Nietzsche (1882) contended, it reflects personal preference rather than a law of nature:

For it is selfishness in a person to regard his judgment as universal law, and a blind, paltry and modest selfishness besides, because it betrays that you have not yet discovered yourself, that you have not yet created for yourself any personal, quite personal ideal-for this could never be the ideal of another, to say nothing of all, of every one!

The question of whether affective, internal processes can ever be considered to reveal universal truths or external realities beyond the individual may be further

⁶⁹ A point also made by Stephen Jay Gould (1997).

examined. Carl Jung (1916), for example, postulated a shared unconscious that connected all individuals and perhaps all of life. Similarly, quantum theory suggests that all existence arises out of a single, collapsed quantum waveform. Einstein (1936) contended that deep affective processes produce self-evident truths. However, given the position in this paper, these premises are unsupportable, for no matter how far the logical progression is followed the same conceptual paradox is encountered. Indeed, Einstein did acknowledge the dilemma in what he called the ‘prison’ of consciousness:

A human being is part of the whole called by us *universe*, a part limited in time and space. We experience ourselves, our thoughts and feelings as something separate from the rest. A kind of optical delusion of consciousness. This delusion is a kind of prison for us, restricting us to our personal desires and to affection for a few persons nearest to us. Our task must be to free ourselves from the prison by widening our circle of compassion to embrace all living creatures and the whole of nature in its beauty...We shall require a substantially new manner of thinking if mankind is to survive. (reported in *Einstein’s wisdoms*, 2002)

Thus, I may believe that my deeper affective processes reflect or reveal universal truths but I cannot prove it beyond contention for the benefit of the rest of humanity – this remains an assumption, a statement of belief. Again, any other position betrays the classical linear fallacy that only if we dig hard and far enough or are able to divide a phenomenon into enough of its fundamental parameters we will be able to grasp and describe all – that we shall have the theory of everything⁷⁰, the perfect description, the reality revealed. However, it is impossible to achieve this scientific ideal. Rather, at the best, we are exploring and perfecting our processes of discourse. As Michel Foucault (1983) pointed out, this is at odds with modern conceptions of

⁷⁰ An aim Ilya Prigogine described as a “great naivete.” (Interview with Asada Akira, 1998, p. 10). David Bohm put it another way: “The grand unification [of the four forces of the universe] could be nothing but an abstraction in the face of some further unknown.” (Quoted in an interview with F. David Peat, 1987)

inquiry but not with those of the ancient Greek philosophers who saw an approach to truth as primarily discursive:

...since Descartes, the coincidence between belief and truth is obtained in a certain (mental) evidential experience. For the Greeks, however, the coincidence between belief and truth does not take place in a (mental) experience, but in a verbal activity, namely, *parrhesia*. It appears that *parrhesia*, in his Greek sense, can no longer occur in our modern epistemological framework.

Furthermore, whatever perceptual tools we have at our disposal – overt senses such as sight and touch or covert and unconscious processes that may connect us with individuals or phenomena outside ourselves, it remains the case that our experience of all phenomena resides within ourselves – within our own minds. As John Lye (1996) has observed:

There is no unmediated knowledge of 'reality': knowledge is symbolic; what we 'know' are signs; signs gain their meaning from their distinction from other signs. Therefore there is no knowledge of 'reality', but only of symbolized, constructed experience. Our 'knowing of our experience' is itself then mediated knowing, which is the only thing knowing can be.
(P.1)

However, the conception of a subjective and affective process of inquiry and discourse should not be equated with any sense of denigration of this process – it is not a prescription for nihilism, as Nietzsche was led to conclude⁷¹. Our response to stimuli may be entirely personal, but it is one of the wonders of our existence. Within the cage of our affective, individual universes lie all our feelings and beliefs, our contentions and our intentions. We can engage in scientific discourse and enjoy

⁷¹ Or to follow Harlan Miller (1994) and become depressed either: “It is probably salutary, if depressing, to remind ourselves that hundreds of millions (billions) of our conspecifics manage to build and repair automobiles, win friends and gain power, avoid walking into walls, and have and raise children without knowing or caring about the questions, and standards for answers, that we hold dear.” (p. 4) Rather, *vive la difference!*

a novel; we can converse with our loved ones and debate politics with strangers. Our affective responses drive all of our ethical and moral paradigms. All that is best and worst in human beliefs and behaviours is generated within and by this process. Indeed, it may be considered to be one of the defining characteristics of being human. Above all, we are symbolists. We interpret the world through symbols and communicate through them. The symbols we use, and the structures that underlie those systems of symbols, are among our greatest gifts. There can be no scientific discourse without them, no literature, art or music, no philosophy, no religion or politics.

We can, therefore, assert our personal truths with confidence – they define who we are and what we have achieved. The American psychologist Carl Rogers has put this another way:

Experience is, for me, the highest authority. The touchstone of validity is my own experience. No other person's ideas, and none of my own ideas, are as authoritative as my experience. It is to experience that I must return again and again, to discover a closer approximation to truth as it is in the process of becoming in me. Neither the Bible nor the prophets, neither Freud nor research, neither the revelations of God nor man, can take precedence over my own direct experience.⁷²

Indeed, the very fact that we hold a diversity of worldviews adds to the richness of our experience within our communities – social, scientific and so on. Certainly, if we all agreed on the nature of existence then scientific discourse would be extinct – we would not engage in it because all explanations for ourselves and the world we inhabit would appear self-evident⁷³. Thus, a celebration of our pluralism is in order, complete with all the divisions, contradictions and conflicts that may ensue. It is clear that although Nietzsche correctly identified the nature of our prison, the jailhouse must nevertheless be considered effectively infinite for it potentially encompasses all that we are and all that we experience.

⁷² Quoted in *Carl Rogers* <http://www.wynja.com/personality/rogersf.html> from *On Becoming a Person* Accessed 10/01/2003.

⁷³ This has also been noted by Denzin and Lincoln (1998).

There are some profound consequences in asserting this position for it entails not just a celebration of the greatest products of our civilisations – art, science, philosophy – but a recognition of the worst as well. Given that subjective diversity defines the fundamental nature of individuals it is the case that every possible worldview is likely to coexist at any one time. Thus, the motivation or decision to repress or hurt others will always be extant in some individuals. War will always be possible, exploitation likely. For every Ghandi there shall be an Adolf Hitler, for every Nelson Mandella a Slobadan Milosovich. Nationalism shall walk side by side with internationalism and charlatanism with idealism.

This view, although perhaps chilling, is not a prescription for either despair or inaction. It is rather a call to considered action. It behoves each of us as individuals to examine our assumptions and motivations. Indeed, morality and ethicality become entirely a personal responsibility for they arise out of our subjective and affective internal processes – they are not imposed, simply influenced. We can potentially choose our viewpoints and modify our behaviours. We are free to attempt to become what we feel we need to be. This position supports Jacques Derrida's (2002) argument for,

...a politics of the right to philosophy for all (men and women) not be only a politics of science and of technology but also a politics of thought which would yield neither to positivism nor to scientism nor to epistemology, and which would discover again, on the scale of new stakes, in its relation to science but also to religions, and also to law and to ethics, an experience which would be at once provocation or reciprocal respect but also irreducible autonomy.

Indeed, the *science community* is often referred to as if it has a life of its own – is an animal, perhaps, or a tree. It is, though, made up of many individuals with their own thoughts, motivations and activities. When we refer to the business of science, we are in fact talking about the collective labour of autonomous and self-directed individuals. As Clive Beck (1993) has noted, postmodernism has highlighted that,

...we need *individual* scholarship: Jane Doe scholarship, José Sanchez scholarship, Shui Chun Leung scholarship, etc. We have not taken the personal quest of individuals seriously enough: every human being is constantly questioning, observing, theorizing, trying to understand life and make the most of it in his or her own very distinctive situation. (p. 7)

Again, central to this consideration is the nature of the process of discourse. For no matter to whom the discourse is directed, or who responds to that discourse, it nevertheless remains also an internal process. We are holding a life-long conversation with ourselves. Every thought, every utterance, not only arises out of an affective base, but further engenders an affective response within ourselves in a cycle that is only ended with our deaths (though that is an assumption, of course - many believe this process survives the physical death of the body). We are therefore active creators of ourselves - and of all the products of our minds - as well as the products of the actions we choose to take. Acting in concert and interacting with others, we are the creators of our families, societies and civilisations. It is at our peril that we cede this responsibility to an "other", physical or metaphysical, for our lives then become controlled by factual and/or illusory beliefs that we do not own. We, in fact, lose control of our lives.

One of the central messages, then, that may be taken from an analysis of the tension between the modern and postmodern paradigms is that we are individually responsible for every aspect of the processes of scientific inquiry we enter into. The subjective dimensions of our conceptual and intellectual functions entail a close attention to our assumptions, our motivations and our methodologies. We can no longer rely on an automatic assumption of an objective Platonic ideal, either in relation to our processes of discourse or the universe we inhabit. Rather, we are faced with justifying our decisions, both to ourselves and to others, against a volatile and potent mix of paradigmatic pluralism and change.

The demands on the individual are therefore significant. The questions raised by this debate in relation to the validity of any scientific endeavour are complex and indeed may have no final resolution. It is the case that the subjective/objective paradox has remained unaltered for at least two and a half millennia. It is also highly likely that it will remain unaltered for as long as we are recognisably human, for it

appears to highlight the defining feature of our relationship with both our internal and external realities. On the other hand, differing perspectives offer enriched and enriching opportunities for inquiry. Thus, the period in the history of science that we are entering may well be one of the most important and productive we have yet experienced. The landscape we now gaze upon may be daunting and unknown, but the journey through it – I believe – will be highly rewarding if each of us, individually, is willing to take the risk of exploration.

Alowyn's Journey

One day Alowyn went to see his father. They sat together as they had on many occasions before, in front of the family home and facing the river that wound through the hamlet. They sipped cold, black tea, sweet and strong, and watched the boys herd the communal flocks down to the water. Beyond the river, on the lower ground, the food crops were spread out in neat patches, each tended by a different family. Those crops, together with milk and meat from the animals, ensured survival through the winter months and were lovingly cared for and jealously guarded. Even now, late in the afternoon, many people could be seen with their backs bowed, working amongst the plants.

Alowyn looked at his father. Now in middle age, he was lined of face and his hair was grey. The already dark skin on his arms and on the backs of his hands had been burnt nearly black by the sun, and his palms and fingers were deeply callused from years spent in hard labour. Alowyn put his glass down and shifted uneasily in his seat. "Father, I have something to tell you." The older man nodded but did not look at him. "I have reached the age of my majority and may claim my inheritance. I wish to do so."

The older man turned to him. "And what will you do with that inheritance? Will you build a home, perhaps, and take a wife? Will you raise a family? Or is it, as I suspect, its a different purpose you have in mind?"

