

**Science and Mathematics Education Centre**

**Culture and Conceptualisations of Nature: An Interpretive  
Analysis of Australian and Chinese Perspectives**

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**"This thesis is presented as part of the requirements for  
the award of the Degree of Doctor of Philosophy  
of the  
Curtin University of Technology"**

**March 00**

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## ABSTRACT

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Issues of culture and worldview and their impact on students' learning of science have become increasingly important to science teachers. This study details work that I carried out in the period 1995-1999 which examined the effect of culture on students' conceptualisations of nature. It is framed as the creation of my own 'living educational theory' as I, a teacher-researcher, dealt with what I perceived were the cultural inequities experienced by students in my classroom. I carried out my first study with a group of seven rural high school students in the Far North of Queensland in Australia, where I was teaching in 1995. Later, in two visits to China, I was able to carry out the same sort of research with a group of seven Chinese college students in Jinan, Shandong Province, PRC, largely using the Chinese language. I used a naturalistic inquiry approach and a semi-structured interview technique to determine students' conceptualisations of nature. I have chosen to embed the results of these two studies within narratives that describe my experiences in the two cultures as I carried out my research. For each culture, I have also developed an epic description of the role of science from the literature and history of that culture. From my three sources of data, interview, narrative and historical description, I have made knowledge claims about the students' beliefs about the natural world.

My research findings are ironic to me since they are diametrically opposite to what I had expected. Initially I had believed that Mainland Chinese students would possess a world view full of alternative perspectives to that of Western school science. My research indicates however that students in rural Mainland China hold a traditional and integrated modern Western scientific world view. Although some researchers in other South-East Asian communities propose alternative frameworks for the teaching of science, frameworks that are actually 'pre-modern', these do not appear to be appropriate for Mainland Chinese students. I had expected that the Australian students would bring a modern Western scientific world view to the science classroom. However, the group of rural Western students that I interviewed displayed a world view that is not recognisable as that of modern Western science. Postmodernism and other cultural and social effects appear to have influenced them to such an extent that some have clearly not 'crossed the border' to a modern Western scientific world view. This thesis reflects my desire to overcome the perceived problem of inequity in my own teaching. The knowledge claims made here give some indication as to how I may improve my own practice. A return to the classroom will allow me to continue the cycle of action and reflection by which I can validate, develop and refine my living educational theory.

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## ACKNOWLEDGMENTS

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I would like to thank all the colleagues who have inspired me during the time I have been working on this thesis. I am particularly grateful to my colleagues at the Flexible Learning Centre of the University of South Australia who have taught me so much about teaching, learning and educational research.

My family, Pete, Jeremy, Hannah and Emily, have given me incredible support over the last ten years and encouraged me in my journey from housewife to lecturer. I am thankful for their encouragement, especially during the periods I have spent away from home in China and Africa during the course of this research.

Many of the staff and students at the National Key Centre for School Science and Mathematics, Curtin University of Technology, have encouraged me in significant ways in the short amount of time I have spent at the Centre. However, I am particularly grateful to my doctoral supervisor Peter Taylor for his input, direction and critical comments. Peter has guided my reading and challenged my assumptions, and his research has become a model for my own. He has helped me to understand something of the nature of qualitative research in science education, and opened the areas of alternative genres and epistemologies for me. I believe he has played a significant part in shaping me as both a science educator and researcher and I look forward to future collaborative work with him.

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TABLE OF CONTENTS

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<b>ABSTRACT .....</b>	<b>II</b>
<b>ACKNOWLEDGMENTS.....</b>	<b>III</b>
<b>TABLE OF CONTENTS.....</b>	<b>IV</b>
<b>TABLE OF FIGURES AND TABLES.....</b>	<b>VII</b>
<b>SECTION 1.....</b>	<b>1</b>
<b>CHAPTER ONE: INTRODUCTION.....</b>	<b>2</b>
OVERVIEW OF THE CHAPTER .....	2
MY EXPERIENCE OF CULTURE .....	2
QUESTIONS ABOUT CULTURE .....	5
<b>CHAPTER TWO: SCIENCE EDUCATION AND CULTURE .....</b>	<b>7</b>
OVERVIEW OF THE CHAPTER .....	7
SITUATING MY RESEARCH IN THE FIELD.....	7
DEVELOPING RESEARCH QUESTIONS AND DEFINITIONS.....	8
DEFINITIONS OF WORLD VIEW, CULTURE AND MULTICULTURALISM FOR SCIENCE EDUCATORS ....	9
<i>What is a world view?</i> .....	9
<i>What is culture?</i> .....	9
<i>What is multiculturalism?</i> .....	12
<i>Non-Western research in socio-cultural constructivism and science education</i> .....	15
<b>CHAPTER THREE METHODOLOGY.....</b>	<b>19</b>
OVERVIEW OF THE CHAPTER .....	19
FINDING A METHODOLOGY FOR MY RESEARCH.....	19
SITUATING THIS STUDY IN THE FIELD.....	21
ADAPTATIONS TO COBERN'S METHODOLOGY .....	23
<i>Australian Study</i> .....	23
<i>First Chinese Study</i> .....	25
<i>Modifications after a Second field trip to China</i> .....	26
WRITING UP THE RESEARCH .....	28
MAKING ASSERTIONS .....	30
'EPIC DESCRIPTIONS' .....	32
<b>SECTION 2.....</b>	<b>34</b>
<b>CHAPTER FOUR: WESTERN WORLD VIEW .....</b>	<b>35</b>
OVERVIEW OF THE CHAPTER.....	35
PRODUCING THE SKELETON OF A WESTERN SCIENTIFIC WORLD VIEW.....	35
THE GREEKS AND ROMANS.....	36
THE RISE OF CHRISTIANITY .....	41
MEDIAEVAL TRANSFORMATION AND A MODERN WORLD VIEW .....	43
POSTMODERNISM.....	47
A MODERN WESTERN 'SCIENTIFIC' WORLD VIEW .....	49
<b>CHAPTER FIVE: NORTHERN AUSTRALIA .....</b>	<b>50</b>
OVERVIEW OF THE CHAPTER.....	50
BACKGROUND TO THE LOCATION AND STUDY .....	50
AN INTRODUCTION TO THE CULTURE .....	51
<i>Far North Queensland, Australia 1991</i> .....	51

SCHOOLS AND TEACHING SCIENCE .....	53
MY SCIENCE TEACHING CAREER.....	53
THE PHYSICS TEACHER.....	55
PHYSICS PRACTICALS AND FIELDTRIPS.....	57
CARRYING OUT RESEARCH IN SCIENCE EDUCATION 1995 .....	58
SEEKING SUBJECTS FOR MY RESEARCH.....	59
CELIA.....	59
<i>Celia's Thoughts On Nature</i> .....	62
KAI.....	63
<i>Kai's Thoughts On Nature</i> .....	64
JB.....	65
<i>JB's Thoughts on Nature</i> .....	66
HAYLEY.....	67
<i>Hayley's Thoughts on Nature</i> .....	69
JEROME.....	70
<i>Jerome's Thoughts On Nature</i> .....	71
BETH.....	72
<i>Beth's Thoughts On Nature</i> .....	73
ELEANOR.....	74
<i>Eleanor's Thoughts On nature</i> .....	75
DISCUSSION OF TENTATIVE ASSERTIONS.....	76
<i>Assertion #1</i> .....	76
<i>Assertion #2</i> .....	77
<i>Assertion #3</i> .....	77
<i>Assertion #4</i> .....	78
<b>SECTION 3.....</b>	<b>80</b>
<b>CHAPTER SIX: CHINESE WORLD VIEW .....</b>	<b>81</b>
OVERVIEW OF THE CHAPTER.....	81
PRODUCING THE SKELETON OF A CHINESE WORLD VIEW .....	81
HISTORY.....	82
PHILOSOPHY AND RELIGION.....	89
SCIENTIFIC THEORIES AND CONCEPTS.....	93
THE CHINESE EDUCATION SYSTEM .....	96
THE SKELETON .....	100
<b>CHAPTER SEVEN: CHINA 1.....</b>	<b>102</b>
OVERVIEW OF THE CHAPTER.....	102
CHINA 1995.....	102
<i>Arrival</i> .....	102
THE CHINESE EDUCATION SYSTEM .....	104
<i>Inside the University</i> .....	105
<i>Students</i> .....	108
<i>Chinese traditional science, medicine and computers</i> .....	109
<i>Forming a relationship with a Middle School</i> .....	111
<i>Inside the science classroom</i> .....	112
FINDING A SUBJECT FOR MY RESEARCH .....	113
<i>Qin</i> .....	113
<i>Qin's thoughts on Nature</i> .....	118
TRAVELLING IN CHINA .....	119
<i>The countryside</i> .....	119
<i>Beijing</i> .....	122
<i>Public security</i> .....	125
<i>Religion</i> .....	126
<b>CHAPTER EIGHT: CHINA 2.....</b>	<b>127</b>
OVERVIEW OF THE CHAPTER.....	127

CHINA, EASTER 1998 .....	127
<i>Revisiting the Culture</i> .....	127
RESEARCH .....	143
<i>Meeting Students and Doing the Research</i> .....	143
<i>Yan</i> .....	146
<i>An Interlude in the park</i> .....	149
<i>Li Na</i> .....	151
<i>Bao Cai</i> .....	153
<i>Sheng Bo</i> .....	155
<i>Da Peng</i> .....	157
<i>Jie (Another Interlude in the Flower park)</i> .....	159
<i>Hai Tao</i> .....	161
TENTATIVE ASSERTIONS .....	163
<b>SECTION 4</b> .....	<b>167</b>
<b>CHAPTER NINE: CONCLUSION</b> .....	<b>168</b>
OVERVIEW OF THE CHAPTER .....	168
STUDENTS' CONCEPTUALISATIONS OF NATURE .....	168
<i>Australian Study</i> .....	168
<i>Chinese Study</i> .....	171
WHAT DID I LEARN IN THIS STUDY? .....	172
CONCLUSION .....	174
<i>Creating my own Living Educational Theory</i> .....	174
<i>Culturally sensitive science education – perspectives from research</i> .....	175
<i>Reflections on research perspectives</i> .....	177
<i>Implications for my teaching</i> .....	179
<i>Moving on</i> .....	181
<b>REFERENCES</b> .....	<b>183</b>
<b>APPENDIX 1</b> .....	<b>192</b>
INTERVIEW ELICITATION DEVICE (COBERN 1995A) WITH CHINESE TRANSLATION AND PRONUNCIATION .....	192
<i>Task One Terms</i> .....	192
<i>Task Two Statement Sort</i> .....	193

CHINA, EASTER 1998 .....	127
<i>Revisiting the Culture</i> .....	127
RESEARCH .....	143
<i>Meeting Students and Doing the Research</i> .....	143
<i>Yan</i> .....	146
<i>An Interlude in the park</i> .....	149
<i>Li Na</i> .....	151
<i>Bao Cai</i> .....	153
<i>Sheng Bo</i> .....	155
<i>Da Peng</i> .....	157
<i>Jie (Another Interlude in the Flower park)</i> .....	159
<i>Hai Tao</i> .....	161
TENTATIVE ASSERTIONS .....	163
<b>SECTION 4</b> .....	<b>167</b>
<b>CHAPTER NINE: CONCLUSION</b> .....	<b>168</b>
OVERVIEW OF THE CHAPTER .....	168
STUDENTS' CONCEPTUALISATIONS OF NATURE .....	168
<i>Australian Study</i> .....	168
<i>Chinese Study</i> .....	171
WHAT DID I LEARN IN THIS STUDY? .....	172
CONCLUSION .....	174
<i>Creating my own Living Educational Theory</i> .....	174
<i>Culturally sensitive science education – perspectives from research</i> .....	175
<i>Reflections on research perspectives</i> .....	177
<i>Implications for my teaching</i> .....	179
<i>Moving on</i> .....	181
<b>REFERENCES</b> .....	<b>183</b>
<b>APPENDIX 1</b> .....	<b>192</b>
INTERVIEW ELICITATION DEVICE (COBERN 1995A) WITH CHINESE TRANSLATION AND PRONUNCIATION .....	192
<i>Task One Terms</i> .....	192
<i>Task Two Statement Sort</i> .....	193

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**TABLE OF FIGURES AND TABLES**

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**FIGURES**

FIGURE ONE - CELIA'S THOUGHTS ON NATURE .....	62
FIGURE TWO - KAI'S THOUGHTS ON NATURE.....	64
FIGURE THREE - JB'S THOUGHTS ON NATURE.....	66
FIGURE FOUR - HAYLEY'S THOUGHTS ON NATURE .....	69
FIGURE FIVE - JEROME'S THOUGHTS ON NATURE.....	71
FIGURE SIX - BETH'S THOUGHTS ON NATURE.....	73
FIGURE SEVEN - ELEANOR'S THOUGHTS ON NATURE.....	75
FIGURE EIGHT - CHINESE DYNASTIES .....	82
FIGURE NINE - TEACHERS .....	105
FIGURE TEN - CONFUCIUS TEMPLE IN NANJING .....	114
FIGURE ELEVEN - QIN'S CONCEPT MAP AND NARRATIVE .....	118
FIGURE TWELVE - MARKET TRADER IN THE VILLAGE .....	121
FIGURE THIRTEEN - OLD WOMEN IN THE MARKET .....	122
FIGURE FOURTEEN - TIANANMEN SQUARE SHOWING 'LIBERATION' OF HONG KONG .....	123
FIGURE FIFTEEN - VIEW FROM THE GREAT WALL.....	124
FIGURE SIXTEEN - 'MICHELIN MAN' AT THE GREAT WALL.....	124
FIGURE SEVENTEEN - MORNING AT THE SHANDONG INSTITUTE OF ARCHITECTURE.....	129
FIGURE EIGHTEEN - VIEW FROM MY BIKE .....	132
FIGURE NINETEEN - STREET SCENE IN JINAN .....	133
FIGURE TWENTY - MY FAVOURITE INTERPRETER .....	136
FIGURE TWENTY ONE - THE WEDDING .....	137
FIGURE TWENTY TWO - CONFUCIUS IN THE RAIN.....	139
FIGURE TWENTY THREE - NATIONAL FOREIGN EXPERTS' DAY BANQUET .....	141
FIGURE TWENTY FOUR - A SOMEWHAT PREMATURE TITLE? .....	142
FIGURE TWENTY FIVE - LITTLE RED HAT ENGLISH CORNER .....	144
FIGURE TWENTY SIX - YAN'S THOUGHTS ON NATURE .....	148
FIGURE TWENTY SEVEN - WITH LI NA, YAN AND CLASSMATE IN THE FLOWER PARK.....	149
FIGURE TWENTY EIGHT - LI NA'S THOUGHTS ON NATURE.....	152
FIGURE TWENTY NINE - BAO CAI'S THOUGHTS ON NATURE .....	154
FIGURE THIRTY - SHENG BO'S THOUGHTS ON NATURE.....	156
FIGURE THIRTY ONE - DA PENG'S THOUGHTS ON NATURE .....	158
FIGURE THIRTY TWO - JIE'S THOUGHTS ON NATURE.....	160
FIGURE THIRTY THREE - HAI TAO'S THOUGHTS ON NATURE .....	162



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SECTION 1

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CULTURE

*CONFUCIUS SAID:*

*'THERE IS NOTHING THAT I CAN DO ABOUT THOSE WHO NEVER ASK  
THEMSELVES WHAT THEY SHOULD DO WHEN THEY ARE TO SET  
ABOUT THINGS'*

(ANALECTS 15:16)

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## CHAPTER ONE

### INTRODUCTION

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#### OVERVIEW OF THE CHAPTER

This thesis tells the story of my journey as I endeavoured to examine the relationship between students' world views and their conceptualisations of nature. In this chapter, I provide an autobiographical perspective on my experience of culture and my own understanding of the world. I also give some insight into the experiences that have motivated me to undertake this research.

#### MY EXPERIENCE OF CULTURE

My own interest in culture and its effects on students' understanding has been a growing one. I feel that I have always been intuitively aware of the many different cultural groups and environments that existed around me. I have also understood the need to use the language and the understanding of the group in order to live within it or along side it.

I grew up in a part of London that was originally predominantly Jewish and working class. We saw waves of immigrants come into the area: Cypriots, West Indians, Pakistanis and Indians. This did not really affect me because we lived in our own little world - our micro-culture. My father was Jewish but, as a Marxist, had turned his back on his family's faith, while continuing to long for roll-mop herrings and other delicacies of East London Yiddish cuisine. My mother's family was steeped in the Cockney tradition of rhyming slang and multi-layered superstitions from her spiritualist family. Cultural differences became crystallised for me when I passed the entrance exam for the local girls' grammar school at the age of eleven. This was the beginning of living in two different worlds - the loud Cockney atheist one at home and the refined world of the young Anglican lady at school. We learned a new vocabulary, developed a new accent (less nasal and no more dropped aitches) and set our sights on university. I cannot remember any confusion or difficulty in the transition - just an intuitive awareness that it was necessary to use two sets of behaviour in order to survive in my two worlds.

Our refined Anglican tradition was threatened when Ugandan Asians began to arrive in our part of London. Our school uniform had to be adapted to allow for the shalwar kameez and sari and we added Urdu and Hindi to the Greek and Latin languages of our predecessors' curriculum. This influx also added a rich new meaning to many parts of our understanding. We learned about

arranged marriages and families that behaved so differently from our own. People, who seemed so very polite and distant with excessively engendered behaviour, strangely covered bodies and a different use of our language, were firstly very confusing and later, just accepted as part of life.

Another facet was added to my understanding of culture when I left school and enrolled on a degree course in Mechanical Engineering. This was the early 1970s, with its incipient feminism and a push to move women into non-traditional areas of study. I was naive enough to be unaware that women did not usually study engineering. I left the all-female world of school for the male-dominated world of engineering, where I was the only female in a class of sixty. This was a real shock since I was not expecting to have to make this sort of change as I entered the world of higher education. I had expected that there would be differences, and that there would be a new academic world to experience and understand, but I did not realise that the world would also be a male-oriented one. I soon discovered that there were two ways to live in this 'male' world. The first was displayed by one or two beer drinking, motorbike riding girls in the year above me, who seemed determined to try and be like 'the men'. The alternative, which I preferred, was to study hard and excel in all the maths-based subjects, and then to be excessively feminine and helpless when I had problems with practical work. Welding, soldering and technical drawing were a mystery to me but my 'learned helplessness' allowed me to receive immediate and excessive male attention in all our practical classes.

I faced many problems as a female engineer in the male world of light engineering. The culture of the factory had its own taboos that were broken by my presence. There was no traditional role for a woman on the shop floor as a supervisor or innovator - she was automatically classed as a 'nag' along with all the stay-at-home wives. Neither was there a place for a female engineer in a foundry. Legend has it that women cause 'bad luck' in foundries, and I usually left a trail of middle-management problems in my wake as I attempted to carry out my work.

I moved to Hong Kong, with my husband and two young children, while I was in my twenties and lived and worked there for ten years. I immediately started to learn to speak Cantonese and developed different vocabularies for the market, the work place and the church, with varying degrees of formality depending on the context. I learned about tradition, ceremonies and customs, Confucius and ancestor worship. I believe that while I was there I intuitively began to be able to live in two more different worlds - the Western one of the privileged expatriate, and the Hong Kong Chinese world of my new colleagues and friends. This involved the growing ability to think,

understand and reason in a Chinese manner. New comprehension grew as I watched and imitated Chinese people, my friends, who patiently answered my questions regarding the reason why they behaved as they did.

One other major cultural influence on my own life in the last twenty-five years has also been the effect of my Christian faith. Christians strongly and positively influenced me when I first started tertiary study. I would call myself an evangelical Christian, a Protestant, which means to me that my adult life has been shaped by the values and principles of the Bible. I would also say that I have an active and dynamic faith. This means that I believe that, parallel to the physical universe, there is spiritual truth and spiritual power that impacts peoples' lives. I believe that this power, may for example, cause physical or psychological healing or, in various other ways, have an impact on the physical world around us.

My understanding of what, I believe, is a spiritual world, and spiritual power, allows me to be sympathetic to the views and values of those whose culture incorporates different or similar understandings of spiritual phenomena.

I believe that my greatest cross-cultural experience has been the adoption of a Chinese daughter in 1983. Emily was born in Hong Kong and, as a family, we have worked through the implications of 'what does it mean to be Chinese?' At the age of four it seemed to mean 'You have brown hair, different eyes to me and your skin is a bit browner in colour' but, at the age of seventeen and thoroughly Australian, it seems harder to explain. I do not see a Chinese face any more, just a daughter.

When I moved to Australia in 1991, I suffered the problem of adjusting to a Western culture that was similar to, but definitely not identical with, the culture in which I had grown up. This was heightened by the fact that, rather than living in a major Southern capital city, we settled in a township in Far North Queensland.

When I began to teach tertiary information technology, I realised that students from another cultural background, particularly a Chinese one, would not understand the content or processes, which I was carefully imparting, predominantly to 'natives' of Far North Queensland. This provided me with a problem that ultimately became the subject of this research. I felt intuitively that I was asking 'foreigners' to think and reason in the same way as my Australian students which would be difficult because the concepts I was teaching were embedded in a Western cultural understanding

(and, also, usually delivered with a particularly Australian use of the English language). I also realised that many of my students of non-European origin, although Australian by nationality, had grown up in a distinct sub-culture within Australia. They would probably be having similar difficulties, even though their language problems were not so noticeable.

#### QUESTIONS ABOUT CULTURE

During my classes, and as I prepared my lectures and practicals, I began to ask questions of myself:

- What is this thing we call culture?
- What is the effect of culture on people?
- What is unique about, say, Chinese thinking?
- How does their cultural framework affect the way in which Chinese understand scientific concepts?
- What sorts of fundamental beliefs do other cultures have?
- Are they the same as, or similar to, Chinese ones?
- Does gender, urbanisation, poverty, religion make a difference to the students' understanding within a given culture
- How do teachers deal with classes of students from many different cultural backgrounds?
- Can we teach overseas students, or export our Australian educational courseware, without making cultural adaptations?

When I began to consider these issues, nothing in my education or experience had given me the tools necessary to identify or measure the effect of culture on an individual's understanding of science. My understanding of culture at the time was that it was a largely undefinable quality of an individual that was a reflection of his or her upbringing, race, religion, gender, tradition, social class, education and many other variables. It appeared to me that this culture could not be gauged scientifically, but had to be understood experientially. However it seemed that, once experienced, a

culture could be interpreted, its particular signifying factors isolated, and their effects demonstrated. I felt that those who live within any definable culture live within their own safe and sure world, and that many people live, apparently in quite a balanced way, moving between two or three identifiably different worlds.

I decided that I would be a better teacher if I knew how to deal with the cross-cultural issues involved in teaching and learning. I was aware that my teaching experience was limited and decided that I would need to study more and do some research which would help me to understand about culture and particularly Chinese culture.

I realised that I would need to have a deeper understanding of educational research than I had gained on a Graduate Diploma course. I started to look around to find a University where I could do Masters or Doctoral studies and examine the effects of culture on teaching and learning in my field of Information Technology.

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## CHAPTER TWO

### SCIENCE EDUCATION AND CULTURE

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#### OVERVIEW OF THE CHAPTER

In this chapter, I provide a review of research in science education and culture that arose from my reading in the field during the period 1994-1998.

#### SITUATING MY RESEARCH IN THE FIELD

I decided to enrol in the Doctorate in Science Education at Curtin University because it really was unique in structure. It was convenient too, because I would be able to study externally from my home in Queensland, which was situated thousands of kilometres away from Perth. When I began to study the coursework, I was introduced to modern research methods in science education and to the concept of constructivism. As I studied, I saw that cultural effects were evident in some of the papers that I was reading. However, I could not find anyone with a similar passion for culture and the gauging of its effects on students' learning. In 1995, I attended an advertised Summer Institute on 'Culture, Constructivism and School Science', taught by Bill Cobern. This finally introduced me to a field of research, and a methodology (described in Chapter 3), that I could use to investigate the characteristics of the Chinese culture and their effects on science learning.

The most significant concept to which I was introduced was the one of 'world view' - the 'culturally dependent, generally subconscious, fundamental organisations of the mind' (Cobern, 1991). Cobern stated that teachers must endeavour to see the world as the learner sees it, in order to aid the process of conceptual change.

He also stated how he believes it is important to view the student as a product of, and grounded in, his or her culture; and he quoted Clifford Geertz:

Man is an animal suspended in webs of significance he himself [sic] has spun. I take culture to be those webs, and the analysis of it is not an experimental science in search of law but an interpretative one in search of meaning. (Geertz, 1973, p.5)

This explanation of 'world view' and culture immediately made sense to me, because I felt I had spent most of my life observing the 'webs of significance' which different people had spun in distinct locations, and at specific times. I had learned to move carefully among the fragile webs,

identifying meaning intuitively, without being able to lay down laws and predict behaviour according to my scientific training. I had also observed, and had deep friendships with, people who had no real idea of the essential difference between the ‘fundamental organisations’ of our minds. Therefore, this definition of worldview was one that excited me since it gave me a basic referent that so far I had lacked.

After the course, I obtained and read a considerable amount of Cobern’s work and decided to carry out a study (results shown in Chapter 5) using the methodology (see Chapter 3) which he had developed. I wanted to do this in my own teaching setting and with my students in Northern Australia. I believed this would help me begin to form solutions to some of the questions I had formulated about culture and its effect on teaching and learning, which I identified in Chapter 1.

### **DEVELOPING RESEARCH QUESTIONS AND DEFINITIONS**

In order to begin the study however, I felt that I needed to understand more about cross-cultural work in science education. Therefore, I read widely to understand the field and to situate this study within it.

Bill Cobern had introduced me to the concept of “world view” and I felt I needed to understand the wider use of this concept. I also wanted to find out how ‘culture’ was defined and studied in the literature of science education. I commenced by seeking an answer to the following questions from science education literature.

- What is a world view and how can it be defined?
- What is culture?
- What is multiculturalism?

It soon became clear that I would need to read widely in other discipline areas to provide myself with a background in the human sciences, which my education so far had lacked. I discovered that I would need to answer the questions about culture and multiculturalism from the literature of anthropology and ethnography, as well as from that of education in general, and science education in particular. My purpose in doing this was to provide myself with a broader understanding of culture, multiculturalism and world view. I would then be able to consider the effects of culture



(and the ensuing problems of multiculturalism) in the narrower field of science education and specifically on students' concepts of the natural world.

I have gained my current understanding of culture and its role in science learning over about 5 years. My understanding has unfolded as I have read, travelled, asked questions and reflected on the answers given, and this unfolding is reflected here.

#### **DEFINITIONS OF WORLD VIEW, CULTURE AND MULTICULTURALISM FOR SCIENCE EDUCATORS**

This section details my understanding in 1995, after reading widely in science education research of the time, and before I began my first study in Australia.

##### WHAT IS A WORLD VIEW?

The term 'world view' (Cobern, 1991) has two different connotations in English. The first has a philosophical meaning and involves a person's concepts of human existence and reality; the second is an individual's picture of the world that he or she lives in. The term 'world view' as used in anthropology refers to the 'culturally-dependent, *implicit*, fundamental organisations of the mind (Cobern, 1991, p.19).

