Theatre and Science, with specific reference to Shelagh Stephenson's An Experiment with an Air Pump (1999)

Dion van Niekerk

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Declaration

I undertake that all material presented for examination is my own work and has not been written for me, in whole or in part, by any other person(s). I also undertake that any quotation or paraphrase from the published or unpublished work of another person has been duly acknowledged in the work which I present for examination.

Signed: 

(Dion van Niekerk)

Date: 15/01/2002

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Abstract

Science has featured intermittently as the subject of theatrical texts since Thomas Shadwell first represented the Renaissance scientist in The Virtuoso (1676). The late twentieth century, however, saw an incremental growth in theatre's interest in scientific exploration, a growth concommitant with the vast impact that science has had on technology, warfare and the machinations of political power. The tensions generated by the disjuncture between the rationality of science and the unpredictability of human society have provided a rich source of material for theatrical investigation into the human experience. The purpose of this thesis is twofold: to reveal some of the thematic concerns that emerge in this genre, and to examine the interplay between theatre and science. Shelagh Stephenson's An Experiment with an Air Pump (1999) provides a useful point of focus for this inquiry. By parallelling two time periods, exposing the scientific objectification of women and, in addition, opening up contemporary ethics for negotiation with the audience, Stephenson calls into question the objectivity and certainty of history, gender and ethical conduct. These she presents as dynamic and evolving fields of discourse that contribute to, but do not solely constitute, knowledge and understanding of the world. An Experiment with an Air Pump also displays an awareness, through its meta-theatricality, of theatre itself as an imaginative, subjective discourse which parallels the more intuitive and personal aspects of scientific exploration. The play functions as a microscope, bringing into focus a contemporary world in which traditional systems of understanding and knowledge need to be reassessed and reinvented.

Contents

Pencil, ink marks and highlighting ruin books for other readers.

INTRODUCTION

i. The Science Plays

Although science has become an increasingly popular theme for theatrical exploration, very little academic literature has taken cognisance of this development, and researchers of this aspect of theatre are best served by directing their attention towards scientific journals and articles where this trend seems to have attracted at least the attention of some members of the scientific community. Two such articles, by W. Brouwer, 'The image of the scientist in modern drama' (1988) and 'The image of the scientist in modern drama (Part 2)' (1994) are particularly useful as starting points for an inquiry into theatre's growing interest in a field traditionally designated the opposite corner to the arts in the arena of human experience.

Brouwer cites Thomas Shadwell's The Virtuoso, written in 1676, as the first play featuring a Renaissance scientist in its cast of characters. Although Ben Johnson's The Alchemist (1610) and Christopher Marlowe's Dr Faustus (1592) were written considerably earlier, neither of these plays recognise the emergence of Francis Bacon's "New Method" of science in the early seventeenth century, a method that sought to integrate science and technology, thus ending science's indifference to the practical application of its conclusions. (Forbes and Dijksterhuis, p.10). Brouwer also notes that while scientists have featured intermittently in plays written in the eighteenth and nineteenth centuries, it is in the twentieth century, and especially since 1945, that science and scientists began to command serious attention on the world's stages.

The devastating potential of scientific discovery, particularly in the light of nuclear warfare, prompted a reaction from theatre that saw dramas debating the implications of

scientific endeavour. Bertold Brecht's Life of Galileo, originally written in 1938 with the title The Earth Moves, underwent several revisions during World War II, the final version being a direct response to the bombing of Nagasaki in 1945 (Esslin, pp.54-88). Shortly after the play performed in New York, 1947, Brecht was called to appear before the House Committee on Unamerican Activities, led by Joseph McCarthy. The wave of anti-communism inspired by 'McCarthyism' provided the source for Heinar Kipphardt's In the Matter of J. Robert Oppenheimer (1969), a dramatic reconstruction of the proceedings initiated against Oppenheimer by the U.S. Energy Commission which sought to prosecute Oppenheimer for delaying the production of the hydrogen bomb. The discovery of great power by scientists is also the central theme of William Golding's The Brass Butterfly (1958), Charles Morgan's The Burning Glass (1953), Friedrich Dürrenmatt's The Physicists (1964) and Carl Zuckmayer's Das Kalte Licht (1960), all of which respond to the advent of a nuclear age.

Although science plays covering a broad spectrum of scientific issues, discoveries and personalities were written during the 1970s and 1980s, these were not decades overly concerned with the scientific world, the discourse engendered by the nuclear age having been exhausted in politics, society, film and literature. The success of Robert Wilson's Einstein on the Beach (1976) owed more to its theatrical innovation than it did to its familiar subject and, similarly, Andrew Buckland's Thing? (1986), drawing on the Quark Model for its analogy of human development, was received as an important contribution to the theatre of mime, rather than as an inquiry into the scientific universe.

It was the end of the 1980s and the last decade of the millennium that inspired another wave of active engagement in the procedures and consequences of scientific exploration, a trend that paralleled revolutionary advancements in mathematics, physics, bio-technology and computerisation (Spielberg and Anderson, pp.231-235). The plays that

emerge as significant in this period include Tom Stoppard's Hapgood (1988) and Arcadia (1993), Timberlake Wertenbaker's After Darwin (1998), Michael Frayn's Copenhagen (1999) and Shelagh Stephenson's An Experiment with an Air Pump (1999).

A discussion of the interplay between theatre and science could well incorporate a thorough investigation into all of these works (and the many that could not be accommodated by the limits of this study) and into the thematic links between them. However, this thesis will focus mainly on An Experiment with an Air Pump, one of the last important science plays of the previous millennium and, to my mind, the most representative of the present stage of evolution in the development of the science play. And within this contraction, further discernment will be exercised as the most pertinent and current themes are chosen for more detailed discussion. This narrowing of focus should nonetheless highlight the current position of the science play and should serve as a useful starting point for further research.

ii. An Experiment with an Air Pump

Stephenson's play parallels two plots, one set in 1799 and the other in 1999, both playing out in the final days of their prospective centuries. The setting for the two stories, both centering around women, is the same - a large house in Newcastle, England. In the 1999 plot, Ellen, a genetics scientist, and her husband Tom, an English lecturer, find themselves on the verge of a new millennium and a new life as they pack up their belongings and prepare to move out of the huge historical home that they can no longer afford to maintain. In addition to this move, Ellen is troubled by a job proposal she has received, inviting her to join a company that is engaged in the plotting of the human genetic code. The offer is financially attractive and recommended by her friend Kate, a scientist who already works for the company, but Ellen is concerned by the ethical

implications of offering up her services as a foetal diagnostician to the corporate world. She debates her concerns with her friend, her husband and Phil, a builder who appears at intervals to survey the house in preparation for the renovations he has been commissioned to undertake. These discussions are the essence of the 1999 narrative that ends with Ellen finally choosing, on New Year's Eve, to accept the offer.

The 1799 story revolves around a Scots serving girl, Isobel, who finds herself in the service of Joseph Fenwick's household. Fenwick is a scientist, busily preparing for an end-of-the-century meeting of the Newcastle Lit and Phil Society, with the assistance of two younger scientists, Thomas Armstrong and Peter Mark Roget. As they go about their business, they must contend with a number of distractions: Susannah, Fenwick's wife, drinks herself into a state of inebriation, loudly bemoaning her status as an ignored wife and mother; Harriet and Maria, Fenwick's twin daughters seek advice on a play Harriet has written and for which they are rehearsing; and a riotous mob clamours for food in the streets outside the house. Isobel enters into this upheaval as a bit-part actress in the twin's drama, and attracts the attention of Fenwick and Roget because of a gift for language that belies her peasant background. But it is Armstrong who shows the most interest in Isobel, not because of her way with words, but because her twisted spine makes her an interesting anatomical anomaly. Armstrong sets about seducing Isobel in the hope of getting a closer look at her disfigurement, an objective he nearly achieves but for his boastful nature. Isobel overhears him detailing his deception to Roget and, broken-hearted, attempts to hang herself. She is rescued from the rope but once again falls victim to the cruel Armstrong who, alone and aware that Isobel's corpse would make for an interesting medical dissection, suffocates her. The story ends with a sombre private service for Isobel in the Fenwick home.

An Experiment with an Air Pump is interesting for its theatrical treatment of these two

plots. Stephenson juxtaposes the two stories by constructing them in alternating scenes, a device that allows for rhythmic variation and comparisons between the two stories. She also allows Ellen a moment to address the audience directly, at the start of the play, which heightens the theatricality of the play and offers additional insight into Ellen's character, motivations and personal dilemma; this convention will be discussed further in the following chapter. By calling for a doubling up of the actors playing certain characters, Stephenson again draws attention to the play's theatricality and again facilitates an alternative perspective on the two plots. This device too will receive attention in a later chapter.

Reviewers of the first runs of An Experiment with an Air Pump at the Manchester Royal Exchange, February 1998, and the Hampstead Theatre in London, October 1998, have acknowledged the play as a worthwhile contribution not only to the growing collection of science plays, but also to theatre. The Camden New Journal (29 October 1998) reported: "Recently this theatre gave us Timberlake Wertenbaker's excellent After Darwin and the history lesson continues with this absorbing and thrilling play; The Financial Times (19 October 1998) called the play "an effective *coup de theatre*"; and the Morning Star (29 October 1998) wrote that "Stephenson's writing enthralls with its intelligence and wit, producing a multilayered drama which, within the philosophical debate, never loses touch with the questions about the nature and importance of humanity which are at its root." More importantly, the play's critics recognised the perspective that An Experiment with an Air Pump offers on the processes of scientific research and discovery: "It is the scientific quest that links the play's two strands...the worrying model is the corruption of the inquiring mind which the quest results in" (Morning Star, 29 October 1998); "Her second play again explores women's lives in a house haunted by the past, but also ambitiously embraces the history of science and social politics" (The Daily Telegraph, 24 February 1998); "Stephenson's play poses the

question of whether the aim of science is to understand the world or change it, but also deals with the clash between the arts and the sciences, the role of women and social status across the 200-year divide (Broadway Ham and High, 16 October 1998).

Although An Experiment with an Air Pump touches on many themes that link it to other science plays, including science's uneasy relationship to religion and to politics, I have chosen to focus further discussion of the play around the common aspects recognised by the above reviews: the play's engagement with history, gender and ethics. History and ethics are themes common to many science plays, while issues of gender have rarely been addressed in this context. The conclusion of this discussion will address the confluence of science and art recognised by Stephenson in An Experiment with an Air Pump.

CHAPTER ONE:

REPRESENTING THE SCIENTIFIC PAST

The predominant structural feature of An Experiment with an Air Pump is its double-narrative. The play unfolds in episodes that alternate between two plots situated in time-periods two hundred years apart. The link between these narratives, between past and present is established almost immediately as Ellen, dressed in contemporary clothing, is transformed into an eighteenth century Englishwoman, Susannah. As the transformation takes place, Ellen addresses the audience, referring to projections of Joseph Wright of Derby's painting, 'An Experiment on a Bird in the Air Pump'. At the end of her monologue she joins a *tableau vivant* of characters, suggestive of the painting, and the first narrative, set in 1799, begins. Ellen's prologue indicates that this narrative is a fanciful creation of Ellen's, inspired by Wright's painting, and as the contemporary scenes of An Experiment with an Air Pump begin to unfurl later in the play, it becomes clear that this story is an imaginative illustration of a personal dilemma that she, as a scientist, is faced with in the present, in 1999.

'An Experiment on a Bird in the Air Pump', painted by Wright in 1767 -68 depicts an experiment demonstrating that life could not exist in a vacuum. The programme notes for the London premier of Stephenson's play describe the nature of this experiment:

> The airpump was a German invention of the mid-17th century, consisting chiefly of a glass globe, into which a living creature was placed. Most of the air was then pumped out of the globe, which caused the creature to become convulsed as it suffocated. Air was then readmitted in time to revive the creature: this is what the scientist, who is the focal point of the picture, is about to do.

For Ellen, this painting is representative of the role of the scientist and science. As she explains in the opening monologue:

> This painting described the world to me. The two small girls on the right are terrified he's going to kill their pet dove. The young scientist on the left is captivated, fascinated, his watch primed, he doesn't care whether the dove dies or not. For him what matters is the process of discovery. The two young lovers next to him don't give a damn about any of it ... But the elderly man in the chair is worried about what it all means. He's worried about the ethics of dabbling with life and death. I think he's wondering where it's all going to end. He's the dead hand of caution. He bears the weight of all the old certainties and he knows they're slipping away from him, and from his kind.
>
> (Experiment, p.4).

Ellen is articulating a tension that she recognises in the artwork, a tension generated by the responses of the observers to the experiment being conducted. One the one hand is the progressive spirit of the young scientist who revels in "...the process of experiment and the intoxication of discovery" and, on the other, the conservative caution of the old man who is "...worried about the ethics of dabbling with life and death". This is the tension that plagues Ellen who must weigh her love of science, and the opportunity to earn a better salary, against her own moral qualms about foetal diagnostics. For Ellen, the painting represents perfectly her inner dilemma: the "drama at the centre of it all", is the same drama that characterises her "ethical crisis" (Experiment, p.36).

Wright's painting is an artistic representation of the Age of Enlightenment. In A Glossary of Literary Terms (1987), M.H. Abrams describes the Enlightenment as:

> ... an intellectual movement and cultural atmosphere which developed in western Europe during the seventeenth century and reached its height in the eighteenth. The common element was the trust in man's reason as adequate to solve all the important problems and to establish all the essential norms in life, together with the belief that the application of reason was rapidly dissipating the darkness of superstition, prejudice and barbarity, was freeing man from his earlier reliance on mere authority and unexamined tradition, and was preparing him to achieve an ideal existence in this world.
>
> (Abrams, p.49).