Alowyn dropped his eyes under his father's gaze. "I have no interest in a home or a family, father. I wish to take my inheritance in gold and go out into the world." He got to his feet. "I feel hemmed in here. My heart burns to see the world and to uncover its secrets." He pointed to the mountains, pale and shimmering at the farthest edge of sight, their tops white with snow. "Have you ever been there, father? Have you talked to the people who live there? Have you learnt what they know, listened to their stories?"

The older man shook his head. "I have never left this place, as you well know. My whole life has been bounded by our land here, and the river. And I have never wanted to leave it, not even for a moment. But you, well, you were always the restless one, even as a child. The questions you would ask! We hoped that you

would settle as you grew older. You were such a serious child.” He shook his head and sighed. “You will break your mother’s heart.” He stood next to his son and placed his hand on his shoulder. “Must you go, Alowyn? What can be out there that is better than here? And who knows what dangers await you. Life is hard here, but we never go hungry. And there is a roof over your head here, and a warm bed, and people who love you. What more can you want?”

Alowyn moved away from his father’s hand. “I wish to know the secrets of life, father, and I won’t find them here. I want to know why the sun shines and why it rains, and why it is that some grow ill and others do not. And I want to know why we are here on this earth and why we die. I have to find people who know the answers to these questions, in the great city perhaps. I have to leave, father.”

The older man’s shoulders dropped slightly in defeat. “So be it. But it may be that you will be lost to us forever.”

α

Alowyn followed the well-used paths along the riverbank, moving downstream past the many communities so much like his own home with their small houses and patchworks of fields. Alowyn knew that three weeks march away the great city stood at the mouth of the river where it emptied into a limitless expanse of water called an ocean. He had listened to the traders’ stories avidly whenever they had called into the village and could picture in his mind’s eye great buildings, paved streets and people beyond count. The traders had also talked about learned men and women who prophesied the future and studied the stars. Somewhere in that city, his heart told him, he would find those with the wisdom to answer his questions. He quickened his pace and adjusted his pack more comfortably across his back. He also put his mother’s tears out of his mind. Every step was taking him closer to his goal.

He travelled in this way for many days, eating the dried fruit and cheese he carried in his pack and supplementing his diet with his hunting and fishing skills. Mostly, he avoided the settlements, preferring his own company and his own thoughts, perhaps speaking only one or two words of greeting to other travellers in a whole day’s walking. At night he would try to find a soft spot amongst the trees that lined the banks of the river and sleep as best he could, using his pack as a pillow, the small bag of gold his father had given him hidden within.

It was while he was asleep one moonless night that he was attacked. Confused and in pain, he became suddenly aware of the shapes of men around him in the darkness and their grunts as cudgels were swung at him, hitting him on the body and head. He cried out and struggled to rise but lights exploded in his head with a blow to the temple and he was knocked senseless to the ground.

α

Alowyn became aware of the scratch of a woollen blanket on his skin and the sound of someone moving around near his feet. He was also hurting inside and out from the beating he had taken, but had not suffered any broken bones as far as he could tell. Cautiously, he opened his eyes. He was in a low-ceilinged room lit by candles, their light flickering in the corners and making the shadows dance. He was lying on a high bed, his head propped up on feather pillows. In front of him stood an old woman with a mane of white hair. Her head nearly brushed the ceiling and he could tell immediately that she was very tall – much taller than he was – though her back was somewhat bent with age. She was watching him impassively.

“Back in the world, are you boy? Well, it’s better than being dead. Whoa, stay there!” she said as he tried to rise. Immediately his head spun and nausea closed his throat. He felt a bowl pushed into his hands. “Here, use that.” He brought up a thin bile and started to recover. The bowl was taken off him and, looking down, he saw that he was naked. He quickly grabbed the blanket and covered himself where he sat on the edge of the bed. The old woman laughed. “Don’t worry, boy, I’ve seen better than that. There’s some water beside you.” Gratefully, he took the earthenware cup and sipped at the cool water, cleansing his mouth and clearing his throat. He realised that he was very weak and lay back down on the bed.

“Where am I?”

“Just relax now. Get some sleep. There’ll be plenty of time for talking later.”

Suddenly, Alowyn did feel sleepy, very sleepy. Had she drugged him? He was too tired to worry. He drifted off.

And that, naked and sick, was how Alowyn met Rianan the Witch, healer and dealer in potions and spells. Over the next few days, as he grew stronger, he learnt to trust and like her. He also learnt that he had been carried to her cottage by some men from the local village. They had found him floating half in and half out of the water

at the edge of the river. Whoever had attacked him had taken every stitch of his clothing and his pack, gold and all. He had lost everything. But when he had shown his shock at this news, Rianan had dismissed it. “I think you have your priorities all wrong,” she had said. “You have your life. Clothes or gold are no use without that.”

He was black with bruises and stiff and sore, but with the food and the medicines that Rianan gave him, he was soon able to get up and move around. She had also given him some homespun clothes, thin with use. But she did not have boots to fit him, so he had to go barefoot. Several times he had to pull splinters from the soles of his feet picked up from the rough wooden flooring.

She, in turn, learnt his story. She had shaken her head when he spoke of his yearning for knowledge. “Ah, Alowyn, you can learn everything that has any importance by staying in the one spot the whole of your life. Mind you, I did not. I too was restless and went out into the world. I saw goodness and evil, found some things and lost many others. Eventually, I returned home, too old to travel any more.” She had looked at him keenly. “If you continue this journey it will change you. Then, if you return home, you will no longer fit in. You will be treated as an outsider. I became Rianan the Witch when I returned. What will you become? Alowyn the Idiot, perhaps?”

After a few days he felt recovered enough to leave. “And where will you go?” Rianan asked. “Back home, is it? It’s a rough world for innocents like you. At least it’s safe at home, and people to protect you against the thieves of this world.”

Alowyn shook his head. “No. I will find out about the world, or die trying. I will go on. There are no answers for me back in the village.”

Rianan looked him up and down. “Very well. In that case I shall help you a little, if help it really is. After all, you could be going to your own destruction.” She shook her head, her white hair flicking like a halo around her face. “But I know the need to travel only too well. So. In all my travels I only ever heard of one place in the world where you may have your questions answered. There are many who would *claim* to know, oh yes, and charge you well for the lesson, charlatans all. There is one place, though, one true place, where you will gain the knowledge you seek. Have you heard of the Cave of Knowledge? No? It is a long way away, at the top of the highest peak we can see from here, at the edge of the world, snowbound and desolate. I once tried to climb that peak, for I too once sought knowledge and understanding, but it was beyond my strength, and I returned to the bottom beaten

and unenlightened. But, there was a man there. How old he was I don't know. He was much older than I am now, but still clear of eye and mind. He had climbed the mountain he said, and I believed him for I had met enough liars to recognise truth when I saw it. In the Cave of Knowledge there is a great door. He said he had opened that door and found the true meaning of the world, but he would not tell me what it was." She laughed. "He said it was for me to find for myself. Anyway, he came down from the mountain and has been there at the bottom ever since, waiting for other travellers." She looked at him. "He is the one you seek. Find him and he will direct your steps. Then, if you have the strength and the will, perhaps you shall get your answers."

Alowyn felt immediately that this was no chance meeting. He had been meant to meet Rianan, and he was being directed, helped somehow by forces outside himself. His quest would be successful, he was sure. Excitedly, he questioned her as to the way and was told to simply aim for the tallest peak that was always in view and make his way across the empty lands and forests in between until he reached the only village there, nestled in the flank of the mountain.

"Ask for the man with no name, boy," Rianan had said. "He told me that he left his name on the mountain."

Rianan helped him with more than advice. She gave him a pack to replace the one he had lost and provisions for the journey. She even went down into the village and bartered for a pair of boots for him. He felt deeply in her debt.

She had waved his thanks away. "Just come back and tell me what you found, if you can. Or help someone else one day, when they need it, as others have helped me." She looked at him and smiled. "Mind, I grow old, Alowyn. I'm not sure I'll be here if you do return." Then she had leant over him and kissed him on the forehead.

α

Alowyn walked through the wilderness for so many days that he lost all count. Trees and open grasslands he passed by in an endless sequence, the mountain peak always the same distance away on the edge of sight, mocking his slow progress across the world. In the end he entered a sort of trance state, putting one foot in front of another, manoeuvring around obstacles without thought, eating when hungry, drinking from the streams he came to and sleeping where he was at darkness each

night. At last, the bite of the night air brought him out of his reverie. It had grown noticeably colder and he shivered in his worn clothing. He lit a fire and slept as close to it as he could, savouring the comfort it brought.

The next morning he looked up at the mountain and saw to his astonishment that it dominated the sky, huge and forbidding, filling his vision. He was growing close and his spirits lifted. Soon he came across paths wandering through the trees, the first sign of human beings since he had left Rianan's cottage. Then he smelt wood smoke on the breeze and saw the roofs of houses rising amongst the treetops ahead of him.

It was the children that saw him first, shouting in their high voices as they ran down the path ahead of him. Almost immediately two men stepped out and blocked his way. They both looked at him with suspicion.

Finally one walked forward and stood before him. "Hello stranger," he said, "what is your business here? Speak up!"

"I am searching for the man with no name," said Alowyn and listened to his own voice with amazement, rough, unheard and unused for so many days, it sounded strangely like his father's. He saw both men relax.

"Ah! It's been a long time since a searcher came through. When I was still a child indeed. Come, follow us."

He was escorted through the village, so much like his own with its houses arranged near a stream and crops in the fields beyond. For a moment he felt a pang of homesickness, but pushed it aside. He was too far away to worry about that now. They came to a small dwelling, surely no more than one room, its boards faded and peeling with age. The door was open and he stood before it uncertainly, unsure what to do next. Then a man's voice called, "Come in, come in!" and he walked forward into the half light inside. His escorts, their duty done, turned away.

As his eyes adjusted to the gloom he made out a man sitting on the floor in front of him. He was without doubt the oldest man he had ever seen. His skin was riven with folds and cracks and was almost translucent. His hair was thin and pure white, tied back behind his head. He was so thin that Alowyn wondered he didn't break, arms and legs like sticks in their clothing. The old man raised an arm and waved him closer and Alowyn saw that there was plenty of life there yet. The movement was sure and quick and the eyes that observed him were steady and sharp.

“Come and sit beside me,” he patted some cushions, “and tell me your story. It’s been a long time since I’ve had a visitor like you, young man.”

And so Alowyn did. His childhood, his growing desire to go into the world and learn its secrets, Rianan, his journey, his hopes and dreams, the Cave of Knowledge and the mountain rising up so close to them, its head lost in cloud. The old man had listened without moving or speaking, but at that he nodded.