Kearney's understanding of world view, and the one used by Cobern (1991), is the working definition which I have used in my study:

.. the world view of a people is their way of looking at reality. It consists of basic assumptions and images that provide a more or less coherent, though not necessarily accurate, way of thinking about the world. (Kearney, 1984, p.41)

##### WHAT IS CULTURE?

Culture is a concept that is often discussed in educational literature. The definition of culture is often 'understood' by researchers in different academic fields as they carry out their studies. In my reading I have found definitions of 'culture' in science education research that have originated in one of two domains:

- anthropology and ethnography
- political empowerment

### *Anthropology and Ethnography*

A classic definition of culture found in early anthropological literature is that it is the 'knowledge, belief, law, morals, customs' (Tylor, 1871) which are passed on from one generation to another within a particular society or group of people. He saw his field as one in which the workers' primary role was that of compiling a 'philosophy of primeval history'. Anthropologists of Tylor's generation were expected to examine a 'civilisation' and produce a taxonomy with categories such as weapons, textile arts, myths, rites, and ceremonies. Tylor saw this activity as a scientific one and as a parallel to that of the plant and animal scientists of his time who were completing classifications of 'botanical and zoological species'.

Malinowski (1948 [1922]), another early anthropologist, is famous for his ethnographic fieldwork particularly among Trobriand islanders. In his time, he was considered unscientific because of his reliance on the detailed field notes of his observations. It had already become traditional, in his time, to rely on the written opinions of experts on specific aspects of culture such as religion or magic. However in his work, Malinowski demonstrated the study of culture as an art rather than a science, and failed in his attempts to produce anthropological and positivist scientific laws regarding culture from his collected work. He states in his essay *Baloma; The Spirits of the Dead in the Trobriand Islands* (1922), that one of his major rules in commencing his field work had been to gather 'pure fact'. He stated that he wanted to keep interpretation separate from 'pure fact'. However, he realised that there had to be a form of interpretation in the field otherwise, he was dealing with a mental 'chaos of facts'. He concluded that what he was dealing with were not scientific facts and that the 'often fragmentary, incoherent, non-organic nature of much of the present ethnological material is due to the cult of 'pure fact' ' (Malinowski, 1992, p.45). Malinowski's perspective on the study of culture was that it consisted largely of identifying particular human behaviour, and interpreting the underlying beliefs causing the specific behaviour.

'Civilisations' and societies have become much more complex during the twentieth century, and anthropological concepts of culture have been applied in many fields of study, including nursing, studies of policing and factory work (Van Maanen, 1995). The definition of 'culture' has

thus been extended, and described in many complex and diverse ways. Van Maanen comments (1995) that there is still considerable debate concerning 'the sacred heart of ethnography, the culture concept'. Postmodernists and deconstructivists also have problems with the concept of discrete and finite cultures and an 'incredulity towards metanarratives' (Lyotard, 1984). Others regard the concept of culture as something left over from a colonising era (Fabian, 1983).

The definition of culture that is most commonly found in the literature of science education (Cobern, 1991; Waldrip & Taylor, 1995) is that of Clifford Geertz:

The concept of culture I espouse ... is essentially a semiotic one. Believing.. that man is an animal suspended in webs of significance he has spun, I take culture to be those webs, and the analysis of it to be therefore not an experimental science in search of law but an interpretive one in search of meaning. (Geertz, 1973, p.3)

Geertz' definition is one which proposes that a person's knowledge of his or her world, is essentially mediated by signs, and it is the structure of these signs which establishes reality for an individual or a group. The role of the anthropologist is to act as the interpreter of the structure of the signs that are revealed by a distinct people group to members of other groups.

### *Political Empowerment*

Another definition of culture that is common among educators is that of a 'straightjacket fashioned by irresistible societal forces' (Taylor, 1994). There is a link also between this notion of culture and multiculturalism, and the ensuing effect of multiculturalism on pedagogy, which will be examined later. Giroux's understanding of culture in this domain is one that is widely accepted in education:

culture is reduced to a type of monumentalism and the pedagogy through which it is expressed is organised around the process of transmission and the practice of moral and political regulation. (Giroux, 1990)

Within the literature of science education, especially when dealing with issues of multiculturalism, the definitions of culture become blurred. Some researchers adopt a critical perspective on the explication of culture from anthropology and Geertz's (1973) 'webs of

significance' become interwoven with the politicised 'straightjacket' of the system, as expressed by Giroux (1990).

#### WHAT IS MULTICULTURALISM?

Multiculturalism involves the concept of 'including many cultures'. From a literature review, it appears that science educators, in talking about multiculturalism, use definitions of culture that are derived from both anthropology as expressed by Geertz (1973), and the realm of 'political empowerment'. It is important to disentangle the two perspectives to identify the main thrust of the researchers' arguments. I have done this in further reading, as I have attempted to answer the questions:

- What are the implications of multiculturalism to Western science educators?
- Have science educators from non-Western cultures researched the effect of culture?

#### *The implications of multiculturalism to Western science educators*

Multiculturalism has become a highly politicised issue in Western society. The basic American issue appears to be a perceived attack on America's 'single unified culture' (Chavez, 1994). The problem is expressed succinctly by Kimball:

Implicit in the politicising mandate of multiculturalism is an attack on the idea of common culture, the idea that despite our many differences, we hold in common an intellectual, artistic and moral legacy, descending largely from Greeks and the Bible, supplemented and modified over centuries by innumerable contributions from diverse hands and people. It is this legacy which has given us our science, our political institutions, and the monuments of artistic and cultural achievement that define us as a civilisation. Indeed, it is this legacy, insofar as we live up to it, that preserves us from chaos and barbarism. And it is this legacy that the multiculturalist wishes to dispense with. (Kimball, 1990)

D'Souza sees that:

the debate about multiculturalism is not over whether to study other cultures but how to study the West and other cultures. Multiculturalism is better understood as a civil conflict within the Western academy over contrasting approaches to learning about the world. (1995)

Several science educators deal with aspects of the politicised concept of multiculturalism, particularly within American society, and its effect on pedagogy. Stanley and Brickhouse (1994) perceive that multiculturalism is an issue that is central to modern educators, and one which is challenging the basic underpinning concepts on which science educators build their modern curricula. They state:

Multiculturalists are raising questions that pose a fundamental challenge to those traditional forms of knowledge that have assumed Western canonical thought ought to compose the core of school curricula. (Stanley & Brickhouse, 1994, p.387)

They draw attention to the fact that many Arts curricula have been criticised for their white, middle-class cultural perspectives. These are seen as perspectives which does not allow for the different conceptual frameworks of those with, for example, different world views or sexual orientations. However, they note that science education has been largely unaffected by the same criticism. They believe that this is due to the Universalist position which is commonly held by scientists and science educators, which asserts the absolute reality of science, unaffected by the context of the investigator.

In their opinion, the result of the positivist tendencies among Universalists allows them to present their interpretation of scientific reality without any sense of responsibility for the 'truth' they present. This then also gives permission for the 'destruction of knowledge systems deemed inferior' (Stanley & Brickhouse, 1994, p.393) by Western standards. They give examples of this destruction of knowledge systems with reference to African agriculture, and with the replacement of traditional midwifery by physician-attended childbirth.

They conclude by stating that if the Universalist position is just one view among many, then there cannot be a single conceptual framework for the presentation of science and, therefore, for science education. They feel that this implies that the science curriculum should present many cultural perspectives, rather than its traditional single one. They do not believe that each cultural

perspective should have the same degree of influence on the curriculum, but rather be exemplified within it, in order to demonstrate to the student the thinking associated with different world views and cultures.

In his response to Stanley and Brickhouse, Good (1995) asserts that science is multicultural because it is carried out throughout the world. He challenges Stanley and Brickhouse to find some significant scientific example from cultures outside of the US to enhance the American science curriculum. He provokes them to be more specific in their criticism of positivism and re-emphasises his Universalist position, inasmuch as he quotes 'science presumes that the things and events in the universe occur in consistent patterns that are comprehensible through careful systematic study' (AAAS, 1989, p.25)

Loving (1995) chooses to compare the work of Stanley and Brickhouse (1994) with that of two other studies. The first is that of Rakow and Bermudez (1993), whose conclusion is that the inclusion of the values and world view of their Hispanic students should enhance the curriculum. The second is that of Hodson (1993) who appears radical in his desire to make the science curriculum relevant to each culture, perhaps to the exclusion of traditional 'Western' scientific understanding. Loving 'inserts' Stanley and Brickhouse in the middle of the spectrum that has Rakow and Bermudez at one extreme and Hodson at the other.

Loving also questions the Stanley and Brickhouse position with regard to universalism, and the method by which they would change the existing science curriculum to allow for the inclusion of culturally appropriate additional material. She also questions whether Stanley and Brickhouse are just advocating a culturally sensitive, multicultural approach, or 'many sciences' presented from many cultural backgrounds. She agrees with them that science has often appeared to be a very narrow discipline, but she tends to allot a greater portion of blame to poorly prepared science educators rather than to philosophers.

Having examined the work of Stanley and Brickhouse and the comment from Loving and Good, it becomes immediately apparent that there are two aspects of one problem being faced simultaneously. The first is the debate on the absolute reality of science, which is a major issue in this study if I wish to assert that culture and world view does genuinely effect a student's conceptualisation of nature.

The second aspect for me is that they, and their respondents, have embedded their argument in the current American educational situation. Their definitions of multiculturalism are ones where culture has a partial political flavour, which is not appropriate to my study. The 'cure' proposed by Rakow and Bermudez (1993) and Hodson (1993) is one that, for my study, seems either too localised (to the USA), or too simplistic for the complexities of life in a transnational multicultural teaching setting.

In reading the debate between Stanley and Brickhouse, Good and Loving I felt like a bystander in a local American, but nevertheless, valid philosophical debate. In this debate, I did not find clarification for my own teaching situation but was given a wider perspective on the theoretical positions held by those in the field in the USA.

#### NON-WESTERN RESEARCH IN SOCIO-CULTURAL CONSTRUCTIVISM AND SCIENCE EDUCATION

I then read widely among non-Western science educators in order to discover the views being expressed among science educators and researchers in other cultures, and the nature of their 'local' debates. I found that with the development of the Science, Technology and Society (STS) perspective in Western science education (Yager 1980) there has been a stream of research from Asia and Africa with a non-Western socio-cultural viewpoint.

Ogawa (1986) commented that a STS perspective did not always provide a comprehensible explanation for non-Western science education that is not immersed in a society that is primarily based on science and technology. He suggested that, for the non-Western society, the term 'Society' needed to be replaced with the concept of 'culture'. He proposed a model for a rationale of science education that could deal with the interaction of Traditional Culture and Western Culture. He summarised his model thus:

1. Science should be viewed in a cultural context and be relativized.
2. Characteristics of science as a culture (especially of the scientific view of man and nature and the scientific way of thinking) should be compared with their traditional culture.

3. Science as a culture should be seen within the context of the students' traditional culture (Ogawa 1986, p.118)

Ogunniyi (1988), basing his thinking on the work of Ogawa (1986), tried to bring together what he saw as the conflicts between a Western and an African world view. His argument was that although Western and African sciences both deal with the issue of interpreting the natural world, they are founded on divergent abstract models. 'Science is based on a mechanistic explanatory model, while the traditional world view is based on an anthropomorphic explanatory model' (Ogunniyi 1988, p.6). His solution was that further studies should be attempted to determine the traditional view of various cultures and determine areas of shared understanding. With this shared understanding as a basis, and with an understanding of potential conflict, the science education curriculum could then be determined.

In an investigation in 1991, other African researchers, Jegede and Okebukola (1991) examined the relationship between African students' beliefs and their acquisition of science process skills. In this study, African students were given experimental tasks that conflicted with traditional beliefs and sometimes broke taboos. It was found that students with a low level of traditional belief scored more highly on the tasks that involved the breaking of taboos. However, when there was no conflict with traditional beliefs, then all students performed relatively equally.

They also completed a different study (Okebukola & Jegede 1990), using a survey instrument that attempted to correlate four factors with the attainment of scientific concepts. These factors were General Environment (manual or automated), Reasoning Pattern (empirical or superstitious), Goal Structure (cooperative, competitive or individualistic) and Nature of the home (authoritarian or permissive). In this, they showed that there is a correlation between superstition and lack of attainment of scientific concepts.

Jegede (1994) saw many cultural factors involved in the teaching and learning of science; these included a traditional world view, societal expectations and the extent to which a society holds magical views incompatible with Western thought. In respect to the STS movement and its implications for African science education, he commented that the best way to improve science education in Africa was to use a 'conceptual ecocultural paradigm' that consists of:

1. Generating information about the African environment to explain natural phenomena



2. Identifying and using indigenous scientific and technological principles , theories and concepts within the African society
3. Teaching the values of the typical African humane feelings in relation to, and in the practice of, technology as a human enterprise (Jegade 1994, p.130)

In a later study, Ogunniyi, Jegede, Ogawa, Yandila and Oladele (1995) examined the world view presuppositions of 250 science teachers from Botswana, Indonesia, Japan, Nigeria and the Philippines. Their findings suggest that science teachers, who themselves come from non-Western cultures, hold varying views on the nature of science and often hold 'scientific' and 'nonscientific' world views in tension. They question the implications of their findings on curriculum development and pedagogy, and consider that further examination needs to be made of the issue of science teachers' world view on their students' learning.

Rampal (1994) reports on a study in India, similar to that of Jegede and Okebukola (1991), in which teachers and their students were taught to break taboos in their scientific investigations. She comments that it is difficult, in an Indian context, to distinguish between traditional religious, magic and superstitious beliefs. She sees that this has produced a 'closed' system of thought that constrains students, not allowing them to consider scientific alternatives as explanations for natural phenomena. In her work, science teachers were consulted. They were involved in such a way that 'science was seen as a specific system of knowledge, based on empirical validation, which did not necessarily interfere with one's personal philosophy or mode of worship' (Rampal 1994, p.134). She comments that after teachers were helped to distinguish taboos and superstitions then they were encouraged to break them and conduct genuine inquiry into what were once forbidden topics, such as human reproduction and the dissection of frogs. She observed that once teachers were willing to accept alternative solutions then their students became much more active and confident learners.

My conclusions from the work of these non-western science educators, from Japan, India and Africa, are that they agree that science needs to be perceived in a cultural context. They feel that there needs to be some form of examination, within a culture, of the conflict between 'scientific' and traditional concepts of science. Some have been able to link traditional belief and the understanding of scientific concepts or performance of experimental tasks. Others have also shown that science teachers' world views and their traditional beliefs affect their teaching and thus their students' learning.

After reading this literature, I felt that I wanted to situate my research with that of these non-Western science educators. This was due to the fact that, during my time in Hong Kong, I had lived and worked with Chinese people and had seen and believed in the reality of Chinese "magic". This included superhuman strength and ability, curses, potions and cures, and other features of Chinese traditional belief that defy the Western scientific explanations that I had grown up with. The Western science of my own schooling does not allow me to acknowledge the existence of supernatural phenomena, although I have my own explanations for them that are all based on my spiritual beliefs. Jegede and Okebukola (1991) and Rampal (1994) each acknowledge unashamedly and make explicit in their work the alternative cultural explanations that challenge my Western scientific upbringing.

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## CHAPTER THREE

### METHODOLOGY

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#### OVERVIEW OF THE CHAPTER

In this chapter, I provide a description of my research methodology and its development during the process of my research. I show how I have legitimated my research claims and how I have represented the data that I have gathered over five years of investigation.

#### FINDING A METHODOLOGY FOR MY RESEARCH

I commenced my search for an appropriate methodology, taking the position that I wanted to study the effect of traditional Chinese beliefs on a Chinese understanding of Western science and compare these to Western ones. However it became rapidly apparent that although, like Jegede and Okebukola (1991) and Rampal (1994), I could develop a survey instrument based on local beliefs or cosmology, I could not easily transfer such an instrument from one culture to another.

I was directed to the work of Cobern (1991, 1993, 1995a, 1995b) who is a major contributor in cross-cultural research science education. In his introduction to his monograph on *Worldview Theory*, Cobern (1991) looks at work that has recently been carried out in misconception research which, he notes, has also been called 'primitive science' or 'alternative frameworks' (Cobern, 1991, p.2).

He explains how researchers have come to realise that students bring to the science classroom a framework of perceptions and values which have been formed by their own culture and society.

He draws attention to the learner as a personal constructor of meaning and then to research in student conceptions (Driver, 1983) and misconceptions (Novak, 1987). Much work has been carried out in the area of identifying misconceptions held by science students, and the related perception of teaching as facilitating the undoing of misconceptions by replacing them with the more traditionally held scientific ones.

Cobern (1991, p.3) notes that misconception research contains some basic assumptions. He comments that these include a perception that students come to study science with relatively similar basic views of the natural world, valuing modern scientific understanding. He challenges this research with the question, 'Is it possible that this scientifically misconceived idea is a logical deduction from some fundamental view of nature held by the student?'

He notes that there has been recent interest in students' epistemological structures *per se*, and draws attention to the Alternative Conception Movement and research (Gilbert & Watts, 1982). This allows for the fact that students do not simply possess distinct and separate misconceptions, and accepts that these ideas are part of an integrated comprehension of the world. Cobern points out that culture is not simply race or language but includes other factors such as socio-economic grouping, education and belief system. He indicates that within science education, culture affects the way in which the student and the teacher perceive the world around them and their ethical and value systems.

Cobern then examines the development of constructivism over the past twenty years. He traces its development through the work of Novak (1977), Ausubel, Novak and Henesian (1978) and others. He arrives at the definition of constructivism as a process where the teacher works with the student to facilitate the student's construction of new knowledge, on top of the foundation of his previous conceptual base. He then uses the concept of world view - the 'culturally dependent, generally subconscious, fundamental organisations of the mind'- and applies this to science education. He states that teachers must endeavour to see the world as the learner sees it, to aid the process of conceptual change.

Cobern (1991 p.38) introduces the Kearney model of world view. In this introduction Cobern explains how this model 'begins with the idea that a world view is an organised set of fundamental, cognitive presuppositions about reality'. The model presumes a logical and structural integration of presuppositions and therefore the model is known as logico-structural one. He then identifies seven logico-structural categories contained within a given individual's world view.

- The Other
- Classification
- Causality
- Relationship
- Self
- Time & Space

These categories serve as a framework for analysis of a world view. Kearney (1984, p.65) draws the parallel between these factors of an individual world view and the categories a doctor uses for the diagnosis of a patient's disease. In order to determine the world view of an individual, his or her understanding of the seven categories of Other, Self, Time & Space, etc., would need to be identified and integrated to produce a picture of the complete world view.

In a study, Cobern (1993) used Kearney's logico-structural model to examine students' attitudes to the NonSelf. In this case, he determined that the NonSelf was everything that an individual did not identify as Self, and in his study concentrated on that part of the NonSelf that

could be defined as Nature, or the natural world. (The methodology is described later in this chapter). His findings showed that students, American Caucasian nursing students between 22 and 45 years of age, possessed a wide range of ideas about nature and the natural world. However, very few of their concepts involved the perceptions which one might have inferred from the 'naturalistic-mechanistic view of nature common to science education', which they had been taught.

He later used the same methodology, which is expanded on in another paper (1995a), to carry out an interpretive study of ninth graders conceptualisations of nature (1995b). This study produced a series of assertions made by a group of American ninth graders, from a High School in a rural, desert region of Arizona, about the natural world. These assertions included:

- Students use various standpoints (religious, artistic, environmentalist) to deliberate about the world
- There was no apparent correlation between gender and concepts used to describe the natural world
- A religious standpoint was apparent in many narratives
- The level of integration of science and everyday thinking was low
- A high degree of concern about preservation and protection of the environment was expressed

He felt that his research raised additional questions and opened further areas of research.

These additional questions are partially summarised as:

- How would students from different communities conceptualise nature and how would these conceptualisations vary with gender, age, urbanisation, teachers' worldview?

#### **SITUATING THIS STUDY IN THE FIELD**

My study is at least a partial response to that raised by Cobern above. His desire to examine how students from different communities conceptualise nature paralleled my own and provided a framework, within the field of science education, for my own research.

In my study I have, with Cobern, chosen to adopt Geertz's (1973) understanding of culture as 'webs of significance'. I have also embraced his understanding of 'world view' - the 'culturally dependent, generally subconscious, fundamental organisations of the mind' (Cobern, 1991). I have used the logico-structural model of world view which Cobern (1991) adapted

(Cobern 1993b) from the work of Kearney (1984). I have also used and adapted Cobern's 'modified naturalist inquiry approach.. using a semi-structured interview technique ..' (Cobern, 1995b, p.5). This has provided a methodology that I have been able to replicate, and is one that has allowed for cross-cultural adaptations.

I would then summarise my research question, as I understood it in 1995, as:

- How do students from Australia and China conceptualise nature and how do these conceptualisations vary with gender, age, urbanisation, and teachers' worldview?

I have identified with the non-Western researchers described in Chapter 2, who have, as insiders, sought to make comparisons between their own culture and the West, and to identify the importance that world view plays in the teaching and learning of science. I have taken this position because, after living in Hong Kong for ten years, I have a subjective intuition about Chinese culture, and both an objective and subjective knowledge of many Chinese beliefs, traditions and practices. I hesitate to treat myself as an insider to the Chinese culture. I am a Westerner who has lived in the privileged position of a guest within the walls of the Middle Kingdom - it is culturally inappropriate for me to claim a detailed understanding of Chinese culture but nevertheless true.

Although I recognise the disempowerment of many of those I have observed and reported on here, I recognise too that they come from a social and political background that is extremely different from those of either America or Australia. Western concepts of democracy have not been prevalent in China, and the Chinese world view has, to some extent, been formed by the characteristics of its own political system. Nevertheless, the cultural effects that I have looked for are those attributable primarily to Malinowski's (1922) '*social ideas and dogmas*'. I have not attempted critical examination of the 'straitjacket' (Taylor, 1994) of forces within society but have noted it where it has appeared important in the forming of a world view.

With Baker and Taylor (1994), I recognise that language has an effect on the learning of science. Since 1992, I have also been learning Mandarin and, at present, can speak, read and write at a basic level (native Grade five literacy, maybe). This means, where my vocabulary permits, I have signalled the role that language has played in traditional Chinese explanations of natural phenomena, where they have arisen in my research.

## ADAPTATIONS TO COBERN'S METHODOLOGY

### AUSTRALIAN STUDY

My Australian study is described in Chapter 5. However, it is important to state here that, although my first intention was to replicate one of Cobern's studies (1993b) with my own students in Australia and then to repeat this in China, **I have only partially been able to replicate Cobern's methodology in my research.** Major differences, and their implications, are detailed as follows.

I chose to follow Cobern's methodology because, at the time, this was a logical decision. He had adapted a methodology that was already well established within social science and recently applied it to cross-cultural research in science education in America. This research had been well received and it appeared that this methodology would easily transfer to other cultures and therefore I decided to use it. In order to isolate and identify cultural factors as much as possible, I initially endeavoured to follow Cobern's methodology as much as possible. I believed this would later allow me to compare my results with his, and attempt to make broader assertions by comparing my results with his.

It seemed important to me that I should use samples of students of the same age as those in Cobern's study in order to replicate it exactly. This proved impossible, however, since by this time, I had a different teaching position and no longer taught high school students (I was now teaching in TAFE and University environments). I found it impossible to recruit a local high school teacher as a collaborator, or even to find a high school science teacher who would allow me access to a science class. This meant that, although I was finally able to recruit students of a similar age to those in Cobern's study (1993b), I could not replicate all the conditions, as I had first intended.

The objective behind Cobern's methodology is expressed as 'Our objective is to map belief space or terrain of belief regarding nature, i.e., to map the qualitatively different conceptualisations of nature held by the students, including their perceived relationship to nature, and causality' (Cobern 1995a, p.3). This was done so as to understand the 'place science plays in those conceptualizations' (Cobern 1995a, p.1).

Cobern believed that he could carry out a naturalistic inquiry, in which students 'would be observed in a number of settings over a lengthy period of time' (Cobern, 1995a, p.3). The results of this would be descriptive categories and brief narratives. However, he felt it was more appropriate, for timesaving purposes, to use a modified form of naturalistic inquiry and to use

'elicitation devices' (Cobern, 1995a, p.3) to persuade a student to talk about 'nature, relationship to nature and causality'.

The elicitation devices devised by Cobern consist of three tasks. The tasks contain some redundancy and allow some overlap to provide triangulation. The basic method involved is that students sort words and sentences about nature, while 'thinking aloud' over the task. These thoughts are taped for later analysis. The first task is completed in a primary interview of 45-60 minutes, and the second and third tasks are completed in a second follow-up interview. The first task uses pictures of nature to provide images to focus the student on the subject of discussion. The student is then provided with a list of words that are designed to draw out answers and 'are based on studies of western culture and represent aesthetics, religion, order control and knowledge.' (Cobern, 1995a, p.4). The students sort the words into two groups. The first group describes what 'nature is' and the second describes what 'nature is not'. The interviewer uses the words to provoke conversation and extract meaning.

Task 2 uses sentences about nature rather than words, in a similar way to the first task. Task 3 involves comparing pairs of the sentences used in Task 2, so that a ranking of the statements is obtained.

The analysis of the data involves producing transcripts of the tapes and then coding them by attaching codes to sections of the information within the transcripts. Some of the codes are the words used in Task 1. Software (*The Ethnograph*) is used to sort and list the codes to prepare concept maps. A narrative is constructed for each concept map and content from the transcript. The student then reads and discusses the final narrative with the researcher.

My Australian interviews largely followed the pattern of Cobern's 'modified naturalistic inquiry'. The students were told that I need their views to help me with research. They knew that the ultimate purpose of my research was to help teachers to understand more about what their students thought about science, and thus become better teachers, and they were very enthusiastic participators in the project. I used Tasks 1, 2 and 3 as described above in my interviews. However, I found it very difficult to engage the students in protracted and relevant conversation, and my transcriptions are all very short. This may be due to my inexperience or the difference between the Australian and American temperaments.

I was not able to obtain *The Ethnograph* but found similar software, *NUD\*IST (Non Structured Data, Investigating, Structuring and Theorising)*.

When it came to coding I realised I needed to use a simpler method than Cobern used in his research. This was due to the fact that his method for producing the assertions was time and



labour intensive and, in his work (1995a, p.13) he describes a team of three researchers working together using the following process. Taking transcripts, codes are assigned to pieces of information within a transcript. Some codes come from the words used in Task 1 but the researchers assign others when necessary. A lexicon is developed from the codes that have been used. When the coding is complete the software is used to sort and print text segments ordered by code word. This provides the material for a concept map which Cobern (1995a, p.13.) describes as an 'interpreted overview' of the 'ideas that appear to have the most importance for the informant and how various ideas are related'.

I decided that I could maintain Cobern's emphasis on a concept map as an 'interpreted overview' of the ideas that were most important to my subjects. I then used a simpler method, with the more limited data that I was able to collect, and coded by looking for the use of words and concepts drawn from Task 1. I chose only to include other concepts if they were very different from these. I then produced simple concept maps from the codes in my much smaller lexicon, and narratives from these codes and the raw text of the transcripts. I was able to check these narratives with the students.