The painting exemplifies the illuminating effect of scientific reason through its portrayal

of light. The people surrounding the experiment are all lit by the glow of the experiment, suggesting that the quest for understanding, through observation, is illuminating their lives, "dissipating the darkness of superstition" and ignorance. Wright chooses to represent a cross-section of eighteenth century society in the work, demonstrating the far-reaching effects of an enlightenment brought about by scientific discovery. The painting involves both scientists and lay-people. The assembly of observers is made up of active researchers and passive observers, men and women, young and old, all of whom are anticipating the outcome of the experiment, all of whom will be impacted upon by the result. The painting is a metaphor for the age, attempting to capture a moment in time, a scientific moment that could radically affect future thought and understanding. According to Rempel (2001):

> We can call the eighteenth century the age of enlightenment because it was both a culmination and a new beginning. Fresh currents of thought were wearing down institutionalized traditions. New ideas and new approaches were setting the stage for great revolutions to come.
>
> (Rempel, p.1).

This was an age greatly influenced by scientific discovery. Isaac Newton's (1642-1727) formulation of universal laws to which the cosmos adheres, impacted greatly on thought and progress. The notion of a discoverable causality (and its practical application, "determinism") gave rise to the notion of "natural science", a science of philosophy, history and social science that emphasised the importance of observation in the accumulation of knowledge. Philosopher, John Locke (1632 - 1704), whose interests included the sciences, pre-empted the Enlightenment's concern with empiricism, an epistemological method that denied innate ideas and derived all knowledge and opinions from sense experience (Urmson, p.159). Pierre Bayle paralleled these ideas in the field of historical criticism (1697), developing a method that insisted on the acquisition of reliable and incontrovertible facts of history, an objective examination of the human record, a method that prevailed amongst historians during the eighteenth century. Social

commentators proposed a natural rights theory, epitomised in the writings of Montesquieu (especially Spirit of the Laws , 1748), Jean-Jacques Rousseau and the Encyclopedists, who believed in "...metaphysical norms to which society must conform. Hence natural religion, natural morality, natural rights, and natural economies should prevail." (Rempel, p.5) Rousseau, in particular, appealed to an increasingly literate public with his passionate assertion of "...the moral and legal equality of man, the sovereignty of the people and the authority of the general will" (Rempel, p.5). The idea of equality spread throughout the Western world, fueling a growing spirit of dissatisfaction with aristocratic systems and colonial control. Great revolutions marked the period: a Cossack revolution occurred in Russia, a peasant revolt was recorded in Austria and, of course, the French Revolution took place in 1789 (Unstead; pp.86-87). Another significant manifestation of this call for equality and freedom occurred across the Atlantic Ocean as the American Colonies declared their independence from the rule of the British Empire, an event that, along with the French Revolution, gave impetus to a riotous spirit developing among the working classes of Britain.

Britain's industrial development in the 18th century was incremental, a direct result of scientific progress and technological invention. The invention of the Steam Engine and the Spinning Wheel revolutionised industry. Britain became a leading producer and exporter of textiles and iron. These industries, alongside the mining of coal to fuel steam-driven engines, lead to the emergence of the factory system and this, in turn, accounted for the rise in urbanisation as agricultural workers moved to industrial centres in the hope of finding more profitable employment. But, for the most part, this was a vain hope. Britain's wars against Spain, America and France during the 1700s closed the doors on much of Britain's foreign trade, and optimism turned to despair as the export market declined and employment opportunities decreased. With unemployment rife, wages low and living conditions unbearable in towns ill-equipped for the influx of job-

seekers, a growing dis-ease characterised the streets of England's major urban centres. Riots, inspired by hunger and fueled by the notion of equality and natural rights, erupted frequently during this period (Unstead, pp. 80-86).

It is this atmosphere of revolution, in the sciences, society, thought and politics, that predominates scene one of the play. From outside the house the *"... sounds of rioting ... breaking glass, a baying mob, crashes, screams etc."* (Experiment, p.5; omissions mine), indicate a late eighteenth century Newcastle beset by a disgruntled public, making riotous demands for a decrease in the price of fish. Although Susannah feels besieged by the "...crazed mob, mad on drink and wild for blood" (Experiment, p.6), Fenwick's determined search for appropriate lectures for the New Year's meeting of the Newcastle Literary and Philosophical Society continues unabashed. Stephenson presents her audience with the spirit of scientific progress, embodied in Fenwick and further illustrated by the surrounding litter of his scientific paraphernalia, framed by societal and political upheaval. The on-stage and off-stage realities, as well as an awareness of the impending new century, are constructed to capture the mood of a *fin de siecle*. Fenwick's criteria for the selection of suitable papers further articulate this climate of radical change:

> We're talking about New Year's Eve for God's sake. The last night of the century. Has this fact bypassed these people? We want something worthy of the past and fired by visions of the future. We want to excite the audience, exhilarate them, we want to celebrate the intellect, march towards a New Jerusalem with all our banners flying. We discussed this at the last meeting. What did we say our aim was? 'A lively ferment of minds producing a radical vision for the new century.'
>
> (Experiment, p.8).

The notion of an age of scientific enlightenment is obviated by the variety of proposals that Fenwick and his assistants are sifting through for the meeting of the "Lit and Phil". Stephenson refers here to an actual society that was established in 1793 and has survived

into the twenty-first century. The Hampstead Theatre's programme notes for their production of An Experiment with an Air Pump explain that the "Lit and Phil" was set up for the discussion and argument of a variety of subjects ranging from medicine, chemistry and natural philosophy to literature, antiquities, commerce and the arts. The proposals which Stephenson's scientists are considering indicate the Enlightenment's trend towards the "natural science" of observation recognised by Rempel: 'On the Fundamental Laws of Vegetable Bodies, Whether Plants Have A Principle Of Self Preservation, And The Irritability of Plants In General' (Experiment, p.8); 'A History of the Flute from Roman Times to the Present Day' (Experiment, p.11); and 'The French Revolution. Success Or Failure? Its lessons for the New Century' (Experiment, p.10). Stephenson is clearly attempting to create a sense of historical authenticity.

Recourse to the past as a source for the material of the drama, is a frequent feature of plays dealing with science. William Golding's The Brass Butterfly, for instance, draws on the Rome of Julius Caesar for an examination of the conflict between naive rationalism and the destructive impulses of humankind, the same themes explored in Golding's famous novel, The Lord of the Flies (1954). Heinar Kipphardt's In the Matter of J.Robert Oppenheimer refers to events that pre-date the writing of the play by twelve years, using transcripts of the trial of Oppenheimer as the source for a dramatic reconstruction of those events, while Bertold Brecht's Life of Galileo focuses on the 17th century in its presentation of the consequences of scientific discovery. In the last two decades of the 20th century, this trend has become more evident with plays like Copenhagen, Arcadia and After Darwin all rooting themselves strongly in historical representation.

In his book, What is History? (1954), V. Gordon Childe adopts the Marxist opinion that the progress of humankind is intricately bound up in the processes of scientific and

technological discovery, that the continuing discovery and invention of tools for the control of the environment, for production and for warfare have provided a more accurate historical model than any social order. Control of the natural environment, he asserts, has yielded more advances than any attempts to control the social environment, a result of "...the absence of any science of society, the failure of sociology to become genuinely empirical and the impossibility of conducting experiments under laboratory conditions in human relationships." (Childe, p.2) It is perhaps this very distinction between scientific empiricism and social unpredictability that has engendered a corresponding interest in history in many science plays. The disjuncture between the rationality of science and the unstable nature of human society is an historical theme that provides a rich source for theatrical exploration into the human experience.

The Age of Enlightenment provides Stephenson with just such a source; the emerging new scientific order, one of rationalism, indicating a quantum leap in progress and technological advancement, underscored by social and political revolution. However, despite accurate historical reference, Stephenson is at pains to remind her audience that the 1799 story is an imaginative reconstruction. She makes use of a number of distancing techniques to keep the audience at arm's length. The episodic structure of the play with scenes alternating between past and present, a format reminiscent of Brecht's Epic Theatre, enforces a comparison between the two time-periods, and allows time for reflection on the action of both ages. This is visually reinforced in Act 1, Scene 3 when Isobel and Armstrong, *"frozen in time"* (Experiment, p.48), share the stage with Tom and Ellen who are discussing the corpse discovered below their house. The connection between the skeleton and Isobel is established, giving the audience an ironic distance when the action once again focuses on Armstrong's seduction. A similar distance is established in the Maria/Edward sub-plot as a naive Maria fails to recognise Edward's growing interest in Miss Cholmondely as a threat to their relationship - the developing

affair should be easily recognised by a suspicious audience who, unlike the artless Maria, would detect the hints at infidelity in Edward's frequent references to Miss Chomondley's adventures in India. Stephenson's sketch of Roget also provides a number of moments of dramatic irony, facilitated by the audience's awareness of Roget's impending fame not as a "great physician" but as a "man who made lists" (Experiment, p.71). A similar effect is achieved in Act One , Scene 3 when Fenwick and Roget discuss the British monarchy. Fenwick's prediction that "...the monarchy will disappear, Roget, it's inevitable" (Experiment, p.44), acquires ironic perspective in a present day performance, and Susannah's interjection might easily be the voice of a contemporary, tabloid-reading English commoner:

> I feel sorry for them, poor creatures. So much responsibility, so much money, and so badly dressed. The last time I saw the queen she looked like a catastrophe in a cake shop -
>
> (Experiment, p.45).

Mostly, this irony is used for comic effect, and it is comedy that cements the *verfremdung* of the 1799 scenes. The plot is styled along the lines of the Bourgeoise (or Domestic) Tragedy popular in the eighteenth century, a form of tragedy involving a protagonist from the lower classes who falls victim to a commonplace or domestic disaster (Abrams, p.204). But the full extent of Isobel's tragedy is undermined by the use of comedic conventions that serve to discourage a complete Aristotelian empathy. For instance, Fenwick and Susannah's dysfunctional marriage shows a promise of redemption by the end of the play as the two soberly discuss the state of their relationship, a resolution more common to comedy than tragedy. And Isobel's involvement in the sisters' farcical play-within-the play, is an amusing comic sub-plot more suited to a Jane Austen novel than to the Gothic dimensions of the 'Obsessed Scientist and Deformed Servant' main plot.

A strong reinforcement of the distancing that Stephenson encourages in the play comes

from the play's self-awareness, the use of meta-theatricality. This is established early on when Fenwick alikens the riots to the structure of a play:

> Maria. A riot is like a play. Action, reversal, climax, catharsis and we all go home. A relief, generally speaking, in a play. Disappointing in a riot, but true nevertheless.
>
> (Experiment, p.13).

The sisters' play adds to this meta-theatrical awareness by focusing on the point of tension set up by Stephenson at the start of An Experiment with an Air Pump. Their "hymn to progress" (Experiment, p.15) pits the forces of scientific advancement, "Empire, Industry, Science, Wealth and Reason" (Experiment, p.15), against the bliss of "Pastoral Innocence" (Experiment, p.16). The playlet becomes a microcosm for Stephenson's *grand motif*, and a reminder that this theme is being explored, theatrically, in the larger dimension of An Experiment with an Air Pump itself.

These effects all serve to distinguish the historical plot as an artistic reconstruction that draws on historical facticity, but is beholden to its own recreation, and is a subjective revisiting of a past epoch. This approach is a marked feature of science plays written at the end of the millennium; the past is no longer used only as metaphor for the present (as it is in The Brass Butterfly and Life of Galileo), but is given an autonomy, an identity linked to, but distinct from, the present. And it is interesting to note that the double narrative, an historical story presented in conjunction with a contemporary one, is a favoured strategy for emphasising the artistry of historical reconstruction.

After Darwin, for instance, juxtaposes a contemporary (late 1980's) setting with a Victorian past. The Victorian segments of the play recount Wertenbaker's version of events aboard The Beagle, the ship that carried Charles Darwin around the world, and on which he began to formulate his theories of Natural Selection. The plot focuses on the conflict that arises out of Captain Fitzroy's inability to reconcile his staunch Christian

beliefs with the implications of Darwin's theories. The Victorian scenes are revealed early in the play to be the rehearsals for a contemporary production of a play based on Darwin, and the interactions between the actors, director and playwright make up the present day scenes that intersperse the rehearsals. This structure encourages a *verfremdung* similar to that achieved in An Experiment with an Air Pump. Switches between the two narratives, an overt meta-theatricality, and the episodic nature of the play, unashamedly Brechtian, all promote an awareness of the artifice of the Darwin and Fitzroy story and, subsequently, of how it has been manipulated to suit the intentions of the author. Wertenbaker exploits the metaphor of evolution to draw attention to the nature of the development of ideas and images, showing how the details of the past are consciously adapted by the artist, through a process of selection, to best suit the demands of the present day.

Stoppard's Arcadia, which, like An Experiment with an Air Pump, also hearkens back to the Age of Enlightenment as the source for the historical plot of its double narrative, draws attention to its artificiality and, in so doing, demonstrates an active engagement in the notion of historical research into the past. The 1809 plot is paralleled by an investigation, in the 1990's plot, into the details of three consecutive evenings in 1809, an investigation that is informed by factual evidence but thwarted by the variety of interpretations that evidence must suffer. Melbourne (1998) notes Stoppard's application of a mathematical model to the structure of the play, a structure that demonstrates, through its "interaction of the unpredictable and the predetermined" (Melbourne, p.557), that "Arcadia [is] no imitation of real-world space and time, but a self-consciously artistic creation - an aesthetic object." (Melbourne, p.557) She develops her argument to suggest that:

> The fragmented story and plot lines in Arcadia rearrange sequence and causality just as a Cubist painting rearranges elements of reality into a

> new configuration in order to highlight underlying shapes often masked by habitual modes of perception.
>
> (Melbourne, p.557).