“Oh, yes, its there, waiting for those like yourself in whom the need burns strong. If you have the courage and the fortitude to climb the mountain, enter the cave and open the Door of Perception you shall know the meaning of life. The source of all we are and can be will be revealed to you.” He looked Alowyn up and down as if gauging his strength. “It is a hard and dangerous journey, young man. Many fail and come back broken in strength and spirit. Some never come back and their bones are lying up there somewhere on the mountainside. Those who make it and survive, well, some find only despair while others find peace. Some return and go out into the world to wealth and success, and others become powerful and greedy, taking what they want from the world without thought for others. No one can tell how you will be after you have entered the cave and opened the door. Do you know your own heart? Few do.”

Alowyn looked at the old man. “I must at least try, whatever the outcome. I have been searching all my life for the knowledge you say is up there.” He leaned forward. “Can you not tell me what I shall find? Did you not go up there yourself?”

“That I did. But this journey is a personal one, for each of us alone. Also, young man, you would not believe me, and you would go anyway. If you want to learn this, you shall have to climb the mountain yourself.”

Alowyn nodded, accepting the words without understanding them. “Then I will. Tell me though, what did you find out about yourself – what was in your heart?”

The old man laughed. “Me? Can’t you guess? I found a purpose in life.”

α

Alowyn pulled the furs the old man had given him closer round his face and body and trudged on through the snow, up the winding path that lead to the summit. It was bitterly cold, and the wind found every gap in his clothing, draining his warmth and his strength. There were still plenty of trees at this height, and they afforded some

protection, but above him there were only rocks, jumbled and windswept. He shivered. This was the third day of his climb up the mountain, and already he felt exhausted. He wondered if he would be able to continue to the top and for the first time became afraid.

For another two days he struggled on, past the tree line and out amongst the rocks, the wind doubling in intensity. He began to pant and grow dizzy. Occasionally, black spots would dance before his eyes. Finally, he stopped, the wind whipping at his body, and looked into himself. Should he turn and go back down? It would be so much easier to travel back down the slope to the warmth and comfort in the village. He could go home, back to his village where his family waited for him. What was he doing on this mountain anyway? Was it worth his life?

For a moment, his decision hung in the balance, finely weighted like a coin balanced on its edge. And then his old stubbornness returned and the balance tipped. He staggered on up the slope, bent forward into the wind, his world reduced to moving one foot forward at a time, his pulse pounding in his head.

So intent was he in forcing his body on and upward that he almost walked straight past it. The darkness of the opening against the stark white of the driven snow caught the corner of his vision and he turned round and stumbled forward, into the dark and out of the wind. For a minute or two he leant against the cold rock of the cave wall while his breathing settled. He had made it.

At last, he felt his strength returning and he began to move deeper into the cave. It wound like a snake into the darkness before him and he carefully followed its path until the light faded too much for him to see any further. He took the torch the old man had given him out of his pack and lit it with flint and tinder. Its bright light and warmth seemed wonderful here in the darkness as the shadows danced around and away from him. He moved on, further and further into the mountain – into its heart, it seemed.

Just when he had begun to wonder if the torch would last he entered a large chamber, its roof arching up and away beyond the reach of his light. And there ahead of him was a great wooden door, studded with iron. Above the door was a script he could read. He hurried forward, his heart beating wildly, and stood before the door. He read the message there and hesitated for a moment. Then he reached forward and grasped the round, iron handle. It turned easily in his hand and he pulled the door open towards him, his torch held high.



THE DOOR OF PERCEPTION
IF THE SOURCE OF ALL MEANING YOU WOULD SEE
OPEN THE DOOR AND LOOK INTO ME
CHAPTER EIGHT

THE METAPARADIGM

*May you live
in interesting
times*
Chinese curse

I have been
arguing that
the insights
afforded by
an analysis of
the modern
and
postmodernist
paradigms
clearly place
the
responsibility
for all aspects
of scientific

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

inquiry on the individual. This last Chapter presents conceptual models for the paradigmatic changes I have identified that encapsulate these arguments, and also places the changes within their historical context. As I detailed in Chapter One, there is nothing necessarily new in what we are now experiencing. Rather, we are rediscovering a paradox that the Greek philosophers were only too aware of.

I have emphasised that not only are we free to choose whatever methodology we might use in the exploration of phenomena, but are also responsible for what we explore and the discursive tools we use to express that exploration. After all, scientific paradigms are not set in stone. They have not been handed down by a supreme being to a prophet of science. They are human creations arising out of human intellectual activity. The ideas, beliefs and values that underpin those paradigms have been explicitly proclaimed by many commentators throughout the history of science from Plato and Aristotle, to Descartes and Newton, and Foucault and Derrida. Many others have adopted those paradigms as guiding principles for their work, sometimes consciously and sometimes through a process of enculturation into the mores of the scientific communities. They are indeed *memes*, part of our cultural heritage, as real as any great building or machine. And they are just as powerful as any machine we have ever invented. Scientific, together with religious, political and social paradigms, form and channel human thought and behaviour in direct and fundamental ways. We can never be free of the influences of paradigms – they are after all a collective expression of our assumptions and beliefs. However, as creative, inquiring individuals we can certainly be aware of them and gain control over their influence upon us.

Unlike individuals, paradigms are effectively immortal. They may change over time as ideas and mores vary, but they do not die. Indeed, from the moment our ancestors first formed collective beliefs in a social group to the moment that the last human group ceases to exist they have accompanied and will accompany our every thought and action. Our paradigms are already tens of thousands of years old and show no signs of old age yet.

Being consciously aware that scientific paradigms are artefacts, and therefore like all artefacts may be used or not as the case warrants, raises some crucial issues for the scientist. As I have detailed, up until about the nineteen seventies the classical, or modern, paradigm was virtually unchallenged. The assumptions imbedded in that paradigm may be characterised as reductionist – in other words, that phenomena may be understood by analysing constituent elements. The tools considered appropriate to conduct those analyses were therefore mathematical measurement and statistics. For the researcher, it remained unnecessary to justify the methodology – it was a given that this was the way to do science. This paradigmatic model may therefore be represented as follows:

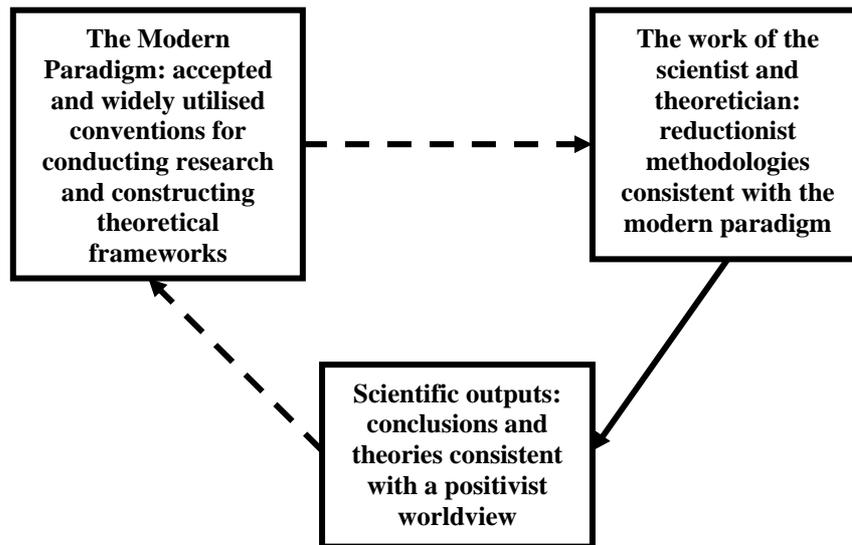


Figure 26: The Modern Paradigmatic Circle

In this model, as long as the separate components are consistent with one another – that is, embody the same principles – then the ongoing functioning of the system remains untroubled. Importantly, the actual practical and intellectual work of the individual scientists, or teams of scientists, constantly reinforces the paradigm through re-emphasising the conventions. A system such as this can therefore remain unchanged indefinitely as long as the embedded principles and the practices of the participants are unchallenged.

Another, and crucial, aspect of this model is that the scientists involved are not necessarily required to have a knowledge of the principles underpinning the system. Activities are guided by conventions of methodology and discourse without, necessarily, ever being made explicit. It is ‘the way things are done’. The only overt connection is between the scientists’ methodologies and the outputs. The paradigm is there, driving the system and being supported by it, but without needing to be recognised. Under this model, therefore, it is never a requirement to question the paradigm that is the root and the destination of the scientific activities it engenders. Rather, the model, based as it is on a set of conventions, encourages a passive and even unconscious (or unknowing) acceptance of the embedded principles. Thus, the principles involved are rarely examined or justified for they are conceptually invisible within the system - or as Paul Feyerabend (1975) put it are, “simply declared to be non-existent” (p. 3). Although there are constant disagreements between participants, the focus is not on principles but on the ‘visible’ aspects of the system - outputs and methodologies.

In times of paradigmatic change, such as we are experiencing now, alternative principles and methodologies are established. Again, however, the new system is self-supporting, internally consistent and unchallenged as long as the proponents do not question the underlying principles. And again, an explicit knowledge of those principles is unnecessary for the new system to maintain itself⁷⁴.

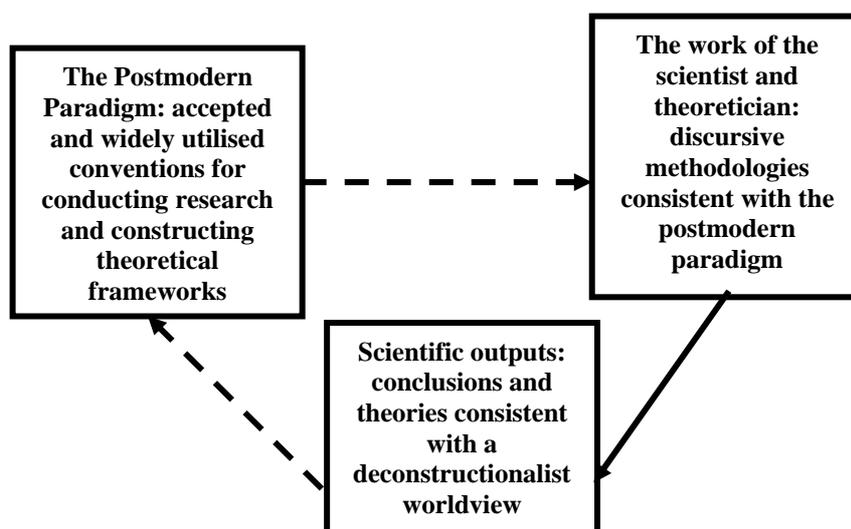


Figure 27: The Postmodern Paradigmatic Circle

⁷⁴ As Benz and Shapiro (1998) have noted, “Postpositivism can become, like positivism did, an excuse for not reflecting on the grounds of one’s beliefs and practices about knowledge and about one’s social and historical context.” (p. 31)

In this case, the underpinning principles include the subjectivity of inquiry, power relationships embodied in discourse and holistic conceptual frameworks. Narrative rather than mathematical tools become central. However, as long as the methodologies utilised reflect the principles, those principles also remain conceptually invisible. It can be ‘the way things are done’ in the social sciences. Once again, the paradigm is reinforced through the activities of the proponents without necessarily receiving recognition; and, again, disagreements between the proponents will tend to be about form rather than principle.