#### FIRST CHINESE STUDY

After I completed my study in Australia (see Chapter 5), I decided to attempt a study in Mainland China. I hoped I would be able to use the methodology as I had adapted it in Australia, with Chinese students of a similar age in order to replicate Cobern's study.

This first visit to China was very difficult to arrange. Although I still had many contacts in Hong Kong, I did not have the slightest idea about how I could make contact with a school and students in Mainland China. I did not want to carry out this study in Hong Kong or Taiwan because I was looking for what I hoped was a much more 'traditional' Chinese world view. This to me would be one which was not somehow 'tainted' by the obvious Westernisation that I had known in Hong Kong.

By this time, I had studied Mandarin for about 2 years and felt relatively confident that I would be able to communicate with Chinese people. However, I found it extremely difficult to imagine how I would make the academic contacts. I therefore enrolled on an Australian University's Summer School at Nanjing Normal University, an 8 week course in Business Chinese at Australian 4<sup>th</sup> Year level. I felt this would provide me with extra language training, a personal tutor who would help me with my research, and give me access to local universities, colleges and schools.

I found it very difficult to make any academic contacts while in Nanjing, although I learned a lot about Chinese language and culture. The timing (during the Northern Hemisphere Winter holiday) meant that I was unable to meet many academics, and my own status as a student meant that I had little free access to school students, be they primary, secondary or tertiary ones.

I was able to use Cobern's methodology, described above, to interview one teacher. The results of this have been recorded in Chapter 7. However, I learned that if I was going to interview Chinese students, I would have to make several changes. Firstly, I saw a need to change my status in China. In my experience, all foreigners are treated with respect, interest and courtesy. However, I realised that I would need to return as a teacher rather than as a student if I was going to have the status, even as a foreigner, to get contacts made and visits to schools arranged for me.

I also saw that I would need to get all my interview questions translated into Mandarin. I believed this would need to be done in Australia where I could work with a Chinese graduate student or lecturer. They would have to have sufficient understanding of English to comprehend the deeper meanings of words such as 'spiritual' and 'mysterious'. I would need these in my vocabulary if I were to use the questions as presented in Cobern's research methodology (1993b).

In my first interview in China, I had taped the conversation in order to collect evidence of the work and to replicate Cobern's methodology. I realised however that taping Chinese language conversations was quite difficult, since any evidence of a dialect in the speaker made the tapes incomprehensible to me. Therefore, my second change was the decision to replace tapes and transcripts with hand written summaries and field notes in English. These would concentrate on identifying the students' use of the words and concepts expressed in Cobern's Task 1 and would provide further data for the narrative as field notes.

#### MODIFICATIONS AFTER A SECOND FIELD TRIP TO CHINA

In 1998, I made a second trip to China. This time I went to work as a teacher/ researcher for 6 weeks. I translated my interview questions into Chinese, having continued to study the Chinese language with the help of books and Chinese graduate students who study at the University where I now teach. I was able to complete the interview work that I had set for myself, but my thinking about my research had changed considerably from when I first started. This was partially because my employment had changed again, and I was now involved as an academic staff developer in a university, and in research in higher education. I saw that the original questions I had asked about culture that I had summarised as

- How do students from Australia and China conceptualise nature and how do these conceptualisations vary with gender, age, urbanisation and teachers' worldview?

were now rather naive and needed an improved pedagogical framework within which to be expressed. I felt that although I understood each separate part of the work I had undertaken and intended to complete, it now lacked the coherence that I believed it had had at the beginning.

I was excited to discover the work of Whitehead (1989; 1993) on the creation of 'living educational theory' from teachers' practice. I see 'living educational theory' as action research applied to education. Carr and Kemmis define action research as:

a form of self-reflective enquiry undertaken by participants in social situations to improve the rationality and justice of

- their own social or educational practices
- their understanding of these practices and the situations in which these practices were carried out. (Carr & Kemmis, 1983)

I realised that Whitehead's research legitimates assertions that I might make from data collected as a teacher and researcher on the effects of world view and culture on students' conceptualisations of Nature. So I have found that it has been helpful to me to structure my research, and this thesis, around the questions that Whitehead suggests:

1. I identify a problem because some of my educational values are negated
2. I imagine a solution to the problem
3. I act in the direction of the solution
4. I modify my actions and ideas in the light of my evaluations (Whitehead, 1989)

This has meant that I created a framework for the questions I was first asking about culture in the following manner:

1. I feel that in my teaching, and in what I have observed in the teaching of others, there is no deep comprehension of the effect of the students' culture on their understanding of science. This means that my teaching is not fair and equitable to all those in my class.
2. I want to investigate students' attitudes to scientific concepts and determine whether they correlate to a western scientific worldview or a worldview gained from their own

culture. Then I will be able to adjust my teaching to allow for differences in attitude caused by different cultural perspectives.

3. I will interview students who are receiving a traditional western science education either in English (my first language) or Chinese (which I can speak reasonably well). I will use the methodology that Bill Cobern has established but will adapt the interview technique if it proves culturally inappropriate. I will maintain the same focus as his research and use the same survey instrument but will simplify the method for the development of concept maps and assertions. I will tell the stories of my experiences in carrying out the interviews to illustrate particular aspects of the culture and world view of those I have interviewed.
4. I will use the results of my interviews to make assertions regarding the effect of culture on students' understanding of the natural world. I will use these assertions to make adaptations to my own teaching and in my current work in academic staff development.

I carried out 'modified naturalistic inquiry' (Cobern, 1995a) with seven students as planned. This is reported in Chapter 8. However, I was unable to analyse the data while in China and so was not able to discuss the concept maps and narratives with the students. This means that the criteria against which these concept maps and narratives are to be gauged, cannot be those of dependability and confirmability established by Guba and Lincoln (1989). They should be held up to the criteria of adequacy and plausibility (Connelly & Clandinin, 1990) since they have to be seen as my interpretation. However, they are embedded in my narrative which itself has to be held accountable for its adequacy and plausibility. Therefore the 'image' of the student produced by the concept map and narrative should be held up to the image of the student as portrayed in the stories and then literary research criteria such as plausibility may be used.

#### WRITING UP THE RESEARCH

I made two trips to China and two visits to Namibia in South West Africa where I also used the same methodology to interview High School children in a city and a rural location. I realised that writing up the research would need to be more than a simple description of the use of Cobern's methodology in another culture. (The African studies are not reported here)

As the research progressed, I had become increasingly aware of the issue of my interpretive role as a science educator applying ethnographic methods within a scientific field. I saw that it would be easy to bias the results through my own Western interpretation of the data that I had gathered.

I had first believed that, since my research followed that of Cobern, then the only issues of legitimation I needed to address would be those that Cobern (1993a, p.3) had faced, namely trustworthiness and credibility. However, since I had by now adapted Cobern's method considerably to deal with the difficulties of working alone in different cross-cultural situations, I did not have the basic safeguards of external validation by peer review and cross-checking which Cobern had meticulously developed to legitimate his interpretive research.

It now seemed necessary to legitimate my research in another way. My previous experiences in research had been in quantitative research in Mechanical Engineering in 1975. I was directed to the work of Guba and Lincoln (1985) who had introduced an alternative measure for the quality of qualitative research. They had replaced the familiar positivist concept that the 'Quality' of research was equal to the sum of its 'Validity + Generalisation + Reliability + Objectivity', with that of 'Trustworthiness' which could be gauged by its 'Credibility + Transferability + Dependability + Confirmability'.

I developed a desire to write ethnography so as to provide some background to the lives of the subjects of my interviews. I also decided to include personal narrative as part of my interpretive research so as to make my own interpretive role transparent, and to expose the reader to the personal and cross-cultural issues I faced in collecting data. I saw therefore that I would need to turn elsewhere to find broader criteria for the legitimation of narrative and interpretive aspects of my thesis. This is because a reader in another situation or context cannot interpret stories of fieldwork against criteria such as transferability and confirmability.

Research in science education has been influenced for about 20 years by forms of representation that originated in other domains. Science educators (Tobin, 1990; Taylor, 1997) have embraced qualitative and interpretive research approaches. They have been influenced generally by the work of Denzin and Lincoln (1994) and particularly by those working in the fields of ethnography (Erickson, 1986) and narrative inquiry (Clandinin & Connelly, 1996).

Denzin and Lincoln (1994, p.2) indicate that qualitative research is a 'set of interpretive practices' which have varied with the arguments of prevailing epistemologies. Their definition of qualitative research includes the point that qualitative researchers 'study things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them'. They produce the powerful metaphor of the qualitative researcher as *bricoleur*, producing a *bricolage*, 'a pieced-together, close-knit set of practices that provide solutions to a problem in a concrete situation'. Narrative inquiry methods (Clandinin & Connelly, 1996), combined with impressionistic tales (Van Maanen, 1998), have allowed some researchers in science education (Taylor, (in press); Taylor, 1997; Geelan, 1997) the opportunity to use

different literary genres to portray their research experiences. This has thus allowed them to create a deeper and more emotionally subjective awareness for the reader. I have therefore taken the perspective that this work is a *bricolage*, and in it, I have pieced together several 'solutions' to my research question

For both cultures examined here, I have carried out research with students and teachers and provided results, adapting Cobern's (1993; 1995a; 1995b) methodology as described above. These should be tested against the criteria of credibility, transferability, dependability and confirmability established by Guba and Lincoln (1989). These are reported in Chapters 5 and 8. For both cultures, I have also written impressionistic tales (Van Maanen, 1988) as a means of narrating my lived experience as a fieldworker. As Van Maanen describes (1995), I have followed new non-realist styles of ethnography in which I have made the fieldwork itself the subject of my research. This literary genre has now become more evident in science education research (Taylor, 1997; Geelan, 1997). These tales are also reported for each culture in Chapters 5, 7 and 8 with the results of the research using Cobern's methodology, described above, embedded in them to produce a more complete bricolage (Denzin & Lincoln, 1994).

Connelly and Clandinin (1990, p.7), in discussing 'What makes a Good Narrative' feel that it is 'important not to squeeze the language of narrative criteria into a language created for other forms of research'. They suggest that a narrative can be judged 'good' if it acts as an 'invitation' to the reader, and allows the research to be 'read and lived, vicariously'. They use the concept of 'adequacy and plausibility' as other criteria against which a narrative may be gauged.

The standards by which narrative and interpretive stories which I tell here should be judged are the research standards of adequacy and plausibility (Connelly & Clandinin, 1990) rather than that of scientific accuracy (Taylor, 1997). The reader must judge these, like any other story, on their ability to attract and hold, on the integrity of the plot and their ability to paint a representation of my experiences in the field.

#### MAKING ASSERTIONS

In his methodology, Cobern (1995a; 1995b) deals with the concept of 'assertions'. These assertions are statements that can be made by grouping and correlating concepts found as a result of analysing the data provided in the case studies (Cobern, 1995a, p.14a). Cobern reports that in his study (1995a, p.17.) '37 tentative assertions were grouped and reduced to seven semi-final assertions'. He also explains how these were subject to stringent checks from the research team.

Erickson (1986, p.146) explains that there has to be 'an evidentiary warrant for the assertion that one wishes to make'. He states that assertions are generally made 'through induction' and may be based on the analysis of 'field notes, interview notes, tapes or other site documents'. The nature of the assertions may be broad or narrow in scope and high or low in 'inferential level'. He emphasises the need to search the data continually for discrepancies and linkages. These linkages provide the key to identifying patterns of generalisation from which to identify the assertions. Cobern (1995b) has fulfilled this requirement in his searching and cross-checking for 'consistencies' and 'differences'.

However I do not believe that my research is as robust as Cobern's since it was not subject to the same detailed analysis and cross-checking. Although I have used a similar methodology to Cobern (1995b) and used the data collected in interviews to produce transcripts, concept maps and narratives, I have a relatively small amount of material in my narratives. This was due to my inability to produce relevant discussion with some of my Australian respondents and difficulties in working in what was a second language for both interviewer and respondents in China. The data collected was therefore relatively small in quantity and thus provided the basis for only a small number of possible assertions. Also the process of developing them was not subject to peer review. I do not believe then, I have been able to display the same kind of evidence for making assertions, as required by Erickson (1986, p.146) and as displayed by Cobern.

I have thus turned to other research to assist me in making much more tentative and limited assertions based on my interviews, transcripts and concept maps. For each interview I have described the circumstances surrounding the interview (from my field notes) in an interpretive story. In dealing with the knowledge I am claiming about students' understandings of nature in my interpretive stories, I turn to Fenstermacher (1994, p. 49) in his call for an establishment of the 'epistemic merit' of 'practical knowledge'. He states that he believes that:

.. concept of practical knowledge is a legitimate epistemological category, so long as we attach to it demands for justification or warrant in the same way that demands are attached to formal knowledge. (Fenstermacher, 1994, p.47)

He expresses the view that the 'epistemic merit' of practical knowledge might be established by the criterion of 'objectively reasonable'. To him, this means that interpretive research should be presented in such a way as to demonstrate the reasonable nature of the claims made. He criticises the work of some in the field of interpretive research in education who have treated the justification of practical knowledge too lightly.

He adds that an additional standard is that of 'practical reasoning' taken from the field of philosophy. This involves the establishment of 'good reasons' why the knowledge claimed is valid. He adds, most helpfully, that 'the challenge for teacher knowledge research is not simply one of showing us that teachers think, believe or have opinions but that they know'.

In making knowledge claims from the narratives in which my case studies are embedded, I have adhered to the principles of 'objectively reasonable' and 'practical reasoning' as expressed by Fenstermacher (1994).

#### 'EPIC DESCRIPTIONS'

While wrestling with the issue of the legitimation of my experimental results, I came across a new perspective on science education expressed by Ogawa (1998, p.139), whose work I had previously studied, in a new book by Cobern and other science educators working in this field (Cobern 1998). Ogawa's standpoint was that science and science education as understood in any culture is an interpretation by the people of that culture. Ogawa emphasised that while the context-dependency of science education is well recognised, it is generally understood that 'science' itself maintains a 'culture-independent existence'.

Ogawa argued that science itself is a cultural 'image'. He dealt with this concept of 'image' and produced a cultural history of science in Japan. In this history, he provided 'a thick cultural and historical background of the Japanese people and the interrelationship between the Japanese people and science and science education in Japan' (Ogawa 1998, p.141). It provided an '*epic description*' of science and science education in Japan, identifying features of theory and practice which are culturally and historically uniquely Japanese. It attempted to situate the Japanese 'image' of nature with respect to Western images of the same. He argues that, although it is possible to teach the concepts and processes of science as advanced by the West within a Japanese world view, Japanese science classes would appear markedly different to those of a Western school. In addition, Japanese cultural values would demand that a science curriculum would include important concerns (Ogawa 1998, p.145), encapsulated in the word 'shizen', which is used to mean 'nature'. These include the concept of the integrity of man and nature, and a deep spiritual and emotional respect for the nurture and preservation of nature.

In my study I have used a similar theme to that of Ogawa (1998), and have provided an 'epic description' of science and science education China. I have, in this case, examined the concept of 'nature' from a Chinese perspective. I have obtained this perspective from China's literature of history, philosophy, religion and education, and have made use, as much as possible of Chinese sources. This perspective from the history of the Chinese culture has provided me



with a third source from which to make assertions as to elements of a Chinese world view and their effects on Chinese students' conceptualisations of Nature. This is reported in Chapter 6.

I then realised that, although reference is often made to a Western scientific world view, that I was not totally clear how it had developed and, more importantly, whether it is a real or theoretical entity. I have then been forced, as it were for completeness, to search literature and have developed an equally 'epic' description of the development of what is seen to be a theoretical Western scientific world view and its relationship to science education in the West. This is reported in Chapter 4 and allows me some criteria against which to gauge concepts of world view expressed by Australian students and with which to compare elements of theoretical and lived Chinese world views.

Chapter 9 discusses the assertions and knowledge claims, obtained from my studies in China and Australia, and the implications of these for my own 'living educational theory'.

THE WEST

*CONFUCIUS SAID:*

‘WE CAN UNDERSTAND A MAN BY OBSERVING WHAT HE DOES,  
HOW HE ARRIVED AT HIS PRESENT POSITION AND HOW HE FEELS  
ABOUT IT. THEN IS THERE ANYTHING ABOUT HIM WE DO NOT  
UNDERSTAND?’

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## CHAPTER FOUR

### WESTERN WORLD VIEW

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#### OVERVIEW OF THE CHAPTER

The purpose of this chapter is to provide a cultural history of the development of a Western world view and details of the relationship between this world view, science and Western science education. This 'epic description' is obtained from the review of sources in history, philosophy, religion and education and predicts the conceptualisations of nature that might be held by Western school science students.

#### PRODUCING THE SKELETON OF A WESTERN SCIENTIFIC WORLD VIEW

Bronowski (1978), in his treatise on *Magic, Science and Civilisation*, offers a starting point for the definition of a Western scientific world view in his explanation of the role of science in the interpretation of nature:

First, science is not an independent, value-free dissociated activity which can be carried on apart from the rest of human life, because second, it is, on the contrary, the expression in a very precise form of the species-species human behavior which centres on making plans. Third, there is no distinction between scientific strategies and human strategies in guiding our long-term attack on how to live and how to look at the world. Science is a world view based on the notion that we can plan by understanding. Fourth, science is distinguished from magical views by the fact that it refuses to acknowledge the division between two kinds of logic. There is only one logic; it works the same way in all forms of conduct and it is not carried out by any kind of formula but by an active view of how you apply the logic of long-term planning strategies to the whole of your life. Finally and most crucially, science is distinguished from earlier forms of trying to achieve a unitary view of the world by the fact that there is only one form of truth in it. There is no distinction between man and nature, there is no distinction between the logic of magic and other logics, and there is no distinction between means and ends. (Bronowski, 1978, p.17)

This definition is important because, if 'science is a world view based on the notion that we can plan by understanding' then it is necessary to examine the faiths and philosophies which have formed the basis of current Western understanding. This will enable us to find elements, which have been inherited from each specific era, in our own understanding.

If science 'refuses to acknowledge the division between two kinds of logic' then it is also necessary to examine the historical intersection of science, magic and religion in Western societies to determine which kind of logic is, and might be expected to be, prevalent in a Western scientific world view.

Three world views, which are connected to three distinct periods - the classical, the mediaeval and the modern - have traditionally been identified as those affecting the cultural history of the West (Tamas, 1991, p.1). The classical era was that of the Greeks and Romans. In the medieval period the world experienced the growth of Christianity and eventually the production of a modern world view through Scientific Revolution, Enlightenment and Romanticism. A later transformation was that of Postmodernism.

### THE GREEKS AND ROMANS

The Greeks were an Iron Age and sea-going society. Their culture developed from that of the Babylonians and Egyptians. The first Greek natural philosophers came from the city of Miletus (Mason, 1962, p.25) in around 600 B.C. Their early scientist-philosophers had, in their thinking about nature, hypothesised that the earth was a disc, floating on water, with water above it producing rain. They began the process of 'separating their gods from nature' (Mason, 1962, p.26) and saw the sun and moon and other astronomical objects as material and concrete, rather than granting them god-like roles in their daily life. This was the beginning of a new paradigm with gods being given more spiritual and abstract roles, and the prevailing society being more concrete and impersonal in its working.

The early Greeks identified the existence of four elements, water, air, earth and fire that had been derived from an earlier primal substance. They developed a systematic cosmology and believed in a type of evolution with organisms being formed from water and that 'Man was like another animal, namely a fish, in the beginning' (Mason, 1962, p.27).

During the fourth and third centuries B.C. the Greeks developed skills in engineering and surveying as well as botany, biology, zoology, astronomy and medicine. Some medical theories, such as those of Galen 198 B.C. (Mason, 1962, p.59) have had an influence which has been retained until this century.

During the period from about 600 B.C until the Greek empire was conquered by Rome in 146 B.C., there were many notable philosophers. While it is difficult generally to separate Greek scientists from Greek philosophers (since science and philosophy were largely inseparable during this period), the ones of note here are Thales, Anaximander and Anaximenes of Miletus 600 B.C.

Miletan philosophy occurs at the point (Tarnas, 1991, p.19) where Greek thinking was aspiring to describe natural events in terms of observation and logic rather than resort to solutions provided by their own culture's ancient mythology. At the same time another philosopher, Parmenides, developed the concept of deductive logic. His premise was that 'to be' something made it impossible for it to change into something it is not, for what 'is not' cannot be said to exist at all' (Tarnas, 1991, p.20). This concept forced the superiority of rational intellect rather than sense perception as the arbiter of reality.

In the search for the primordial substance that Thales claimed constituted the foundation of the cosmos, Leucippus and Democritus developed an elementary atomic theory with matter being made of minute particles controlled not by any godlike force but rather by random and natural effects. These minute particles, it was claimed, produced all human knowledge and all the emotions to which humans were subject.

Pythagoras chose to disagree with this explanation, favouring to follow Apollo and the Muses, and lived a life 'dedicated to the pursuit of moral purification, spiritual salvation and the intellectual penetration of nature' (Tarnas, 1991, p.23). Pythagoras maintained an interest in magic and mystery religions while making enormous advance in scientific discoveries.

The Greek civilisation peaked in the Greek Enlightenment of the 5<sup>th</sup> Century B.C. New philosophers, the Sophists, built on the foundations of rationalism and naturalism which had developed with the Milesians and developed a confident and less-speculative (Tarnas, 1991, p.27) form of critical argument in which truth was relative and human judgement overrode all wisdom created by all other religious or philosophical systems. They considered nature an 'impersonal phenomenon whose laws of chance and necessity bore little concern for human affairs'. Their beliefs gave man a greater status in his world than had previously existed. In freeing him from gods and other belief systems and from the equally burdensome belief that, with his small intellect, he might be able to fathom the mysteries of a large and random cosmos. This led to a destabilising of society and political power struggles and the demise of ethical and moral values.

During this time, Sophocles, a man who had studied the science and philosophy of the Sophists, developed his own philosophy which opposed that which prevailed among the new Sophist intellectuals. He developed the concept, new to the Greeks, of the soul as the seat of individual consciousness, and the need to 'know thyself' (Tarnas, 1991, p.33) and live a good life. He developed a distinctive form of dialectical argument, logical and rational dialogue within a foundation of scepticism. Although his form of argument is still famous, his philosophy was

not popular with his government. He chose suicide over a death sentence that had been cast on him.

Socrates played an important part in forming Greek thought. Although Socrates did not write anything (Tarnas, 1991, p.39) which remains, Plato, one of his students, was influenced strongly by him and became his interpreter after his death, holding him up as the epitome of goodness and wisdom. Plato developed a more mysterious form of philosophy than had existed previously and which embodied the principle of universal Ideas, the Good, the True and the Beautiful, existing in the cosmos with 'knowledge of the divine implicit in every soul' (Tarnas, 1991, p.41). Plato believed that it was important to study astronomy in order to develop human wisdom and somehow to discover the ordered and eternal movements of the planets. This would then allow him to find absolute divinised Ideas, the eternal truths upon which the universe is based.

If Plato's views can be described as mystical, then his follower Aristotle developed a pragmatic philosophy that has been far more influential on the Western mind (Tarnas, 1991, p.42). He did not share Plato's focus on a transcendental reality and abstract Ideas, but instead developed a doctrine of categories, of concrete classification of objects of substance. He argued as an empiricist, in fact he was the first empiricist, and defended the principle that knowledge of nature derives from the observation of concrete particulars of the material world from which common patterns can be recognised, and general principles derived.

One set of general principles that can be derived from Greek philosophy and religion, arising particularly out of the work of Plato, are those (Tarnas, 1991, p.69) of:

- An ordered world whose disposition is similar to that of the human mind. This means that intelligent analysis of experimental data is possible for man.
- The universe expresses an intelligence which can be understood by man if man is willing to develop the mental and philosophical capacity to do this
- The visible world contains evidence of a deeper hidden eternal and transcendent dimension that can also be perceived by man.
- So as to perceive the transcendence of the world man must develop his mind and soul.
- The apprehension of the transcendence of the world satisfies a deep longing in man which is intellectually and spiritually liberating to him.

These have to be held in tension with an equally influential and often conflicting set of tenets also derived from Greek philosophy and notably the work of Aristotle (Tarnas, 1991, p.70):

- Human knowledge is gained by the disciplined use of reason and logic
- The grounds of truth are physical and concrete not abstract and transcendent
- Nature is impersonal and physical. Mythical and supernatural solutions are not valid as causal explanations of natural phenomena
- Theories must be gauged against empirical reality of tangible evidence
- No system of comprehension is final because human knowledge is comparative and questionable and in need of continual amendment.

Education in Greece, in the period after 600 B.C., developed in two phases, the Old Education and the New Education. During the Old Education period (Boyd & King, 1977, p.17), teaching took place in gymnasia with a major emphasis, as the modern use of the word suggests, on deportment and physical training of young boys. General education focussed on music, with a limited amount of poetry reading and counting. There was no particular emphasis on moral, philosophical or other intellectual education after the age of 14 or 15 although physical training still continued until the boy was old enough to join the army.

New education began towards the second half of the fifth century B.C. with the rise of the new intellectuals among the Sophist philosophers of the time. Whereas the old schools had focussed their teaching on traditional music and a strict regime of physical fitness, the new schools introduced a far more liberal education system with a more relaxed form of discipline and an equal emphasis placed on literature and the inclusion of some training in the human sciences (Boyd & King, 1977, p.24).

Each of the philosophers described in the section above developed his own educational theories that were founded on his particular philosophy. Plato, in his master work *The Republic*, draws a picture of his ideal school with education following the pattern of the Old Education. However he added 10 to 15 more years of study of mathematics, science and philosophy for both male and female so as to develop good citizens (Boyd & King, 1977, p.37).

Distinctives of Aristotle's educational theory included, as might be imagined, in addition to Plato's requirements, the training of the soul through the study of biology and history to

metaphysics period (Boyd & King, 1977, p.40) with the development, he supposed, of higher-level moral and ethical values.

During the period between the death of Aristotle and the downfall of Greece (320 -140 B.C.) higher education, for those of more than 14 or 15 years of age, began to develop with the establishment of academies which extended the methodology of Aristotle. Aristotle himself developed the concept of the library (Boyd & King, 1977, p.50) and much analytical work was completed in geometry (Euclid), Archimedes (physics) and other disciplines such as astronomy, poetry and literature.

While the Romans developed a relatively sophisticated organisational system within government, and an equally organised systems of road building around Europe which they used to transport goods and soldiers from one battle ground to another, they did not develop a sophisticated science of their own (Mason, 1962, p.61). Once they had become aware of Greek culture with its interlinked science and philosophy, and especially after the fall of Greece to the Romans in the 1<sup>st</sup> Century B.C., they began to absorb Greek wisdom and scholarship.

After the reign of Alexander, who had been tutored by Aristotle, the Greek Empire fell to the Romans. The Greek way of thinking then began to effect larger parts of what was now the Roman Empire. However social, political and personal upheaval (Tarnas, 1991, p.75) began to produce defensive and fatalistic changes in both the philosophies of Plato and Aristotle which still prevailed. The philosophy of Stoicism was developed in Athens to counteract the new trends in existing Greek philosophy. This viewpoint saw a divine wisdom, Logos, behind all that happened in the Universe and sought to find God's will in all that happened. The philosophy was characterised (Tarnas, 1991, p.76) by 'sternness in self-discipline and the conscientious performance of duty'. It was, however, largely unconcerned with outside events but focussed inwards on the individual.