Melbourne goes on to demonstrate how Stoppard has dramatically employed the fundamental premises of Chaos Theory to give a fresh and modern perspective on the nature of knowledge and, in particular, historical knowledge. The play's characters, she points out, are limited in their knowledge of the world by definitions of space and time, and can never have a universal understanding. Thomasina and Septimus can guess at, but never know, the implications of Thomasina's discovery of Iterated Algorithms, a mathematical system that will, two hundred years later, be rediscovered as the central premise of Chaos Theory. And, on a more personal level, Thomasina will never know the full extent of Septimus's feelings for her, feelings that will ultimately drive him into a hermitage. Similarly, the researchers, Hannah and Bernard, must deduce the happenings of the past from selected evidence, but cannot recreate the events of 1809 beyond a shadow of a doubt. It is the audience who, with their privileged perspective, have the most comprehensive knowledge of the two worlds; it is they who will be alert to inter-period references, to the miscalculations and indefinite conclusions of the characters and to repetitions in Stoppard's motifs. Alwes (2000) also recognises this effect:

> It is not only that Stoppard's play covers two different historical moments, it is also the way that the characters repeatedly remind us that we are "outside" of the play, that our perspective is larger than theirs, that underwrites the play's final effect. When the twentieth-century researchers, Hannah and Bernard, are trying to reconstruct the earlier historical moment from documents and fragments, they each are forced to acknowledge that they cannot be certain about their conclusions because "I wasn't there, was I?" (57). The scholar's lament in the face of incomplete knowledge, however, underscores the completeness of our own. We were there. Like God, we see the two historical moments as a single moment on stage - an eternal present.
>
> (Alwes, p.393).

By paralleling the two story lines, and allowing the audience a dual perspective not

afforded to the characters, Stoppard denies knowledge based on the Newtonian principles of causality, and presents a new, artistic understanding of the world, one which incorporates "the notion of repetition and variation on possible eternal verities." (Melbourne, p.563)

Although Copenhagen does not make use of a dual narrative, the play does also confer on the audience a privileged perspective by distinguishing the immediacy of the theatre event from the historical present. All three characters operate within the two time frames, but it is mainly Bohr's wife, Margrethe, a non-scientist, who functions as the intermediary between the two times, sometimes participating in the action, sometimes addressing the audience directly, always a reminder of the artifice of the play. The action that she comments on is situated mostly in the attempt by Bohr and Heisenberg to reconstruct their past, an effort that is frustrated by differences in perspective. But it is through these differences that Frayn is able to comment on the elusive nature of historical accuracy. And, as with Arcadia, the metaphors are drawn from scientific models. When Bohr says of particles and waves, " We have to choose one way of seeing them or the other. But as soon as we do we can't know everything about them" (Copenhagen, p.36), Heisenberg responds, "So we can't completely understand your behaviour without seeing it both ways at once, and that's impossible, because the two ways are mutually incompatible" (Copenhagen, p.36). This argument derives from Heisenberg's own famous Uncertainty Principle, another scientific metaphor used by Frayn to describe the difficulty in accurately recapturing the past. Johnson (1998) points out in his review of the first London production of Copenhagen:

> The play is not so much about the science itself, however, as it is about how scientific ideas can help us to understand the manifold possibilities the future holds, and how history consists of a constant transformation from this indeterminate future, through the present to a single past. Copenhagen asserts that human motives are knowable only within definite limits. The characters in the play argue that even the past is

> difficult and, in terms of motives, impossible to determine. Frayn compares the psychological difficulty of understanding motive with the difficulty in simultaneously measuring the movement and speed of subatomic particles, which is the subject of Heisenberg's Uncertainty Principle.
>
> (Johnson, p.3).

The play is an hypothesis, of course, and as such must be viewed as an artistic creation sourced from the past and shaped to question the nature of history and expose the ambiguities of truth.

It is apparent then, that After Darwin, Arcadia and Copenhagen, are not concerned so much with an accurate reconstruction of the past, as they are with supplying a model whereby interpretations of the past can be called into question. In other words, these plays function, to a large degree, as interrogations into the very meaning of history itself. In *Re-Thinking History* (1991), Keith Jenkins discusses the notion of history, as a discipline, being an authoritative account of the past. He argues that:

> ...the past and history are not stitched into each other such that only one historical reading of the past is absolutely necessary. The past and history float free of each other, they are ages and miles apart.
>
> (Jenkins, p.5).

Jenkins points out that the writing of history has a number of epistemological problems; knowledge of the past cannot be absolutely concretized; historians are required to be selective because of the sheer bulk of the past, and they have to interpret events through a personal understanding. Also, their narratives are constructed, through language, to become written texts. This can be problematic for texts are open to a multiplicity of interpretations, interpretations that are subject to the context of a reading. But the context of a reading never repeats itself, and so "each reading is another writing" (Jenkins, p.24). The historian, says Jenkins, is not a conveyor of absolute truth; she is rather an interpreter of facts, accounts and versions of what has happened in the past. He proposes a re-thinking of the terms 'history' and 'the past', suggesting that the writings of

historians be considered as 'historiography'. He goes on to suggest that historiography be considered "...not as an extra to the study of history, but as actually constituting it" (Jenkins, p.12). The implication here is that the way the past is interpreted is as crucial to a reflection on the past as the events of the past.

Carklin (1998) points out a vital aspect of Wilson-Tagoe's argument in Historical Thought and Literary Representation in West Indian Literature (1998):

> We should also note Nana Wilson-Tagoe's argument, however, that "an imaginative interpretation of the past offers leeway for creating meanings over and above the existing historiography" (Wilson-Tagoe, p.x). She suggests that such a construction of history is also in part an act of definition, and that what distinguishes drama from other fictive forms is its ability to focus on the "complex ramifications of a particular problem, making its medium less amenable to history's linear portrayal of events and their causal links. It recognises drama's performance aspect and sees its ability to mobilise and disperse emotions within performance as a different way of relating to history" (Wilson-Tagoe, p.7). In this light then, we are concerned with drama as both part of the experience of daily life and as a reflection and interpretation of that life.
>
> (Carklin, p.3).

These sentiments are echoed by David Kerr's report, 'A Vision in a Dance: Negotiating History and Myth Through Theatre' (2000):

> ...the "truth" of historical drama is a normative, complex construct between both sources and ideology, past and present, not to mention between players and audience. As such, it can never be identical to the densely footnoted "truth" of the history books, ever striving for objectivity. Drama should not lose sight of that objective truth, but its real fires are stoked by moral passion and the urge to create aesthetic sense out of history's chaotic contingency.
>
> (Kerr, p.172).

The manner in which Experiment, After Darwin, Copenhagen and Arcadia draw attention to their reconstructions of the past suggest the playwrights' awareness of these same understandings of the past, history and historiography. Rather than attempting to portray an objective "truth", they have constructed artworks that draw on the past to

extract the essence of the lived human experience. The works also promote a self-awareness of this selectivity, and encourage the audience to suspend insistence on factual representation in favour of interpretation. In An Experiment with an Air Pump, Stephenson chooses to focus her attention on the conflict between rational advancement and passionate revolution, using the double narrative structure to parallel the problems of the 18th century with the dilemmas that might be faced by a scientist in the 20th century. It is this comparison that allows Ellen and, through a privileged perspective on both worlds, the audience, to contemplate, compare and contrast the past and the present in a consideration of the future.

CHAPTER 2:

THE GENDERISATION OF SCIENCE

In Reflections on Gender and Science (1995), Evelyn Fox Keller argues that science has historically been associated with masculinity and objectivity, and notes that academic criticism of this relationship has been virtually non-existent. She asks:

> Why is that? Is it not odd that an association so familiar and so deeply entrenched is a topic only for informal discourse, literary allusion, and popular criticism? How is it that formal criticism in the philosophy and sociology of science has failed to see here a topic requiring analysis? The virtual silence of at least the nonfeminist academic community on this subject suggests that the association of masculinity with scientific thought has the status of a myth which either cannot or should not be examined seriously.
>
> (Keller, p.75).

She proceeds to point out that the popular view of science as a masculine domain cannot be attributed solely to the fact that the scientific community is, and always has been, made up mostly of men. Science, she suggests, is firmly entrenched in social and psychological conceptions as a male enterprise, and that this 'genderization' has come about through the description of reality that science offers. It is science that has divided the world into "the knower (mind) and the knowable (nature)" (Keller, p.70), and goes further to prescribe a relationship between the two in which their interactions, a consummation of their union, provides knowledge. Keller argues that mind and nature are assigned gender; the mind, rationality and logic become masculinised, whilst nature, emotionality and sensory experience are feminised (Keller, p.79). Over and above that, the scientific mind is distanced from the natural world, from what is knowable so that "...its autonomy - and hence the reciprocal autonomy of the object - is guaranteed" (Keller, p.70). The masculinisation of the scientific mind becomes significant for Keller because:

> Masculine here connotes, as it so often does, autonomy, separation and

> distance. It connotes a radical rejection of any commingling of subject and object, which are, it now appears, quite consistently identified as male and female.
>
> (Keller, p.79).

The genderization of science may have attracted very little academic attention, but theatre has displayed even less concern with the implications of this separation of masculine and feminine modes of knowledge, with the scientific association of the subject with a male world order and the characterisation of the object as female. An Experiment with an Air Pump is a rare example of an awareness of this dichotomy, and must be noted for Stephenson's theatrical deconstruction of this historically entrenched ideology.

As Ellen addresses the audience for the opening monologue of An Experiment with an Air Pump, the stage directions call for two dressers to come on stage and transform Ellen, in front of the audience, and by degrees, into Susannah. The audience sees her gradually change from being "dressed casually" (Experiment, p.3) into being a corseted, bewigged eighteenth century woman, all the while delivering her monologue as Ellen, a modern day scientist. This opening image draws attention to Ellen's physicality and, by extension, Susannah's physicality. The audience is confronted with a physical transformation that runs concurrent to, but is uninformed by, and distinct from, the monologue that is being delivered. This device serves to bridge the divide between Stephenson's two time periods but, more importantly, it signals a need to view the ensuing drama in terms of gender.

This prologue to An Experiment with an Air Pump indicates an awareness of some of the major aspects of feminist theatrical practice and critique. In Feminism and Theatre (1988), Sue-Ellen Case outlines a "new poetics" for theatre:

> New feminist theory would abandon the traditional patriarchal values embedded in prior notions of form, practice and audience response in

> order to construct new critical models and methodologies for the drama that would accommodate the presence of women in the art, support their liberation from the cultural fictions of the female gender and deconstruct the valorisation of the male gender...This 'new poetics' would deconstruct the traditional systems of representation and perception of women and posit women in the position of subject.
>
> (Case, p.115).

A vital strategy in cementing these poetics is the consideration of the semiotics of theatre, those signs that interact in their production and communication to produce meaning. For Case, an awareness of the "semiotic constitution of the performance text" (Case, p.116) becomes a useful notion for deconstructing patriarchal systems of representation, for it is through imprinting the imposition of values and beliefs on the sign, 'cultural encoding' (Case, p.116), that dominant ideologies are able to prescribe meaning. With this in mind, she points out that:

> Feminist semiotics concentrates on the notion of 'woman as sign'. From this perspective, a live woman standing on the stage is not a biological or natural reality, but a fictional construct, a distillate from diverse but congruent discourses dominant in Western cultures. In other words, the conventions of the stage produce a meaning for the sign 'woman', which is based upon their cultural associations with the female gender.
>
> (Case, p.118).

Stephenson demonstrates an acute awareness of the cultural encoding of the sign 'woman', by constructing her historical counterpart before the audience's eyes. They are witness to two commentaries on the presentation of women, commentaries that work in opposition but simultaneously. Firstly, the audience sees Ellen being corseted and clothed in layers, taking on the apparel of the 'historical' woman. Within this action a deconstruction of the semiotic presentation of the twentieth century woman is played out; the sign 'woman' is given a cultural and historical context that presents Ellen as being more than just a woman here and now, but as representing an image of social change. Who she is now, is determined by where she fits into the cultural and historical order. Secondly, the audience is witness to the re-construction of 'woman' in the eighteenth century. Layer by layer, Susannah is constituted in front of the audience. As

the finishing touches are applied, the fictional, cultural and historical representation of woman, and the artificiality of that construct, are obviated. This double commentary demonstrates a semiotic awareness on Stephenson's part, and a conscious attempt to foster that same awareness in the audience.

Also crucial to the feminist project is the notion of the male gaze and the objectification of women. This is a notion whose main exponents include the French feminist theorists, Helene Cixous, Luce Irigaray and Julia Kristeva, but has also found popularity with other feminist writers influenced by the theories of psychoanalyst, Jacques Lacan. (Aston, p.35/6) The essential argument for these theorists is that theatre has long been a patriarchal stronghold in which women have mostly been objectified; characterised as something 'other' than man (Aston, p.45). This 'otherness', they contend, has been reinforced by dramatic structure, visual representation and dramatic language, all of which embody a phallocentric order that denies women their subjectivity. For Cixous, this is a result of binary opposition, a phallocentric strategy for dividing up the world according to sexual difference. Lacanian analysis offers up the idea that the objectification of women is a psychosexual symptom; the division of the Self during development separates the feminine out from the masculine, making it 'other', but the longing for re-integration of the feminine into the self means an eroticisation of that 'other', which then becomes an object of desire to the male gaze. Feminist theorists agree that women have been denied narratives, language and authentic representation in theatre, these being under the authority of the dominant masculine order, and must seek to establish a position of subjectivity.

Stephenson addresses this particular goal by mediating the play through Ellen. Ellen acquires an authoritative and subjective presence through her engagement with the audience in the prologue, and establishes the narratives to follow as being about her, and

presented through her, even though Stephenson does not maintain Ellen's authorial presence - she never again addresses the audience directly. But the notion of woman as object is continued in Isobel's story. Case applies the concept of the male gaze and the objectification of woman to the traditional realist drama:

> A simple example of how everyone sees a play as a male would see it might be the way a play induces the audience to view the female roles through the eyes of the male characters. When the *ingenue* makes her entrance, the audience sees her as the male protagonist sees her. The blocking of her entrance, her costume and the lighting are designed to reveal that she is the object of his desire. In this way, the audience also perceives her as an object of desire, by identifying with his male gaze. This example illustrates one major cultural assumption - that the male is the subject of the dramatic action.
>
> (Case, p.119).