In neither model, therefore, is an individual either required or encouraged to question the assumptions that underpin practice. On the contrary, there are powerful disincentives to do so, as Feyerabend (1975) has noted in relation to this issue.

Scepticism is at a minimum; it is directed against the view of the opposition and against minor ramifications of one’s own basic ideas, never against the basic ideas themselves. Attacking the basic ideas evokes taboo reactions which are no weaker than are the taboo reactions in so-called “primitive societies”. (p. 5)

Thus, the established group conventions will actively work to control the behaviours of members. Furthermore, behaviours that do not conform will be viewed with suspicion by those enculturated into that system – and that includes legislators, government departments, corporations and university departments. Funding for research and development will, by definition, mostly be reserved for conventional and accepted tried-and-true approaches.

However, as soon as paradigms compete with one another, not only is the focus directed towards the underlying principles, but every aspect of the system comes under question. The existence of two competing paradigms relating to the same human activity inevitably entails comparison between the two. Thus, the underlying principles of both are brought into sharp focus as the opposing proponents question the other camp's rationales. Explanations and justifications, critiques and criticisms increase exponentially. The middle ground – in this case the business of doing science – becomes a battleground as individuals and institutions fight for both the high moral ground and funding. Unlike the first two models, personal attacks on integrity, honesty and professionalism become as common as attacks on outputs.

Similarly, the relative outputs – the theories and research outcomes – are often dismissed by the opposition. In turn, the opposing outputs are used to attack the opposition’s first principles, and so on round the circle.

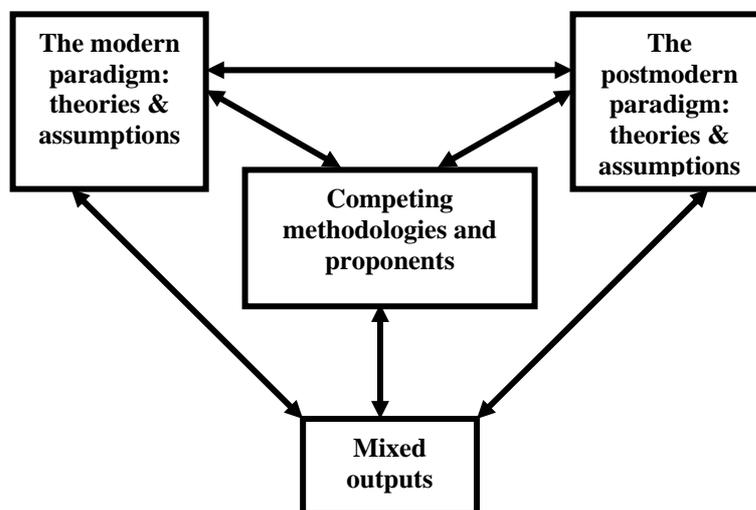


Figure 28: The Competing Paradigmatic Model

Unlike the first two models, this latter one is highly unstable in that it cannot continue indefinitely. It represents a battleground between two opposing worldviews and the battle is over some highly valuable commodities – beliefs, conventions and limited funding resources⁷⁵. The battle will therefore continue with increasing energy until the system enters a new state of stasis. The only resolutions that will achieve this are the vanquishment of one of the paradigms or the emergence of a third paradigm that subsumes the other two⁷⁶. Interestingly, both the modern and postmodern paradigms have already received somewhat hopeful obituaries – from members of the opposition, of course⁷⁷.

In fact, the battle is far from over. Natural scientists show few signs of abandoning the classical methodologies that have served them so well for over two centuries. Similarly, social scientists are increasingly embracing the powerful new tools that have arisen out of the postmodernist movement. It is clear that both paradigms are internally robust enough to survive the challenge presented by the other. As I have

⁷⁵ Or as Richard Tarnas (2006) puts it, “...there is so much investment – psychological, unconscious as well as economic – in the old paradigm by individuals who have lived their whole lives within it.” (p.2)

⁷⁶ Denzin and Lincoln (1998) have put forward a similar argument.

⁷⁷ In this context, the *Science Wars Homepage* is an interesting place to visit: <http://members.tripod.com/~ScienceWars>

argued, the reasons for that are two-fold. First, both paradigms encompass principles that are valid and applicable within their own contexts. Secondly, generally speaking, they both apply to differing areas of the human pursuit we call science – the modern paradigm to the ‘hard’ sciences, and the postmodern to the ‘soft’. They are in fact different tools for different jobs. On the one hand, I doubt very much that many postmodernists would be happy to take a new medication that had not undergone rigorous research and testing by scientists utilising empirical methodologies. Similarly, it would be a misguided positivist indeed who based their opinion of pedagogy on the statistical analysis of other people’s opinions. Listening to people’s narratives, and taking note of one’s own, are much more appropriate in this context.

Thus, the resolution I am both recommending and predicting is the blending of the two extant paradigms for scientific inquiry into a third. That new paradigm is a *metaparadigm* in that, following the original Greek meaning of the prefix, it represents a standing side-by side of first principles. Indeed, in this model the principles are not conceptually invisible within it. Rather, they represent the explicit *raison d’etre* of the unavoidable choice between methodologies. In other words, the scientist and theorist refer to first principles to guide research and theory.

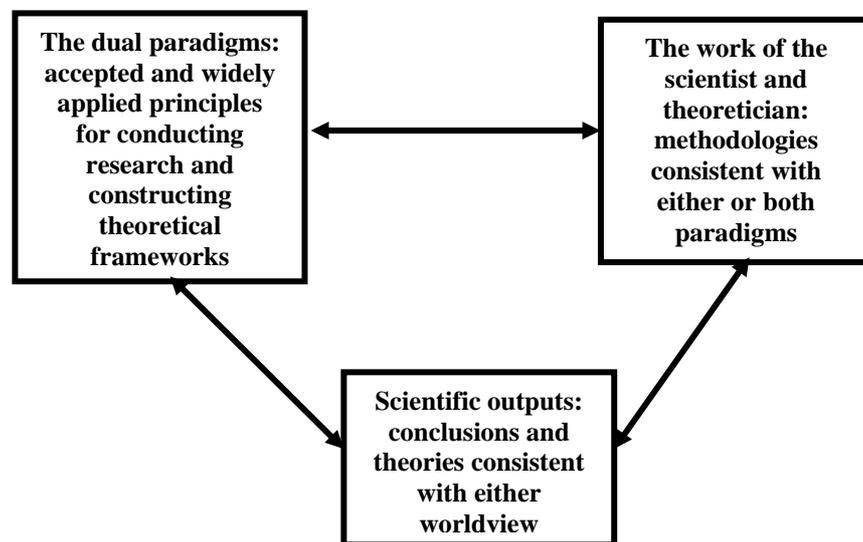


Figure 29: The Metaparadigmatic Circle

In this model, therefore, unconscious acceptance of principles embedded in a paradigm are much less likely, for a choice between methodologies entails the examination of the rationales for that choice. Also, the various outputs entail an

examination against methodologies *and* against first principles to ascertain, or support, claims of validity. In this system, critiques between participants will thus centre more on the applicability of the choices that are made rather than personal characteristics. The metaparadigmatic circle of scientific inquiry is therefore an interactive and self-reflective feedback system that has built within it mechanisms for ongoing refinement and change. In many ways, this model makes explicit the often hidden processes of theoretical and paradigmatic development that have characterised scientific endeavour since Plato. It does, however, put paid to the comfortable option of relying on *convention* rather than *rationale*. Scientists will have to work harder to justify their approaches and their conclusions.

Without having a crystal ball it is of course impossible to foresee with certainty whether or not new paradigms will emerge in the future. Perhaps there will be pristine discoveries that will fundamentally change perceptions, or an evolutionary change within the human species, or ecological, meteorological, geographical, religious or political changes so profound that science as we know it ceases to continue. Barring changes of this magnitude, however, it is difficult at this point to envisage the emergence of a third superparadigm from the self-reflective feedback model above. Since our earliest records in ancient Greece there have always been two dimensions, and two dimensions only, to this debate. The subjective/objective paradox of human experience has defined, and in all probability will continue to define, our processes of scientific inquiry. There certainly appears to be an objective universe that we are a part of and with which we maintain a relationship. On the other hand, the tools we have for exploring that relationship are cultural artefacts that enmesh each of us in a subjective cycle of assumptions and beliefs. The tension between these two elements of the proto-metaparadigm is at the heart of the current disruption to the processes of inquiry. It was also embedded in the rationalistic seventeenth century formulations of research methodologies, and was explicit in the interactions between proponents of the same two worldviews in first century BCE Greece. The battle, therefore, has not altered in content in two and a half thousand years. The forms certainly have altered as distinctive discursive methodologies have been developed, but conceptually there are no differences. There is little reason to believe that this dimension, so indicative of the human condition as it is, will change into our foreseeable future.

The emergence of the metaparadigm may therefore be seen as a maturing of the processes of human scientific inquiry. Plato and Aristotle may have won the dialectic battle with Protagoras but that did not change either the nature of reality or our relationship with it. The paradoxes survived them and their works and were encountered again by Descartes and Newton. Both these scientists were able to appeal to a theocratic solution, but this was only a temporary reprieve. David Hume and Immanuel Kant applied their particular brands of scepticism to the idealist position in the eighteenth century and Wallace and Darwin further undermine this construct a century later, placing human beings alongside and in the animal kingdom rather than being separate from it. As the nineteenth century progressed, there were growing murmurings of discontent from Frederik Nietzsche and Charles Peirce and then, early in the twentieth century, it was Dewey that resurrected Protagoras's sophist spectre. This was given full life soon after by advances in quantum physics, complexity theory and postmodernism.

The beginning of the twenty-first century has thus returned us to the arguments that occupied the ancient Greek philosophers, but the outcome this time is likely to be different. Plato and Aristotle, or their third millennium counterparts, will not be able to suppress the opposition this time around. The voices proselytising for the rediscovered or renewed paradigm – Foucault, Derrida and Lacan notable amongst them - have been articulate and profound and the adherents to the new movement are a growing force in the scientific community. The debate that humanity could not forever avoid about the nature of reality is alive and well at last. In essence, this is both a return and an advance to a philosophical/scientific engagement with the full complexities of the human condition and the universe of which we are a part. The comfortable, Platonic idealisations are being superseded by the difficult and multifaceted demands of a pluralistic worldview. Thankfully, we now have insights from quantum mechanics and the complexity sciences not available to those who have preceded us, as well as much more potent physical and discursive tools for exploring our world. For these reasons, I am optimistic that we, as a community, are well placed to embrace this rare and uniquely valuable opportunity for change and growth.