Other minor philosophies were established and radical ideas entertained. Scepticism became popular again with its claims that no truths could be certain and only a complete suspension of judgement on any issue could be supported.

Roman poets, indeed Roman culture, flourished on the foundations of Greek philosophy, derived particularly from the concept of Logos found in Stoicism, but without the development of any particular Roman philosophy as such. Romans were influenced greatly by magic, alchemy and astrology and used their superiority in government and military strength to advance Greek wisdom rather than any that was particularly their own.



The Romans tended to incorporate magical principles into both their astronomy and their chemistry, believing, for example, that metals were organic elements, sexually generated in some primitive manner, which were on a path to achieving perfection in their existence as gold (Mason, 1962, p.66).

Medicine was of greatest interest to the Romans. However they failed to develop a great interest in mathematics and they tended to lose some of the distinctives of the 'scientific method' that had been grasped by the Greeks (Mason, 1962, p.62). Ancient Roman science began its demise with the establishment and growth of Christianity.

Roman education built on the foundations of the Greek system and extended learning to a large part of the population of the Empire. The Emperor Vespasian (Boyd & King, 1977, p.78) established libraries and funded both school and higher education. This now extended through rhetoric, history, geography, maths, philosophy, politics and religion to astronomy, natural history, anatomy and botany. The rise of Christianity in the Second Century saw a divide between Christian (catechetical) schools and the traditional Roman ones. This caused concern to both Christian leaders, who would not allow Christians to be teachers in 'pagan' schools, and Greek scholars who saw the rise of Christian education as a blow to their liberalised tradition. The Christianising of education became a long-term process lasting during the Third and Fourth centuries. By the Fifth Century all Neo-Platonic (Greek-style) teaching was banned with the amalgamation of Christian doctrine and science. Science had however become 'a strange jumble of inaccurate geography, mystical mathematics and traditional astronomy' (Boyd & King, 1977, p.84) in its efforts to remove all traces of Greek and Roman paganism from its curriculum.

#### THE RISE OF CHRISTIANITY

Christianity grew out of Jewish monotheism. The Jews had originally been a nomadic people and over hundreds of years of moving among various tribes and in different lands, through victory, defeat and exile, in the modern Middle East, had developed a faith in one God, Jehovah, and saw themselves as his Chosen People. They trusted God and believed in his sovereignty over the whole world and that one day, the Day of the Lord, he would establish a physical and earthly kingdom for them. They were waiting for a Messiah, a person chosen by God to rescue them and usher in his kingdom.

When Jesus of Nazareth started his ministry there was great expectation and desire for the Messiah among the Jews, because life in the Roman Empire had not been good for them. The Jewish religious leaders did not, however, expect him to be a carpenter's son.

Jesus taught and ministered for three years and his life consisted of miracles, healings, and novel teaching about God's love. This was accompanied by controversy and opposition from the Jewish religious authorities culminating, eventually, in his crucifixion by the Romans at the instigation of the Jewish chief priest.

Jesus' followers reported, and fervently believed in, Jesus resurrection. This enabled them to understand Jewish prophecy in a new way, and his followers, the Christians, saw Jesus as a spiritual Messiah who had come to establish a spiritual kingdom rather than a physical one. They began to experience a God who was both one and three. They acknowledged God as Father from their Jewish heritage; they declared that Jesus was God because of their experience of his life. They attributed the miracles and healing associated with their own work after Jesus death and resurrection to the power of God in a third spiritual form, the Holy Spirit.

Christianity spread very quickly from Galilee. It was one man, Paul, a tent-maker and leather worker from Tarsus, who was able to bring Christianity to the wider non-Jewish (Gentile) world. He was able to make links between Greek philosophy and religion of the time and the new truths of Christianity. He was able to link the concept of Jesus as the Word of God and the Wisdom of God with older Greek philosophical concepts (Tarnas, 1991, p.101). Platonic concepts harmonised with and enhanced Christian teaching, and the older Greek desire for transcendence was found to be fulfilled in Jesus and the presence of the Holy Spirit among God's people after Jesus death, resurrection and return to the God the Father in Heaven.

Augustine, an early Christian writer of the 5<sup>th</sup> Century, made a link between philosophy and religion in that he came to a conclusion, after a progressive conversion from pagan to Christian philosophy, that a 'true philosopher is a lover of God' (Tarnas, p104). Augustine also added to Platonism the concept of man gaining knowledge and understanding through God's direct revelation. This was a third alternative to the two views, empiricism and sense experience, which were already held in tension by the Greeks.

Augustine's understanding of epistemology is summarised with 'I have faith [in God] in order to understand' (Tarnas, 1991, p.112). This foundational Christian belief brought a new sense of morality that affected the pagan world, but this did not encourage intellectual or scientific development but rather emphasised spiritual realities of the natural world.

The overall effect of Christianity then was to:

- establish a monotheistic faith which undermined the existing metaphysical constructions of Greek science and philosophy

- develop a matter-spirit dualism
- diminish the value of the rational empiricism and emphasise a reliance on faith and the will of God
- submit human intellectual understanding to the revelation of God in the Bible

#### **MEDIAEVAL TRANSFORMATION AND A MODERN WORLD VIEW**

By the end of the 12th century there were signs of a widespread awakening and progress felt across Europe. There was the beginning of social upheaval with the emancipation of serfs (workers who were tied to a Lord of the Manor and his land). There was a development of the countryside. New towns began to appear around older cities and hundreds of new villages sprang into being. Agricultural developments of the time included crop rotation, primitive ploughs and other farming implements and trees were planted and marshland was reclaimed.

With this urbanisation and agricultural development there was also, in the 12th and 13th centuries, a revival of the arts in Western Europe. One of the major characteristics of this early precursor to the 14<sup>th</sup> and 15<sup>th</sup> Century Renaissance was the rediscovery of numerous Latin classics. Besides the ideas implicit in these classical authors, they also contributed to a growth in the use of the vernacular, or modern style, literature. Authors of the time included Chaucer and Dante.

By the 13th century, universities were also established in major European cities. These provided a forum for intellectual debate. Some of this debate was disturbing to the Christian Church at the time, since this challenged its authority and the rule of faith, as opposed to empiricism and rationalism. Vernacular movements and wandering evangelists often challenged the authority of the Church. Various heretical movements sprang up and were quashed.

Scholars, who were being informed and trained in the new universities, began to make a distinction between knowledge learned by faith (and theology) and that understood by the application of scientific principles. Albertus Magnus and his pupil Thomas Aquinas (Tarnas, 1991, p.178) sought to integrate the Aristotelian empirical principles within a loyal biblical Christianity. Aquinas believed that God had given mankind reason and intellect and the freedom to use them and, in the search to understand nature, mankind was glorifying God.

Aquinas' concept of reality integrated Plato's concept of Ideas with Aristotle's of a human soul with both an intellectual and experimental capacity. Aquinas' theory of knowledge was not

expressed in terms of divine revelation but of human reason. He conjectured that being endowed with reason, man could understand the universe. But as an animal, man can know only that which he can experience with his senses. Aquinas stated 'whatever is known is known in the manner in which man can know it.' (Tarnas, 1991, p.189) He thus established two fundamental principle of all knowledge:

- Man can know of the world only that which he learns from experiencing the material world.
- The world is intelligible to rational man. Everything that exists can be understood. Everything that exists has a set of causes. These causes are known only through man's experience and his reflection upon that experience.

During the 14<sup>th</sup> Century there was increasing secularisation of the institutional Church and in the universities the rise of critical scholasticism. Scholars such as Ockham (Tarnas, 1991, p.207) encouraged debate that led to the conceptual division of human reason and divine revelation. His thinking (a precursor to modernism) led to a move towards a distinction between empirical (scientific) reality and theological reality.

The Renaissance of the 14<sup>th</sup> and 15<sup>th</sup> Centuries saw a rise in humanism and a return to the philosophies of the 'golden age' of Greece and Rome. There were great artistic and technological developments and the growth in understanding of mankind as creative individuals, no longer willing to conform to strict societal expectations.

Another movement of the time was the Reformation of the church in the 15<sup>th</sup> Century. This was a conservative movement, motivated by Christian believers who wanted to remove immorality and ritualistic behaviour from the Church hierarchy and replace it with a 'true' Christianity that was founded on belief in the Bible, and biblically sanctioned behaviour, alone. Its only obvious link to the Renaissance in art and literature, which was a humanistic movement, is perhaps its recognition of the freedom of the individual. In this case the individual Christian was free to develop a way of life which was not bound by priests and rites, but moderated by biblical principles.

The Scientific Revolution was another aspect of the development of the Renaissance. The Scientific Revolution was a revolution in the manner in which mankind perceived the world. Scientific thinkers began to question mankind's epistemology and to provide alternative methods by which one could understand and explain the natural world. The outcome of the works of scientists such as Copernicus, Descartes and Newton was to challenge the strongholds

of intellectual authority in society and to provide alternative frameworks for the understanding of science.

In the 16th and 17th centuries, scientists, theologians, philosophers and mathematicians were engaged in a vigorous debate over the natural world. The Renaissance had allowed for personal interpretation and the expression of individuality in art and literature, and this now began to be expressed in science as scientists sought to describe natural phenomena in terms other than those used in the Bible. They would also justify their knowledge claims empirically, and by reason, rather than resorting to faith and revelation.

Early scientists displayed this new sense of independence through experimental astronomy. A 16<sup>th</sup> Century scientist, Copernicus, determined that the sun was at the centre of the cosmos and that the earth moved. This theory offended the Church, and his contemporaries, who believed that the earth was the centre of the cosmos and justified this belief theologically. His work was so controversial that it was only published just before he died in 1543. His views appeared to challenge God's sovereignty and current scientific thinking which, as yet, had not fully embraced mathematics as the 'language' of science.

In the late 16<sup>th</sup> Century an Italian scientist and mathematician, Galileo, hearing of the development of the telescope, made one and proved that Copernican science was accurate and that the sun was truly at the centre of our universe. He also developed other aspects of mathematics and mechanics. However he, too, enraged the Church which insisted that he should stop teaching. His life ended in tragedy when, having published a defence of Copernicus' work he was forced by the Church to recant because of its 'heresy'.

Descartes developed an early atomic theory and deduced theories on inertia, force and momentum. His work too built on the work of Copernicus and allowed other scientists to develop their own astronomical work (Tarnas, 1991, p.269).

Isaac Newton, espousing the modernist philosophy, synthesised Descartes' mechanics and Galileo's work, with that of Kepler, to produce laws of motion and gravitation which are foundational to all modern mechanics.

Philosophy and science, at this stage of history, were still not viewed as two separate academic disciplines. It was necessary for scientists to turn to philosophy to establish their epistemology before turning to experimentation. Descartes, in France, developed a philosophy summarised in the well known 'I think, therefore I am'. This placed the onus on man to establish first his own existence out of his experience and then, in his opinion, the existence of

God out of 'logical necessity' (Tarnas, 1991, p.279). He saw human reason as having the highest authority, and having the ability to achieve scientific understanding of the natural world.

The work of Francis Bacon in England, in the early 17<sup>th</sup> Century, had produced a link between science and the knowledge of nature, and power and control. He saw the means, in science, of returning to man the 'mastery over nature' (Tarnas, 1991, p.273) that Adam had lost with his expulsion from the Garden of Eden. Bacon did not approve of abstract theories and concepts and depended on the unbiased analysis of concrete data, and then the use of cautious inductive reasoning to reach general conclusions.

When integrated, Bacon's and Descartes' views, those of empiricism and rationalism, produced what is essentially a modernist understanding of the natural world. This includes a rational concrete universe, devoid of spiritual properties, with a newly empowered mankind using science to extend power and control over the natural world.

In summary, a modern world view, which arose in the 16<sup>th</sup> Century, contained the following elements (Tarnas, 1991, p.285):

- an impersonal world governed by physical laws and understandable by the language of mathematics
- Christian dualism of mind and spirit had been transformed into a dualism between man and the world.
- Science displaced religion as the organiser of human thinking
- Subjective and objective realms were completely separated
- Knowledge of the intrinsic order in nature was recognised as being able to be completely understood by mankind by means of science
- Newton (and later Darwin) presented the nature and origin of man as purely physical and deducible by science.
- Man's independence was affirmed, with the deprecation of religious belief and any other philosophy that detracted from his right of self-expression and autonomy.

Secularism triumphed, although many of those who made enormous contribution to the scientific revolution attributed their discoveries in nature to God, and saw themselves working for his glory. Much was done to try to accommodate the tension between religious and

scientific views. Religion became compartmentalised to a Sunday, as Christians struggled to deal with the essentials of their faith. Resurrection, and transformation of water into wine, could now be explained in terms of scientific phenomena rather than miracles to be accepted by faith.

In 18<sup>th</sup> Century Europe, philosophers such as Kant and Hume began to refute the existence of God. They were able to argue that, although it was possible to have faith in a God, there was no rational certainty for his existence. They attempted to ground faith, and knowledge of the natural world, science, in the absolute of the human mind. The Enlightenment of the 19<sup>th</sup> Century, accompanied by the Industrial revolution and the discovery of the value of technology in empowering mankind, allowed the extension of the secularisation of society and the increase in faith in science and scientific method.

Philosophers became increasingly inward looking in their examination of mankind and their thinking. The Enlightenment was a time when Criticism was espoused as a powerful force in society, designed to liberate mankind from the entire fortress-like nature of previous religious and scientific thinking. However the outcome of Kant's work (Tarnas, 1991, p.350) and others had a destabilising effect in many ways, with a growing awareness of the limits of human reason, in a society which had to a large extent lost the stability of its foundational beliefs in God.

#### POSTMODERNISM

The modern perspective on nature and culture dominated society from the 16<sup>th</sup> Century until the early part of the 20<sup>th</sup> Century, with the removal of the spiritual and superstitious replaced by the deductive logic of mathematics and science. Just as Luther and the Protestant reformation made Christianity a personal faith, so scientific knowledge also became a personal issue in the public domain. Marx, Darwin, Freud, and Levi-Strauss, were key players in 20<sup>th</sup> Century intellectual history, in areas such as politics, evolution, psychology, and anthropology, who founded disciplines and sub-disciplines in which scientific method was applied.

However, using the Criticism espoused by Kant and others in the Enlightenment, philosophers and social scientists began to challenge the very possibility of simplistic models of knowledge put forward to describe complex issues. These issues could be easily 'deconstructed' to show that they, themselves, were founded on other causative phenomena.

Postmodernism describes a wide range of philosophical points of view. Here I use the term simply to mean the view that came after the modern view. It is seen to be the successor to the 'modernity' of the scientific worldview of the Enlightenment.

However, the problem which is presented when examining issues of world view (Burbules, 1996), is that 'postmodernism is not a specific theoretical position itself, but an intellectual trend that comprises several quite different philosophical theories'.

Poststructuralism, one of the differing 'philosophical theories' which is really synonymous with postmodernism, begins to challenge the possibility of simplistic, causative analysis, while continuing to argue that reality is in some significant sense hidden from direct observation and commonsense. Poststructuralism removes all foundational categories by re-examining them as the causative products of some other factors. It proposes that there is no direct experience of reality without interpretation; and all interpretation is, in some sense, corrupted by the cultural and personal prejudices or prejudgments of the interpreter. Reality then becomes an issue of interpretation, or hermeneutics.

Other views such as phenomenology, certain forms of critical theory, hermeneutics, some feminist thought, neopragmatism, and "post-analytic" philosophy are often categorised as 'postmodern' as well. Philosophers and theorists as dissimilar as Foucault, Heidegger, Habermas, Nietzsche, Derrida, and Dewey, are all variously clustered within this field. However it would not be postmodern to expect to find a common thread linking all their views or philosophies. The most quoted quote on postmodernism is from the work of Lyotard (1984): 'Simplifying to the extreme, I define postmodernism as incredulity toward metanarratives.'

The focus in much literature (Burbules, 1996) is on the concept of metanarratives, 'our attempts to offer general and encompassing accounts of truth, value, and reality'. Postmodernism seems to relate to the denial of the possibility of these, and rejects as monolithic and hegemonic the ones that Western traditions have embraced. But a key concept expressed in this quote is the fact that the postmodern world can not *believe* in the metanarratives of past generations; it does not appear to deny their possibility.

Three aspects of the 'incredulity' mentioned by Lyotard can be isolated. Firstly the realisation that culture plays a large part in forming mankind's conceptual framework causes pessimism for those who attempt to provide cross-cultural metanarratives. Burbules (1996) states that there is a 'growing awareness of the radical diversity and potential incommensurability of the different cultural forms of life that sustain groups and individuals'.

The second aspect is an awareness of the power relations which are implicit in all human transactions even the greatest altruistic acts, and the third is the awareness that language and its use, its discourse, effect our ways of living and being in the world.



In education therefore, postmodern thinking expresses a desire to allow for doubt and uncertainty as opposed to the rigid legalism of the modern world view and particularly as expressed in science, and in some aspects of science education.

#### A MODERN WESTERN 'SCIENTIFIC' WORLD VIEW

For the purpose of my study it is necessary to provide a definition of a current Western scientific world view since it is often debated without a definition being provided. A modern Western 'scientific' worldview, found in many science classrooms and around which science curricula have been developed, is one that builds on the foundations of Enlightenment science, described above. This world view, founded on empiricism and rationalism, is encapsulated in the words of the (American) National Science Teacher's Association:

Science is a method of explaining the natural world. It assumes the universe operates according to regularities and that through systematic investigation we can understand these regularities. The methodology of science emphasizes the logical testing of alternate explanations of natural phenomena against empirical data. Because science is limited to explaining the natural world by means of natural processes, it cannot use supernatural causation in its explanations. Similarly, science is precluded from making statements about supernatural forces because these are outside its provenance. Science has increased our knowledge because of this insistence on the search for natural causes. (NSTA, 1998)

However postmodern thinking in Western society has progressively influenced this 'typical' world view. As Giroux explains (1990, p.29), postmodernism has provided the basis for the questioning of many modernist ideas, especially that of 'critical rationality', and has offered 'new theoretical tools to rethink the broader and specific contexts in which [pedagogical] authority is defined'. He also notes that postmodern thinking rejects 'human reason as the foundation of all human affairs' and performs 'a critical reading on all scientific, cultural and social texts as historical and political constructions' (Giroux, 1990, p.30).

It would be naive to claim that all, or even many, science teachers cling to perspectives on the world which are as critically postmodern as that of Henry Giroux. However it is realistic to assert that this is only a theoretical modern Western scientific world view. Western students, if not their teachers, will bring to the classroom a world view which includes concepts that are as much influenced by the cultural relativism of the postmodern, or the multi-faith perspective of New Age religion, as those of the Enlightenment.

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## CHAPTER FIVE

### NORTHERN AUSTRALIA

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#### OVERVIEW OF THE CHAPTER

In this Chapter, I offer interpretive tales of my experiences during the period 1991 to 1995. The purpose of these tales is to provide a representation of the setting in which my Australian study was carried out. They allow the reader to develop a personal perspective on a possible Far North Queensland world view as I paint a picture of parts of Australian life. These stories also allow me to show details of the effect of culture on students' learning of school science as I relate details of my experience in the science classroom.

In this chapter, I also report, in narrative style, data obtained from semi-structured interviews with nine students about the natural world (Cobern, 1995b). For each student, I supply a concept map and simple narrative. I have chosen to present my data in the same way that Cobern presented his data in his study in Arizona (Cobern 1995b), for the sake of comparison. I conclude the chapter by making assertions (Erickson 1986) about students' world views from these data, as in Cobern's 1995 study.

#### BACKGROUND TO THE LOCATION AND STUDY

The tropical weather in many parts of the north of Australia brings about an informality in lifestyle which is envied by many inhabitants of larger southern cities. There has been a steady movement of population from the south of Australia to parts of the north from people who are looking for new possibilities and a better way of life. This movement of population, plus the growth of the leisure industry which caters for both national and international tourists, has meant that there has been a large number of employment opportunities for the young and unskilled.

The effect on the local largely conservative rural population of approximately 100,000 people who live in Cairns, has been an influx of people seeking an alternative lifestyle, as well as warm weather and work. Groups who are attracted to the area range from ultra fundamentalist Christians to the 'feral' dropouts who live an alternative 'New Age' lifestyle in large animal-skin tents in the rain forests. Many troubled people, suffering from the aftershock of divorce and family breakdown, often seek a new beginning in the Far North. There is also large indigenous Aboriginal and Islander population. While many of these indigenous people live comparatively urban lives in the larger towns, there are still many small communities that resemble those of the

undeveloped world. Social problems include drug misuse, HIV AIDS, alcoholism and chronic unemployment.

I was employed to teach Physics and Chemistry at a small Christian school that attracted children from troubled backgrounds and alternative lifestyles. My reflections on classroom practice are based on one year of teaching a group of Grade 11 and 12 students (16 and 17 years old).

The students whom I interviewed using Cobern's methodology (1995b), were not drawn from my own class but from two other local schools. These were a Lutheran High School which catered largely for the children of professional families, and a local Government-funded High School in a public housing area (Housing Commission Estate). I chose this mixture to provide myself with a range of student backgrounds. Some of the students were born overseas or from a mixed cultural background. This was not deliberate or intentional but representative of the population of parts of Far North Queensland society.

#### AN INTRODUCTION TO THE CULTURE

This story illustrates aspects of the nature of society in the Far North of Queensland. Although much of the Australian way of life grew out of some of its population's European history, the Far North does not present a 'European face'.

#### FAR NORTH QUEENSLAND, AUSTRALIA 1991

I had already been asking Australians 'What exactly is an Australian?' for several years and now I had arrived in the Great Southland of the Holy Spirit to find out for myself. We had decided not to go back to England after our almost 10 years in Hong Kong. Many enthusiastic Australian friends had, over the years, sold us the land where the quality of life was so good and different that even the sun shone brighter and the sky was bluer than Europe (*It is!*). We spent a couple of years going through the immigration process before finally receiving our visas.

We moved to the Far North of Queensland, where an interesting Government engineering job was available for my husband, with no understanding at all of the culture and the people. A wise friend from Sydney, the cosmopolitan capital of New South Wales, had told me: 'You're not going to like it, Jill' and had sown in my mind some seeds of doubt. I could not really

understand how these people could be different from their intellectual cousins from the major Australian cities who we had met working in many professional capacities in Hong Kong.

The scene that we were faced with after a 2-day journey by train from Brisbane up the eastern coast of Australia was a pleasant one. The journey had been difficult because torrential rain had produced flooding and we had travelled slowly through literally thousands of kilometers of fields of tall, closely-packed sugar cane, as our children played 'house' in their small sleeper compartments. In some places we had to wait, or travel very slowly, as the train passed over small partially flood bridges and culverts.

The city reminded me somewhat of a Malaysian one, with tall coconut palms, white sand and tropical beaches, colourful flowers and so many different types of parrot. We were surprised to find a very mixed population with maybe 40% black - some Aboriginal but predominantly Torres Straits Islanders. There were a fair number of Asians, some of whom were descended from those who had migrated to work in the Australian Gold Rush of the late 19<sup>th</sup> Century. I had been told that the Australian Far North is like the American Deep South and presumed that there would be some sort of conservativeness in the white population, but had not thought to investigate this further.

There were two sorts of houses. The newer ones were small and single-storey, mostly built of the concrete blocks we would use for sheds and toilet blocks in England, and were collected together in small groups or sub-divisions. The older ones were wooden and founded on high stilts, gazing down from their alternating opulence and dilapidation on the metal roofs of their concrete cousins.

(My mother on a visit from London was heard to comment 'Why do they still build shanty towns? These building certainly lacked the solidity of the structures we had grown up with in London, although we were assured that they were pinned down well enough to with stand the harshest storm or typhoon.)

We bought a concrete house on the edge of a rain forest, twelve kilometers to the North of the city (*less than 100, 000 people*), and began the process of looking for schools for the children and a job for me.

## SCHOOLS AND TEACHING SCIENCE

These stories illustrate my introduction to the education system in Queensland in general, and to science teaching in particular. Although I had never taught High School science, I approached the issue without fear because, at the time, I believed that school science was acultural. I could not conceive of any other science than that which I had learned at school and university in England. These stories describe my confusion when I was asked to apply another conceptual framework to that of 'Western science' and my difficulties in teaching a class of students who held a range of alternative beliefs to my own. They also illustrate what I believe are the effects of the students' culture on their behaviour and performance in the science classroom.

## MY SCIENCE TEACHING CAREER

The beginning of my science teaching career arose out of a pure accident in location. I was just unemployed and in the right (*wrong?*) place at the right time. This is how it happened.

I was looking for a school for my children, who should have been entering Grade 5, 6 and 10 at the time. Life was complicated because the two youngest, my girls, had already spent about 3 weeks in primary school in Brisbane (a larger southern Queensland city) on our arrival in Australia, and the older one kept saying 'This is boring. I did this in Grade 2', to the reading books and other material she was presented with, and so I wanted to see if a local school would allow them to skip a grade.

I visited our local primary school and I did not gain a good impression. Probably the wooden buildings, on their high 'stumps' (raised wooden foundations), were the major reason it just did not look like a good school, and the playground was a field, not a bit of concrete or tarmac in sight.

I was a bit surprised with the children too, and especially their clothes. Kids were running about all over the place. No one seemed to be wearing shoes, and most wore what I considered their sports uniform. Little boys wandered around with their tee shirts half hanging out of their black shorts (*why black for little boys?*) climbing on anything in sight. I was not impressed with the brusque way I was dealt with by the headmaster either. I had tried to get an appointment to see him, but he did not seem to work by appointment. He made it clear that the State Primary

School offered free education to all children living in the right area but that nobody, whatever their circumstances, was allowed to skip a grade. I left deciding I could not possibly entrust my children to him (*it was the barefooted children though who confirmed my decision as they pushed and shoved each other in the field they called a playground*).

I visited several of the local private schools because I had heard that they were more flexible in allowing students to study at a level appropriate to their ability. I discovered that I lived in a country where I had the choice of Christian denominational schools or the State system. The Church schools included a highly-developed and well-regarded Catholic system, and several small schools belonging to denominations such as the Assemblies of God, Seventh Day Adventists, Lutherans, Anglicans and other independent churches. This was a confusing system to me but the problem was easy to rationalise, first theologically, then economically. The Anglicans and Lutherans (*acceptable theologically*) were expensive. The Seventh Day Adventists and Catholics were not acceptable theologically but reasonably priced. The Assemblies of God was bearable theologically (*with reservations*) and cheap, so I set out to examine the Assemblies of God.