Stephenson subverts this phallocentric tradition in the 1799 plot by exploiting the romantic storyline and exposing the male gaze. The story takes on a romantic edge for Isobel who is seduced by Armstrong into believing that he finds her attractive despite the malformation of her spine. His seduction has all the elements of the romantic ideal: he calls her pretty, kisses her and gives her a book of poetry, Shakespeare's sonnets, pointing out a particular verse that suggests his infatuation. This plot subscribes neatly to the explanation of female objectivity given by Case. But Stephenson does not allow the audience to fall victim to the male gaze. Instead, she reveals it and allows it to condemn itself. This she achieves by exaggerating Armstrong's objectification of Isobel and allowing the audience access to his true motives, motives a lot less romantic than Isobel is led to believe. Armstrong reveals his misogynist attitudes early in the play, saying to Fenwick: "This goes to prove the point I was making earlier, sir: Keep infants away from the fireplace and women away from science." (Experiment, p.5) His duplicitous nature is then brought to the fore when, after declaring to Isobel that he considers her beautiful, Armstrong discloses his true interest in the servant:

> **Roget**: Pretty?
> **Armstrong**: She loves it. Ever woman loves a compliment. Especially a

plain one.
Roget: You're toying with her. It's cruel beyond belief.
Armstrong: No, I'm not actually. I don't find her plain at all. I find her quite fascinating.

He pours himself a glass of brandy.

A strange little thing isn't she? I wonder...
Roget: What?
Armstrong: I wonder what caused the hump.

(Experiment, p.25/26).

This, and Fenwick's assessment of Armstrong as a "clever young bastard, but cold of heart" (Experiment, p.47), establishes Armstrong as a callous, self-serving opportunist. He is interested in Isobel as a thing, a scientific curiosity to be examined for her 'otherness'. His cold-heartedness could be interpreted as a thirst for knowledge, but Stephenson is careful to show that his objectification of Isobel has psychosexual roots. He reveals the source of his fascination with Isobel, and his sexual delight in having a degree of power over her, to Roget:

Armstrong: ...So. I tell her I love her and so forth, right?
Roget: Yes...
Armstrong: I flatter her, look suitably love struck when she comes into a room, I call her beautiful -
Roget: But why? -
Armstrong: And eventually I get her into the sack.
Roget: That would seem to be a logical, if cynical progression. It's not in itself an explanation.
Armstrong: Oh, for God's sake, man, I get her in the sack which means she takes off her clothes -
Roget: Not necessarily -
Armstrong: I make sure she takes them off, that's the whole point because then I get to examine her beautiful back in all its delicious, twisted glory, and frankly that's all I'm interested in. D'you know the first times I saw it I got an erection?

(Experiment, p.85).

It should be noted that this interchange comes just before Maria's letter to Edward, the letter in which she severs contact with him because of his infidelity. Maria too has fallen

victim to the seductive lies of a man. However, she is fortunate enough to be able to vent her anger and accept that Edward is, in Harriet's words, "a fickle fool" (Experiment, p.81). Isobel is not so lucky, for while she might recognise, as the audience does, that Armstrong is a cruel villain, she also recognises her complicity in this tragedy, as the following excerpt from her suicide note suggests:

> '...How may I explain to you my fall from contentment to despair? I was never a loved thing; it was not a condition I had ever known. Recently, and most fleetingly, I discovered the rapture of that state. Now I know it to have been a fiction. My life stretches before me, and it is now a bitter road. All pleasure's pale now that I have felt love and may never feel it again. You will say that it was not a real love, and I would agree. **It was a lie and it was moonshine, but how happy I was to bathe in it watery glow.** Now my mouth is full of ashes. He caused dreams in me where none had thrived before, and I am without hope or consolation...'
> (Experiment, p.91; emphasis mine).

Isobel admits to enjoying the romance of the lie, a lie propagated by the romantic notions of the male gaze - Isobel only finds 'contentment' when she believes herself to be admired and loved by Armstrong.

It would be of interest to feminist critics that Maria's liaison is conducted through correspondence, and that it is through language that she is mislead by him, for this is precisely what has happened to Isobel too. She has been seduced by Armstrong's words and, when his imagination failed him, Shakespeare's. It is language, her one true love, that has deceived her and, ultimately, failed her: "Loving words as I do, I now find my vocabulary insufficient to describe my anguish." (Experiment, p.91) Whereas Maria can still use the written word to lash back at Edward, Isobel finds that she can only resort to a physical action as an expression of her despair - hanging herself. This is a strong reinforcement of the feminist engagement in the notion of the body, especially in the writings of Julia Kristeva. Kristeva subscribes to the Lacanian notion of a split between the pre-Oedipal (or Imaginary) and Symbolic orders, the pre-Oedipal order being a

human state that Lacan equates with the mother and that exists before the human being encounters the Symbolic order, equated with the father (Aston, p.46). It is the Symbolic that imposes the rules of society and language, and it is this state, according to Kristeva (and Cixous), that has denied women a voice. Instead of calling for a 'feminine language' as Cixous does (Case,p.128), Kristeva directs attention to the notions of subjectivity and marginalisation. The Symbolic order, she argues, is predicated on phallocentric rules, logical, scientific and causal in nature. Women, having no part in the establishment of this order and being therefore 'other' to the structure, find themselves marginalised and objectified. For Kristeva, the feminist project entails affirming the Semiotic order (Kristeva's adaptation of Lacan's pre-Oedipal order) - an order that resists definition but is akin to emotionality, instinct and physicality - and creating an interrelation between it and the Symbolic order. She believes that the Symbolic has subjugated the Semiotic and, in doing so, subjugated those who embody the order, namely women.(Oliver, p.33-58) Isobel's suicide becomes a theatrical manifestation of this subjugation of the Semiotic. Deceived by the Symbolic order, and denied consolation by that order, the embodied Semiotic order is destroyed.

However, Stephenson does provide some hope on a Semiotic level and in so doing extends her theatrical feminist discourse to include the approach of materialist feminism which "...underscores the role of class and history in creating the oppression of women" (Case, p.82). This she does by calling for the actors playing Fenwick, Susannah, Harriet and Armstrong to double up as Tom, Ellen, Kate and Phil. The effect here is intriguing on a number of levels. To see the actor playing Armstrong light a candle in the twentieth century, as Phil, for the dead body of Isobel, (Experiment, p.66) is a provocative irony. But it is the visual connections between Fenwick and Tom, Susannah and Ellen, and Harriet and Kate that reinforce an awareness of woman's history. In the twentieth century, Fenwick and Susannah's roles have been adjusted, and the modern husband and

wife reflect a society where women have access to occupations previously denied them, and find themselves more empowered both in the work market and at home. Ellen is regarded as a "brilliant scientist" (p.36), and the respect accorded her by colleagues and husband is in stark contrast to the marginalisation that Susannah feels when she cries out, " I want you to take me seriously, do you understand, Joseph?" (Experiment, p.78). It is this awareness, created in performance, by the embodiment of both characters by one actress, that highlights the progress achieved in women's liberation - at least in Britain. Freedom in education is highlighted by the distinction between Susannah, who has "...painted, read poetry and plays, a little Greek of course..." (Experiment, p.77), but knows nothing of politics and science (Experiment, p.78), and Ellen, who is a leading authority in genetic engineering. This is echoed in the associations set up by the doubling up of Harriet and Kate. In 1799, Harriet aspires to be a scientist like her father, an idea that seems preposterous to Susannah (Experiment, p.63) who, despite a cognisance of her own restriction, continues to propagate the cultural notion of the time that women should pursue more aesthetic ambitions. But on stage, in the semiotic order of the performance, Harriet achieves her goal in her incarnation as Kate, a scientist who wants "...to eat up the world...to tear it apart and see what it's made of." (Experiment, p.88; omission mine) Again, the advances in the scientific world's acceptance of women into the field are given prominence by semiotic association, through the recognition of bodies in different historical contexts.

Despite Stephenson's optimism, it should be recognised that women are still a significant minority in the sciences. As Timothy Ferris points out:

> The sciences began as a man's activity in a man's world, and remains mostly male today. Sexist attitudes are especially widespread in "hard" sciences like physics. Although growing numbers of women are to be found in the physical sciences, progress has been painstakingly slow. In the United States there was a widespread outcry when in 1999 the National Academy of Sciences elected only five female scientists among

> its sixty new members; the following year the Academy elected fifty-nine new members, and once again only five were women. The unwelcome result of this sort of inertia is that most sciences continue to recruit from only half the brain power of the human species.
>
> (Ferris, p.78).

This inequality in the field is not confined to the United States as is indicated in the following excerpt from a report by van Vuuren (1997) on the position of women in South Africa's scientific arena:

> Women in the professional workforce still appear to be heavily influenced by tradition. The fields customarily associated with women, such as nursing, paramedical sciences and sociology, attracted more than 80% female practitioners in 1993, and psychology, pharmaceutical sciences and economics just under 50%. The highest representation of women in SET (Science, Engineering and Technology) fields was approximately 35% for the biological, computer and mathematical sciences, and this dropped to under 10% for the physical sciences, architecture/surveying and engineering.
>
> It is therefore clear that although women are well represented at the lower educational levels and in some disciplines, the higher the level of the degree and the higher the rank, the lower the percentage of women. Female representation varies enormously from discipline to discipline. Women still have a long way to go to achieve parity in SET fields at levels that really count.
>
> (van Vuuren, p.11).

If theatre draws from its social context for its material, this might explain why women have seldom, if ever, found themselves subjectively positioned in science plays. Texts like The Physicists, Life of Galileo, In the Matter of J.Robert Oppenheimer, The Burning Glass and Blinded by the Sun (1996) are centred around male protagonists, their conflicts and their relationship to the sciences. Even theatre less reliant on text and more aware of physicality tends to avoid the issue of gender in science rather than address inherent inequalities and phallocentric representations. Wilson's Einstein on the Beach acknowledges the individuality of physical rhythms and vocality, and might well subscribe to the notion of a pre-Oedipal/Imaginary order with its emphasis on the

imagaic, but it is still an exploration into the psyche of the male scientist. Buckland's Thing? simply sidesteps issues of gender by casting the two actors and actress as sub-atomic particles, costuming them alike, and allowing for a free interplay between different characters, regardless of gender: in effect gender is neutralised and so de-politicised. More recent theatre, obviously more sensitive to feminist issues, sees a far more sympathetic treatment of its female characters, with Copenhagen affording Margrethe a pivotal role in the theatrical experience of the play, and both Arcadia and Hapgood casting women in positions of authority: Thomasina is sketched as a mathematical genius in Arcadia and Hapgood is the head of MI5 in Hapgood. It is notably women playwrights, however, who demonstrate a political engagement with the representation of women. Although After Darwin deconstructs the relationships between men struggling to reconcile their differences in belief, it is Millie, the foreign director who best embodies Wertenbaker's central scientific metaphor of 'the survival of the fittest'. It is she who, alone and alienated, has had to lie and alter her identity to find work in Britain. But even Wertenbaker, who has tackled the subjugation of women and actively questioned the representation of women in theatre in The Love of the Nightingale (1988), offers little on the role of women in science.

To this end, An Experiment with an Air Pump stands as an important contemporary work. Stephenson clearly recognises the masculine ideology inherent in scientific discourse. This is evident in her nimble association of Isobel's objectification with the objectification of nature (the bird in the air pump). And in an interview with Mark Cook (Broadway Ham and High, 16 October 1998), Stephenson refers to the cultural indoctrination of this ideology: "I went to a school where the girls did languages and the arts and the boys did physics". But she takes her critique of this genderization further by demonstrating the possibilities for the integration of supposedly feminine characteristics into the personal and professional aspects of the scientific arena. The practice of foetal

diagnostics may, for instance, be seen as an invasion of the female body, of a masculine interference in the female reproductive system. But she casts Ellen as a "brilliant scientist" whose work has developed a non-evasive approach to this field. And Ellen's decision to take the position in Kate's firm is based not on the unemotional rationality expected of a scientist, but is instead impulsive and unashamedly sexual, as the following interchange with Tom indicates:

> **Ellen**: Science is supposed to be cold and considered and rational.
> **Tom**: But it's not, is it?
> **Ellen**: In practice it is. But I suppose my urge to pursue it is a passion, it's intense, the same as your for George Eliot or John Webster. Actually, it's more than that. It's sexy. It makes me fizz inside. To me it's a form of rapture.
>
> (Experiment, p.87).

Stephenson has presented an image of science that can no longer sustain the genderization that Keller has noted, that must take cognisance of the sexism inherent in the polarity of masculine and feminine characteristics and must acknowledge the need to integrate subject and object in formulating a reliable system of knowledge for the new millennium.

CHAPTER 3:
"WHAT OUGHT I TO DO?"

Central to a large number of science plays is the question of ethical conduct or, as Raymond Cattell phrases it, "What ought I to do?" (Cattell, p.3). It seems inevitable that this question should arise in the field of science which has often provided sources of new power or discoveries that challenge humanity's understanding of itself and of the universe. Theatre has recognised the dilemmas that face a scientist who, in the name of science, has made a revolutionary discovery and must now give control of those findings over to the world. The fundamental crisis between the discovery of power and the control of that power provokes the ethical debates that fascinate many writers of science plays.

Life of Galileo is a prime example of theatre's recognition of the dilemmas that often accompany momentous scientific discoveries. The play centres around Galileo's quandary: should he retain his integrity and stand by his theories of planetary revolution, at the risk of death, or should he recant those theories, keep his life and live with his betrayal of himself? Brouwer notes how the events of world history influenced Brecht's re-writing of Galileo:

> Brecht wrote his first version of The Life of Galileo during his exile in Denmark ... In this Danish version of the play, Galileo is portrayed "as an intellectually heroic figure, who fights for progress, who deliberately introduces a new age of scientific truth."... However, when Brecht began, with Charles Laughton, to prepare an American version of the play, the atomic age had made its debut ... Suddenly, Galileo became a different symbol for Brecht, not a courageous figure, fighting for the independence of science from authority, but as a traitor to science, who bowed to the authority of his day. In Brecht's own words: "Galileo's crimes can be regarded as the 'original sin' of modern natural sciences."
>
> (Brouwer, p.614; omissions mine).