In relation to this observation, it is worth noting at this point the current resurgence of the realist/anti-realist debate that is occupying many philosophers. In essence, this debate is equivalent to the subjective/objective dimension identified in this thesis and has arisen for the same reason – the emergence of the competing paradigm – or

competing viewpoints - in the processes of inquiry. Significantly, Donald Davidson (1984), Arthur Fine (1986) and Richard Rorty (1979, 1999, 2000) have each argued that all experiences exist as subjective functions in the mind of the individual and therefore distinctions between a “real” and a “non-real” world of experience – for example between the experiential worlds of objects and thoughts – should be discarded. Rorty (1999) in particular has extended this position to the processes of inquiry.

I see the increasing consensus on this thesis as marking a breakthrough into a new philosophical world. In this new world, we shall no longer think of either thought or language as containing representations of reality. We shall be freed both from the subjective-objective problematic that has dominated philosophy since Descartes, and from the appearance-reality problematic that has been with us since the Greeks. We shall no longer be tempted to practice either epistemology or ontology.

(p. 1)

As I have done in this thesis, Rorty goes on to make observations on the correspondence between religious and philosophical/scientific beliefs. However, his outlook on the potential outcomes of the debate he highlights is pessimistic.

The realist conviction that there must be a non-human authority to which humans can turn has been, for a very long time, woven into the common sense of the West.....I think it would be a good idea to reweave the network of shared beliefs and desires which make up Western culture so as to get rid of this conviction. But doing so will take centuries, or perhaps millennia.

(1999, p. 4)

As I have detailed, my view is more optimistic than this. The emergence of pluralistic ideologies – or what I have called the metaparadigm - will, I believe, lead to a re-evaluation of these very assumptions. Indeed, as I have previously noted, this is an exciting time to be alive if one has an interest in inquiry into the mysteries of ourselves and our universe. We are being gifted with a metaparadigm so powerful

that every aspect of our processes of inquiry and discourse as well as our all our scientific beliefs and assumptions are being placed under question. From my point of view, the current realist/anti-realist debate in philosophy is an emergent and inevitable feature of those processes. The potentialities for innovation, insight and invention are therefore unlikely ever to be greater across the whole field of scientific/philosophical inquiry. Periods of rapid paradigmatic change are always going to present rich opportunities, both intellectually and affectively, for those willing to accept the lessons that are presented. The opportunity available here, after two and a half millennia of human endeavour primarily in response to one paradigm, is surely not one to be missed.

As noted earlier, Kuhn (1962) was the first to use the term *paradigm* as it is presented in this thesis - as an umbrella term that refers to the conventions, or terms of consensus, that guide scientific endeavour at any point in history. Kuhn, therefore, has given us a highly effective conceptual tool for encapsulating the cycles of stasis and change that have characterised science since Plato. However, Kuhn identified many historical scientific paradigms in his work. In contrast, I am suggesting that two broad and overarching paradigms subsume all the others – the classical or modern and the postmodern paradigms. In other words, there may be many subdivisions or stages identified in this process, but this thesis is concerned with the objective/subjective paradox in human processes of inquiry and the two fundamental ‘poles’ that emerge from the analysis. Indeed, the metaphor of a magnet is particularly apt in this context. A magnet has two poles – opposite to each other conceptually and physically. Yet, one could not exist without the other. The two poles are in fact functions of each other, or of the underlying electromagnetic events that give rise to them. The two great paradigms of scientific inquiry are no different. They are simply different faces of the same phenomenon – of the relationship we have as inquiring beings with the realities we are part of and that we represent. The one cannot exist without the other.

Kuhn went on to suggest that opposing paradigms are *incommensurate* (1977) with each other, that is cannot reach an accommodation and remain in competition until one defeats or overcomes the other. He pointed out that opposing paradigms are followed by scientists that hold differing beliefs and who utilise differing methodologies. My analysis of the modern/postmodern *science war* certainly may be seen to support this insight. However, I would propose that Kuhn was in fact describing changes within one *superparadigm* – in this case the modern or classical

paradigm that has underpinned almost all scientific inquiry since Plato and Aristotle. As I have outlined above, disagreements amongst participants in a monoparadigmatic system are characterised by division over methodologies and outputs rather than principles. The re-establishment of the second superparadigm, now called the postmodern, thus supersedes Kuhn's model to the extent that superparadigms are not *incommensurate*. Rather, they represent the two poles of the one metaparadigm of scientific inquiry and thus may coexist. Kuhn's model still may be entirely applicable to the on-going battles within each superparadigm, however. Divisions over methodologies and theoretical frameworks are as frequent between proponents of postmodernist approaches as they have been between modernists. The divisions between postmodernists and modernists, however, centre more on principles or beliefs. For reasons explored at length elsewhere in this thesis, contradictory beliefs may quite happily coexist indefinitely within groups and even within the single individual. Furthermore, the opposing seminal beliefs that underpin both the superparadigms were there at the beginnings of recorded scientific inquiry in the first century BCE, and have remained unaltered until this day. They will also, in all probability, remain unaltered for as long as we remain human, for they reflect the operation of the two poles of the one and the same phenomenon. In other words, it is likely that a metaparadigmatic viewpoint will always be useful, in one form or another, in defining our processes of scientific inquiry. At different points in history those processes may present as monoparadigmatic, as a competition between paradigms, or as a combination of the two superparadigms. After two and a half thousand years, we are now moving again into the third stage, or seeing the third face, of a metaparadigmatic process.

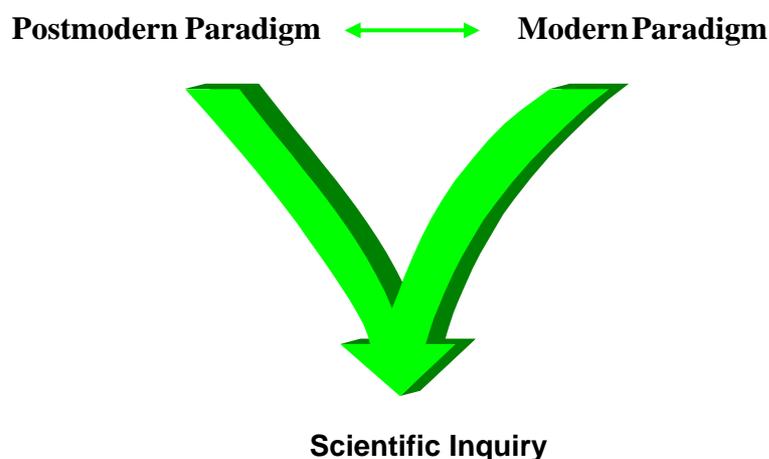


Figure 30: A Bipolar Model for Scientific Inquiry: the two superparadigms are the coexistent poles of the one process

Yogesh Malhotra (1994) has expressed a similar opinion on the modern/postmodern divide.

Insomuch as these two sets of opinions contradict each other flatly in every particular, it seems hardly possible that they should both be true; but anyone who has actually done or reflected deeply upon scientific research knows that there is in fact a great deal of truth in both of them. For a scientist must indeed be freely imaginative and yet sceptical, creative and yet a critic. What are usually thought of as two alternative and indeed competing accounts [are] the *two* successive and complimentary episodes of thought that occur in every advance of scientific understanding. (p. 4)

Thus the emergence of the metaparadigm, or the establishment of a metaparadigmatic approach, may be seen as the explicit recognition of the underlying processes that characterise all scientific inquiry. Indeed, as I have argued, a belief in either paradigm to the exclusion of the other is to display paradigmatic blindness – the inability or refusal to recognise the full process. As Stephen Jay Gould (2000) has pointed out, any other position only upholds,

...the false dichotomy of objective realism versus social constructionism that defines and fuels the illusory science wars. But small concrete cases debunk this spurious conflict even more effectively by proving that both supposedly opposite poles invariably work together, as science builds genuine items of natural knowledge from constantly changing and persistently indivisible mixtures of observation and socially embedded interpretation. (p. 5)

As I have detailed above, it is my contention that the armistice in this war is only a matter of time as the metaparadigmatic approach inevitably becomes the new orthodoxy. Furthermore, one of the central lessons of a pluralistic viewpoint must surely be that we can choose between alternatives, or blend them, or even perhaps invent new ones at will based on our own internal and affective frameworks. Conventions of thought and action are indeed only guides, or perhaps just represent

limited alternatives amongst an almost infinite selection. In a very real sense we can therefore move beyond paradigms and take responsibility as creative and inquiring beings for all aspects of our intellectual, emotional, social and ethical lives. The opportunity to be self-aware, self-organising, independent human beings free from externalised conceptions created or imposed by others is available to us if we choose to take it.

CONCLUSION

A JOURNEY'S END

What we call the beginning is often the end
And to make an end is to make a beginning.
The end is where we start from. And every phrase
And sentence that is right (where every word is at home,
Taking its place to support the others,
The word neither different nor ostentatious,
An easy commerce of the old and new,
The common word exact without vulgarity,
The formal word precise but not pedantic
The complete consort dancing together)
Every phrase and every sentence is an end and a beginning,
Every poem an epitaph.

T.S. Eliot, The Four Quartets (1969)

Human beings as we understand the term today – complete with all our facilities for language and imagination - are one of the most recently evolved species on this planet. We came into existence probably only 50 000 years ago, or 14×10^{-8} % of the time that life has existed on earth. Geologically speaking, blink and you would miss us, or depending on how long we survive as a species perhaps not even notice that we had ever been here at all. Indeed, we are currently faced with many threats to our continued existence and most of these are a direct result of our industrial/technological civilisation. That civilisation has been formed and driven by the work and beliefs of those in the scientific community.

In this thesis I have argued that scientific inquiry has largely been the provenance of one dominant superparadigm since the first century BCE. That superparadigm embodied two crucial idealistic assumptions – that the world was composed of perfected, external forms and that human beings had received a god-given ability to objectively observe those forms. Further, Aristotle introduced at the same time a reductionist template for the process of observation that still underpins all empiricist

methodology today. In seventeenth century Europe, these concepts were given the modern framework of the null hypothesis and the medium of mathematics. From that point on, our industrial and post-industrial civilisations were inevitable. Descartes established human beings as the exploiters and controllers of the natural world and this view, together with the newly developed conceptual tools, led directly to the technological interventions that now affect virtually every corner of the planet as well as every aspect of our lives.