The largest of the three Assemblies of God schools had a campus that was impressive, with a large modern architect-designed building. The children lined-up neatly and wore school uniform (check dresses, green shorts and white, yellow or beige shirts, green hats) and everyone wore shoes. They welcomed my girls as students with open arms although we were subjected, as their parents, to a fairly detailed cross-examination about our personal lives, faith and history. My previous work for a church in Hong Kong, and a somewhat low-level qualification in theology, convinced the pastor/ principal that we were returning missionaries. In fact his wife, who was the school administrator, seemed to like me so much she asked me if I could teach physics (seeing that I had a degree in engineering). I had never dreamed of teaching in my life and had not studied physics for about twenty-five years. I was interested enough to come back to discuss the issue with the headmaster because I knew that, locally, unemployment was high, and there were no vacancies in information technology, my career of choice. (*This was strange because although the Pastor was the Principal, he was not a teacher, but an ex-printer. The headmaster was a qualified teacher but turned out to be a puppet figure dancing to the tune of the dominating pastor and his charismatic [in its secular sense!] wife*)

I found out that the educational system in Australia is organised on a State basis. In Queensland, and in the Far North in particular, it is hard to get qualified Maths and Science teachers. A suitable graduate without a teaching qualification can get a temporary registration to teach, although the school has to prove that it had advertised for several months. Particular kindness is shown to Protestant schools in the country because of the influence of a previous

old Australian politician, Joh Bjelke Petersen, who decreed that these schools, like the one I was considering working for, be favoured.

I learned too that the school had previously been an Accelerated Christian Education school (*this did not mean anything to me at the time!*) and had taught a Christian curriculum imported from America up to Grade 10. They now needed to expand their curriculum and teach Australian Government-approved curriculum Physics and Chemistry to Grades 11 and 12, the two final years of High School. The alternative was that the older children would have to leave and go to a State High School. This was not acceptable to their fundamentalist Christian parents. I did not really understand what this meant at the time, and was not sure if I was one of these fundamentalists myself.

### THE PHYSICS TEACHER

Three weeks later I was standing at the front of a science laboratory saying to myself 'But I don't know how to be a teacher!' and giving myself a little lecture saying, 'Just act like a teacher. You must know more about physics than these kids. Talk like a teacher. Stand like a teacher. Think; think about your school and you'll remember how it's done'. I formed a mental picture of my favourite maths teacher, Mrs. Styles, drawn from fond memories of her lessons twenty-five years previously, and began to 'be' her in my own classroom.

During the three weeks that had intervened between being hired and starting teaching, I had wandered somewhat aimlessly at times through a maze of educational bureaucracy and translated a Government imposed Physics curriculum into a workable school 'work program' for my class. Although I was given some help by one or two local science teachers in other schools, I relied mostly on my memory of what I had learned 23 years earlier in London.

Actually, it all seemed a big mess to me. The school, I mean, and then there were the students and the laboratory. The curriculum was a big puzzle too, which I was not sure if I would be able to solve.

Firstly the school. It had so many strange and archaic rules. The one that stands out the most is the '6 foot' rule. Students were not allowed to come within six feet of each other in any form of activity. This was to avoid the possibility of fighting or romance. This rule was enforced along with all the other ones like keeping socks firmly pulled up, uniform to be correct in its minutiae, etc.

The school had one laboratory for Physics, Chemistry and General Science and another for Biology. When I had a look around my lab I was horrified to find that I truly only had, apart

from laboratory glassware, three slinky springs and some thermometers, and no money to buy any equipment. When I'd paid a visit to a local State High School to beg for help, I heard the local horror story of my school. They told me of a rapid turnover of unqualified teachers, poor results at University Entrance Level (we were the lowest-but-one school in the State) and no money to fund Grade 11 and 12 Science. I think that these peers (and later the School Inspector) had my best interests at heart when they suggested I quit immediately.

I had now begun to understand the problem, and decided I should try to teach physics for 9 months, until the end of the academic year. I felt I could at least prepare the three students who wanted to apply to university and who were facing tertiary entrance exams. I had a textbook and could cover the curriculum theoretically, and I worked out some field trips to local industry that would allow me to demonstrate some of the more difficult aspects of physics, such as radioactivity and electronics.

My own learning was rapid, since physics had changed a lot in twenty-five years. My biggest weakness was in the area of atomic theory since I was sure I had never heard of some of the new particles (*I reckon they weren't discovered in the sixties*). Transistors were a bit of a problem to me too because, although I had used them, I got a bit confused when they kept popping up in circuits, and I had no idea how to solve the problems.

My downfall actually started with radiation and half-lives. I had had some inkling that maybe there was some underlying agenda in our science curriculum when, one day cleaning out old books in the Lab, I came across some pseudo-scientific magazines with pictures of a flat earth (*unfortunately I am not joking*). I was going to throw them away but the headmaster wanted to keep them because they might be useful!

When I started teaching about half-lives and carbon dating to my class, we dealt with issues of dating trees in this manner. One of the students said 'Miss, you are wrong'. I checked the textbook just to make sure I really understood it. The one high-achieving student had to help me, by telling me that the school only believed in the Bible and any theory that allowed, for example, for an 'Old Earth' was not allowed to be expressed or taught. When I talked to the headmaster, the Biology teacher, about this, I found that what I had been told was true. I wondered why a) I had never heard of this weird kind of Christian school, b) how these students would cope in the real world and at University and c) if there were any possible truth in the Creation Science with which I was being presented.

I read several books about Creation Science very quickly and could not, however pleasant and Christian I was trying to be, accept or teach its tenets. I kept taking the non-fundamentalist



position in all the arguments that were being presented. I had never had any problem with faith and 'normal' science myself. I also realised that we were legally obliged to teach what the Australian Government required and details of curriculum were very specific. The Headmaster did not heed my arguments.

I found it almost impossible to find a position that could be called the 'middle ground'. My own learning of science had taught me that maths was the underlying language of science. If I personally wanted to deal with half-lives then I would use the appropriate formula and trust the results (provided the maths was done properly). I found that all of my students except one had no concept of the role of maths in science. They actually had no problem in believing that the earth was 'young', flat, or anything else at all. This was because they had been taught across the curriculum and during their ten years in the school, that faith predominated over the application of theory or proof by induction or deduction.

Most of my class came from families that lived, or had lived, alternative lifestyle. I can remember stories a father who lived out in the bush prospecting for gold and of large families, with up to twelve children, living a basic lifestyle in wood cabins in the tropical rainforest.. The students told me of previous science teachers who had taught physics from the Bible and regaled me with stories of long lunch hours down by the river doing drugs before 'seeing the light'.

The only exception in the class was the one Australian Chinese student. He intuitively understood science, he could do maths very quickly and easily, and understood it as the basis of physics. I asked for his help in dealing with, or at least trying to understand the thinking of the rest of the class. It appeared to me as we talked and commiserated with each other that he, as did I, separated science and faith into two separate realms. He and I concluded that the rest of the class had a poor grounding in maths and therefore did not have a basic tool for studying physics.

#### **PHYSICS PRACTICALS AND FIELDTRIPS**

I decided I would make a major effort with supplying some physics practicals. My logic was that if the students had poor maths and therefore struggled with the application of concepts, I could at least try to provide some good practical illustrations and opportunities for experimentation.

I found that my students did not have any practical laboratory experience in General Science in Grades 8-10 because, at the time, the school did not have a laboratory. I started with

some simple experiments with my limited equipment but found that, for my students, the link between experiment, hypothesis and theory had never been established.

My class saw the physics practical sessions as an opportunity to become inventors. They would 'play' with any equipment that I could obtain but it was difficult for them to be focused on replicating experiments from workbooks. Their behaviour in chemistry was equally 'unscientific'. They grasped the concept of mixing together two chemicals but did not make the conceptual leap that we could actually predict, or know, what was going to happen if we read the textbook first. Science was perceived as an adventure, or a series of disconnected and random events.

I resorted to taking the students out to seeing science in action. We visited the telephone exchange, the local government soils testing laboratory, the water treatment works and a local dam. Once again, the majority of students were fascinated and entertained. However, they did not seem to make any links between the contents of their textbooks, the problems I asked them to solve, our practical work, and our visits to local industry.

Several of the students had spent much time in the 'bush' and had wide-ranging practical skills. One student, Cody, was an amateur taxidermist and collected (probably illegally!) native animals and stored them in his mum's refrigerator until he got around to stuffing them. He had excellent abilities in recognising animals and in hunting (he was not an Aboriginal student from a remote community, just a boy from the Housing Commission). Another student had spent many months with his father, prospecting for gold, and had become expert in short-wave radio and amateur electronics. I spent much time with both boys, trying to build bridges between their existing knowledge, gained mostly from their fathers, and the basic concepts that existed in their science curriculum. I found I was unable to help them, although I enjoyed their company and I learned much from them as I spent hours giving 'remedial maths' lessons.

This is where my career as a physics teacher ended and I started teaching maths and computing. Only my Australian Chinese student passed his Grade 12 exam!

#### **CARRYING OUT RESEARCH IN SCIENCE EDUCATION 1995**

These stories illustrate my efforts in finding subjects for my research. They also describe the process of my interviews and, in retrospect, and as someone who was deeply aware of their own lack of experience in research, my relatively anxious and stilted reflections on my subjects and their conceptualisations of nature. They also have embedded within them the results gained

from investigations into the relationship between students' world view and conceptualisations of nature.

### SEEKING SUBJECTS FOR MY RESEARCH

My first problem, having worked out how to use the research methodology, which seemed relatively straightforward, was to find my subjects. I could not interview my own students because, by now, I was teaching older students in TAFE and university. I was first really quite obsessive about finding students who were of the same age as the subjects of one of Bill's studies, about 16 to 17 years old. I was fortunate enough that two of my children fitted into this age range and so I asked their science teachers for help. I was surprised to find the teachers were more threatened by me as a researcher than anything else. I put this down to the problem of country schools (and perhaps my lack of tact).

Eventually I sought the help of some mothers who I had got to know well in my one year as a physics teacher. Through one of them, I made contact with Hayley, JB, Celia and Kai who are all Australians from very mixed cultural backgrounds and attending a local State High School. Their families are definitely low socio-economic in background and I talked to them all in their homes in one of the local government housing areas.

I eventually interviewed some friends of my daughter, children of professional acquaintances, attending a local Lutheran High School, in their own homes with their parents' permission. These students, Eleanor, Beth, and Jerome, are the children of professionals, well travelled and middle class and equally multicultural in their family background. *(The students' real names are not used here for the sake of their privacy)*

### CELIA

Celia was about 16 years old and, typical of the age group, it took me a long time to arrange a time for our meeting. She had been so busy with sport that it was hard to find a time when she was home. She is the daughter of a friend and lives with her mother and her brother Kai, whose story follows this one. She lives in a relatively small unit (apartment) in a large housing area, situated on the southwestern edge of a large (for Australia) tropical country town. Her mother has followed the trail of many battered and battling Australian women and, leaving her drunken husband in a large southern city, has taken the long train journey to establish herself in a new life in the North. After 2 years the family has now moved out of the caravan where they were living and is settled in small, densely packed Government-owned accommodation.

Celia's mother once had money. The family (her husband was a Maori, a native New Zealander) used to own a holiday resort on traditional land on a remote island off the coast of New Zealand. This is where the children were born and grew up until Kai and Celia were 9 and 7 years old respectively, when they moved to Australia, their mother's home.

The first impression of Celia is one of vitality. She is full of life, sturdily built and seems to exude intelligence. She does not seem to need time to reflect on her answers to my questions, she just wants the interview to move along very quickly; her life is filled with sport, especially netball, and the other activities that she seems to need to use up all her energy. Celia spends a lot of time at home alone or with her cousins; the cousins are the product of another failed Australian/Maori marriage. The cousins spend a lot of time together playing sport and generally 'hanging out' in a neighbourhood where their ethnic origins would be presumed, by an outsider, to be the same as those of their Aboriginal neighbours.

I talked to Celia in her bedroom, at her request. She did not want her mother to overhear what she was going to say. She felt quite pleased to have been asked to help with my research and wanted to be able to influence science teachers in their classroom practice.

As we talked it became apparent that her whole perspective on nature had been formed as a child on her remote island. She talked about being outside all day and playing with the things she found around her. She emphasised repeatedly the absence of TV and any other sort of appliances (they had no electricity). I felt her views reflected those of her uncles and aunts, who I had got to know reasonably well during the previous two years.

To Celia, Nature does not seem to include mankind at all. It seemed too that Celia does not make any apparent connection between the Nature she grew up with, and the things she now learns in her science classes. She talked about the majesty of nature, its unpredictability and the damage that might be caused by storms and high winds. Although she is a higher achiever and does well at school science, she is actually quite annoyed by some of the things that her teachers say. She feels that they have no right to make statements about living things and natural phenomena, because they have not lived in the middle of them. She makes little connection between what she has learned in her school science classroom and her experience of nature. There are underlying elements of self-pity mixed with superiority in her explanation, I feel.

Celia is definitely a religious person. Her spirituality seems to be a mixture of the Protestant Christianity, which has risen out of the ashes of New Age in her mother, mixed with the traditional religion of her father. 'Of course we cannot control and predict nature, it belongs to God, he made it'. Her tradition does not seem to be embedded in the holy and sacred, Jesus

and the Bible, but rather an acknowledgment of the power found in nature itself, which she holds in awe. God-in-nature is a great power in her eyes, the source of everything, and therefore cannot be tied down by scientific rules and theories.

Celia was one of the first students I interviewed and she raised a theme that is echoed in almost all my respondents, the one of damage to nature by pollution. This is Celia's fear. She thinks it is difficult to understand nature but she feels that we must try to understand it so that we can stop pollution now. She thinks we desperately need all the 'outdoors' we have, the rainforests which predominate among the flora in the far North of Queensland, especially for sport which is so important to her. The interview with Celia was short. She had told me all she wanted to say in an hour or so (we completed all three tasks) and, as I left, she was changing into her netball uniform.

CELIA'S THOUGHTS ON NATURE

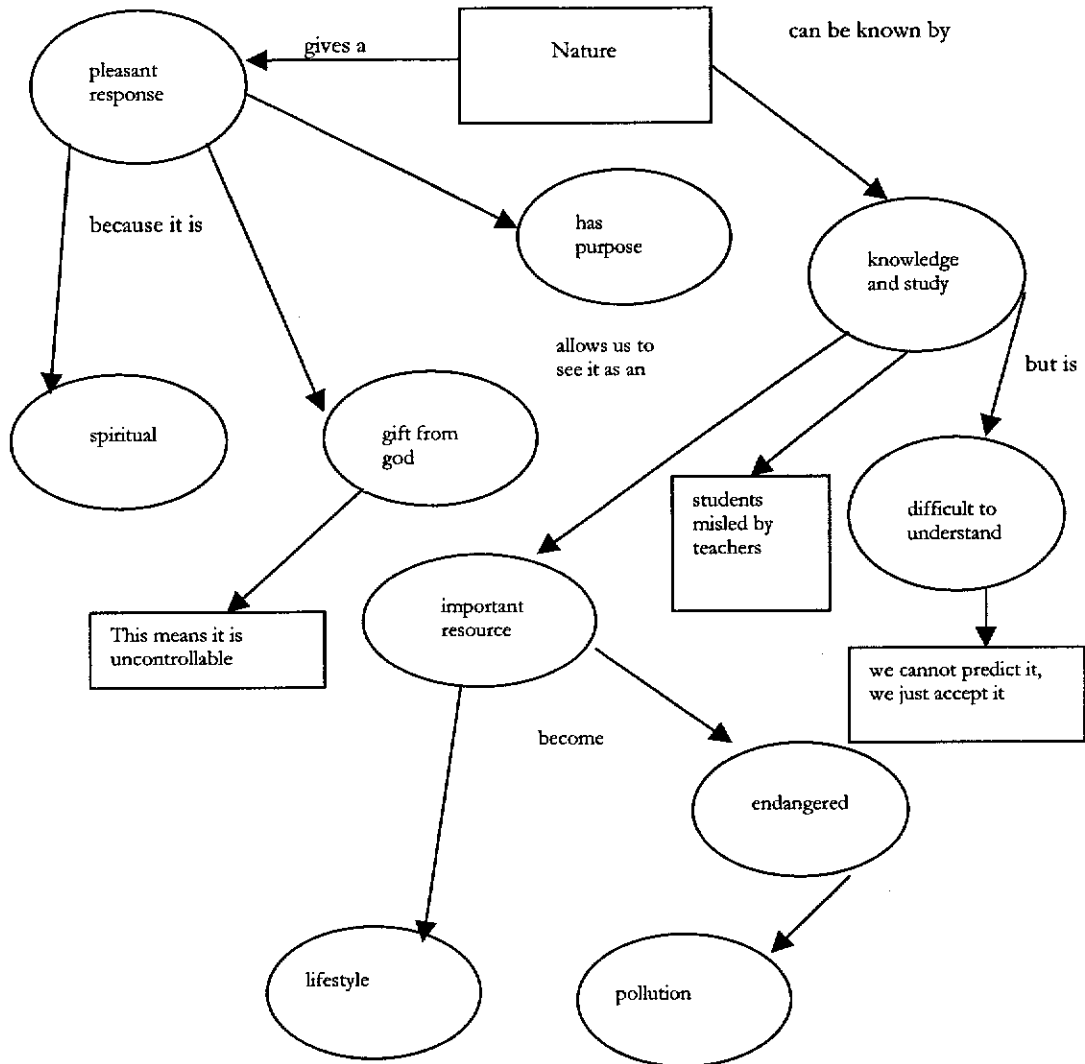


Figure 1 Celia's thoughts on nature

I believe Nature is beauty, living beauty. It is a gift to us from God and we cannot control it. We need to have a response to Nature before we can appreciate it. Nature is not understandable; it is very unpredictable and hard to explain. We should not expect to be able to predict it or understand it because it is spiritual. We need to accept it. I grew up with nature. We did not have a television and we were cut off from the outside world. It was just nature to me and we had to accept it. I do not think you can teach someone Nature though. That is why students are misled, because of the teachers. You have to study Nature before it can become an important resource. It is difficult to understand while you are studying it. However, this is important because it affects our lifestyle and we have to worry about protecting it.

## KAI

Kai is about fourteen months older than Celia, and at 17 was tall and well built. He had the same sporting interests as his sister but his major interest is in the sea. He wants to be a sailor on large merchant ships. He gained a love of the sea from his father. It seems that going to sea on small to medium sized fishing boats is traditional in his family. He disdained the fisherman's life, although it attracted him with its high pay, and started to tell me about life on the island.

He remembered most vividly the times with his father and uncles when they had gone fishing and told me how they would catch turtles. I had seen the large turtle shells in his aunt's house, ranging in size up to two meters wide. From Kai's description, I could see the picture of the independent and reliable boy, walking and working alongside his uncles, learning traditional hunting and fishing methods. Since Kai had left the island seven years previously, I was surprised that such rugged conditions existed until so recently.

Kai explained how his attitude to nature had been formed on the island and how he had seen the strength and power of rain and wind, and saw these as aspects of God's power and indication of his control. I knew he could not have overheard my conversation with his sister, but he articulated an almost identical perspective on God, man and nature. Kai is more reflective than his sister (I have spent time with him before talking about his career prospects and his dreams). He seems to have developed and articulated a philosophy where the God of power, who controls nature, is far more like the Christian interpretation of God he has learned at church.

Kai's own intuitive understanding of nature is that it is simple and just commonsense. However, Kai is a high-achieving student at science and he has realised that nature can be 'partially explained' by study. He thinks this is useful but he actually believes that it is mankind's study of nature that has caused man to identify the valuable resources in nature, and thus endanger it. His reasoning was that if man had not studied nature, it would not now be endangered by pollution. He also saw that if man had not studied nature, then man would not have to contend with the issues of predicting and controlling natural phenomena. He felt that this was not possible anyway. Although Kai did not always want to articulate the context to which he referred, I felt that he was often talking about storm, wind and cyclone that are problems to the fisherman and island-dweller. His perspective on Nature was a narrow one that really seemed only to include natural phenomena, flora and fauna and did not account for man.

## KAI'S THOUGHTS ON NATURE

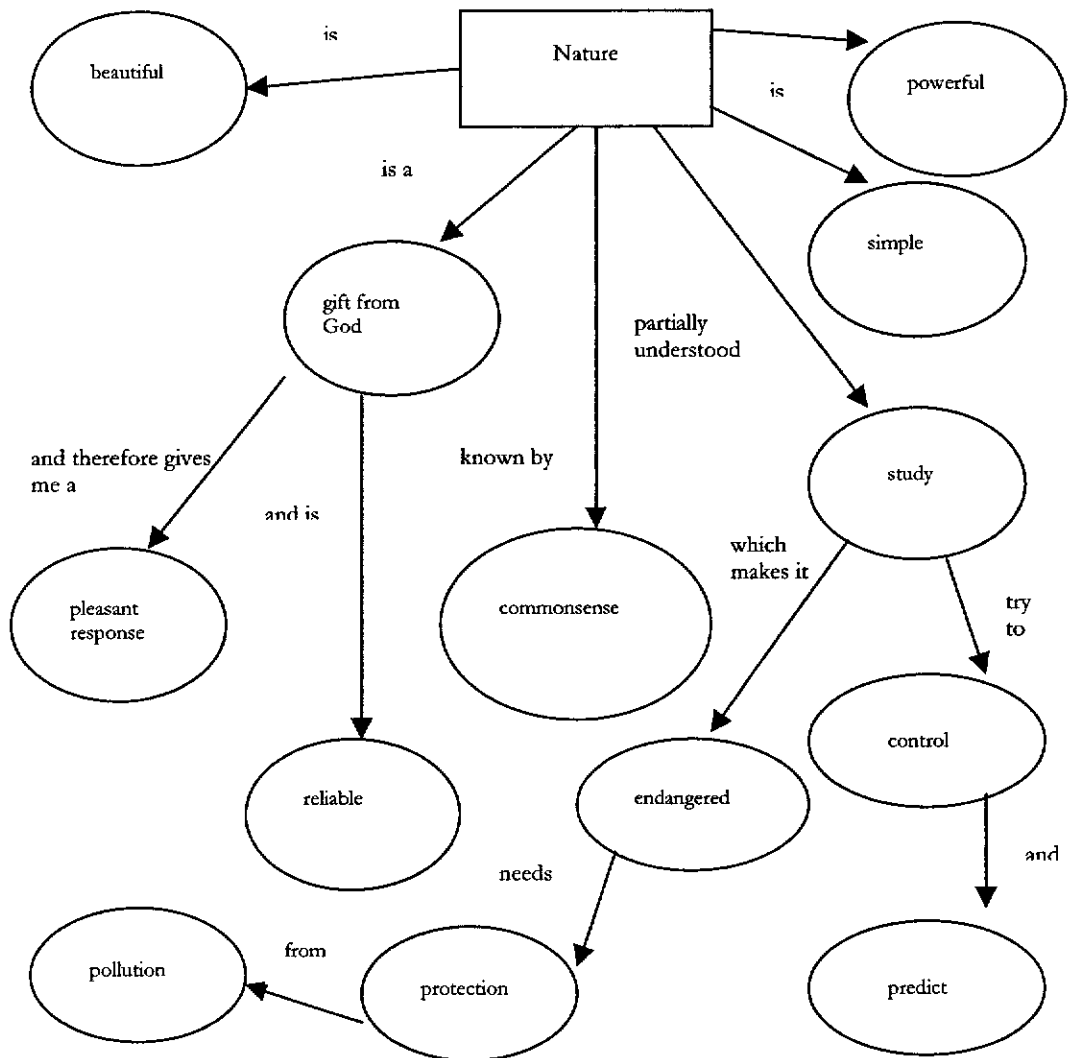


Figure 2 Kai's thoughts on nature

When I think of Nature, I see something beautiful. I think Nature is powerful because nothing can stop it and unpredictable because it does just what it wants. It is not complex, it is pretty simple. I think we should study Nature but not to the point of destroying it. Nature is not just there; it is holy and spiritual because God put it there for us to use. I do not believe that the material world is the only real world because there is also the world of gods. It is a gift and everything we have comes from Nature. I believe that things happen in Nature because of a purpose, but sometimes the purpose is mysterious. You have to think about Nature all the time because it is always there. Teachers are just trying to use what they learned at University and not their commonsense. They say you can control and predict Nature but you cannot.



## JB

I did not go hunting for examples of multicultural backgrounds when I was looking for subjects for this research. I was still asking myself the same question ("What is an Australian?") that I had been asking since we decided to emigrate. Since I am still unclear of my own identity, choosing to identify myself randomly as English, Australian and from Hong Kong, I was surprised at the truly cosmopolitan nationalities who were in Kai's class at school.

JB is half-Hungarian and half-Indonesian and has lived in Australia since he was very young. JB is not particularly academic; he is small, and pragmatic in his approach to life. He wants an apprenticeship as a mechanic and loved doing practical things. He was not the sporting type like Kai and Celia.

JB says that does not have any religious beliefs of his own and that he has not been exposed to the Moslem faith of his mother. He believes that nature is mysterious, sacred, and holy but there is no inclusion of God in his concept of holy. However, he does not mind if others want to attribute natural phenomena to God.

He likes nature and likes to study it so that he can work things out for himself. He thinks we should study nature to protect it from pollution and to preserve the resources we need for our modern lives.

He appreciates that a theoretical view of nature as explained in science classes is possible, but is really unhappy with the academic way that teachers have presented nature to him. He would really prefer to be allowed to spend time in nature and work things out for himself. He feels that nature is peaceful and beautiful and, if he could spend enough time outside, he would learn all that he needed to know.

Once again, JB did not have a lot to say to me. He made the points that were important to him and then went off to fix his bike.

JB'S THOUGHTS ON NATURE

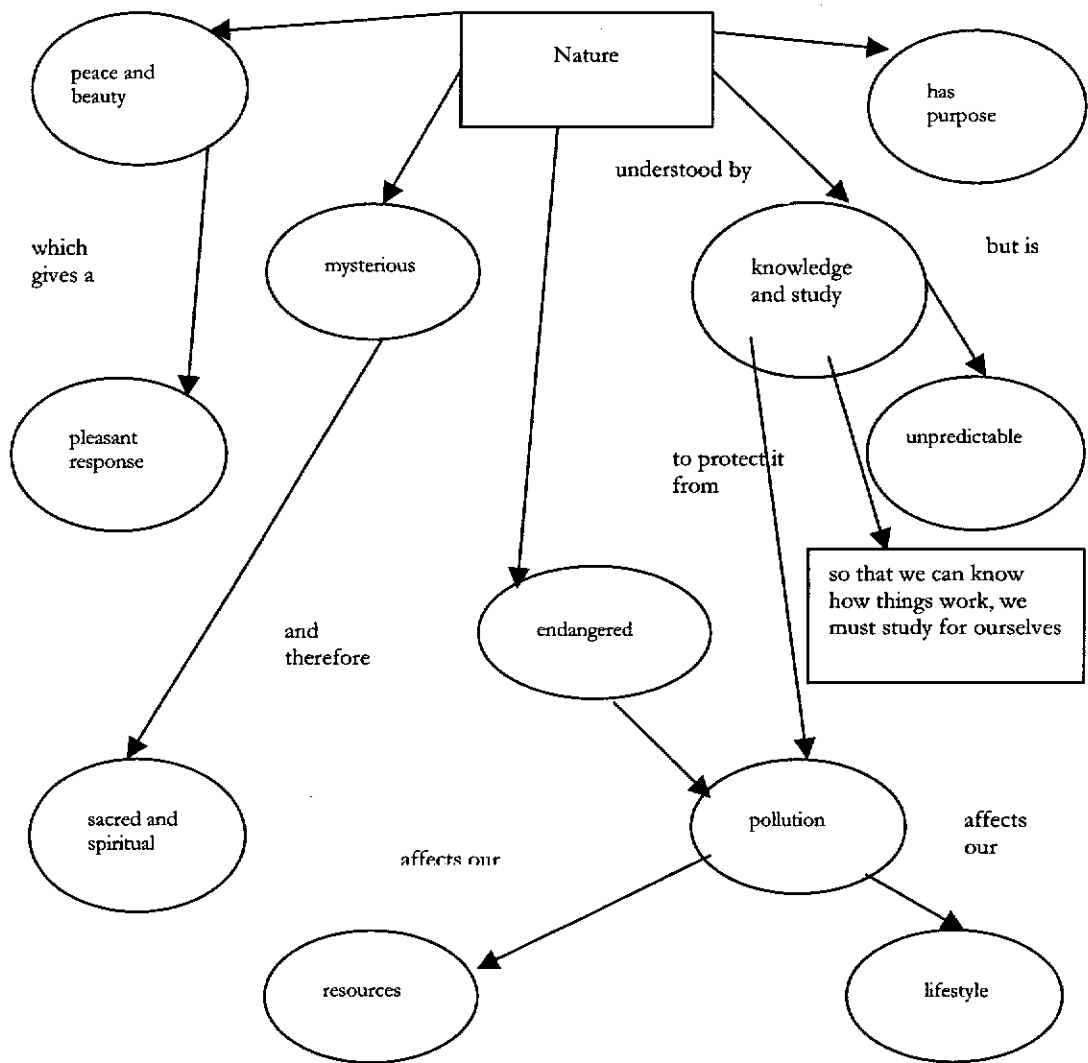


Figure 3 JB's thoughts on nature

I believe Nature is beautiful and peaceful. I believe Nature is mysterious, sacred and spiritual but it depends on your religion whether you see it as a work of God. I believe it is not difficult to understand Nature if we have the right equipment. Nature cannot always be predicted using rules - it does not always obey the rules it should. We cannot understand nature unless we study it for a long time. Nature needs to be protected from pollution and we need to study how to protect it from pollution, as a resource, and for our lifestyle. Teachers try to tell us all about nature but they can only tell us some things about it. We have to go to Nature and study it for ourselves before we can understand it fully. It is hard to understand if you have not experienced it for yourself. Teachers teach on a higher level and all we do is listen to what they say and never have an opinion.