It's clear that the central argument of Galileo, for Brecht, is the question of "What ought

I to do?"; what is the ethical stance a scientist should take when in possession of knowledge that can change the world inexorably?

The discovery of great power is also a predominant theme in The Burning Glass. Here, the scientist Christopher is faced with the realisation that his weather control machine has greater, more terrible, applications - it is capable of focusing the sun's rays, as a lens would, on any chosen spot on the planet's surface, magnifying the sun's energy a thousandfold. Christopher is uncertain as to how much of his discovery should be revealed to the British Government, which is engaged in a Cold War with a totalitarian army. He articulates his anguish before the prime minister arrives to inspect the machine:

> I feel almost a different being with that monstrous power over nature in my hands! How much I tell the prime minister goes to the root of things. To be or not to be. Science has never kept back its knowledge... We have always said: 'Ahh, but this power has beneficent uses as well...' We have never yet said: 'We are unfit for it.' The time may have come for that.
> (The Burning Glass, p.11).

Although Christopher decides not to share the full extent of his discovery with the world, the very presence of the machine causes international turmoil and even leads to the suicide of his partner, Tony Lack, thus demonstrating a justifiable cause for Christopher's ethical concern.

In The Physicists, Dürrenmatt's central character, Möbius, withdraws to a sanatorium, fearing that his discoveries, with regards to the problem of Gravitation, the Unitary Theory of Particles, and the Principle of Universal Discovery, might be used for malicious purposes. In the sanatorium he encounters two undercover spies, Kilton and Eisler who, keen to secure his knowledge, each put forward an argument. Kilton, opens the discussion by advocating scientific freedom in the service of the military, offers the

following proposition:

> It seems to me, if it can restore the greatest physicist of all times to the confraternity of the physical sciences, that any military machine is a sacred instrument. It's nothing more or less than a question of freedom of scientific knowledge. It doesn't matter who guarantees that freedom..."
>
> (The Physicists, p.76).

Eisler attempts another approach to the debate:

> We are providing humanity with colossal sources of power. That gives us the right to impose conditions. If we are physicists, then we must become power politicians. We must decide in whose favour we shall supply our knowledge, and I for one must have made my decision...my political power, to be precise, lies in the fact that I have renounced my own power in favour of a political party."
>
> (The Physicists, p.76).

Möbius chooses not to subscribe to either argument, instead opting to withhold his knowledge:

> Our knowledge has become a frightening burden. Our researches are perilous, our discoveries lethal. For us physicists there is nothing left but to surrender to reality. It has not kept up with us. we have to take back our knowledge, and I have taken it back.
>
> (The Physicists, pp.80-81).

Möbius convinces the spies that the sanatorium offers them the only place to indulge in their knowledge without having to consider the consequences, although this too proves an untenable option as Möbius's notebooks are stolen and used to help Fraulein von Zahnd, the resident psychiatrist, establish herself as leader of a powerful new country.

In the Matter of J. Robert Oppenheimer offers similar conjecture in its representation of the court proceedings instituted against Oppenheimer by the U.S. Atomic Energy Commission in 1954. In the play, Oppenheimer, a nuclear physicist, is accused by Senator Joseph McCarthy of deliberately delaying the development of the hydrogen bomb, and thus exhibiting treasonous behaviour. The trial forces Oppenheimer to

consider his personal relationship to scientific endeavour and to the government that employs him. In his closing argument, Oppenheimer reflects on these relationships:

> When I think what might have become of the ideas of Copernicus and Newton under present-day conditions, I begin to wonder whether we were not perhaps traitors to the spirit of science when we handed over the results of our research to the military without considering the consequences...I ask myself whether we, the physicists, have not sometimes given too great, too indiscriminate loyalty to our governments, against our better judgement...We have spent years of our lives in developing ever sweeter means of destruction. We have been doing the work of the Devil, and now we must return to our real tasks.
>
> (Oppenheimer, pp.126/7).

As Brouwer notes, "Oppenheimer seems ready, at this point, to assert a sort of aggressive independence of science from the military, from governments, and perhaps from industry" (Brouwer, p.616).

The above are selected examples of dramatic texts that acknowledge the attachment of ethical concerns to scientific inquiry.[1] Common to all of these, indeed the very fuel of the dramas, is the tension that is generated by the schism between personal morality and the externally dictated course of action that the individual is expected to follow. The playwrights focus on the incompatibility of personal morality and the institutionalisation of morality into a code of ethics by religion, government, business or society. For the most part, this incongruency is presented as being without solution and points to a fundamental problem facing the modern scientist. This problem is the subject of Zygmunt Bauman's argument in Postmodern Ethics (1993). Bauman argues that by applying a postmodern perspective, the possibility of a fixed code of ethics falls away. It is the 'modern' age, he suggests, that has sought to universalise morality, sought to establish a uniform approach to practicing morality and, in so doing, has created its own

[1] Further instances of plays dealing with ethics as a major theme include Copenhagen, Blinded by the Sun, After Darwin, The Brass Butterfly and Das Kalte Lucht. To some degree, Stoppard engages with the ethics of research in Arcadia, but this is a minor concern of the play.

dilemma. He argues that:

> ...modern legislators and modern thinkers alike felt that morality, rather than being a 'natural trait' of human life, is something that needs to be designed and injected into human conduct; and this is why they tried to compose and impose an all-comprehensive, unitary ethics - that is, a cohesive code of moral rules which people could be taught and forced to obey; and that is also why all their earnest efforts to do so proved to be in vain (though the less successful their past efforts proved to be, the harder they tried).
>
> (Baumann, p.21).

Bauman goes on to explain that an established set of laws, by its very nature, denies the experience of diversity and ambivalence, integral aspects of human existence. This, in turn, sets up a contradiction between personal morality and the code of conduct applied by external legislators, and it is this contradiction that characterised modern thought:

> This *aporetic* situation (aporia: in a nutshell, a contradiction that cannot be overcome, one that results in a conflict that cannot be resolved) was to remain the fate of modern society, as a self-admittedly 'man-made' artifice - but it was the trade mark of modernity *not* to admit that the fate was irreparable.
>
> (Baumann, p.23).

According to Bauman, the moral thought and practice of modernity "...was animated by the belief in the possibility of a *non-ambivalent*, *non-aporetic* ethical code" (Baumann, p.24), but failed to bring this code about. He concludes that "...an ethics that is universal and 'objectively founded' is a practical impossibility" (Baumann, p.25), and suggests a postmodern approach to the subject. This approach must acknowledge the following: "Given the primary structure of human togetherness, a non-ambivalent morality is an existential impossibility" (Baumann, p.25); the codifying of morality "...shifts moral phenomena from the realm of personal autonomy into that of power-assisted heteronomy...It places answerability to the legislators and guardians of the code" (Baumann, p.26; omission mine); morality is unavoidably aporetic, "Few choices...are unambiguously good. The majority of moral choices are made between contradictory

impulses."(Baumann, p.26; omission mine); morality cannot be universalised (Baumann, p.27); morality is irrational (Baumann, p.28); and:

> By exposing the essential incongruity between any power-assisted ethical code on the one hand and the infinitely complex condition of the moral self on the other, and by exposing the falsity of society's pretence to be the ultimate author and the sole trustworthy guardian of morality, the postmodern perspective shows the relativity of ethical codes and of moral practices they recommend or support to be the outcome of the *politically* promoted parochiality of *ethical codes* that pretend to be universal, and not of the 'uncodified' moral condition and moral conduct which they decried as parochial.
>
> (Baumann, p.29).

The implications of this approach, for Bauman, indicates a need to shift responsibility from the authors (and legislators) of ethical codes to the moral self, and the self, he suggests, must establish its morality in relation to the "Other" rather than to a pre-existing code. This thought is echoed in the views of Garber *et al* (2000), who see ethics as being a praxis as well as a principle, "a process of formulation and self-questioning that continually re-articulates boundaries, norms, selves, and 'others' "(p.viii). These thinkers regard ethics as a process, as opposed to a fixed truth, requiring constant re-negotiation and re-definition.[2]

With these views in mind, it is interesting to examine Stephenson's treatment of ethics in An Experiment with an Air Pump. The central ethical debate is, of course, Ellen's, and her dilemma lies in the possibility that her genetic research, in the hands of institutionalised forces, could be misused and abused. It is her husband who articulates this dilemma:

> But who's really going to want this information? Insurance companies.

[2]This argument has been used to support the findings of research conducted into the uses of drama in science education. This research was presented in a paper delivered at the 4th World Congress of the International Drama/Theatre and Education Association (IDEA) in Bergen, Norway in July 2001. This paper is attached as Appendix A to illustrate the possible directions for further research into science and theatre.

> Mortgage lenders. Private health companies. employers. All I'm saying is it's complicated. In the hands of people who don't understand it properly, which is most of the above, it'll be something else to judge people by and discriminate with. What starts off as something with all the forces of good behind it, will be swallowed up by the market-place.
>
> (Experiment, p.52).

However, Ellen must consider the ramifications of her possible choices for herself, and to this end she subscribes to her imagination. Read (1993) points out that "Imagination is inextricably interconnected with ethics. Learning to be ethical requires that we use imagination to consider past, present and future events from other people's positions". (Read, p.84) Stephenson demonstrates a similar belief in the imagination and allows Ellen to give voice to this in her response to Kate, who makes light of her ethical dilemma: "The fact that you've never had a moral qualm in your life doesn't mean you have superior reasoning power, it just means you have a limited imagination -". (Experiment, p.36)

Ellen exercises her imagination by indulging her fascination with Derby's painting and creating the drama she imagines the experiment on the bird is a prelude to. Isobel's story is Ellen's imaginative engagement with the past. She considers a world in which the research of the time, like the present research into genetics, had no specific ethical code to which it could subscribe.[3] Roget's reaction to the fact that Dr Farleigh and Armstrong scout out possible cadavers before they are dead, exposes his personal morality, but also brings to light Armstrong's morality. What Armstrong is doing is not 'illegal', and may be distasteful to Roget, but is perfectly supportable by Armstrong's commitment to scientific research:

> Digging up corpses is necessary if we're to totter out of the Dark Ages.

---

[3]The programme notes for the original production of An Experiment with an Air Pump point out that while the number of corpses allowed for medical study were restricted by law in England, suspicions that people were being murdered and their bodies sold to medical researchers, prompted the introduction, in 1831, of the Anatomy Act which made the donation of bodies for medical purposes illegal.

> You can dissect a stolen body with moral qualms or with none at all and it won't make a blind bit of difference to what you discover. Discovery is neutral. Ethics should be left to philosophers and priests. I've never had a moral qualm in my life, and it would be death to science if I did.
>
> (Experiment, p.71).

This is certainly one facet of Ellen's internal debate and the echoing of the words "moral qualms", as well as Kate's agreement that she would "...dissect [her] own mother if [she] thought it might give [her] the answer to something." (Experiment, p.88) suggests that Ellen has cast Kate as Armstrong in her private drama. Ellen acknowledges that there are scientists for whom science is "value free...morally neutral" (Experiment, p.88) and, as she points out to Tom, "You can't not pursue something. You can't say the road might have complications so I won't go down it." (Experiment, p.88) This is the aporetic situation that Ellen recognises; for her moral values are intrinsic to scientific inquiry, while for others, her friend included, science is distinct from ethical consideration.

Stephenson is making it clear that Ellen's final decision to take the job in Kate's company has boiled down to a personal moral decision, informed by an imaginative consideration of the past in conjunction with the present. She supplies no ethical code for Ellen to subscribe to. What she 'ought to do' is decided by a negotiation of differing viewpoints, imagination, acknowledgment of ambivalence and irrationality. Ellen makes sense of this 'irrational' moral decision by describing it as a decision of the heart:

> I could have avoided filthy commercialism and struggled along on bits of funding from now till doomsday. I did consider it actually. But this is too exciting. I can't resist it, basically. It wasn't an intellectual decision. It was my heart.
>
> (Experiment, p.87).

Bauman recognises this process of personal decision in a postmodern context:

> In so many situations in which the choice of what to do is ours and apparently ours alone, we look in vain for the firm and trusty rules which may reassure us that once we followed them, we could be sure to be in

> the right. We would dearly wish to shelter behind such rules (even though we know too well that we would not feel at all comfortable were we coerced to surrender them). It appears, however, that there are too many rules for comfort; they speak in different voices, one praising what the other condemns. They clash and contradict each other, each claiming the authority the others deny. It transpires sooner or later that following the rules, however scrupulously, does not save us from responsibility. After all, it is each one of us on his or her own who has to decide which of the conflicting rules to obey and which to disregard. The choice is not between following the rules or breaking them, as there is no one set of rules to be obeyed or breached. The choice is, rather, between different sets of rules and different authorities preaching them. One cannot be, therefore, a true 'conformist', however strongly one might desire to shake off the vexing burden of one's own responsibility. each act of obedience is, and cannot but be, an act of disobedience; and with no authority strong enough or bold enough to disavow all the others and claim monopoly, it is not clear the disobeying of which one is a 'lesser evil'.
>
> (Baumann, p.31).

It would appear then that Stephenson's solution to the scientist's dilemma is to acknowledge one's personal morality. Not only does the uncharted field of genetics not supply a code of conduct for Ellen to refer to, but she is also at odds with her colleague's ethical stance and reminded by her husband that the decision is ultimately hers. Stephenson supplies the metaphor of the heart to describe irrational, instinctive morality, a metaphor that resounds throughout the play. Tom explains to Ellen:

> Apparently the heart is involved in the choices we make. Literally. It's not just a pump. That's a scientific fact ... I read it somewhere. It's the main motor of the body. It's what drives us, it's what defines us. You're not just your brain. Apparently, if you give someone a new heart, they quite often take on some of the characteristics of the donor ... The heart retains information, they understand how, yet, but everything's connected one way or another, nothing exists in isolation. When you feel grief, your heart hurts. When you feel love, it's your heart that hurts, not your brain. You took this job because your heart told you to.
>
> (Experiment, p.87; omissions mine).