I am not suggesting here that our technological civilisation is in some way 'suspect' - far from it. I would certainly not be alive today if it were not for modern medical intervention, and I entirely appreciate sitting here in comfort and safety with the opportunity to use the technologies available to me to pursue the ideas and concerns that I find important. Also, it is only two centuries since nearly two in four women, even in the Western democracies, died in childbirth and half of all children that were born alive died before they were five. Food technology, medicine, sanitation, and power driven tools and vehicles have all made fundamental differences to the quality of life of billions of individuals. The forms of knowledge that have arisen out of our processes of scientific inquiry and the products of the application of those forms of knowledge have profoundly impacted on our world in many positive ways. The fact that many individuals in the world still do not benefit from these advances as much as my children and I do, for example, is a political and social issue, not a scientific or technological one.

The problem as I see it is the lack of control we have had on the *processes* of science and technology, not necessarily that we overtly attempt to control the natural world. As I have detailed, the assumptions and beliefs implicit in the adoption of the conventions attached to the modern paradigm remove the individual as an affective parameter in these processes. Rather, the relationship the individual has with the natural world is considered an impersonal one. The ethical dimension of our interventions in the universe is therefore secondary to objectifying the phenomena we investigate and acting upon them, or as Denzin and Lincoln (1998) have noted ethics is extrinsic to this form of inquiry process. The consequences of this worldview have led inexorably to the negative by-products of our scientific/technological revolution – overuse of resources, pollution, environmental degradation and the greatest extinction event since the Yucatan Peninsular comet impact 65 million years ago that wiped out almost all the species then existing in the world. The concept of the objective

observer, separate from world in some way, has allowed a separation from responsibility as well.

Few commentators suggest that we can carry on in this way indefinitely. There are limitations on continued growth – in economies and populations – defined by limited resources and space. The environmental changes we are observing are also disturbing – global warming, salinity, deforestation, industrial pollution, and so on. The question must surely be: *do we want to continue in this way into the future?*⁷⁸ If the answer is even a qualified no, then it becomes essential to examine our processes of science and technology and gain control over them.

I believe that the emergence of a second superparadigm is grounds for some optimism that this goal is not unattainable. Quantum mechanics, the complexity sciences and postmodernism have given us the opportunity to place the individual squarely in the centre of all processes of scientific inquiry as an affective/subjective parameter. The assumptions that underpin an objectified universe have been substantially invalidated and questions over our motivations for any scientific or technological pursuit have become starkly highlighted in an environment of paradigm pluralism and change. The opportunity for gaining control over our own activities is thus clear – the genesis for all the effects of all our science lies within us and is therefore amenable to changes in what are entirely affective processes. The Nobel Prize winner Roger Sperry (1987b) has also emphasised the applicability of the recent advances in the social sciences to all disciplines and its importance for our future.

...I think time will show that the new approach, emphasizing emergent “macro” control, is equally valid in all the physical sciences, and that behavioral and cognitive disciplines are leading the way to a more valid framework for all science. Although the theoretical changes make little difference in physics, chemistry, molecular biology, and so on, they are crucial for the behavioral, social and human sciences. They don’t change the analytic, reductive methodology, just the

⁷⁸ Richard Tarnas puts it this way: “...there is a real awareness that things have to change. People are becoming increasingly conscious of the fact that the ecological situation is critical and that we cannot continue to live according to the same assumptions with which we have lived blithely for the past several hundred years.” (In London, 2006, p.1.)

interpretations and conclusions. There seems little to lose, and much to gain. (p. 3)

I should admit here that although I am sure it is possible, I am neither optimistic nor pessimistic about the chances of this scenario becoming a reality. It seems to me that the human race is indeed a complex phenomenon and therefore almost every conceivable variation on human personality and motivation will coexist at any one time. Thus, even if the debate I have outlined above becomes generic, this does not mean that our post-industrial technocratic states will necessarily alter. After all, the freedom to make decisions entails the freedom to make decisions that may be considered destructive, greedy or simply asocial. Furthermore, actions are not necessarily coincident with an ethical or moral position – they may well be pragmatic instead. I am suggesting here, however, that we do have the opportunity to have this debate in a way that has not been possible before. The establishment of what I have called a metaparadigm offers new perceptions and tools that may allow us to take control of our future as a species. This outcome will need the implicit or explicit support of a significant portion of the scientific community – in other words, it will need to become the new convention for scientific inquiry if significant change is to be engendered in the ways we operate on and in our world.⁷⁹ Roger Sperry (1987b) has expressed a similar position.

We're beginning to learn the hard way that today's global ills are not cured by more and more science and technology. Technical solutions...only tend, over time, to escalate the problem. What is needed to break the vicious spiral is a worldwide change in attitudes, values, and social policy. (p. 3)

⁷⁹ Richard Tarnas (1998) has put forward a very different historical perspective on the paradigmatic change evidenced in the emergence of the postmodernist movement. Tarnas argues that we are witnessing an evolution of human thought that will lead to a rebirth of the human psyche and a reconnection with the purpose of the universe – indeed a spiritual renewal. While I have no way of proving or disproving this view, I would argue here that there are no evolutionary imperatives that will lead to any particular outcome. Rather, my position is that we have the choice whether or not to follow any particular path; that it is not predetermined. I would argue that any directions we choose to take will require commitment and extended effort, and we may not even then achieve our goals – that the future is as yet unwritten, that many differing outcomes are possible. This position is more in line with Ilya Prigogine's (1980, 1984 and 1997) conception of bifurcating time – of potential branches in the direction that human history may take. Prigogine also believes that we may be able to influence that historical direction (2002, 2004).

As I have emphasised throughout this thesis, the focus must therefore always come back to the individual. The scientific community is made up of autonomous individuals with their separate lives and differing outlooks and motivations. The choices we make as individuals will decide the future of science and indeed the future of our species. If enough of us decide to take control of our processes of science and technology, then controlled they shall be.⁸⁰ If, however, we insist on being separated from the consequences of our work, then we cede control of our lives and our world either to others or to blind chance. Neither alternative, it seems to me is an attractive option.

The Medium and the Message

All the world's a stage
And all the men and women merely players;
They have their exits and their entrances,
And one man in his time plays many parts,
His acts being seven ages.
As You Like It, 2. 7. 139-143.
William Shakespeare

I have argued in this thesis that all scientific inquiry may be seen as a process of discourse – with ourselves and, through our symbolic systems, with other individuals in our communities. The forms that our discourse may take are therefore legitimate and significant subjects for study and commentary. Furthermore, those forms may be brought under scrutiny as vehicles or *devices* for our attempts to express our research findings or our scientific ideas. Thus, we may utilise a number of discursive techniques in any one paper, thesis or research project. The choices with regard to these techniques represent the culmination of the author's internal and affective decision making processes about forms of expression. At the same time they may be seen as a process of decision making concerning the manipulation of the affective responses of the intended recipients – the readers – in the scientific and research

⁸⁰ Michael Apple's (2001) analysis of the pedagogic choices that arise out of pluralistic perspectives is of interest here as it highlights the importance of both the individual and the collective in achieving hegemonic change. Referring in this case to the conservative and neo-conservative movements in the USA, he advocates what he calls *de-centred unities*, "...the building of coalitions across difference in order to effectively create counter-hegemonic alternatives" (p. 13), but emphasises how difficult he believes this will be to achieve.

communities. Any and all forms of expression may therefore be legitimate in the pursuit of both these end-points. In this thesis the discursive techniques utilised have included classical forms (linear argument, referencing and deductive reasoning), narrative techniques (metaphorical and story formats, quotes from poetry and literature), pictorial representations (illustrations and diagrammatic representations) and philosophical and logical discourse. They have been combined in a holistic construct to both illustrate and support the central proposition of the paper: *that all scientific inquiry is a subjective and affective process*. The consequence of this view is that we are not only free to adopt any paradigms for inquiry that are available to us, but that we are also entirely responsible for all aspects of our discursive processes. Following the insights gained through the emergence of quantum mechanics, the complexity sciences and postmodern research techniques it is no longer reasonable to assume that any conventions for discourse – either classical or postmodern - may be followed without reflection and a process of analytical justification. At the very least, a recognition of the fundamental assumptions underpinning the methodologies and theoretical positions of the proposer would appear to be an inevitable corollary to recent insights into the origins and forms of discourse. Perhaps most importantly of all, we are empowered to make purposeful choices with regards to all aspects of scientific inquiry – from the underlying paradigms, to the subject, to the methodologies and the forms of expression. Benz and Shapiro (1998) have expressed this point as follows:

In our view, methodology is parasitic on epistemology and ontology, and we believe that an individual who uses a particular research method without being able to articulate its epistemological and ontological assumptions and preconditions is not a fully human, fully responsible researcher. (p. 34)

Furthermore, our processes of inquiry describe a circle that returns us to a consideration of the very assumptions that underpinned our starting point, for we cannot either escape or transcend them. Rather, it is in understanding the nature, limitations and potentialities of that circle that a new and more powerful paradigm or paradigms may be established for exploring the nature of our universe and our place within it. Certainly, the processes of scientific inquiry are currently undergoing

fundamental scrutiny and rapid change. It is only twelve years since Ingvar Johansson (1991) confidently made the following claim:

Physics has for a long time now been insulated from political-ideological disputes, whereas the paradigms in the social sciences often and naturally get involved in such struggles. This is to me the difference which explains the multi-paradigm character of the social sciences and the mono-paradigm character of physics. (p. 9)

Since that time, the trenches have been dug and the science wars that originated in Greece two and a half thousand years ago restarted in earnest. Paradigm plurality is changing the geography of this battlefield for both sides.

Another consequence of a consideration of the subjective nature of our forms of inquiry is the abandonment of universalist claims of certainty. None of us, no matter how well informed, skilful or talented, will ever perceive more than part of that elephant lost in the Australian outback. Our answers are necessarily bounded by our limitations – perceptual, physical, emotional and paradigmatic. We are all involved in the same journey of exploration, but shall see different things in different ways and describe those experiences differently too. Thus, a respect for and an appreciation of others' points of view and discursive mediums is also indicated for we cannot with self-evident justification claim that their approaches are 'wrong' – they may simply be wrong for us.

Scientific inquiry may therefore be said to take place in a *virtual* world – the internal world of our minds – even though its products may be acted out on an external world.⁸¹ In our internal world we may create any number of scenarios involving any number of participants. Normally, scientific inquiry concerns what we believe to be real phenomena and the resultant discourse reflects what may be considered reference points to an extant reality – other people's research projects and theories, for example. However, that model is not necessarily required to reach the same end point. In the virtual world of this thesis I wrote about several of the Greek philosophers, quoting their words and commenting upon them. That is the

⁸¹ Francisco Varela similarly puts forward the concept of the virtual self and suggests that this self is evident, or conscious, because it provides a means of interaction with the external world (in Brockman, 1995).

convention. What I could have done was to create an imaginary conversation between, say, Socrates and Protagoras that could have embedded the same preconceptions and the same end points. For my own purposes I could have made Protagoras the victor this time around. This technique may have explored the theme equally well. It would have been unconventional, however, and possibly unacceptable as well (though I have no way of validating that assumption at this time). The point I am making here is that the conventional form gives the *appearance* of objectivity when there is no evidence to support any such assumption. This thesis, then, is no less a mini virtual world than a play, a film or a computer program. Like Sokal I could now make that explicit by revealing a hoax, or like a filmmaker at the end of a film show some out-takes and thus step outside the virtual world of characterisation and plot. In this case, I have directed the performance within this particular mini virtual world to get to this denouement. The emperor does have clothing, but it is only imaginary attire. (Or is it?)