## HAYLEY

I had been introduced to Hayley by Kai's mother, and did not realise that I knew the family until I met her stepmother. I found that, in my current-at-the-time and mixed career, I was simultaneously teaching mathematics to Hayley's stepmother at the TAFE College, and Computers in Education to her father at the local university. I was suddenly quite familiar with her situation, remembering the details from my talks to her stepmother in the student cafeteria.

Hayley's father is a West Indian. He is professionally qualified (in the West Indies), having emigrated to Australia quite a few years previously, and has been working in the prison system. He has found it difficult to get a permanent job and was in the process of being 'adopted' (at such a late age!) by Aboriginal friends and then, as an Aboriginal, will have much better chance of permanent work. I sat with him as he debated with me the ethics of giving up his own cultural heritage so as to find work. He had become quite embittered by his problems. The stepmother was a new addition for Hayley; rumour had it that they found their relationship to be quite turbulent. I felt some sympathy for both of them.

Hayley is fast-talking and vivacious. She lived in the West Indies until the end of Primary School, around Australian Grade 5, and had been in Australia for four years or so.

Hayley's major point on nature, and the one thing that she would like all science teachers to know, is that it is alive. To Hayley, alive means many associated things. It means exciting, frightening and definitely not boring. She thinks that science teachers have made nature boring in their efforts to predict things in nature and to establish rules and laws (I was asking myself questions like 'How would I teach her? What would it be like to be her stepmother?' by this time.) She was so lively that I presumed that the best novelists would call her vivacious and comment on her 'artistic temperament'. She is also incredibly pretty.

Her view on the natural world is that everything in it is random in its occurrence. Everything man-made is predictable, but everything in nature is part of a splendid randomly generated mosaic, each species or variety adapting to fit in with anything else it meets.

I could not get further in understanding these views but she believes her perspective, her spirituality, and her faith in God as the creator are those taught to her by her family in the West Indies. The major reason she believes that nature is alive is because it is spiritual. However, I could find nothing of the language of church in her ideas of spirituality and the sacred. She started talking to me, as Kai and Celia had done when I visited them, about her childhood in the West Indies – the sun, the sand, the palms, all so similar in appearance to what we could see

around us in the far North of Queensland but everything was so different. She was free, nature was free, and life was not ordered and predictable.

I was not too sure how idealised the picture of West Indian life was. I grew up with West Indian friends in London, and my memories of them are their music and their joy in life, so different to the sombre, grey life they were living in London. I presumed that some of Hayley's attitudes to nature were formed by memories of home and the happy early years. I knew she was a high-achieving student but could not detect any of explanations of nature she might have learned in High School in the concepts she presented to me.

I presumed that Hayley would be very passionate about 'saving the world' and in her attitude to pollution. By the time we began to discuss this, she seemed to have become much quieter and said that although she was concerned, she was not really 'a greenie'.

I spent a long time with Hayley and it was definitely interesting to me to hear her opinions. I was inwardly hoping that I would find that my next subject would express some of the concepts that he or she had gained from school science. I did not feel that Hayley had expressed any of these at all.

## HAYLEY'S THOUGHTS ON NATURE

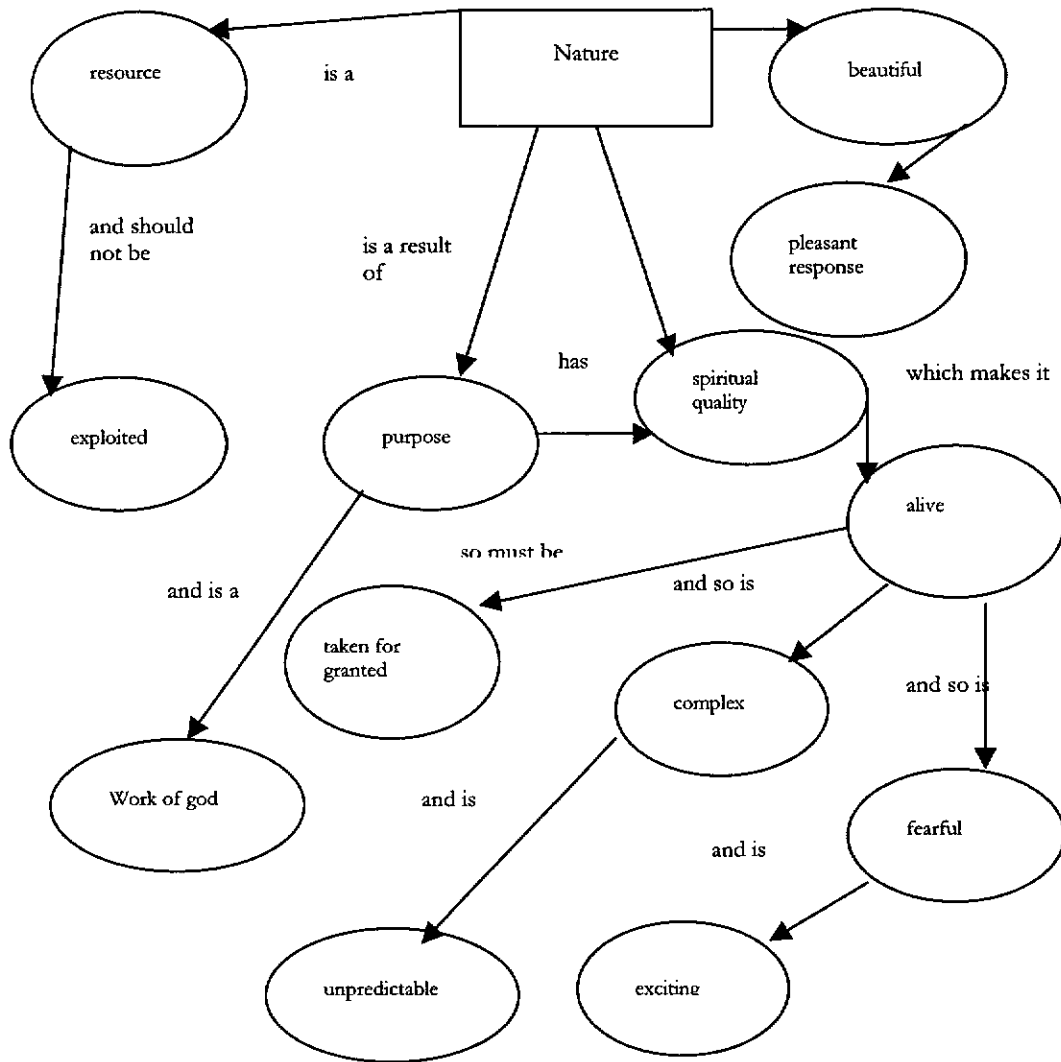


Figure 4 Hayley's thoughts on nature

I believe Nature is essentially alive and is thus both frightening and exciting. I believe that everything has a purpose but Nature appears to be random and unpredictable. Animals can cope with the unpredictable behaviour of nature but we adapt our surroundings to ourselves, which is not natural. Nature is a puzzle, a mosaic, which fits spontaneously. I believe Nature is beautiful and I have a pleasant emotional response to it. It is part of my background to see a spiritual quality in Nature and to believe in the work of God and the sacred. It is not necessary to understand how things work in Nature and I am not sure whether it is difficult to understand or not. It depends how we view it. I think that sometimes we should accept Nature and take it for granted, but I do think it is an important resource and should not be exploited.

## JEROME

I have known Jerome's parents for a couple of years in a professional context and have got to know Jerome too. He is thin with a dark complexion (his mother is a South African of mixed race) and keen on developing an academic career of his own. His major interest is in international politics and economics.

The day I interviewed Jerome was a bad one because he was babysitting his little brother Jeffrey. Jeffrey's voice can be heard interrupting us on the tape and, at one bad moment, he grabbed the recorder and threw it on the floor.

Jerome appears calm and placid externally, although, since his parents are strict and demand high academic and behavioural standards from him and his brother and sister. Since I had known Jerome for some time I had watched him previously suppressing a lot of the rage that he felt about things, especially the kind Jeffrey, the favoured child of his mother's second marriage, engendered.

Jerome has a well-developed Christian faith and believes in God as creator. He sees God as the author of a pleasant and beautiful world and it has a spiritual quality because it belongs to God.

Jerome sees the power in nature. We talked about harnessing the resources of water in hydroelectric schemes. He sees that different countries have varying degrees of understanding of science and technology and have harnessed nature in many ways. He enjoys science himself and is a high-achieving student. He thinks nature is not hard to understand and if we do then it will provide resources for our lifestyle. I felt that Jerome was giving me solutions and explanations from his school science lessons. He seemed to be thinking about the application of scientific principles in technology and the benefits of this for our modern world.

Jerome talked at length of his concerns about pollution. He sees this as an important issue to be faced internationally and one that must be faced as quickly as possible. He feels it is a poor inheritance for his generation to be faced with too and is critical of the generations that have created this problem for those of his age to face.

JEROME'S THOUGHTS ON NATURE

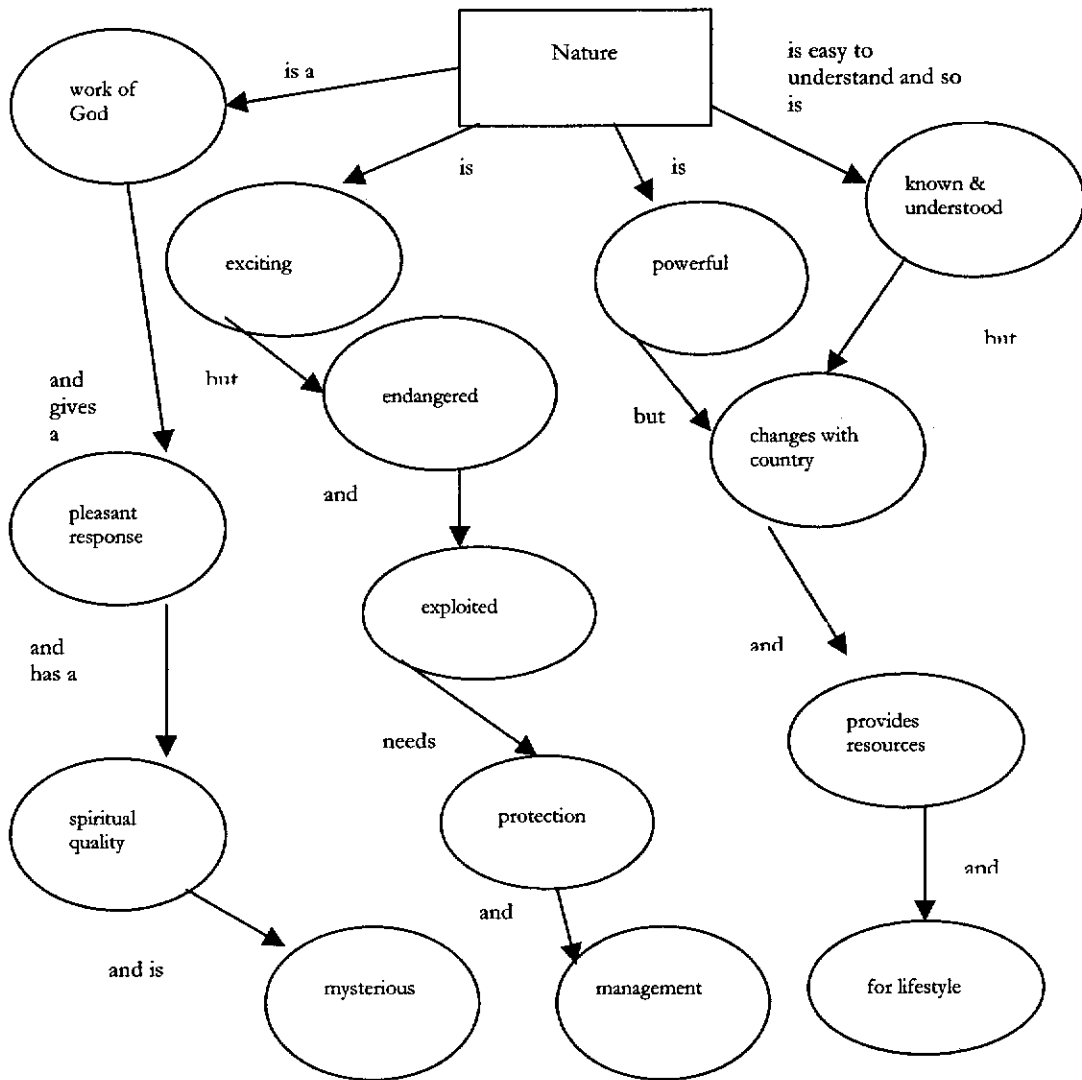


Figure 5 Jerome's thoughts on nature

I believe Nature is made by God and is beautiful. Although it has aspects that are spiritual and mysterious, I believe it is important to understand nature and it is not difficult for us to do this.

I believe it is powerful and changes from country to country. It is very exciting but has become exploited and endangered. We are smaller than Nature but we try to manage it. I believe it provides an important resource for our lifestyle.

## BETH

I think that Beth was probably the most difficult subject I encountered. She was very shy and I just could not really engage her in conversation. She knew me as the mother of one of her friends, her on-and-off best friend, and just was very reserved.

Beth is the second in a family of five children. They have always lived in the Far North. Her father runs the long-established family music shop and the family tend to keep to themselves, spending free time with their relations.

I felt that Beth was presenting the Christian position on God as creator, as taught by her parents. She also saw nature as a thing of beauty and really enjoyed the experience of camping and other outdoor pursuits. This also produced in her the perspective, I believe, that nature is living and unpredictable. This seemed quite an appropriate response for one who has always lived in an area subject to storms, cyclones and flooding.

Concepts like sacred, spiritual and mysterious did not draw any response at all from Beth. She said that she felt that nature was all there was and showed a low-level interest in debating whether nature should be studied or not. She showed some interest in the problems of pollution but no burning passion.

My conclusion was that Beth, a more than average student, was still young. Her views seemed to reflect equal input from her peers, parents and teachers but there just had not been time for an integration of these into an individualistic whole.



BETH'S THOUGHTS ON NATURE

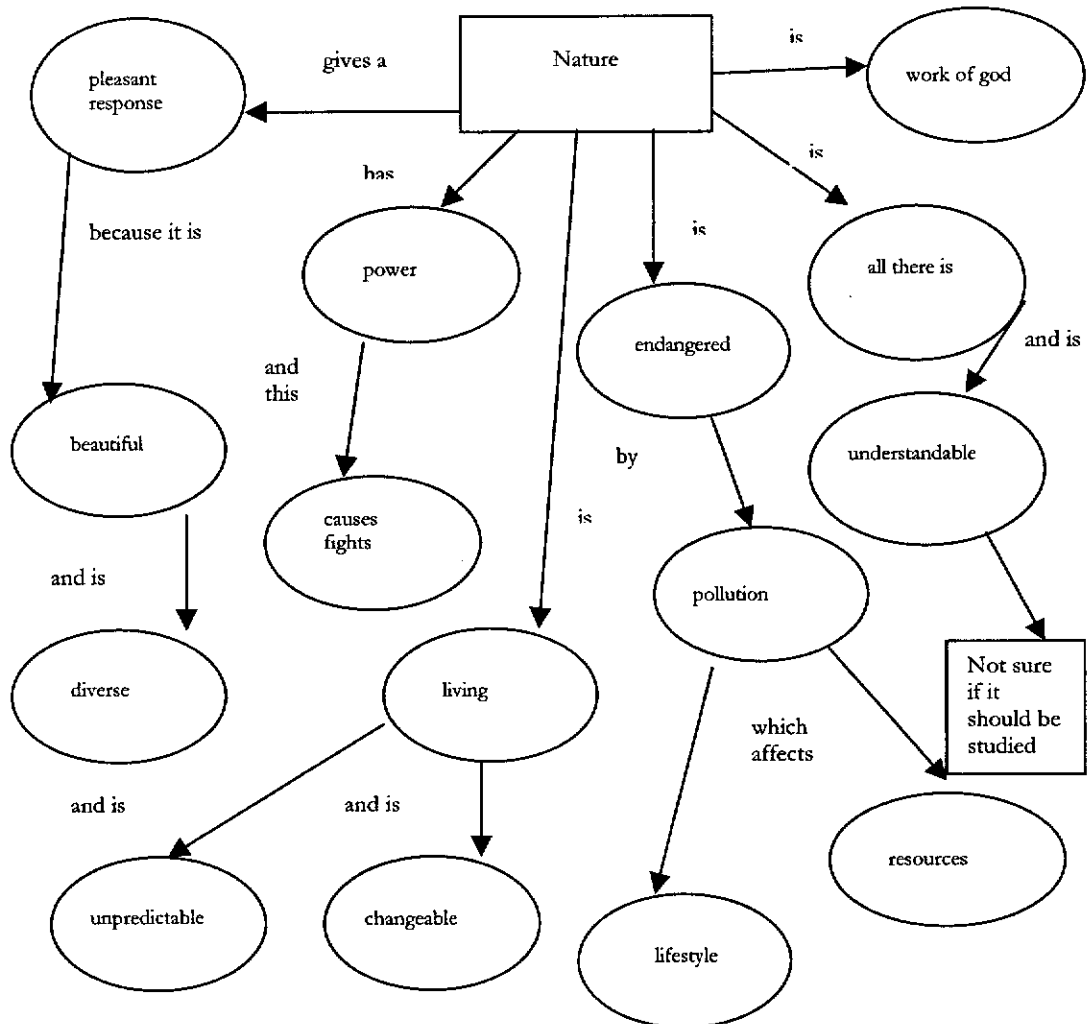


Figure 6 Beth's thoughts on nature

Nature is beautiful and diverse. It is living, changeable, and very unpredictable. It is powerful because people fight about it and it takes up most of our world.

I believe it is not difficult to understand Nature, and it is all there is, but I am not sure if I think it should be studied. I do think it is important to understand how things work in Nature, and I do not think Nature is mysterious.

I think Nature should be protected from pollution because it is an important resource and it is necessary for our lifestyle.

## ELEANOR

Eleanor is another child of professional parents. The youngest of three, she has travelled extensively because of her father's work. She is an above-average student with a passion for dogs, horses and plants.

When Eleanor talked about nature, she continually referred to trees. She did not seem even to include animals in nature and especially not mankind.

She sees nature as having independence from rules and with a will of its own. She believes that the fact that when a tree dies another comes up in its place is an indicator of the unpredictable nature of nature. I was surprised at this comment but am sure I heard her properly. She believes too that trees are an indicator of the eternal nature of nature too. Trees will always be there and will never go away.

She presented concepts that were now becoming common to me because they seemed to be those that her friend Beth had presented too. She was not quite sure if nature should really be studied because it was hard to understand. She was not really sure if we should study it anyway, she did not think this was particularly important.

I felt the same as I felt about Beth after this interview. Eleanor is an above average student but her views are not integrated and still relatively unformed. I can find evidence of her parents, her pastor and her teacher in her explanations but she only presented her own developed thinking when she talked about trees.

ELEANOR'S THOUGHTS ON NATURE

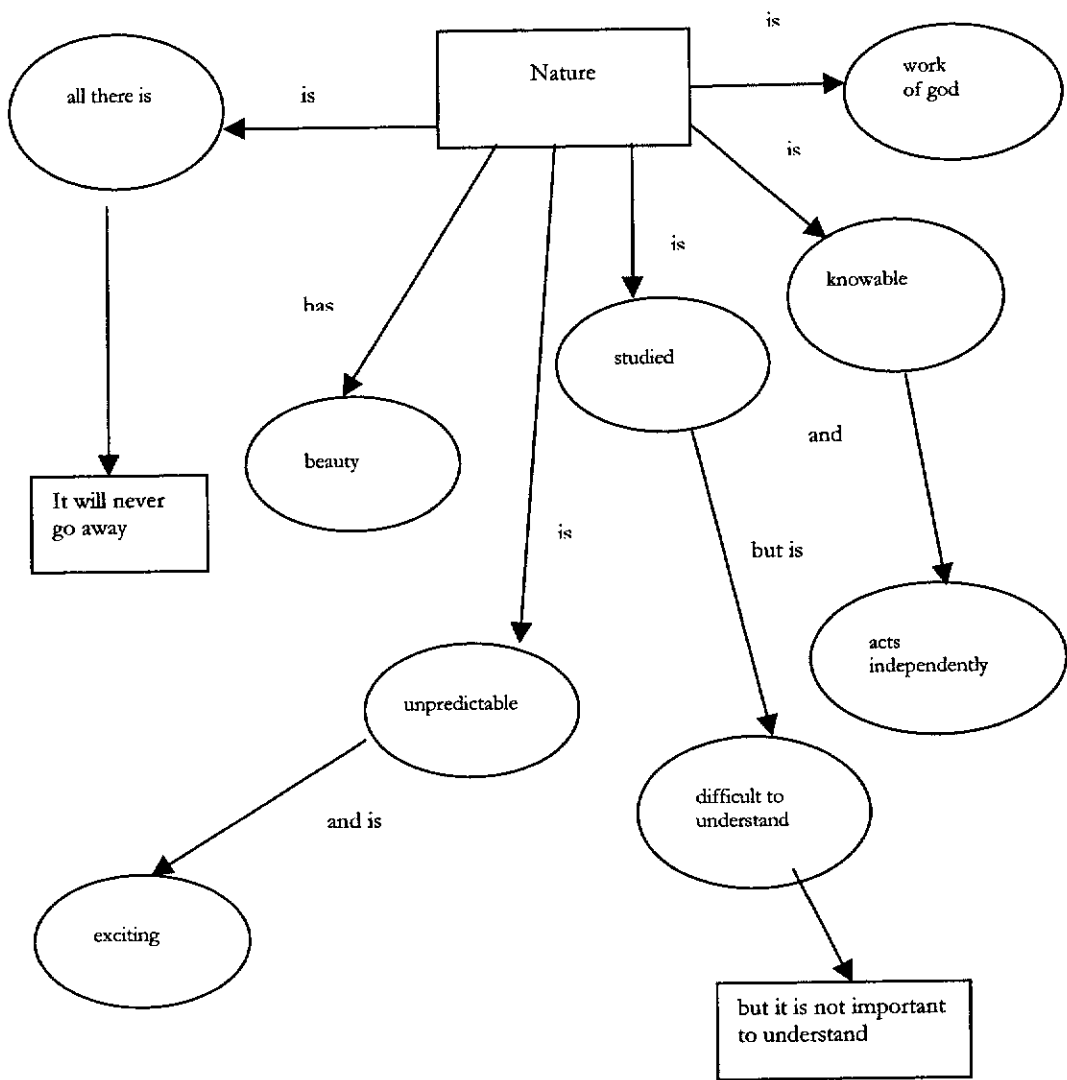


Figure 7 Eleanor's thoughts on nature

Nature is a work of God. It is beautiful and knowable but it does what it wants anyway. If a tree dies another tree comes up in its place so it is unpredictable and exciting.

I think Nature is something to be studied. It is sometimes difficult to understand but I do not think it is always important to understand how things work in Nature.

I think the natural world is all there is and it will never go away.

## DISCUSSION OF TENTATIVE ASSERTIONS

Below, I have presented four of the five tentative assertions developed by induction from my concept maps and narratives. Since the students taking part in the research vary in age from approximately 16 to 17½ years I have not made reference to any particular grade level of student (in Queensland the age range is Grade 10 to 11). I have simply referred to them as senior high school students, or students, because I do not want to make my assertions all-encompassing or as specific as 'Grade Nine'. I have also qualified my description of the students with the phrase 'from semi-rural Northern Queensland' since the group sampled is all from the same semi-rural community.

### ASSERTION #1

Senior high school students from semi-rural Northern Queensland tend to discuss the natural world predominantly using aesthetic and religious perspectives. These views do not appear to be linked or to or held in tension with scientific ones.

The majority of students interviewed link concepts of God and spirituality with beauty in nature. They do not seem to hold this view in tension with a scientific view of the world but link it to 'unscientific' concepts of nature.

This is exemplified in Celia's narrative 'I believe Nature is beauty, living beauty. It is a gift to us from God ... it is very unpredictable and hard to explain'. Hayley also sees God in a natural spiritual world but does not display an understanding of nature that she learned in her school science lessons. 'I believe Nature is beautiful and I have a pleasant emotional response to it. It is part of my background to see a spiritual quality in Nature and to believe in the work of God and the sacred. It is not necessary to understand how things work in Nature and I am not sure whether it is difficult to understand or not. It depends how we view it'.

Eleanor displays the same theme as she identifies 'Nature is a work of God. It is beautiful and knowable but it does what it wants anyway'.

The only exception to this is Jerome who says 'I believe Nature is made by God and is beautiful... I believe it is important to understand nature and it is not difficult for us to do this.'

The Far North Queensland culture is one with a great openness to spiritual reality, based on the mix of conservative Protestant Christianity combined with a very explicit New Age philosophy. Christian assemblies are compulsory in private schools and State (Government) High Schools still hold voluntary Christian assemblies. Within local shopping centres and

markets, all types of alternative healing services and fortune-telling and other similar services can be bought along with the fruit and vegetables. I would suggest that the spiritual emphasis is greater in this part of Queensland, because of the nature of the population (Christian/ New Age) than in other rural areas of Queensland, and also greater than might be found in a much more cosmopolitan city.