The reminder that the heart is a pump resonates with the title of the play. The substitution of Isobel for the bird in the final tableau of the play suggests that the experiment conducted has been one with not an air pump, but with a heart, Isobel's heart.

But it is the reference to another heart that gives Stephenson's ethical position its final clarity.

When Roget asks Fenwick, "Does science require a warm heart?" (Experiment, p.47), Fenwick replies:

> I like to think so, Roget. In fact I suspect pure objectivity is an arrogant fallacy. When we conduct an experiment we bring to bear on it all our human frailties, and all our prejudices, much as we might wish it to be otherwise. I like to think that good science requires us to utilise every aspect of ourselves in pursuit of truth. And sometimes the heart comes into it.
>
> (Experiment, p.47).

This discussion has been prompted by Fenwick's description of Armstrong as "...a clever young bastard, but cold of heart."(Experiment, p.47) This is crucial to an understanding of Stephenson's ethical stance, for it is Armstrong that highlights the problems of personal morality. Although Armstrong has a similar view to Kate, he differs from her in that she "...wouldn't kill. [She] wouldn't murder." (Experiment, p.88). Armstrong's personal morality should, in a postmodern analysis, be as valid as Ellen's, but his murder of Isobel suggests that his morality is not compatible with the well-being of the 'Other'. The suggestion is that his ethics have been tainted by power. His position in a dominant male ideology has afforded him some power over Isobel, the serving girl, and this power has led to his objectification and destruction of her. Morals, Stephenson is suggesting, must take into account the 'Other', for ultimately moral responsibility, "being for the Other", must transform, through action, into "being with the Other". How then is it possible to reconcile diverse, and sometimes destructive, moralities in social interaction? Stephenson does not supply an answer to this question, and rightly so, but does suggest that personal responsibility is the key to this dilemma.

In the play's final scene, Wright's image of the bird in an air pump has evolved to become that of Isobel's body in a coffin. Fenwick, no longer the image of the scientist who knows, says:

> So this is how we're seeing out the century. Not the way we'd imagined it, not with a flurry of trumpets and beacons blazing. I thought it would be a golden night, full of hope and anticipation, and instead, this. Groping blindly over the border in a fog of bewilderment....Here's to whatever lies ahead...here's to uncharted lands...her's to a future we dream about but cannot know...
>
> (Experiment, pp. 95/96).

From outside, the sound of crowds can be heard, but Susannah and Fenwick are unable to determine whether this is the noise of rioting or celebration. As the clock ticks away the change to a new century, the certain and man-made science of chronology is counterpointed by the uncertainty of Fenwick's words and the ambiguity of the mob noises. Morality, like the future, hangs in the balance and no code of ethics is forthcoming in the face of uncertainty. Like Ellen, the audience is denied a code of ethics to subscribe to, by which to judge those like Armstrong, and which will hold true for the next millennium. Instead the open-endedness of this ambiguous and ambivalent image invites the audience to consider the past, imagine the future, and recognise their own morality. For the "theatre image unlike any other is always a possibility without closure, like the ethical relation which awaits creation' (Read, p.88). And it is through completing the theatrical image in their imaginations, that a morality that is sensitive to the 'other' will be negotiated. As Read points out:

> The imagination is a tool in the creation and reception of images. Unless its relevance is better understood it is hard to see quite what purpose there could be in reaching for a deeper meaning from a work or understanding its mode of production more accurately. For in the final analysis it will be the individual imagination that creates the image in question, in collectivity with the theatre performer and the audience, neither one nor the other. The ethical possibilities from such a meeting therefore become of central importance. Theatre values the creative individual and that individual's relation to the 'other', while recognising the overall need for

ethical responses to possible actions. These are the implications of the spaces between 'modes' of discourse, and the 'weapons' of revolution they might be asked to replace, and while asking questions of them is tentative and prone to the threat of the 'religious', not to ask them is to deny the metaphysics and therefore the imagination of theatre.

(Read, p.90)

CONCLUSION:

THE CONFLUENCE OF ART AND SCIENCE

> **Tom:** Art and science are part of the same thing. Likes waves and particles. You need both to define the whole.
>
> (Experiment, pp. 87-88).

A roundtable discussion held at the Mitzi E. Newhouse Theatre in New York, 1975, saw a collection of scientists and artists considering the ways in which the sciences and the arts enrich each other. In a report on these discussions, Sasha Nemecek noted the opening argument that both science and the arts benefit from metaphors and models, finding in these representations that assist the scientist or artist in seeing "...some aspect of the human condition that fascinates them from yet another vantage point" (Nemecek, p20). A similar conclusion is drawn by Bronowski who observes that:

> Science is nothing else than the search to discover unity in the wild variety of nature - or more exactly, in the variety of our experience. Poetry, painting, the arts are the same search, in Coleridge's phrase, for unity in variety. Each in its own way looks for likenesses under the variety of human experience. What is a poetic image but the seizing and the exploration of a hidden likeness, in holding together two parts of a comparison which are to give depth each to the other.
>
> (Bronowski, p.26).

And Robert L. King finds another parallel in the human experience of these seemingly oppositional endeavours. When he writes, "Even in the pursuit of pure scientific knowledge, our affections and affectations, our prejudices and preconceptions, intrude" (King, p.165), he strongly echoes Fenwick's words: "When we conduct an experiment we bring to bear on it all our human frailties, and all our prejudices, much as we might wish it to be otherwise" (Experiment, p.47).

These similarities between science and the arts are interesting enough, but a more causal

relationship between the two has been noted. In The Scientific Revolution (1996), for instance, Shapin gives an historical outline of the reaction of society, politics and art to the great discoveries of science. He argues that scientific revolutions have almost always preceded changes in the way the world is seen and suggests that:

> The notion of a revolution as epochal and irreversible change, it is possible, was first applied in a systematic way to events in science and only later to political events. In just this sense, the first revolutions may have been scientific, and the "American", "French" and "Russian Revolutions" are its progeny.
>
> (Shapin, p.3).

This argument is iterated by Spielberg and Anderson (1987): "Virtually all social and political philosophies embrace or react to specific scientific concepts such as energy, relativism-absolutism, order-disorder, determinism-uncertainty" (Spielberg and Anderson, p.2). The most influential advocate of this opinion, however, is Thomas S. Kuhn who, in his work The Structure of Scientific Revolutions (1962) explains the radical shifts in understanding provoked by new scientific discovery as "paradigm shifts". During these shifts "...scientists see new and different things when looking with familiar instruments in places they have looked before" (Kuhn, p.111). That is, even though the world itself is not necessarily changed, the way in which it is observed and interacted with is fundamentally altered. According to Kuhn, this change in worldview has a ripple effect that eventually affects philosophical and political thought, and asserts itself in the arts, demonstrating that the human experience of the world has undergone a transformation.

But in his article 'Of Sciences and the Arts: From influence to interplay between natural philosophy and drama" (1991), William W. Demastes challenges this causal connection in his consideration of the synchronous development of quantum mechanics in science, and absurdism in theatre, by asking the questions:

> Could it be that science and art contemporaneously developed similar theories of existence, not necessarily one dependent on the other, but both dependent on the current cultural "Zeitgeist"? And could it be that once developed, they each reciprocally confirmed and then fed off of the other?
>
> (Demastes, p. 82).

Demastes does not suggest that this is necessarily true of every epoch, but finds in the contemporary experience of the world increasing instances of current cultural perceptions informing science (Demastes, p.81). In this regard, he ventures the hypothesis that:

> Worlds reasonably certain of ontological, epistemological, and teleological frames produce art that reflects that certainty with a benignity and confidence that assures its public of ultimate order even in the face of apparent chaos ... In contrast, the modern/postmodern Western world is typically set up as the paradigmatic antithesis of confidence and order.
>
> (Demastes, p.75; omissions mine).

The postmodern world, according to Demastes, has begun to embrace the notions of uncertainty, ambiguity, relativity, subjectivity and indeterminacy of action in what he describes as a "conceptual revolution" (Demastes, p.81), and he also recognises the tensions that such a revolution engenders between the desire for social, political and cultural stability on the one hand, and the tidal force of change on the other.

Demastes argument points towards an understanding of science as a means of discoursing about the world, and towards acknowledging the subjectivity of this discourse. This understanding also presupposes the need for science, as just one means of making sense of the universe, to acknowledge the contributions of other discourses like history, philosophy, gender and theatre to universal understanding. Already the literature and practice of these discourses reflect an inter-textual borrowing of science's models and metaphors for illumination or comparison. Case, for instance, uses a scientific analogy to conclude her study of feminism and theatre:

> The feminist in theatre can create the laboratory in which the single most effective mode of repression - gender - can be exposed, dismantled and removed; the same laboratory may produce the representation of a subject who is liberated from the repressions of the past and capable of signaling a new age for both women and men.
>
> (Case, p.132).

The influence of scientific discourse on not only the material, but the very form of recent drama, is notable: Hapgood draws on the theories of quantum mechanics and the indefinable behaviour of light, sometimes as waves, sometimes as particles to inform a structure in which the audience are never certain as to how they should read the behaviour of the characters[4]; uncertainty and a variety of perspectives also characterise Copenhagen, a deliberate attempt by Frayn to give dramatic body to Heisenberg's uncertainty principle; Wertenbaker subscribes to Darwin's theories on species survival to offer a theatrical demonstration of cultural evolution at work in After Darwin; Stoppard structures Arcadia as a dramatic interpretation of an iterated algorithm.[5]

Over and above the inter-textuality that is apparent in these theatrical explorations into scientific principles, is a recognition of the 'blurring' of the boundaries that traditionally separated the arts from the sciences. Both Bronowski and Cattell, in their writings on the impact of science on the world, describe the processes of experimentation and observation as having the qualities of the artistic process. Demastes takes this idea further by suggesting that "...if science can no longer claim strict objectivity, then indeed science itself has become 'art', personal expression/interpretation of existence and belief systems" (Demastes, p.79).

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[4]Demastes recognises this influence in his article 'Of Sciences and the Arts: From influence to interplay between natural philosophy and drama", p.82, as does W. Brouwer in 'The image of the physicist in modern drama (Part 2)', pp238-239.

[5]As noted by Lucy Melbourne in '"Plotting the Apple of Knowledge": Tom Stoppard's Arcadia as Iterated Theatrical Algorithm'.

The quote that heads this conclusion demonstrates Stephenson's engagement in these concepts in An Experiment with an Air Pump. By paralleling two time periods, exposing the scientific and theatrical objectification and marginalisation of women, and opening up the question of contemporary ethics for negotiation with the audience, she has called into question the objectivity and certainty of science, history, gender and ethical conduct. She presents a theatrical work that offers itself up as being conscious of these fields as discourses that contribute to, but do not solely constitute, knowledge and understanding of the world. Moreover, An Experiment with an Air Pump displays a self-awareness, through its meta-theatricality, of theatre itself as an imaginative, subjective discourse on the world and, by positioning Ellen as the subject of the drama, the play shows that science too draws on personal imagination and intuition in its processes, processes that are not simply "cold and rational", but which also involve the heart.

An Experiment with an Air Pump is an example of a postmodern awareness of the ideologies that Michel Foucault's Power/Knowledge (1980) recognises as underscoring the nature of discourses on the world. In her book, Simians, Cyborgs, and Women, Donna Haraway offers a useful conceptualization of scientific discourse:

> Technologies and scientific discourse can be partially understood as formalizations, ie., as frozen moments, of the fluid social interactions constituting them , but they should also be viewed as instruments for enforcing meanings.
>
> (Haraway, p.164).

If we borrow from Haraway's image of "frozen moments", it is interesting to return to Stephenson's starting image of Wright's painting. This frozen moment shows a man at the centre of the experiment, "beatified by his search for truth"; a young scientists who doesn't care whether the bird lives or not, but is more interested in "the process of experiment"; two young lovers "who don't give a damn about any of it"; and a period in which scientific knowledge is the "power of light over darkness" (Experiment, pp.3-4).

If meaning were to be extracted from this frozen image, it might well point to an ideology that forefronts men, not women, as the discoverers and holders of knowledge, that values discovery and control over nature above the life of that nature, that sees no role for the passions of the heart in experimentation, that sees science as the ultimate purveyor of truth. It is Stephenson's animation of this image that suggests the "fluid social interactions" that inform Wright's painting, and thus exposes the meanings that it enforces. Haraway's model, initially conceived to give credence to the idea of a genderisation of science, applies as easily to art, and once again the confluence of the two is brought into focus.

Like Wright, Stephenson uses the notion of experimentation as a metaphor for her contemporary world. For Wright, the processes of experimentation would have required preparation, observation, an acknowledgment of the past, an anticipation of discovery, and a recognition of the possibilities that lie hidden in the unknown future. This holds true in a postmodern age, but experimentation now also requires an acknowledgment of the impact of the experimenter on the experiment, of the influences of the irrational and unmeasurable, of the need to accept ambiguities in results. After two hundred years, the spectacular advances in scientific discovery in the twentieth century have initiated a paradigm shift, the impacts of which are resonating in, and may even have been informed by, the society in which it operates. An Experiment with an Air Pump is representative of the contemporary playwright's recognition of this shift, taking as its focal point the current inquiries into a field of science that has very little precedent, namely that of genetics. The uncertainty and the range of possibilities that this science fosters, indicates a need to question the ideologies that determine the nature of experimentation, for as Spielberg and Anderson point out: "A thorough study of science yields power, both in a large sense and in a very real, detailed, and practical sense. The resulting power is so great there is concern that it not be used for self-destruction rather

than for blessings it can bestow" (Spielberg and Anderson, p.12). This opinion is also directly applicable to studies of history, gender and ethics. It is Stephenson's engagement with these concerns that gives theatrical voice to Demastes's assertion that:

> Science and art...have joined forces to illustrate that we are progressing toward greater comprehension of our world(s) when a culture is not dominated by a pervading frame of thought, or more precisely, when a culture is dominated by a frame of thought that insists on subjectivity, multiplicity.
>
> (Demastes, p.85).