Towards a Beginning

The wheel is come full circle; I am here.

King Lear

William Shakespeare

I began this thesis by enunciating some of the assumptions embedded within my arguments. I also detailed the decision-making processes concerning form. Essentially, this thesis has explored a postmodernistic approach to scientific inquiry through a classical format - that is, what some commentators have referred to as a *blended* approach (Dowse 1996; Culp 1998; Marsland et al 2000). However, I would argue that the position I have taken in relation to paradigm pluralism presupposes this model.

It is the case that the classic format for scientific discourse has been wonderfully successful over a period of two and a half centuries⁸². Currently, though, other formats are taking equal precedence and presenting the scientific community with a far greater range of tools for exploring our place in the universe.⁸³ Thus, a number of

⁸² Or as Richard Tarnas (1998) puts it "...the world is to an indeterminate extent susceptible to this way of interpretation." (p. 421)

⁸³ Michael Apple's (2001) perspective on multiple research methodologies is of interest here: "...what

approaches could have been taken to achieve the same discursive end point. I could have expanded my own narrative, my own eureka moment, or alternatively further explored the metaphorical nature of the topic through a novelistic technique, for example. Because both the writer and the reader are embedded in their own cultural milieu, and because it is impossible to claim a truly objective perspective for discursive processes, all forms of inquiry must be considered valid. It is the case that some models may be considered more elegant than others, or more applicable to a particular environment, but all elicit a response from the reader, or the recipient, at levels far beyond the purely intellectual. I have thus adopted an approach to scientific inquiry that Nicholas Fox (1995) has referred to as *intertextuality*⁸⁴. That is, “the process whereby one text plays upon other texts, the ways in which texts refer endlessly to further elements within the realm of cultural production.” (p. 1) This conceptual framework envisages the product of inquiry – the written text or thesis – as the tip of a complex and hidden iceberg of inter-connected relationships existing in the mind of the creator at both the conscious and non-conscious levels. Similarly, the response in the reader exists in a virtual environment of thoughts and non-conscious affective reactions that, in a process of almost infinite complexity, underpins that person’s responses. The *form* or structure and content of this thesis, therefore, recognises some of the influences that I have brought to conscious awareness. There may of course be many others that I have failed to identify. One of the interesting corollaries of an intertextual viewpoint is that the reader may well identify, or perhaps *think* he or she identifies, influences and textual relationships that are unrecognised, or unacknowledged, by the author. The complexities of the discursive process are therefore clear here. Further, a hierarchical relationship between texts is not assumed in this thesis because of the central proposition that there is no objective postulant that may be used to judge between them. Rather, it is argued that an approach to individual/subjective truths is necessarily guided and influenced at both conscious and non-conscious levels by an experience of all the texts one encounters in one form or

is considered as science and as important and legitimate research has been impressively transformed... Currently on the terrain of legitimate research, there is ethnographic work (both descriptive and critical), critical historical work, and there is much greater emphasis on conceptual work, narrative work, on life histories, analyses based on cultural studies, and so much more--all of which are now generally seen as legitimate. When you add to this the existence and rapid growth of multiple kinds of feminist research, post-colonial research, critical disability studies, critical race theory, critical discourse analysis, and many other exciting areas and approaches, I think there have been major gains.” (pp. 16-17)

another – and that certainly does include non-realist or imaginative texts. Indeed, it may be argued that all texts must therefore be considered a form of fiction, including the scientific, as all have arisen out of individual affective processes. Also, conversely, any one text may have a profound effect on the reader no matter from what genre it may have arisen. For that reason, I have included references to some of the non-realist (or non-scientific) texts that have significantly impacted on my own journey of discovery and explanation – Shakesperian plays, the poems of T.S. Eliot, the Epic of Gilgamesh, the Bhagavad-Gita, the Old and New Testaments, Medieval Miracle Plays, the teaching of Buddha, the writings of Machiavelli, a French children’s story and so on - and created a few texts of my own intermixed with quotes from a wide range of scientific and philosophical commentators to involve the reader in a parallel experience of intertextuality within the mini-world of the thesis. Richard Rorty (2000) refers to the growing importance of an immersion in the world of ideas through texts from all sources to inform and engender the processes of intellectual inquiry as the *rise of a literary culture* and suggests that this culture is replacing, or subsuming, philosophy as a distinct discipline. Rorty’s position is therefore very much in accord with one of the major tenets of this thesis – that the creation and interpretation of meaning is both an individual experience and an individual responsibility. Indeed, if it is conceded that the adoption of beliefs is by definition an internal, affective process, then all experiences that an individual has – textual or otherwise – must necessarily be seen to contribute to that individual’s ideas, world-view, outlook or opinions as mediated through the lens of the inquiring mind. The experiential patterning of our lives in all its ineffable complexity has, with the differing genetic predispositions that each of us has inherited, led to this moving point in our life journeys. This is not, however, in any way meant to be a deterministic viewpoint. Rather, the human gift of the inquiring mind allows us the opportunity to both reflect on the experiences that we have had and to question their influence on our belief systems. Who we are and what we believe is certainly heavily influenced by the chance patterning of our experiences, but we do have the ability to “change our minds” through self-reflection and analysis. Within the context of the theme of this thesis, the essential first step in the journey towards an independence of mind of the sort described here is to take responsibility for managing the processes of inquiry –

⁸⁴ The word was originally coined by Julia Kristeva (1986) in relation to the writing and reading of fiction.

that is, to move beyond the comfort of mono-paradigmaticism and risk the uncertainties and challenges of a metaparadigmatic worldview. Conventions are useful and probably necessary for an ordered society, but they are also limiting and potentially hazardous – and not least in the human endeavour we call science. The difference between the two positions is, I would suggest, the difference between being a passive recipient and a conscious agent in the on-going minute by minute unfolding of our intellectual lives.

This thesis, then, has represented an exploration into the conventions underpinning scientific inquiry. As noted, the approach to the topic has followed the classical model – the hypothesis, the analysis, the conclusion - while at the same time utilising postmodernist conventions of inquiry – and it has been my contention that this approach was required for, or relevant to, the purposes of this thesis in this context. Thus, at one level I am attracted to the classical model because it gives structure, and has attached to it a convention of ‘testing’, or veracity modelling. Logical structuring of argument is an element of this model, as is referencing and the utilisation of a bibliography. Underlying this approach of course is an assumption that such methodologies are more “objective” and therefore more valuable in some way. On the other hand, as I have outlined, there are other, equally valid approaches to structuring the journey I have postulated. Narrative methodologies are powerful tools for imbedding individual experience in the processes of scientific inquiry. Narrative approaches do not necessarily assume that objectivity is desirable, or indeed possible. One of the underlying assumptions here is that one cannot separate the observer from the observed: that the objectivity assumed by classical scientific methodologies is unattainable. Thus indeed, as noted, at one extreme the novel form may well be considered a valid format: that the journey as defined by the author can take us to the desired destination without reference to research or any other aspect of the classical scientific conventions of inquiry. It is for these reasons that I have overtly utilised a range of discursive methodologies within this thesis.

From my point of view, therefore, all intellectual journeys within an individual are aspects of one central affective process. The *expression* of that journey may take three distinct yet related forms: the positivist/rational, the narrativistic/autobiographic and the imaginative/metaphorical. All three forms are included in this thesis as a recognition and to illustrate that divisions between them are founded on convention rather than neo-Platonic idealistic and universal frameworks. This is not to say that

all forms may not be considered more valid and preferable within their own contexts. For example, the reading of a novel, a biography or a scientific treatise may be enjoyed and appreciated in different situations and for different purposes. Nevertheless, all three differing types of *texts* have arisen out of the same conscious and non-conscious processes within the individual and against and through the same experiential life journey. To put it another way, the beliefs that underpin a philosophical/scientific worldview will have been formed through and influenced by the total life experiences of an individual to varying degrees wherever, whenever and in whatever context those experiences may have occurred. It is a process that is both intertextual and inter-experiential. Paul Feyerabend (1975) has made a similar call for an eclectic inclusion of ideas and hypotheses in the processes of inquiry.

....we arrive at the result that the separation of science and non-science is not only artificial but also detrimental to the advancement of knowledge. If we want to understand nature, if we want to master our physical surroundings, then we must use *all ideas*, all methods, and not just a small selection of them. (p. 11)

Any hierarchical divisions between the *forms*, therefore, are arbitrary for each is equally valid and equally ‘real’ or indeed ‘unreal’, depending on the point of view of the reader. Within the virtual world of this thesis I have presented, in differing ways, versions of all three forms. However, I would emphasise here that all three are, intentionally, differing versions of the one personal journey towards an understanding of the parameters underpinning the human processes of inquiry. Thus, the philosophical/rational argument, the personal narrative and the metaphorical stories are all autobiographical to the extent that they each reflect aspects of the one affective journey towards the conclusions I have reached. This does not mean that these conclusions are necessarily universally ‘true’, of course, but they are certainly ‘true’ for me within the totality of my experiences and personal milieu. Whether or not they appear to contain truths for others may well depend on an overlap between individual milieu – similarities in the existential patterning and/or the outcomes of differing life journeys. Thus, the *medium* is also the *message* in this thesis.

As has been discussed at length in this thesis, an interesting corollary of this position is a return to a consideration of one of the oldest concerns of philosophy – the

concept of ‘truth’. For example, I could have made up this entire thesis to the extent that every reference was fallacious, as with the *Postmodernism Generator*, or even adopted positions that were not my own, as did Sokal – I could have lied, in other words. The interesting question is whether or not this would make any difference to the reader’s affective response to the thesis, no matter what the actual truth of the situation was. I would suggest that it may not, for it is the discourse as an emergent and self-contained whole that is being experienced and therefore on that level it will be judged. This must be the case if there is no objective and self-evident truth to judge the content of the thesis against. The converse is also significant – if we cannot identify a self-evident template for the truth of any statement, then all points of view are equally valid, even if they are not considered equally palatable. Furthermore, I could be deluded or just simply mistaken. Or indeed I could be lying and, inadvertently, accurately describe a phenomenon or event by accident, without ever being aware of it. As discussed earlier in this thesis, my intentions and motivations are my own and I may not even be aware of some of them. However, your response to this discursive event is entirely your own as well, and may or may not include any referents or objective postulants.