#### ASSERTION #2

Senior high school students from semi-rural Northern Queensland tend to discuss the natural world using a conservationist perspective.

Each student interviewed uses concepts emphasising the need to protect, or alternatively not to exploit, nature. This is illustrated in Celia's response '.. we have to worry about protecting it' and in both the response of JB ' Nature needs to be protected from pollution and we need to study how to protect it from pollution, as a resource, and for our lifestyle.' and Jerome ' It is very exciting but has become exploited and endangered'.

The Far North of Queensland is a World Heritage Area, which means that conservation is a local as well as national and international priority. Particular local attention is given to preserving the Great Barrier Reef (which is situated just a few kilometers off shore from Cairns) and the tropical rainforest that surrounds the town.

#### ASSERTION #3

There does not appear to be a correlation between the concepts used to describe nature by senior high school students from semi-rural Northern Queensland and gender.

The three boys and four girls each use aesthetic, religious or spiritual, and conservationist concepts in their descriptions of nature. Examples of this from Kai '.. I see something beautiful... I think we should study Nature but not to the point of destroying it. .. it is holy and spiritual because God put it there for us to use.' and Hayley 'illustrate a common perspective 'I believe Nature is beautiful ... It is part of my background to see a spiritual quality in Nature and to believe in the work of God and the sacred. ..but I do think it is an important resource and should not be exploited.'

Jerome links concepts of God and beauty with an appreciation of the use of science and technology to enhance our everyday lives 'I believe Nature is made by God and is beautiful... I believe it is important to understand nature and it is not difficult for us to do this. I believe it provides an important resource for our lifestyle.' However Beth too makes a link between God

and the importance of nature as a source of power through applications of science and technology- she was the only student who did not present spiritual or religious concepts in her perspectives on nature 'Nature is beautiful and diverse. .. I do not think Nature is mysterious.. ..it is an important resource and it is necessary for our lifestyle.'

#### ASSERTION #4

The level of science integration with everyday thinking is low. Discussion of nature by semi-rural Northern Queensland senior high school students involves little use of school science knowledge.

All the students in the study mention topics such as pollution but with little elaboration of the problems involved. These students generally would have more contact with nature than city children and live a lifestyle where hunting, fishing and growing food is a common occurrence.

At this stage of their high school science curriculum, students have been following a statewide science curriculum for 10 years and would have been taught concepts such as laws and theories, predictability, experimentation and empirical data, hypothesis and conclusion. They would be expected to have a relatively well-developed idea of scientific method gained from their Grade 8-10 General Science curriculum. However, this is not displayed in any of the narratives. Concepts displayed are contrary to those which are stated in their curriculum and examined in Grade 10 (all students need to pass Grade 10 Junior Certificate General Science to be allowed to study science in Grade 11 and Grade 12), and the students use terms such as 'random', 'unpredictable' and 'spontaneously'.

Some of the students display concepts that are anti school science. Examples of this are shown in Celia and J.B's narratives. Celia says:

I believe we should study Nature and it is important to understand how things work in Nature. I do not think you can teach someone Nature though. That is why students are misled, because of the teachers (Celia).

J.B. adds:

Nature cannot always be predicted using rules - it does not always obey the rules it should. Sometimes Nature will change from predictions because mankind cannot change Nature. Teachers try to tell us all about nature but they can only tell us some things about it. We have to go to Nature and study it for ourselves before we can understand it fully. It is hard to understand if you have not experienced it for

yourself. Teachers teach on a higher level and all we do is listen to what they say and never have an opinion.

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SECTION 3

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CHINA

*CONFUCIUS SAID:*

*'PEOPLE IN ANCIENT TIMES STUDIED TO ENRICH THEIR  
KNOWLEDGE AND IMPROVE THEMSELVES; PEOPLE TODAY STUDY  
TO DECORATE THEMSELVES AND IMPRESS OTHERS'*

*(ANALECTS 14:24)*



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## CHAPTER SIX

### CHINESE WORLD VIEW

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#### OVERVIEW OF THE CHAPTER

In this Chapter I provide an 'epic description' of science and science education in China and examine the concept of 'nature' from a Chinese perspective. I obtain this thick description from China's literature of history, philosophy, religion and education, and have made use, as much as possible, of Chinese sources. This perspective from the history of the Chinese culture has provided me with a third source from which to make assertions as to elements of a Chinese world view and their effects on Chinese students' conceptualisations of Nature.

#### PRODUCING THE SKELETON OF A CHINESE WORLD VIEW

Within Western society, the cultural and historical differences which exist between China and the West are often acknowledged implicitly without being defined and articulated. An explanation for this might be that over the last few centuries, large parts of Africa, America, Asia, and Australasia have been fought over and colonised to a greater or lesser extent. From these 'power' relationships, a great deal of cultural familiarity has developed. However, a wide gap in cross-cultural understanding still exists between those shaped by their Western scientific world view and the Chinese who have lived and flourished with alternative traditions and perspectives since Stone Age times.

As Fitzgerald reports (1966, p.2), the Chinese did for many centuries live in a closed world with their own country at the centre. They developed a culture that had very little foreign influence for many centuries and the Chinese had no contact with other nations at a similar level of development. Pragmatically speaking, China was the Middle Kingdom, the centre of the known world, for her own people. Fitzgerald (1977) sees a Chinese world view as being constructed around the centrality of Chinese affairs and strongly defined by political and ethical values. The ethical or moral part of this world view encompasses 'relationships in societies and in the overall balance of world forces as well as in the advance or retreat of Right.' Throughout the history of China, the Chinese ruler's ability and continuing right to rule, be it emperor or government, was somehow legitimated by the maintenance of the balance and harmony of these world forces.

In attempting to identify the factors that form a Chinese world view I have examined Chinese history, philosophy, religion, science and education in order to identify the common themes reflected and interwoven within each of these domains.

## HISTORY

Xia	2205 - 1766 BC
Shang	1766 - 1122 BC
Zhou	1122 - 770 BC
Spring & Autumn Annals	770 - 476 BC
Warring States	476 - 221BC
Qin	221 - 206 BC
Han	206 BC - 220 AD
Three Kingdoms	220 - 265 AD
Jin	265 - 420 AD
Southern and Northern	420 - 580 AD
Sui	589 - 618 AD
Tang	618 - 907 AD
Five Dynasties	907 - 960 AD
Song	960 - 1280 AD
Yuan	1280 - 1368 AD
Ming	1368 - 1644 AD
Qing	1644 - 1911 AD
Republic of China	1911 - 1949 AD

*Figure 8 Chinese Dynasties*

Early history describes a civilisation with some rudimentary scientific understanding, controlled by a superstitious belief in the power of nature. Documents from before the Xia Dynasty give details of primitive Chinese society. He *et al* report that primitive Chinese are reputed to have had knowledge of fire, building with tools, fishing with nets and farming. However they state that 'Possessed only with crude knowledge of the natural world, the ancients still remained under the domination of the natural forces. [which] .. gave rise to the predominant role of religion.' They report that the ancient people attributed all natural phenomena to gods of nature and accepted good and bad as the 'Mandate of Heaven', the will of God. These concepts continued through the Shang and Zhou dynasties but towards the end of the eighth Century B.C the concept of the Mandate of Heaven began to decline. People began to question Heaven, and even to call the gods unjust in some of their treatment of them.

During this early period of Chinese history, the Chinese did not have the same sense of nationhood as that found in the West (Fitzgerald 1966, p.3). They existed as a system of kingdoms and tribes with distinctions made between ways of living: the civilised and barbarian, the nomadic and pastoralists or the farmer and the herdsman.

There was also a mythology in China, a deeply pervading one, concerning the establishment of a unified political and social system in China at the dawn of time. Therefore, the cultural expectation was of a politically and socially unified realm. This sense of national unity has

become an important motivator and the basis of an organising framework for Chinese thinking about themselves and their culture.

During the Han dynasty, there was some contact with foreign countries in their dealings with traders from Russia and Europe. This, according to Fitzgerald (1966) is the first time that Chinese history records contact with other Asian civilisation and with the Roman Empire, which the Chinese admired for its power and strength. This was also a time when the Northern Chinese, who considered themselves as more civilised than their Southern compatriots, began to acknowledge and incorporate the values of those from the South, who had always been viewed as old-fashioned.

During the Qin and following dynasties of the third, fourth and fifth Centuries, Chinese technology continued to develop. There was regular international trade with India and Arabia and a cross-fertilisation of ideas and interests. This was the period when the first Chinese monk travelled to India and brought back Buddhism to China.

In the Tang dynasty, the Chinese expanded into the territory that is, largely, modern China, with a population of 60 million people (Fitzgerald 1966). The Tang Chinese traded freely with other Asian nations and tolerated their religions and habits while maintaining a cultural aloofness from them. There was a justification for this attitude. Chinese society was flourishing, well governed, with a well-developed educational system and love of art and music. During this period, the Chinese developed the arts of warfare and wall building with the express purpose of keeping out the barbarians and maintaining control of the country. This is a concept that also appears to be another major factor in a Chinese framework of thinking - removing uncivilised people, barbarians, who might seek to undermine Chinese concepts of civilisation from the country and make it ungovernable by traditionalists.

The arrival of Western 'barbarians' had begun with Arab traders in the 9<sup>th</sup> Century (Ronan 1978, p.72) who had not attempted to convert the Chinese to their religion. However later European traders and then missionaries brought with them a well-developed and evangelistic zeal for Christianity. Matteo Ricci attempted a top-down conversion of China through education and reaching the intellectuals through translation into Chinese of European literature, including the Bible. Largely, Christianity failed because of its claims to exclusivity, its denunciation of superstition and its stirring up of people to action in a manner that might be inappropriate to good governance, and became seen as a menace to society. Eventually all Christian missionary activity was forbidden. Fitzgerald (1977) explains that '[these] importunities were an affront to the Emperor, which, by the disturbance they created, called

question upon the Emperor's virtue; that is upon his ability and therefore his mandate to conduct not only foreign affairs but the affairs of his own country.'

At the beginning of the 19<sup>th</sup> Century China had seemed like a rich jewel, a prize to be conquered and converted to the West. During the 19<sup>th</sup> Century, with the rise of the Industrial revolution in Europe and major developments in science, technology, medicine and social reform, her relative position and value began to decline in Western eyes. China was poorly governed too during this time and suffered socially through sickness and famine.

At end of the 19<sup>th</sup> Century and until the First World War, some Chinese intellectuals began to become convinced that science and democracy were important for Chinese development. It must be emphasised here, as another important organising concept, that it was not European science and democracy in their cultural context, which were being sought (Fitzgerald 1996, p.40). Fitzgerald reports that European learning 'was not valuable in itself, not necessary for a fuller and wider understanding of the whole achievement of the human race, but necessary to give China back the power to compete on equal terms with the West'.

Fen Gui Fen expressed this in 1886:

I have heard that with their new methods the Westerners have found that the movements of the earth conform closely to those of the heavens. This can be of assistance in fixing the calendar.... I have heard that the Westerners' method of clearing sand from harbors is very effective.... This can be of assistance to keep the water flowing. Also, for agricultural and sericultural tools, and things required for the various crafts, they mostly use mechanical wheels, which require little energy but accomplish much. These can assist the people to earn their living. Other things beneficial to the national economy and the livelihood of the people should also be used... There are many intelligent people in China. Surely there are some who, having learned from the barbarians, can surpass them... (Mason Gentzler 1977, pp. 70-71)

Yang (1961, p.363) comments that Marxist philosopher Bertrand Russell was invited to Beijing and Nanjing and he lectured that basically any religion was an enormous barrier to the spread of the scientific revolution. This motivated a movement which sought to devalue all religion, traditional or imported, among modern educated Chinese and for the next decade Western scientific thinking began to spread with the demise of mythological themes in modern literature of the time, and the rising up of themes such as social conflict. There was a parallel call among some intellectuals for Western style democratic government in China. The Russian Revolution of 1912 also had an enormous impact on Chinese intellectuals as they saw a relatively backward country, Russia, become independent and free from foreign intervention.

This view was expressed by Chen Du Xiu, one of the leaders of a 'new (scientific, democratic) culture' movement, the May 4<sup>th</sup> Movement in Beijing in 1916:

Our task today can be said to be the intense combat between the old and the modern currents of thought. Those with shallow views all expect this to be our final awakening, without understanding how difficult it is to put [constitutional government] into practice... There is no difference between the shameful disgrace of submissiveness of men of ancient times hoping that sage rulers and wise ministers will practice benevolent government and present day men hoping that dignitaries and influential elders will build a constitutional republic. (Mason Gentzler 1977, p.168)

Lin (1979, p.155)) believes that the May 4<sup>th</sup> era in China portrays a 'totalistic cultural iconoclasm' with an intellectual revolution, by some, which completely rejected China's past and 'advocated wholesale Westernisation'. For some, this meant a wholesale acceptance of foreign ideology and the need to fight a permanent battle against the superstition and feudalism of the history of China. This battle however was to be fought for the sake of China. So because of an intense patriotism this movement merged with another stronger one, that of Nationalism.

When the Nationalists came into power in 1922, they strengthened the trend towards the scientific secularisation of Chinese society. They introduced methods to remove superstition such as banning the sale of candles and incense and to convert temples and other religious building for secular use.

The Chinese communist party was founded in 1921. A Marxist-Leninist world view requires a 'scientific' view of the state of the world and the definition of a standard or benchmark against which peoples and their beliefs might be measured. Fitzgerald (1966, 1977) comments that this might be seen as contrary to a Chinese world view. Mao Ze Dong seemed to have developed a method of holding in tension an ideologically Marxist world view and a traditional Chinese one. He expressed it thus:

The theory of Marx, Engels, Lenin and Stalin is universally applicable. We should regard it not as a dogma, but as a guide to action. Studying it is not merely a matter of learning terms and phrases but of learning Marxism-Leninism as the science of revolution. It is not just a matter of understanding the general laws derived by Marx, Engels, Lenin and Stalin from their extensive study of real life and revolutionary experience, but of studying their standpoint and method in examining and solving problems. (Mao 1938, pp. 208-09)

It can be asserted that just as European science was perceived as a saviour of all that is valuable in Chinese science and civilisation, then European Marxist thinking was captured and embedded into a cohesive whole within a modern Chinese conceptual framework.

During the Nationalist period of 1928-1937, the government was committed to a program of modernisation and anti-imperialism. It had a policy of trying to undo a series of 'unequal treaties' and claiming back all the territory which had been lost to other nations over the past few hundred years. This was successfully carried out until the Japanese invaded Manchuria in 1931. As the Nationalist government strove to buy time by appeasing the Japanese, the Chinese Communists began to organise resistance to the Japanese invasion. The Japanese had seized parts of China and installed their own puppet Emperor, Pui Qing (Mackerras 1976, p.199). The Nationalists responded by fighting the Communists, perhaps in the hope of ruling the country more effectively, rather than opposing the Japanese. The Nationalists appealed to the Russians for help but to no avail. There was full-blown war between the Japanese and Chinese during the period 1937-45. By 1938, the Japanese had seized the North of China as far South as Nanjing (previously known as Nanking). The Nationalist government continued to appease Japan and fight the Chinese communists.

The Nationalist government and its leader Chiang Kai Shek began to receive massive aid from the USA. Chiang wanted to align himself with America rather than the Soviet Union to avoid any need to collaborate with the Chinese Communist Party. After the Second World War, Chiang chose to build relatively friendly relations with the Japanese and cooperate with the USA on Japanese foreign policy that was favourable to China.

However, there was a fierce civil war in China, which led to the Communists under Mao Ze Dong seizing power in 1949. After such a long period of war both internally and against the Japanese, China's economy and industry were in ruins. The Communist party went through a whole series of reforms - land reform, marriage reform, agricultural and economic reform - to break down the hold of primary structures within society such as the family and the larger clan, and replace this with a fundamental allegiance to the party. One of the tools which was used was collectivisation (Mackerras 1976, p.63) and mutual aid, which later gave rise to rural people's communes throughout the countryside.

Mao's thinking was in some senses culturally very traditional. His attitude to the use of foreign technology and developments was as follows:

Now, there are two different attitudes towards learning from others. One is the dogmatic attitude of transplanting everything, whether or not it is suited to our conditions. This is no

good. The other attitude is to use our heads and learn those things which suit our conditions, that is, to absorb whatever experience is useful to us. That is the attitude we should adopt. (Mao 1957, p.75).

Mao also scolded those who tried to import foreign Marxist dogma to China without allowing for adaptation to Chinese cultural norms:

Many comrades seem to study Marxism-Leninism not to meet the needs of revolutionary practice, but purely for the sake of study. Consequently, though they read, they cannot digest. They can only cite odd quotations from Marx, Engels, Lenin and Stalin in a one-sided manner, but are unable to apply the stand, viewpoint and method of Marx, Engels, Lenin, and Stalin to the concrete study of China's present conditions and her history or to the concrete analysis and solution of the problems of the Chinese revolution. Such an attitude towards Marxism-Leninism does a great deal of harm, particularly among cadres of the middle and higher ranks. (Mao 1971)

There were many movements designed to unite the people, such as the Great Leap Forward of 1959 which was meant to unite China's labour force in the production of iron and steel, and others designed to make China more governable. Another of these was the Hundred Flowers Campaign, which allowed individuals to criticise the Party in the cause of free speech and correction. This resulted in further schisms within the party.

The Cultural Revolution occurred during 1965 as a result of several social issues including educational policy, the role of the military in the context of the Cold War between the USA and Soviet Union, and a Communist Party that was not always responsive to Mao. Mao turned to the urban youth of China who became a new force toppling party officials and bureaucrats. This was the time when many academics were sent to the country to be reformed through 'labour'. This newspaper report carries some of the spirit of the Cultural Revolution:

This mounting revolutionary storm is sweeping the cities of the entire nation. Let Mao Ze Dong's thought occupy all positions; use it to transform the mental outlook of the whole of society; sweep away all ghosts and monsters; brush aside all stumbling-blocks and resolutely carry the great proletarian cultural revolution through to the end! This is the militant aim of the young revolutionary fighters. Their revolutionary actions have everywhere received the enthusiastic support of the revolutionary masses. (Peking Review September 2 1966)

One of Mao's original leaders had been Lin Biao. However by 1971, Lin was suspect and, amid many rumours that still exist today, was killed in a plane crash. However, a new

movement arose, the Campaign to criticise Confucius and Lin Piao (Mackerras 1976, p.75). By now both of these previous heroes had become symbols of 'restorationism' which was defined as a return to the historical cultural values which existed prior to the Cultural Revolution, and all Confucian thought and teaching was suspect.

Toward the end of his life, Mao put forward a new analysis of the international situation in which the world's states are divided into three groups: the underdeveloped nations, the developed nations, and the two superpowers (the United States and the USSR), both of which seek worldwide hegemony. This analysis underscored China's position as a leader of the Third World (i.e. the underdeveloped group) and helped to rationalise a rapprochement with the United States.

The fostering of closer relations with the United States was looked upon as a way to lessen the influence of the USSR, whose relations with China had continued to deteriorate. Mao died in Peking on Sept. 9, 1976. The following month his wife Qiang Qing and her radical associates, known as the 'Gang of Four', were arrested. Mao's chosen successor, Hua Guo Feng, was stripped of his influential posts as the party came under the control of moderates led by Deng Xiao Ping. In 1981, the party criticised the excesses of the Cultural Revolution while praising Mao for his leadership in earlier years. The Constitution of 1982 stated that economic cooperation and progress were more important than class struggle and banned all forms of personality cults. During the early and late 1980s, a general movement away from Mao's beliefs was noted, and his statue was removed from a number of sites throughout China. In February 1989, a member of the Central Advisory Commission to the Communist party wrote in an official Peking newspaper, the *Guangming Daily*, that:

Mao was a great man, who embodied the calamities of the Chinese people, but in his later years, he made big mistakes over a long period, and the result was great disaster for the people and the country. He created a historical tragedy. (*Guangming Daily* February 1989)

By July 1977 Deng Xiao Ping, an old ally of Mao had held several important government positions. He struggled with Hua for control of the party and government, and protégés of his took considerable power during 1980 and 1981. Deng masterminded important reforms in virtually all aspects of the political and economic life of China. He brought into existence decentralised financial management and sensible and adaptable long-term planning to achieve efficient and controlled economic growth. China's peasant farmers were given some autonomy and responsibility for their production and profits, a policy that resulted in greatly increased agricultural production within a few years of its initiation in 1981. Deng stressed individual



responsibility and offered material incentives as the reward for initiative, and the constitution of cadres of skilled, well-educated technicians and managers to spearhead the development of China. He also strengthened China's trade and cultural ties with the West, and opened Chinese enterprises to foreign investment. A recent article states:

Deng Xiao Ping theory is the Marxism of present day China, representing a new development stage of Marxism. The theory has upheld the principles of emancipating the mind and seeking truth from facts, at the same time as inheriting and developing Marxism. .... The theory has objectively and profoundly analyzed the features, the basic conditions, the principle contradictions and the fundamental tasks in the modernizing China. After a thorough understanding of the nation, Deng, the late Chinese leader, developed his wide-ranging theories on building socialism with Chinese characteristics. (China Daily 8 April 1998)

This quote again identifies aspects of a Chinese conceptual framework that can be traced through history. Deng's theory is welcomed by the current Chinese government because it preserves traditional Chinese values while extracting what is good of foreign theory and practice for the development of the Chinese good.

#### **PHILOSOPHY AND RELIGION**

Concepts of philosophy and religion are intertwined in Chinese culture. Fung defines philosophy to the Chinese as 'systematic, reflective thinking on life (1948, p.2) and religion as 'a philosophy with a certain amount of superstructure, which consists of superstitions, dogmas, rituals and institutions'.

Fung explains that China has three philosophies: Taoist, Buddhist and Confucian. Of these, he sees that Taoism and Buddhism are religions as well. It is important then in understanding a Chinese world view to differentiate between the philosophical and religious aspects of Taoism and Buddhism, and to accept that Confucianism is not a religion.

The traditional purpose of Chinese philosophy is seen to be different to that of Western philosophy in that it does not seek to increase man's knowledge of facts, but rather to elevate the mind and to seek for higher moral values. Fung (1948, p.5) sees that for the Western mind there has been a conflict between religion and science since Western culture has focussed on religion which has provided facts that conflict with those provided by science. He asserts that either religion or science can have authority for a person or group and where one gains ascendancy the other declines. He expresses the belief that this conflict does not exist in traditional Chinese thought. He states (Fung, 1948, p.6) that 'the higher values with which man

has become acquainted through philosophy are even purer than those acquired through religion, because they are not mixed with imagination and superstition'. He continues to explain that in Chinese tradition it is not essential that a civilised person should be religious but it is obligatory that he or she should be philosophical.

Early Chinese religious and political beliefs were closely linked during the Shang and Zhou dynasties and until the Han period (16th Century BC – 280 AD). Yang (1961, p.106) records that there were four elements to the traditional religion consisting of ancestor worship, the worship of heaven and other aspects of nature as gods, divination and sacrifice. Ancestor worship served as a stabilising factor in the family and society and the ancestral temple signified political power and authority.

Divinations served as a public and private practice of looking into the future. Many different items, such as bones and tortoises, were used in a ritualistic fashion to determine the future of the individual and the state. Sacrifice was made as an offering to the spirits of departed ancestors (Yang, p.39) by the burning of incense, bowing, burning of candles or paper money. In the temple, and at important festivals, animals plus the above mentioned items were offered in elaborate ceremonies.

Under Han rule, the Yin-Yang Theory stated above gave rise to the theories of the Four Seasons (Spring, Summer, Autumn, Winter) and Five Elements (metal, wood, water, fire and earth). These Five Elements (Buckley-Ebrey 1981, p.37) were seen as paralleled in the Five Viscera (joy, anger, sympathy, grief and fear) and the Four Seasons represented by cold, heat/dryness, moisture and wind. By balancing Yin and Yang, it was believed that sickness and general well being could be controlled.

The following quote, taken from the work of Jia Yi, a minister of the Emperor Wen of the Han dynasty expresses fatalist sentiments concerning man, Heaven and Nature, indicating the perceived role of Yin and Yang in creation.

Nature is a ceaseless cycle with everything transmuted, interacting.  
Clouds gather and rain falls;  
Endless the universal evolution;  
None can fathom Heaven or make plans for the future.  
Who knows how soon or late he must meet his fate?

The universe is a furnace stoked by Nature,  
With the Yin and Yang as fuel,  
The myriad things as metal

(Poetry and Prose of the Han, Wei and Six Dynasties 1968, p12)

During the Han period, Chinese society was also greatly affected by the Confucian philosophy that undergirded it. This contended that there was a basic order in the universe and a natural harmony linking man, nature, and the heavens. The predominant strain of Confucian thought emphasised the perfectibility of man (the ability for mankind to make themselves perfect through correct ceremonial and daily behaviour and actions. Confucius (551-479 BC) believed in the fundamental similarity of all persons and in the perfectibility and educability of each individual. Mencius and Xun Zi, two of his prominent successors, differed in their assessment of human nature, Mencius arguing that it contained the basic seeds of goodness, and Xun Zi in that it tended towards evil. Both, however, believed that human beings were able to perfect themselves through self-determination and the practice of ritual.

Family units were seen as the building blocks of Chinese society and, within the family, five important relationships were identified as undergirding and determining all other societal relationships. These were sovereign-subject; husband-wife; parent-child; elder brother-younger brother; friend-friend. These social relationships were hierarchical and clearly defined: reciprocity, or mutual obligation, between subordinate and superior was fundamental to the Confucian concept of human relations.

The virtue of filial piety, or devotion to parent, was seen as paramount and as a forerunner or facilitator of the highest virtue desired among humankind, humaneness ('jen'), or the sense of relatedness to other persons.

Confucian philosophy undergirded traditional Chinese political thinking about government and rulers. Government was assumed monarchical and modelled in family life. The ruler both represented Heaven and a traditional father figure, and thus need to be treated with an appropriate form of piety. Confucius expresses this:

Young men should be filial when at home and respectful to their elders when away from home. They should be earnest and faithful. They should love all extensively and be intimate with men of humanity. When they have any energy to spare after the performance of moral duties, they should use it to study literature and the arts. (Analects 1:6)

There was also an early understanding of the role of the state as guarantor of the people's well being that developed alongside the empire and the governmental state. The concept of the Mandate of Heaven gave a ruler the right to power. This meant that the peoples' well being had to be provided for. It was accepted that if the ruler did not provide for the people, as both a good father and a god should, then the people had the right of rebellion

After the Han period, which represented the end of communal or involuntary religion (Yang, p.110) there was a rise in Taoism as a religion.

The Chinese word Tao means a way or a path. In Confucian philosophy, which is also called Taoist philosophy by Fung (1948, p3) since it undergird the Taoist religion, the term Tao was used to speak of the way human beings ought to behave in society. Tao, for them, was an ethical or moral way. Those who had Taoist religious beliefs however, preferred to understand the Tao as the Way of Nature as a whole, the spontaneous action of the natural world, similar in concept to the Japanese 'shizen' (Ogawa, 1998). They believed that Confucian philosophy by insisting on a purely human Way, overstated the importance of man and failed to pay attention to the lessons which Nature has to offer about time and change, advantage and detriment, the beneficial and the purposeless.