Appendix:

The Skeleton in the Basement: Educational Drama, Science and Ethics

By Michael Carklin and Dion van Niekerk

Presented at the 4th World Congress of the
International Drama/Theatre and Education Association (IDEA)
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A study of crossovers and intersections between drama and science suggests rich possibilities for exploring the human experience of scientific experimentation and the ethical dilemma that often attends it. It offers the opportunity to examine the personal, social and political tensions that are integral to scientific endeavour, to transcend the often abstract nature of ethical debate, and to engage with the thought, emotion and imagination that comes into play when considering the implications of science for ourselves and society.

As part of our research into the crossovers between theatre, drama, science and education, we have engaged in a range of teaching and research projects. These include:

- a course on Theatre and Science for undergraduate drama students, utilising educational drama teaching methodologies;
- a theatre in education programme on cloning, utilising forum theatre techniques, aimed at a broad range of community members (adults and young people) and performed at a national science festival;
- a drama education project for young people drawing on contemporary scientific dilemmas such as genetic engineering, cloning, and genetically modified foods;

- a participatory theatre/drama project for primary school pupils based on the history of astronomy;
- a participatory community project linked to science and HIV/AIDS;
- an exhibition highlighting the ways in which thirteen different plays from the 1600's to the present deal with issues of science and ethics; and
- the mounting of a full production of Shelagh Stephenson's play, *An Experiment With An Air Pump*.

This paper focuses primarily on the first of these projects, the utilisation of educational drama methodologies at tertiary level in exploring ideas of science and ethics. We would suggest, however, that many of our observations and conclusions would also be of use to those engaged in drama and theatre work with young people and adults in schools and communities.

We have chosen to use the metaphor of the skeleton in the basement to consider the potential of educational drama and theatre for encouraging informed dialogue and debate on contemporary scientific issues. This metaphor has been drawn from Stephenson's play, *An Experiment with an Air Pump*, a good place to start with this study in that it successfully integrates the human drama of science with its complex, ambiguous philosophical underpinnings, making for immediate, compelling and thought-provoking theatre.

The Drama of Science

The impetus for Stephenson's play was Joseph Wright's painting, *An Experiment on a Bird in an Air Pump* (1768), shown below. This seems to serve as an appropriate springboard for our own discussions on educational drama and scientific ethics.

At the centre of the painting is the scientist performing an experiment, and around him are family and colleagues who all appear to be reacting to this work in different ways. This painting is an image of *action* and *reaction*; it encapsulates dilemma and multiple responses; the lighting and grouping of characters are themselves dramatic. Stephenson refers directly to the painting at the start of the play: the actors are frozen in a tableau recreating the painting, whilst the character Ellen addresses the audience directly. She is dressed in casual 20th century clothing, and as the prologue progresses, dressers help her into 18th century clothing until she is finally ready to join the tableau before it comes to life.

Ellen's opening monologue provides good insight into the painting and raises some useful ideas as we begin to consider drama and ethics.

> **Ellen:** I've loved this painting since I was thirteen years old. I've loved it because it has a scientist at the heart of it, a scientist where you usually find God. Here, centre stage, is not a saint or an archangel, but a man.....
>
> This painting described the world to me. The two small girls on the right are terrified that he is going to kill their pet dove. The young scientist on the left is captivated, fascinated, his watch primed, he doesn't care whether the dove dies or not. For him what matters is the process of experiment and the intoxication of discovery. The two young lovers next to him don't give a damn about any of it....
>
> But the elderly man in the chair is worried about what it all means. He is worried about the ethics of dabbling with life and death. I think he's wondering where it's all going to end.[i]

This 'wondering where it's all going to end' perhaps characterises most strongly much of today's discussion and reporting regarding contemporary scientific endeavour. Significantly, in terms of drama, it raises the importance of *consequence*, of making difficult decisions with the future in mind.

Ethics and Imagination

In her book, *Ingenious Pursuits: Building the Scientific Revolution*, Lisa Jardine comments on the response to the cloning of Dolly the sheep at Edinburgh's Roslin Institute. Pointing out that the company explained that this cloning technique might be used to farm the human blood clotting factors needed to treat haemophiliacs, Jardine highlights that be this as it may

> ... Dolly the cloned sheep was not heralded as a glorious piece of innovative science. Aghast, the newspapers of the world responded to this sensational scientific advance with a clamour of moral outrage. Driven blindly by the search for the new, we were told, the Scottish scientists were careering towards disaster along that sinister path to damnation notoriously embarked upon by the demonic hero of Mary Shelley's famous novel, Dr Frankenstein.[ii]

On the one hand, such a response is fully understandable: like the thoughts of the old man in the painting of 'where will it all end?', the consequences of such scientific achievement also bring with them some frightening spectres of a future in which such

research is misused or abused. On the other hand, however, it also points to a significant irony: in an age where there are more popular (accessible) science books available, more scientists participating in talk shows and literary festivals, and on television and radio, there also appears to be a greater ignorance about, and fear of, scientific research. We would therefore argue that it is imperative that informed, imaginative methodologies such as those offered by educational drama and theatre are utilised for developing a critical consciousness about the potentially life-changing and fast moving scientific developments that characterise our contemporary world.

In this light, we should take note of Garber et al's view that ethics is a praxis as well as a principle, "a process of formulation and self-questioning that continually re-articulates boundaries, norms, selves, and 'others'."[iii] It is significant that they see ethics as process, rather than as fixed truth, and that it is one which implies constant re-negotiation and re-identification. This seems to come very close to the kinds of experience that educational drama and theatre approaches demand, and thus suggests that such methods might be among the most useful ways for addressing issues of ethics with adults and young people.

A debate between Brian Edmiston and Joe Winston appears to have been at the forefront of current debate about drama and ethics (at least in drama scholarship available in English). Of particular interest for us in this study is the distinction that Edmiston makes between the process of 'becoming ethical' as a *personal* quest and as a *social* project.[iv] This distinction is part of a detailed theory of drama as ethical education which Edmiston develops, and in which he responds particularly to the work of Joe Winston. In the former view, which he associates with Winston's approach and which he rejects, Edmiston identifies an "atomistic" view of the self, and in terms of drama this is related to 'practising being virtuous'. Here participants understand the complexity of morality as they practice, or rehearse, being virtuous in different situations and in particular social roles, for example, showing fairness, forgiveness and generosity. In the latter view, which he argues in favour of, becoming ethical is not an individual journey but is based in a notion of ethical social responsibility. Influenced by Bakhtin, Edmiston would argue

that a person's actions must always be evaluated in relation to other people; they are more socially and culturally interconnected.[v]

Whilst this distinction makes sense in terms of the examples that Edmiston discusses[vi], we should also take note of Winston's counter-argument that Edmsiton's polarisation of these two approaches creates precisely the kind of binary opposition that he sets out to criticise.[vii] Clearly, there are numerous levels at which the personal and the social intersect, and we would argue that given the fact that drama engages the individual (taking cognisance of developmental concerns) within a group experience, it is useful to work towards a more integrated understanding of what dramatic action might imply in terms of ethics. For, as Mel Thompson argues, ethics is about "choice and intention, about self-understanding and about the vision and view one has of the world",[viii] and further, that "most moral situations are not straightforward, (but)... may involve personal values and needs, common sense, the Law, and a whole range of unknown consequences."[ix]

This complex combination of influences and processes suggests the constant need for *re-conceptualising* the idea of ethics. In what many might call this 'postmodern age', for example, the collapse of the 'Grand Narrative' suggests that there is no longer recourse to an objective ethical foundation. As Zygmunt Bauman suggests in *Postmodern Ethics*, when contemplated from the postmodern perspective, humans are morally ambivalent, not 'essentially good' or 'essentially bad'.[x] It has therefore become more difficult to believe in the possibility of a universal ethical code which is non-ambivalent, is free of contradictions and points the way to correct solutions. Instead we must consider the multiplicity of experience and interpretation in approaching an ethical discourse. If we adopt a postmodern view of ethics, then, we have to acknowledge a shift in responsibility from the authors (and legislators) of ethical codes to the moral self. And that moral self has to establish its morality in relation to the 'Other' rather than to a pre-existing code.

Nonetheless, Edmiston's analysis is useful for any of us devising TIE or drama work related to ethics, in that it compels us to question the way we understand the drama process for participants and to consider our own view of what education about ethics might imply. For example, is it about rehearsing 'moral behaviour'? Is it about seeing a particular issue from many different points of view? Might it have to do with gaining a sense of how ethical dilemmas have been grappled with in different times in history? Does it have to do with 'prediction' and coming to terms with the implications of particular choices for individuals and their societies? Could it be about providing knowledge so that participants are in a position to make informed decisions? Clearly, these are the kinds of questions that can only be answered by practitioners in their own specific contexts, but it suggests the importance of coming to terms with our own assumptions of what ethics education might imply if we are to structure drama programmes effectively.

What seems clear is that central to both drama and ethics is the ability to imagine. As Alan Read highlights, with reference to Johnson, "Imagination is inextricably interconnected with ethics. Learning to be ethical requires that we use imagination to consider past, present and future events from other people's positions".[xi] The significance of the link between imagination and ethics is astutely observed by Stephenson in *An Experiment with an Air Pump*: in a conversation between Ellen, a geneticist researching foetal diagnostics, and Phil, a building contractor with a spirited interest in science fiction, we encounter widely differing views on scientists and experimentation, however they do have one thing in common: a belief in the importance of imagination. For Phil, who is excited by the possibilities of spontaneous combustion and extra-terrestrial life, projects such as the mapping of the Human Genome system represent a threat to the potential of human creativity, imagination and eccentricity in the quest for human perfectability. For Ellen, the implications of her work are by no means clear-cut and her ethical crisis is compounded by the impact it has on her own personal family relations. However, as she tells her colleague, Kate, who laughs off her ethical dilemma: "The fact that you've never had a moral qualm in your life doesn't mean you have superior reasoning power, it just means you have a limited imagination - ".[xii] The

imagination becomes key in looking to the future, to considering the consequences of choice and action, and to picturing the possibilities for humankind.

Science on Stage and in the Classroom

As part of a university course on 'Contemporary Trends in the Theatre' we devised a course on Theatre & Science, run at second year level. The primary aim of the course was to explore theatre that deals with scientific issues and to consider the kinds of concerns and ideas that playwrights were engaging with at the end of the 20th century and first part of the 21st. We also thought that this would be a good opportunity to study plays in an interdisciplinary manner: firstly, through collaborating with the University's Physics Department, and secondly, through applying some of our knowledge about drama and theatre in education at tertiary (higher education) level where it is so often ignored in favour of more traditional university teaching methods (even in drama and education departments). Our main aim at the start of the course was not to teach about ethics or develop moral value systems, however we soon discovered that a study of *theatre*, explored *through* drama and other means, becomes an extremely valuable way to open up dialogues about ethics, both issue-specific dilemmas and more broadly philosophical debates.

We met with students weekly over a period of 12 weeks and focused on four key plays: Bertolt Brecht's *Life of Galileo*, Tom Stoppard's *Arcadia*, Timberlake Wertenbaker's *After Darwin*, and Shelagh Stephenson's *An Experiment with an Air Pump*. Four of the twelve sessions were conducted by a Professor of physics who explored some of the background scientific principles to the plays using range of practical experiments and demonstrations.[xiii] This meant that when participating in practical drama activities during the other sessions, students were already engaging from a point of greater knowledge and information. The course was also complemented by an exhibition on Theatre & Science which we curated, and which students had the opportunity to become involved in, thus extending the range of plays dealt with, and by a full production of *An Experiment with an Air Pump*.[xiv]

Numerous issues and themes were raised by this study of plays, including the links between science, ethics, history, politics and religion. For example, in *An Experiment with an Air Pump*, the juxtaposition of two time periods offers a juxtaposition of ethical dilemmas which highlight ambiguities and provide historical specificity. In 1799, the ethics of anatomical dissection, of grave-robbing for cadavers, and even of pinpointing potential bodies to steal whilst the person is still living, fall under the spotlight. In 1999, the ethics of genetic engineering raises comparable moral qualms. Equally significantly is that both the late 1700s and 1900s are time of social upheaval and revolution. Students soon come to realise that ethics is not separate from history, nor is it 'universal truth'. If, as Garber et al highlight, a great concern for many theorists is that the current turn to ethics is "a turn away from politics and toward moralism and 'self-righteousness'"[xv], then our experience of working through theatre and drama should contribute to allaying such a fear. The interconnection of the personal and social within drama requires a keen understanding of the political nature of morality.

In *Life of Galileo*, for example, students not only confront the story of a scientist clashing with the religious and political powers of the day, that is, with moral dilemmas which are inextricably linked to the political, but the actual process of playmaking and how this links to a deeper understanding of ethical issues. Questions as to how Brecht's representations differ from the known facts of Galileo's life, and to the reasons behind the existence of three different versions of the play, become significant.[xvi] Further historical, political and sociological possibilities emerge as one starts to contextualise these plays in relation to earlier works such as Christopher Marlowe's *Dr Faustus*, Ben Jonson's *The Alchemist*, or Thomas Shadwell's *The Virtuoso*, supposedly one of the first plays to depict the new Renaissance scientist[xvii], and more contemporary works such as Stephen Poliakoff's *Burnt by the Sun* and Michael Frayne's *Copenhagen.*

Important to us is that these plays were not simply studied as university-style seminars. For as bell hooks writes of the university students she teaches in *Teaching to Transgress*:

> They do want an education that is healing to the uninformed, unknowing spirit. They do want knowledge that is meaningful. They rightfully expect that my colleagues and I will not offer them information without addressing the connection between what they are learning and their overall life experiences.[xviii]

It seems to us that participatory drama and theatre methods, although not very often used in higher education, are among the most appropriate ways to achieve this. These are examples of the kinds of activities and exercises that we have experimented with:

- Working with the plays directly, through, for example hot seating characters to probe some of their motivations and dilemmas in more detail or exploring some of the theatrical images of the plays through image theatre;
- Utilising analogous or metaphorical dramatic contexts (which could be related back to the plays) through techniques such as role play; these helped to explore specific issues or ethical dilemmas *in action*;
- Employing drama activities not related to the plays at all, but relevant to the overall themes, for example:
    - forum theatre, based on the issue of cloning and devised by students from a collage made up of different photographs and newspaper headlines;
    - teacher-in-role in which we ourselves were hot-seated, requiring students to work through a thorough process of question formulation - for us it is often as useful educationally to give students opportunities to formulate and structure appropriate questions, as it is to simply look for answers;
    - image theatre, through which concepts such as ethics can be 'physicalised' as a stimulus to debate, offering multiple readings of participants' viewpoints.