Central to my position in this thesis, therefore, is the assertion that an analysis of inquiry is in and of itself valuable whatever model or models are utilised, whatever path of examination is involved – linear or holistic - and from whatever assumptions or paradigms the inquiry arises. Thus, thinking about thinking – the whys and hows of what we do – is both constructive and informative. Simon Blackburn (1999) makes the same point in his work *Think*:

I believe the process of understanding the problems is itself a good...The world is full of ideas, and a becoming sense of their power, their difficulty, their frailties, and their fallibility cannot be the least of the things it needs. (p. 298)

Indeed, at the very least, that process will illuminate our theoretical understanding of phenomena and may well lead to new insights, the formulation of new concepts and the design of more thorough and pertinent research programs. The very act of disagreeing with or rejecting another’s point of view may lead to a process of analysis of our own assumptions - the paradigms that support our every thought, action and

belief system – and result in amendment or change. Again, it is an assumption of this thesis that modifying a point of view is a good thing: that the search for more effective descriptions of phenomena is a pursuit worth undertaking even if that leads to the realisation that one knows less as one learns more.

The purpose of this journey was to explore a topic which I would argue should be of interest to everyone engaged in scientific inquiry: it is an examination of the intellectual and perceptual tools we have at our disposal to engage in an exploration of our universe and our place within it. With regard to this, the implications of the insights offered by complex systems theory and the postmodern perspective generally are currently being explored extensively in economics and physics, mathematics and biology, education and artificial intelligence. Similarly, the strengths of the classical scientific method are being extolled and reinforced by physicists and engineers, mathematicians and economists, biologists and educators. This, I would therefore propose, is a positive process in which principles and rationales are being minutely examined. In fact, as I have stated, it could well be argued that we are observing a complex system at work in the field of scientific inquiry. It certainly has all the indicators: a stable system that has undergone minor change, which has led to major instability as the system enters a ‘chaotic’ state (Gleick, 1987). If this is the case, then we would expect the system to enter a further stage of stability in due course - perhaps, as argued in this thesis, through the wider adoption of a new paradigm or belief system.

Whether I am right or wrong, objectively, about the nature and significance of the paradigm changes that are being experienced in the processes of scientific inquiry, it is clear that the human activity known as science has entered a period of turmoil, questioning and self-doubt. Within the context of the position I have taken here, this must be considered a very good thing indeed. The argument that this debate represents in some way a retreat from reason is to misinterpret one aspect of that elephant again, I believe. It seems to me that we are in fact observing the maturing of the processes of scientific inquiry. If you like, it has been through a long childhood that stretched from ancient Greece to seventeenth century Europe, then entered a brash and overactive teenage-hood⁸⁵ that gave rise to both the industrial and post-

⁸⁵ Or as Paul Feyerabend (1975) colourfully put it, “the hectic barbarism of our scientific-technical age” (p. 7). Bruno Latour (2002) has used a similar phrase to describe the modern age: *a few short centuries of violent spasms*.

industrial states, and now faces the challenges of adulthood, including the pressing need to take responsibility for itself and its effect on others. I must admit that I find the vitriol from both sides of the modern/postmodern debate much like that expressed in the arguments between my two teenage sons – neither is right, as such, but both want to be so badly that an accommodation is rarely reached. I do have hope that both the two boys and the two sections of the wider scientific community will grow up and get on with life productively and in relative harmony. Furthermore, those who do not take responsibility for themselves and their actions may well be condemned to blame others for mistakes that could otherwise have been easily remedied. At least currently with the two children this really is not that significant. However, in terms of the role that the scientific community plays in the world we occupy, this literally may be a life and death matter - and that, at the very least, needs to be taken with the utmost seriousness.

A conceptual journey may begin or end with many unlooked for experiences that lead to many unexpected insights – experiences that may include a scientific treatise, a child’s question or a poem. Each of us experiences different conceptual journeys, as we do indeed journeys through life. Our experiences are ours alone, and our affective response to those experiences cannot be felt by any other human being. We can certainly enter into discourse about those experiences, though, and about our interpretations of their meaning and significance. Bounded by all the physical, perceptual and intellectual limitations of the human being as the processes of discourse are, they are nevertheless the greatest gift we have developed as a species. Not only can we reflect on existence, but we can also communicate with others about it. Without this wonderful ability no process of inquiry would be possible and therefore no science, art or music – indeed all the greatest features of our human civilisations could never have existed. Paradoxically, our processes of discourse also allow lying, deception, manipulation and the promulgation of violent and destructive philosophies. Our greatest gift is also our greatest burden. Perhaps, therefore, one of the central challenges each of us faces in our personal journeys is to acquire the skills to effectively analyse and judge the discourse of others - to consciously apply a metaparadigmatic approach to all discursive processes. Perhaps I may coin a term for this approach here – *positive scepticism*⁸⁶. That is, a continual analysis and

⁸⁶ David Hume (1748) coined a similar term, *mitigated scepticism*, in relation to considerations of truth and knowledge.

questioning of the assumptions and motivations embedded in any discourse. It is the case that no statements of belief are self-evidently true and no human being has a corner on the secrets of the universe⁸⁷. The responsibility for establishing what is ‘true’ and ‘real’ may therefore be seen to lie entirely with ourselves as individuals - and that must be as much the case in relation to discourses in science as with any other human activity. I am confident that the emergence of a metaparadigmatic plurality will significantly engender and increase the generic adoption of a process of positive scepticism as it is described here; that the literary culture described by Richard Rorty will become the norm over the coming decades of this century rather than a hoped for ideal. As detailed earlier, it is the outcome of this cultural shift that I am at present less confident of.⁸⁸

It does seem clear that whether or not our personal journeys, and indeed our journeys as a species, are littered with countless mistakes and false beliefs, the need to explore our universe and our place in it is overwhelming and constant. As the *inquiring hominid* the cycle of inquiry is our most enduring and perhaps our most characteristic feature. It may well also be our saving grace.

We shall not cease from exploration
And the end of our exploring
Will be to arrive where we started
And know the place for the first time.
T.S. Eliot, The Four Quartets (1969)

⁸⁷ Or as Ilya Prigogine (2000) expressed it, “No one possesses absolute truth – as far as that expression means anything.” (p.3)

⁸⁸ David Bohm expressed his own uncertainty as to the outcome of our intellectual journey as follows: “Where we are going depends on the programs of four thousand five hundred million people, all somewhat different, most of them opposed to one another. Every moment these programs are changing in detail. Who can say where they are going to lead us? All we can do is start a movement among those few people who are interested in changing the meaning.” (Quoted in F. David Peat, 1987). Also, Michael Apple (2001) has highlighted what he sees as the dangers of fragmentation ensuing from the pluralism in perspectives arising out of the postmodern movement: “There has been an accompanying growth of private languages and of esoteric ways of expressing our theories, which only specialists in a small area can understand. Thus, while the growth of multiple research perspectives has been for the good, one of the dangers has been that it has gotten harder for generally progressive researchers to communicate with each other easily.” (p. 17). Bruno Latour (2002) similarly refers to the *crisis of multiplicity and fragmentation* that he argues has arisen out of postmodernism. Latour does go on to argue that the science wars, or the tensions arising out of the modern/postmodern dynamic, will change the world even though the outcomes are uncertain. Elsewhere, Latour (in Fronte 2003) suggests that this process must be both scientific and political, thus emphasising the subjectivist dimension in the ongoing debate.

The Bottle

Three philosophers of science – a positivist, a post-modernist and a relativist – were on their way to a conference aboard a small plane. Because their views were so radically at odds the three had been arguing incessantly throughout the journey. The positivist insisted not only that an objective reality existed, but that she and her fellow scientists could formulate and test theories that would explain fully, in time, all phenomena. The post-modernist, on the other hand, held that there were a multitude of explanations for phenomena, dependant on the context, the cultural milieu and methodologies utilized and insisted that he and his fellow scientists could fully explain all phenomena through a multiple range of narrative methodologies that, in time, would complete our understanding of humans as actors in a universe bounded by metaphor. Finally, the relativist argued that both were right, or indeed wrong, depending on the set of assumptions that underpinned their points of view. Unlike the other two, the relativist put forward the view that no scientific methodologies could explain all phenomena to the satisfaction of all: that there could never be a “theory of everything”, either unified positivist or multi-personal post-modernist. The other two found this assertion completely unacceptable and often allied themselves against the relativist, whom they considered some sort of Protagarian sophist.

About halfway through the journey, far out over the Pacific, the plane developed engine trouble and ditched in the water. Fortunately, the three philosophers were able to swim to a nearby island. A quick look round their refuge soon demonstrated that the island was deserted except for the three of them. They were indeed cast away on a desert island.

Thoughts of survival soon surfaced and each began to search around for anything that might be useful. There were palm trees and coconuts, and a pool of fresh water, so it seemed they would not either starve or die of thirst. In time, other items were found: pieces of nylon rope lost from a boat they could use to tie things together, driftwood from which they could build a fire, and an old bottle, crusted with barnacles and still with its cork in place. Curiously, they prised the cork out with a piece of coral, but jumped back in alarm when green smoke hissed out in a great cloud. To their amazement as the smoke cleared they beheld a huge figure hovering over them

in mid air, arms folded, and dressed in what appeared to be a brightly coloured Arab costume. The apparition had its arms folded and glared fiercely down at them.

A thunderous voice boomed over the sand. "About time too! Three hundred years stuck in a bottle is no fun. Come on, let's get on with it. You have one wish each." The genie pointed at the positivist. "You first."

The positivist soon collected her wits. What a chance this was! She knew exactly what she wanted. "Oh genie of the bottle," she started, and was encouraged when the figure nodded solemnly, "my wish is to be transported to a world in which positivist scientific principles have triumphed; a world in which everything has been explored and explained through the good old Newtonian paradigm; a world in which the null hypothesis....." The genie cut her off. "Yes, yes, I get it. So be it." He clicked his fingers and, with a last triumphant look at her companions, the positivist was gone.

The genie pointed at the post-modernist. "Now you." The post-modernist stood up straight. "I wish to be transported to a world in which discursive methodologies have triumphed; where each individual voice has been allowed to speak so that all is explained and illuminated through multiple perspectives embedded in the cultural milieu; where the dominant, Western male hegemony..." Again, the genie interrupted. "Yes, I get that too. So be it." He clicked his fingers and the relativist stood alone on the sand.

The genie frowned down on the relativist. "I suppose you want to be transported to your own version of a perfect world as well?"

The relativist smiled brightly. "Oh no. I think it would be quite dull without the other two around. I'd like them back here so we can continue our discussions."

"So be it," said the genie and clicked his fingers.

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