Here are two detailed examples of role-playing strategies used for two of the texts studied in the course. These are smaller role-plays that would have been part of a broader participatory process. The first was related to the study of *Life of Galileo*, the second to *After Darwin*.

1. *Life of Galileo:* The lecturer asked the students to choose a partner and decide who would be A and who would be B. The A's were then told, without the B's hearing, that they had discovered an alternative energy source that was incredibly cheap, eco-friendly and inexhaustible - a solution to the world's energy crisis - and they would be meeting with a government official to whom they would be relating this news. The B's were told, beyond the A's hearing, that they were government representatives who had been instructed to hear A's claims, and their roles were characterised by disinterest and scepticism. They were also later encouraged to attempt to buy the discovery and bribe the A's to 'forget' that such a discovery had been made.

This exercise placed some of the central issues of *Life of Galileo* in an imaginary contemporary context. Upon group reflection the students immediately recognised issues of political power at play and hypothesised a number of reasons for why 'the Government' should want to silence the discovery of something obviously of benefit to the people: whole economies centred around oil would collapse, the world's power base would shift in an alarming and unpredictable way, First World political clout would be diminished, and so on. The students easily identified parallels with *Galileo*. As importantly, however, they felt, through their brief role-playing, certain dynamics coming into play between the Discoverer/Scientist and the Powers in Charge. They experienced the frustration of resistance to discovery, the reduction of that discovery to economic terms (they were required, after all, to negotiate/consider the price of silence) and the consequences of accepting the bribe (personal benefit versus public benefit). In experiencing these, they were brought a little closer to an understanding of Galileo's own ethical and moral plight. What's important here is that the students' experience of the power dynamics was holistic. They weren't asked to just imagine such a scenario, but were asked to place themselves physically in that position. As such they experienced the physicality of being an excited Scientist or stoney government employee. They looked into the eyes of another as they grappled with the emotions and objectives of their characters, however thinly those characters might have been drawn.

2. *After Darwin*: The students were enrolled as teachers and parents attending a PTA meeting to discuss various items on a not-so-hidden agenda drawn up the lecturer in the guise of the school secretary. Items under discussion included the upcoming Cultural Day Fete and the appropriateness of evolution in the Biology syllabus. The students conducted the entire role-play according to the agenda, as chaired by the headmaster (a student) and prompted by the school secretary who took notes for the meeting.

Although the Cultural Day Fete was an item intended only to give more credence to the drama and perhaps vaguely allude to the comments Wertenbaker makes on multi-culturalism in her play, the brief discussion that ensued was an excellent pre-cursor to the main item of discussion. One of the students suggested that many religions be represented at the fete and, apart from minor resistance from the self-appointed, fundamentalist right-wing parent, the agreement was unanimous. This discussion ended, the headmaster moved on to the next item on the agenda.

It is disappointing to report that the discussion of evolution's place in the school curriculum proceeded quite predictably. There was a general agreement that evolution was a theory that deserved attention and had educational value provided it was taught as theory. Apart from some argument (from the same right-wing parent!) this opinion was unopposed. Perhaps a different choice of Drama might have sparked more contentious debate. It could also be suggested that whilst a metaphorical dramatic structure or context had been chosen, the content itself was still too closely linked to the play, and thus led to predictability. This suggests the need to think in terms of dramatic metaphor of both context and content.[xix]

Nevertheless, engagement and discussion in this activity did happen, and turned out to be enriching on another front. The students found the focus of their attention drawn to the nature of religion. Questions were raised as to the ethics of religious influence. Does any church have the right to insist on legislation based on religious belief? Is the state required to defend any religion, regardless of its practice? Are there areas in which religious discrimination is justified?

Why, then, does drama, appear to offer such a valuable medium for grappling with such issues? Edmiston makes two proposals about drama and ethics which seem to be borne out for us in the above examples: a) in drama we adopt multiple positions in addition to those of our everyday lives; we explore how we may have acted if we had adopted such positions; and b) we use imagination to shift positions so that we learn how to evaluate actions from the positions of those affected by the consequences of our actions.[xx] We would perhaps add to this by extending the latter point. Not only does the imagination help to shift positions within the drama, but the theatrical imagination compels us to participate in the work through imagery, both visually and physically.

Theatrical Imaginings

Working with image in process-based work through, for example, tableaux, image theatre and role play, offers many possibilities for exploring multiple meanings and interpretations in a situation. However, we should not forget the educational possibilities of the theatrical imagination in performance-based educational theatre work. The theatrical image is a central part of the *exchange* between performer and spectator, or between participants in the drama workshop. Through our own work in producing the play, engaging in image theatre, and studying the play as theatre text, it has become clear that the performer-spectator transactions that take place at the level of image are closely related to the ethical transactions, for like theatre, ethics is a social negotiation, it demands a transaction and collusion with an-other. Theatre can demonstrate a physicalisation of ethics and highlight the complexity of ethical practice. This opens up the postmodern possibility of rejecting a logos-centred world in favour of a multi-centred one in which the body and the emotions must be equally valued, alongside the senses and the intellect. It is crucial, however, that the theatre image is understood to be provocative, disruptive and revealing rather than representational.

As Alan Read argues in *Theatre and Everyday Life: An Ethics of Performance*:

> Ethical discourse itself has had very little effect or bearing on ethical acts...Both ethics and theatre are concerned with possibility. On the contrary representation is the reflection of an 'existing' proposition as though it were fact, and this is never what the theatre achieves. The theatre image unlike any other is always a possibility without closure, like the ethical relation which awaits creation.[xxi]

Read's perspective is significant in that it suggests that theatre (especially in performance) is a useful medium for exploring ethics because it is immediate and unpredictable - the written word of the playwright might well dictate certain ethical boundaries, but *performance*, as an act involving the performer and spectator, lies in the action of the here and now.

A Bird in an Air Pump and a Skeleton in the Basement

So what of the metaphor of the skeleton in the basement that we started out with? This image provides a useful point of reference for our concluding comments about the significance of drama and theatre in education in terms of both dramatic activities and theatrical imagery.

In *An Experiment with an Air Pump*, the 200 year old skeleton of a young girl is found in the basement of a house, sparking a range of ethical debates about genetics, scientific experimentation, cloning, anatomical dissection, and discovery. The play is set concurrently in 1799 and 1999, two eras of immense of scientific growth, each on the cusp of a new century. The skeleton that is discovered under a house in the 1999 sections of the play turns out to be the character, Isobel, a servant in the same house in the 1799 sections of the play. Isobel's heart is broken when she discovers that the romantic affections showered on her by the scientist, Armstrong, are merely a ploy to examine her deformed back almost as if she were already a cadaver waiting to be cut up with an almost perverse passion.

The opening and closing images of the play provide a good example of the complex meaning that imagery can convey in engaging in ethics without resorting to trite

representation or closure. At the start of the play, we see the experiment being performed on the bird in the air pump; at the close of the play, the characters are in the same arrangement (as in Wright's painting), but rather than standing around the bird in the air pump, they are gathered around Isobel's coffin. The bird as the object of experimentation becomes a metaphor for Isobel, and the air pump can be seen as a metaphor for the heart, a pump of another kind. Isobel, having committed suicide, is lying dead at the end of the play not because she has been deprived of oxygen like the bird has, but because the scientist's ethics has impacted directly on her emotions, her thoughts, her self worth, her sense of identity, and her confidence.

Perhaps this is where the strength of drama and theatre lie in confronting ethics. We, as participants or audience, are taken beyond philosophical debate or abstract argument, to an understanding of the impact of scientific ethics on ourselves as human beings. Through putting ourselves into some else's position or identifying with a character on stage, through placing ourselves into various fictional relationships with other individuals, groups and society more broadly, we open ourselves to multifaceted insights into the impacts and potential consequences of decisions we make today. In an era in which we are increasingly becoming our own individual moral watchdogs when it comes to scientific matters (which, previously, we might blithely have to higher powers), the final image of *Experiment* certainly gives us pause to reflect - a moment we did not necessarily take when first reading about Dolly the sheep. The skeleton in the basement ceases to simply be an old collection of bones, and takes on a human face and a beating heart, a personality with dreams, ambitions, fears and ideas.

As Fenwick tells Roget in *An Experiment with an Air Pump*:

> Roget: Does good science require a warm heart?
> Fenwick: I like to think so Roget. In fact I suspect pure objectivity is an arrogant fallacy. When we conduct an experiment we bring to bear all our human frailties, and all our prejudices, much as we might wish it to be otherwise. I like to think that good science requires us to utilise every aspect of ourselves in pursuit of truth. And sometimes, the heart comes into it." (p.47).

Perhaps the same might be said of us as teachers and performers, that we bring to bear on our students and audiences "...all (y)our human frailties, and all (y)our prejudices, much as we might wish it to be otherwise." What we aim to do, arguably, is to initiate a drama that allows us too, to give practice to our opinions, emotions, gestures, strategies and decisions. There is certainly responsibility in our choice of material for our drama/classes, but ultimately the teacher too is a scientist, eager to learn under the best conditions possible. It seems to us that cloning, for example, offers a bit more than the immediate benefit of engagement with the issues confronting the contemporary world. It also has the potential to relate to historical themes (minority rights, law, religion), scientific knowledge (DNA and genetic engineering, embryology, psychology, computer technology) and, by way of its unprecedented nature, the imagination. And this is, we would argue, is at the crux of the drama/theatre experience, the opportunity to draw on the imagination in a process of discovery, to adopt roles or positions[xxii], to explore ethical implications through action and image, rather than exclusively through word, to engage in debate, and to reflect on the collective and individual insights awoken through the drama.

Notes

[1] Shelagh Stephenson, *An Experiment with an Air Pump*, Methuen Drama: London, 1998, pp.3-4.
[2] Lisa Jardine, *Ingenious Pursuits: Building the Scientific Revolution*, Little, Brown & Co: Boston, 1999, pp.1-2.
[3] Marjorie Garber, Beatrice Hanssen and Rebecca L Walkowitz (eds.), *The Turn to Ethics*, (Routledge: London and New York, 2000), p.viii.
[4] Brian Edmiston, "Drama as Ethical Education", *Research in Drama Education*, Vol 5, No 1, March 2000, pp. 63-84.
[5] Edmiston, p.64.
[6] Given space constraints it is not possible to enter into a detailed discussion of Edmiston's paper, however readers are strongly advised to read the paper in full (together with Winston's own writing) to gain insight into his very useful analysis.
[7] Joe Winston, "A Response to Brian Edmiston's Article 'Drama as Ethical Education'", *Research in Drama Education*, Vol 5, No 1, March 2000, p. 113.
[8] Mel Thompson, *Ethics*, Hodder & Stoughton: London, 1994. p.9.
[9] Thompson, p.8.
[10] Zygmunt Bauman, *Postmodern Ethics*, Blackwell: Oxford, 1993, p.10.
[11] Alan Read, *Theatre and Everyday Life: An Ethics of Performance*, Routledge: London, 1995, p.67.
[12] Stephenson, p.36.
[13] Whilst not all the science necessarily related to Physics as a field, the lecturer, Professor Eddie Baart, drew on a broad range of scientific study. It helped that Professor Baart had a keen interest in drama and performance himself!

[14] Other plays dealt with in the exhibition included Michael Frayn's *Copenhagen*, Stephen Poliakoff's *Burnt by the Sun*, Andrew Buckland's *Thing*, Frederich Durrenmatt's *The Physicists*, Heiner Kipphardt's *In the Matter of J Robert Oppenheimer*, Tom Stoppard's *Hapgood,* and Thomas Shadwell's *The Virtuoso.*
Production: *An Experiment with an Air Pump*, Rhodes University Theatre, Grahamstown, 2000, Written by Shelagh Stephenson, Directed by Michael Carklin and Dion van Niekerk.
[15] Garber et al, p.ix.
[16] In an Introduction to *Life of Galileo*, for example, Hugh Rorrison points out how the play was revised by Brecht, first in response to the splitting of the atom in 1939 and the role of science in World War II, including Nazi medical experimentation, and then again in response to the dropping of the atomic bomb in 1945 and the trial of J Robert Oppenehimer in 1954 (Bertolt Brecht, *Life of Galileo,* Methuen Drama: London, 1980, pp.xxi-xxii).
[17] W. Brouwer, "The Image of the Physicist in Modern Drama," *American Journal of Physics,* No 56, 1988, pp.611-617.
[18] bell hooks, *Teaching to Transgress: Education as the Practice of Freedom,* Routledge: London & New York, 1994, p.19.
[19] We are reminded again of Dorothy Heathcote's 'Brotherhood Code'. Presentations at the IDEA 2001 congress in Norway also address the matter of metaphor, metaxis, fiction and reality in interesting and challenging ways, especially Tor Helge's "Myth and Metaxy and the Myth of Metaxis" and John Somers' presentation, "The Realtionship of Real and Fictional Narratives in Drama Education".
[20] Edmiston, p.67.
[21] Read, p.90.
[22] It is worth noting that Brian Edmiston uses the term 'position' rather than 'role'. He refers to Davies and Harre (1990) who highlight the dynamic interaction between people – two people interacting, who amintain their same social roles, would nonetheless each have a position relative to the other determined by the immediate situation and social narratives; each person also 'positions' the other. For Edmiston, this concept of positioning is integral to understanding the ethical nature of dialogue (Edmiston, 2000, p.75).

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