Basic Taoist religious thinking and behaviour involved enabling people to realise that, since human life is really only a small part of a larger process of nature, the only human actions which absolutely make sense are those which are in accord with the spontaneous action of Nature. Their sensitivity to the way of Nature inspired them to renounce human thoughts or criteria that might lead to an overly authoritative mode of behaviour or too strong a commitment to the achievement of worldly goals. For these Taoists, such forced assertiveness was the basis and cause of violence and aggression. While Confucian philosophers found virtuous reasons to advise against savagery and to persuade rulers to govern by morality rather than by force, many Taoist believers went even further and denounced violence as reflecting the ultimate ignorance of the Way of Nature.

Their resolution of the problem of how human beings should act is emphasised in the Taoist religious doctrine of wu-wei or non-action. This teaching meant that nothing unnatural, or not in accordance with the Way should be done. Related to the doctrine of non-action was the idea of no desires, which meant that no one should have excessive desires because such longings are bound to cause injury.

The Taoist religion was characterised by the spontaneous and the simple as opposed to the concern of Confucianism with civilisation, culture and moral perfection with a bias toward

artificiality and unnecessary and arbitrary distinctions. Taoists saw a need for each individual to cultivate a personal virtue, 'te', out of a spontaneous and simple response to nature.

The Buddhist religion began to develop in China at the same time as Taoism at the end of the Han period. Buddhism was a foreign faith with an emphasis on magic (Yang 1961, p.115) and appealed to the ruling classes. It managed to attract followers with the claims of the magic powers of its many gods, at a time when society was disillusioned and disaffected with its humanly powerless government. The early development of Buddhism emphasised magic power to ward off demons that caused misery and sickness in a troubled world. Later development of Mahayana Buddhism 'advocated pity for all creatures and salvation for all humanity as the only possible means of achieving personal salvation' (Yang 1961, p.119). This doctrine of universal salvation, peaceful eternal life for all people, endeared Buddhism to large sections of intellectual society and the movement became very powerful by the 6<sup>th</sup> Century. Buddhists displayed this power in a series of armed rebellions against the government during the 6<sup>th</sup> to 9<sup>th</sup> Centuries.

By the 11<sup>th</sup> Century, however, there had been a resurgence of Confucianism as the state philosophy in a time of political unity. Buddhism had retreated to become a haven for the social and economic outcasts of society, with Taoism hiding in its wings (Yang 1961, pp.124-5)

Confucianism, Buddhism and Taoism continued to play their parts in the maintenance of Chinese cultural values throughout the following centuries. The 20<sup>th</sup> Century saw a China that was unable out of its philosophical and religious history (Yang 1961, p.378) to meet the challenge of the materialistic rationalism of alternative social, political and economic systems. Many (Tillich 1948, p.98) have identified 'communism as a non theistic faith with distinctly religious qualities' (Yang 1961, p.381). It was this faith which, with its own distinctive Chinese and embedded in a Chinese cultural context, has shaken the nation during the greater part of the 20<sup>th</sup> Century.

#### SCIENTIFIC THEORIES AND CONCEPTS

Documentation from before the Xia period (He et al 1991, p.136) describes China as an agricultural society. Reference is made to the possession of a primitive calendar and the evidence of astronomical and meteorological observations and mathematical developments such as the decimal system and multiplication tables. Civil engineering had developed with the construction of canals, reservoirs and irrigation works to aid the primitive agriculturalists. Doctors and medical experts of the early days tended to be 'magicians or sorcerers'. The idea of a round earth was first considered during this time (He et al, 1991, p.140) and primitive ideas of the existence of outer space as infinity were also formed..

At the end of the Shang dynasty, the Doctrine of the Five Elements, an elementary method of categorising nature into components of water, fire, wood, metal and earth was put forward. Although this could be seen as scientific, there was also a relationship between this classification and fortune telling and divination. This was accomplished by mental associating each element, by some form of magic, with a taste (salt, bitter, sour, acrid, and sweet), colour (black, red, green, white and yellow) and other characteristics such as smell, number temperament, animal, place to make a sacrifice, etc.

This trend, a correlation between traditional science and divination appears to be quite common in Chinese history. This may be because two questions, equally important to the Chinese mind, needed to be answered. The first arose from a need to understand and classify the world in which the people lived, the second from a need to know what might happen and how these future events might be dealt with. Zou Yan (350 -270 B.C) as the originator of the Naturalist school, is understood by Ronan (1978, p.142) to be the 'real founder of all Chinese scientific thinking'. He developed a systematic method of classifying traditional Chinese thinking on science. Zou Yan is recorded as having:

examined deeply into the phenomena of the increase and decrease of the Yin and the Yang, and wrote essays totalling 100,000 words about their strange permutations, and about the cycles of the great sages from beginning to end. .... First he had to examine small objects, and from these he drew conclusions about large ones, until he reached what was without limit. .... He began by classifying China's notable mountains, great rivers and connecting valleys; its birds and beasts; the fruitfulness of its water and soils, and its rare products; and from this extended his survey to what is beyond the seas, and men are unable to observe. (Ronan 1978, p.142)

The Naturalists had a 'half-scientific, half-political doctrine' (Ronan 1978, p.144) linking the basically naturalistic and essentially scientific concept of the Five Elements with a somewhat speculative theory concerning political power and authority. However, at its heart, the Five Elements Theory was an effort to catalogue the basic attributes of all the Chinese understood as Nature and possessed a partial chemical bias.

By Han times, the Five-Element Theory (Ronan 1978, p.153) had stabilised considerably and 'gradually came to be associated with every conceivable category of things in the universe that it was possible to classify in fives'. This led to an associated form of thinking which led the Chinese to examine everything that was classifiable in the universe and to group it in some other order such as fours, nines, etc. The outcome of this is a number-mysticism or a superstitious

association of particular numbers and functions, e.g., four equals death, which still is a commonly practiced form of superstition in Chinese local and expatriate society which Ronan notes (1978, p.162) 'prevented the rise of true scientific thinking in China'. The practical outworking of this is that Chinese thinking on an issue might begin with scientific observation, collection of data and analysis of results. Any resultant order or pattern of results might then trigger a magical correlation, moderated by the Five-Element theory, and a whole new system of cause and effect would be established.

Another major influencer of Chinese thinking about science was the Yi Jing, or Book of Changes. Ronan (1978, p.182) comments that this complex book, dating back to 6<sup>th</sup> Century B.C. and giving a symbolic understanding of science and nature based on omens and results of divination, was a 'hindrance to the development of scientific ideas in Chinese civilisation'. The book deals with concepts of time, space, physics, chemistry and medicine whose meaning was hidden in signs and hexagrams. Ronan (1978, p.187) claims this book retained a powerful hold on Chinese scientific thinking until recent times.

In the Sung and Yuan dynasties, there was much development in scientific knowledge with the invention of gunpowder, printing, the compass and in astronomy and mathematics, in agricultural technology and in spinning and weaving (He et al, 1991, p341). At this time, during the 11<sup>th</sup> century, He et al, (1991, p342) identify very little of what they call a 'scientific attitude' in a Chinese world where superstition prevailed.

The later Ming and Qing periods were a time of enlightenment with developments in mechanics, natural philosophy and mathematics. This was still mediated however by a framework of Taoism, Yin and Yang, association with the Five Elements or other kinds of superstition (He et al, 1991, pp.399 - 401).

Western knowledge is recorded by He et al (1991, p.403) as having being introduced in the late 16<sup>th</sup> century. They quote a scientist of the time, Fang Yi Zhi as offering the opinion that:

... Western knowledge was introduced into China which was good at observation but poor at generalisation; and hence wise people would reason that there must still be imperfections in their observation (He et al, 1991, p.403)

I believe that the opinion being offered here is one that sees Chinese traditional science as being able to offer generalisation from within its own belief system. This is therefore critical of a Western knowledge system which only reports on observations and fails to draw conclusions, and make associations, using superstitious and magical relationships.

He and other commentators (1991), members of the 'establishment' Chinese Academy of Social Sciences, suggest that even in the 19<sup>th</sup> century Chinese scientists were very 'unclear and baffled' and 'hoodwinked for a long time by Western missionaries'. This was because they saw as contradictory the Christian framework that was being presented at the same time as the one of Western enlightenment science. This meant they were unable to join the modern Western scientific revolution. Some Chinese scientists found difficulty with the developing Western scientific method of experimentation and the subsequent formation of sometimes-contradictory hypotheses, e.g., theories on the nature of light.

They describe how in China in the 19<sup>th</sup> century it was taught that the:

truth or falsity of a scientific theory lay not in whether or not it reflected accurately the laws of change of the objective world, but rather whether or not it more conveniently served or suited a subjective hypothesis. (He et al 1991, p517)

An interesting illustration (Lin 1979, p.109) of this is seen in the life of Lu Xun, a famous poet, author, medical doctor and patriot of the early 20<sup>th</sup> century. When Lu was a teenager, he suffered badly from toothache. He was given vast quantities of herbal medicine that proved to be an ineffective cure. He was also humiliated by the traditional medical theories of the time that associated male teeth physiologically with the kidneys, which were also considered male sex organs. When Lu complained of toothache he was, in traditional thinking, identifying his sexual weakness. He was therefore shamed into enduring toothache for many years rather than admitting to this continual moral weakness. This experience motivated Lu Xun to study Western medicine, and in the reform of Chinese society.

It was not until 1904 and the development of the May 4<sup>th</sup> movement (and of which Lu Xun played a part) that Western scientific thought became important in China. One Chinese interpretation of this (He *et al*, p.522) is that a Chinese translation of Darwin's evolutionary theory caused the concept of 'evolution' itself to spearhead a move towards anti-feudalism (destruction of elitist societal structures) and progress. This progress allowed the demystification of science to the Chinese mind and allowed science to develop as a liberating force in society.

#### THE CHINESE EDUCATION SYSTEM

The earliest formal education offered in China is recorded during the Shang Dynasty around the 16<sup>th</sup> Century BC. This was provided for the children of the elite classes and was designed to supply government officials from the ruling families. The curriculum was focussed on rites and ceremonies, archery and chariot riding, and history and mathematics.



During the Zhou dynasty, education was largely governed by the teaching of the moral codes and rites of Confucianism and the maintenance of the five important social relationships contained within it (see previous section on Religion and Philosophy). The goal of education was good citizenship and the transforming of society through these relationships and the establishment and maintenance of justice and good order.

This early schooling evolved in the 7<sup>th</sup> Century BC into the well-documented Imperial Examination System of the Han period (Hawkins, 1983, p.5), centering on the teaching and examination of the codes of conduct and principles of Confucian philosophy. These examinations were not abolished until 1905 (DEET 1991, p.1) and the Confucian philosophy had a fundamental influence on education until the Communists seized power in 1949.

The Song dynasty saw a revival in Confucian teaching. Education was seen as an agent for societal and cultural change among the people (Hawkins, 1983, p.5). A highly popular textbook of the Song period (c 1300) emphasises correct posture, appearance and behaviour as indicators of a student having gained 'personal virtue as the first criterion; next comes knowledge of the classics and the ability to govern, with writing ability as the last consideration' (Buckley-Ebery 1981 p.114). There was an enormous emphasis on the value of learning by reading and memorisation. The same textbook advises:

You should concentrate on your book and keep a dignified appearance. You should count the number of times you read an assigned piece. If, upon completion of the assigned number, you still have not memorised the piece, you should continue until you are able to recite it. On the other hand, if you have memorised the piece quickly, you should still go on to complete the assigned number of readings. (Buckley-Ebery 1981, p.115)

It has been said (Hong, 1991) that "respect for the elderly and books.. is the central idea of Chinese education." He also states that this ".. also means respect for authority, classics and experience". This tends to lead to principles that include "striving for perfection that causes reflective cognition style." Caution and modesty are also described as virtues in the classroom. Hong also states that methodologies used to achieve learning traditionally include "copying, repeating, reciting and memorising" with "strict training in basics" as necessary approach.

The Qing dynasty saw the rejection of Confucian ideas and a move to a more scientific approach to education, and particularly an emphasis on problem-solving (Hawkins, 1983, p.5). Western education began to take root in China during the mid-19<sup>th</sup> Century under the influence of Christian missionaries and, later, European industrialists who claimed parts of China as spoils

of the Opium war and needed workers for their factories and shipyards. While many of the ruling classes treated these modern schools with suspicion others, more pragmatically, took advantage of the opportunity to learn something of Western culture with a view to share in the benefits of the introduction of Western technology.

Yu Zi Yi, a Chinese teacher who had had some Western education, described the experience of teaching science in a rural school near Shanghai in 1907, as a difficult one. The school was exceptional in that the young teacher was relatively modern and had learned some Western science and the principle permitted some girls to attend.

Even for the curricula of the school, we never followed the imperial regulations. The subject most emphasised in the Qing dynasty was the classics. The old principal was expert in them, but he knew that such recondite philosophy was really beyond the children. Therefore, all he offered for the first grade was a course in morality. I taught the natural sciences, which at that time was called 'physics'. There was no such course as general science or local geography and history for grade schools so I had to invent one. The subjects of our study were the phenomena observed in the vicinity. How do the white lentils climb up the bamboo fences beside the river bridge? Why is the pumpkin as big as the stone plinth while the flower is as small as a cup?

Not only did I teach them, they also taught me a lot.. What they reported were the local experiences and legends, and what I taught was the scientific knowledge stated in the books. Combining these two resources, we found some conclusions which we thought were more convincing... I might passively argue against superstitious legends, but how could a single mouth fight against the beliefs of thousands of people? A much better way was to actively encourage the students to study science. The scientific attitude would make them suspicious of everything and motivate them to seek a thorough solution to every problem, so they would no longer stick stubbornly to superstitions (Buckley-Ebery 1981, p.257).

The defeat of China by the Japanese in the Sino-Japanese war and the fall of the Qing dynasty in 1911 with the establishment of the Chinese Republic saw the end of the old Imperial Examination system. The Chinese government experimented with different patterns of education borrowed mainly from Japan, Germany and the United States, and also sent many scholars abroad for a Western education.

In the post liberation period, between 1950-1958, the Soviet government influenced Mao Ze Dong in the establishment of a national education system and the restructuring of the Ministry of Higher Education. This influence produced many specialised colleges and trade and agricultural schools. After the breaking of relations with the Soviet Union, Mao's government retreated to a model that attempted to balance Confucian and Western-style education. This produced an emphasis on education's primary purpose in serving the political interests of the state (DEET 1991, p.2).

The political upheavals of the Cultural Revolution in 1966 saw University campuses controlled by young soldiers although primary and secondary schools continued to function. The view of education that arose during the Cultural Revolution was one which perceived education as a tool for social change which could be used in the process of political, industrial, agricultural and urban modernisation. Many University-based academics were sent to the countryside for 're-education' and primary and secondary school curricula were reformed with the removal of subjects such as history, geography, literature and core science subjects such as physics and chemistry being replaced with industrial skills.

From 1976 until the present, the education system has been modernised to resemble that of the West. It is difficult to find a modern analysis of the Chinese science education curriculum written in English. A study carried out by Australian science educators in 1992 (Price & Cross, 1992, p.83) concluded that Chinese science courses resembled those of the west. They saw these as 'a stepwise progression through ever increasing complex conceptual layers until finally the scientist or technologist is produced'. However, they considered that the curriculum failed to meet the needs of the average student, the majority in China, who was not going to progress to tertiary education.

Price and Cross (1992, p.83) also noted that the role of science in society is clearly that of 'science for development' (Drotri, 1998). They observed that many in China 'appear to believe that the kind of science they are currently teaching in Chinese schools was the cause of the industrial wealth of countries like England, Germany or the USA.' They also recognised that Chinese educators failed to realise the manner in which Western scientists and educators question their own pedagogical models.

In 1995, a major Chinese government committee, the Chinese National Conference on Education, agreed on a strategy of 'invigorating the nation through science and education'. In 1996, the Ninth Five-Year Plan of National Economic and Social Development and Long-Term Goals Through the Year 2010 was released. Its objective was stated as 'carrying out the strategy

of revitalising the nation by relying on science and education' so as to 'meet the requirement of national economic and social development and make the overall objectives to promote social productive forces, increase comprehensive national strength and improve the peoples' living standards'. Other aims included:

- Nine years of compulsory education
- Elimination of illiteracy
- Development of scientific research
- Reform in admission systems, funding models and a delegation of authority to local governments. (China Org, 1998).

Reading previous Five-Year Plans, the development of the Chinese education system can be seen to mirror the development of that of many Western countries including America and Australia. Recent English language articles in the Chinese press (China Daily, April 24<sup>th</sup> 1998) use the jargon of globalisation, flexible delivery, student centred-learning, and display an emphasis on information technology which is familiar to those involved in Higher Education, indicating, at least publicly, a commitment to all that is valued overseas. In this comment made on 8<sup>th</sup> October 1997, Mr. Tung Chee Hwa, the Special Administrative Region of Hong Kong's Chief Executive stated as one of his objectives for Hong Kong that he would:

launch a five-year IT education strategy to promote the use of IT to enhance teaching and learning. The main tasks are to equip our teachers with the necessary IT skills; to apply computer-assisted teaching and learning across the curriculum; and to place students in an environment where they can use this technology as part of their daily activities and grow up to use it creatively. (Slay 1998)

The same sentiments are increasingly being reported in the English-language press across China.

#### THE SKELETON

A Chinese world view would, in summary, appear to possess the following features. One would expect to find a unified national identity rather than a focus on individualism, with an

understanding of, and pride in, cultural values. Within society, one would expect to find formal well-defined relationships and strict expectations of behaviour.

Among the people, one might find two opposing attitudes to science. The first would be an older attitude that would see spiritual links between science, nature and everyday life. This perspective would also emphasise the importance of balancing natural, scientific and spiritual forces, and elements of magic and divination might be detected. An alternative and more modern view would display a complete division between spiritual and scientific thinking and would espouse Western scientific thinking, in a Chinese cultural context, as a liberating force to be used in the development of a modern technological society.

Within the education system, the prevailing and publicly stated views would be similar to those of the West, but with an emphasis on education serving the interests of the state. Rote learning would still be expected to feature highly as an educational methodology, and a high emphasis on moral values as indicators of academic achievement might be detected.

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## CHAPTER SEVEN

### CHINA 1

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#### OVERVIEW OF THE CHAPTER

In this chapter and the following one, I offer interpretive tales of my experiences in China during 1995 and 1998. The purpose of these tales is to provide a *bricolage* of the setting in which my Chinese studies were carried out, and to provide perspectives on Chinese culture and their effect on students' understanding of science in general, and the natural world in particular.

This chapter is a reflection on my time as a student in China in 1995 and also documents my experiences in finding subjects for my doctoral research. It includes data from my semi-structured interview with one teacher about the natural world (Cobern 1995b).

#### CHINA 1995

*The first story gives my perspective on the Chinese culture on my first visit to the Chinese mainland, to the industrial city of Nanjing, population 6 million people. For me, the most important issues during the visit were to try and discover some of the distinctives of the Chinese culture. I wanted to find out if traditional Chinese beliefs, Taoism and Buddhism, were still adhered to and, if possible, to visit a Church and talk to Christians about their faith and its effect on their world view and their daily life. My reason for doing this was to gauge the influence of Mao's form of communism on traditional Chinese culture and to ascertain if there were still cultural differences between mainland Chinese and expatriate and 'Westernised' Chinese in Hong Kong and other parts of Asia. This seemed an important precursor to my research since I, as the researcher, need to be convinced that I could discover and articulate some of the significant features of Chinese culture.*

#### ARRIVAL

Christmas Eve, enroute to China - the packaged airline meal accompanied by a sprig of plastic holly to celebrate the season, the food was not memorable. Seated sideways on the crowded plane, the pitch of the seats suited for a relatively small version of the Asian physique. Attempting conversation with my neighbour in Mandarin, self-conscious of other listening ears. She was a Taiwanese businesswoman and her English was far better than my Mandarin was.

Touching down at the Airport, memories of a recent major crash came to mind. No apparent problems as we landed at a relatively empty airport. Walking across the tarmac with an Australian Chinese teenager who was suddenly not too sure if she wanted to find her roots.

Being greeted by someone from the Normal University - we could see the waiting bus and the big billboards. I was struck by the enormous amount of advertising of Western products. But first the wait for customs and immigration, dreading having to use more specialised vocabulary than I was comfortable with. Remembering the Bible that I had brought, which I bring everywhere, wondering if it would be confiscated. But - no conversation, no searching, no sniffer dogs, a sort of smile and quickly waved through.

*[Memories of later conversation in Mandarin with a Chinese friend, an ex-spy of sorts and now an amateur philosopher and restaurant owner, back in Queensland.*

*Jill, they did not need to search you. They knew who you were and why you were there. They knew what you were carrying, every book, every detail. You were with a group of students; they knew each one of you from the minute you applied for a visa. They knew where you were staying and they listened to your phone calls until they were sure that you were not a spy' The paranoia of the refugee? ]*

Crowded streets, mostly bikes and buses, and, miraculously, some Christmas decorations. Yes, Nanjing had found out about Father Christmas, his face liberally pasted around the streets. A bit disappointing for me, as I was searching for 'traditional Chinese thought'. Wondering 'is this significant of greater Western influence in society?'

*[Later talked with another student, doing a Masters, from somewhere in Victoria, doing research on the Catholic education system in China - I was surprised to know there was one. He described what he had observed at 'Midnight Mass'. Hundreds of local people queuing for mass, security guards to keep order at the altar. He'd managed to interview the Bishop and was told of the need to build new Catholic churches. Questioning myself to make sure I understood the Chinese, sure he said that there were 4000 at the first service in a new Catholic Church]*

Settling in to the hostel, now obvious that China does not stop for Christmas, just another day really. Actually I breathed a sigh of relief - it would have been extremely disappointing if I found too much Western influence on the first day. Examining the plumbing system in my 'VIP' room, found the flush toilet which had been promised, but the cistern did not have a lid and it was best to keep the water turned off because of the loud drip. Decided to be grateful.

*[My mind flashes backwards and forwards to 'toilets I have known'. Public toilets in Hong Kong, by the Star Ferry, years ago when my children were small. Dreading the need to use them, holding our breath and refusing to let my gaze drop for fear I might be sick. Hanging on to the child because everything drops through the toilet bowl into the Harbour.]*

The smell of Kathmandu in the early '80s. Everyone just goes by the roadside. Surely this must be the smelliest place on earth - public toilets yet to be invented but believe parts of Nepal only found out about the wheel in 1973, so we'll give them a bit more time.

Later, the public toilet in Wuxi, Jiangsu Province. Pay the old lady at the door for toilet paper. Just a trench really but obviously the crowd is going to watch me. Biggest decision is deciding whether to face them or turn away from them. I don't remember whether I managed to maintain any dignity, I expect not.]

#### THE CHINESE EDUCATION SYSTEM

*The following five stories give my impressions of the Chinese education system. I tell these stories to provide some insight into the culture of the university, the lives of teachers and their students and the effects of culture on medicine, computing and science classroom practice.*

- *Inside the university*

*This is the story of my experience of learning more of the Chinese language by the Chinese method. I digress to provide some insight into the lives of university professors and their experience and their beliefs.*

- *Students*

*This tells my experience in trying to find Chinese university students as collaborators.*

- *Chinese Traditional Science, Medicine and Computers*

*This provides a brief insight into Chinese attitudes to the role of medicine and computers.*

- *The middle school*

*This provides an overview of the teaching methodology and practices in a middle school*



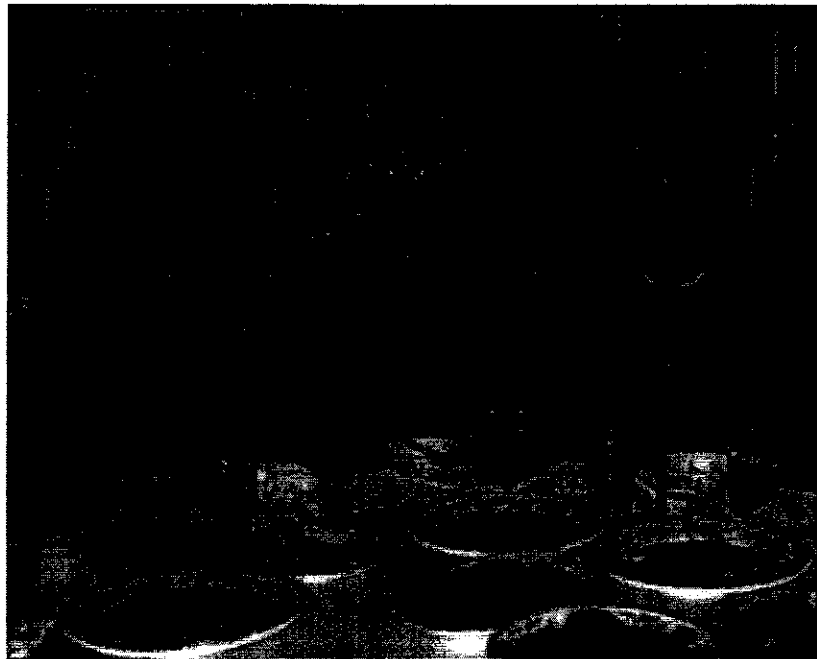
- *Inside the science classroom*

*Some understanding of the Chinese science classroom and the Chinese perspective on science as another set of facts to be learned by heart and retained without application.*

#### INSIDE THE UNIVERSITY

The arrangement was that I would spend my morning in class, improving my Mandarin, and then spend the afternoon with my tutor, who would help me with the vocabulary I needed for my research, and come out with me if necessary. I chose to learn Business Chinese because I did not really need the common household-and-tourist vocabulary of Chinese Language and Culture.

First, I found my tutor, Professor Sun, recently retired but brought back to help because he had good English. Two teachers, Qin Laoshi and Zhong Laoshi, younger men and very intense. A class of 4 students, all Australian Chinese except me.



*Figure 9: Teachers*

Memories of classes starting at 8.00 in a freezing cold classroom. Zhong was relatively easy to understand but I had a great problem since I could not read his Chinese handwriting. I could read typed characters but all the important notes on the board were a mystery. He was famous

in the province for his spoken Chinese and he certainly found my accent hard to bear. No English was allowed

*[Later it transpired that he had spent a very unhappy year in Australia and was not too keen on Westerners.]*

Qin was a far more pleasant person, much taller than Zhong and with an accent that was far more northern and nasal, and difficult for me to understand. Actually we truly could not communicate very well at all, even though I had been learning Mandarin for three years. I write best in pinyin (romanisation); he could not read it. The major advantage I had with Qin was that he had never been out of China and, as a new teacher, he had never met a Western woman before. This appeared to be the major reason he persisted with me.

I was a bit of a problem to both Zhong and Qin because they did not know how to relate to me at first. The rest of the class were undergraduates and the teacher-student relationship in this case is very well defined. An undergraduate is not allowed to ask questions or offer opinions, because he or she is not qualified enough to do so by virtue of the fact he or she has not yet graduated. The accepted teaching method dictates that he or she sits and listens, and only speaks to answer the teacher's question with the answer as stated in the textbook or on the blackboard. The undergraduate is always expected to get the answer right or he or she will be embarrassed ('lose face'), and also be considered a poor student. Qin and Zhong knew I was doing doctoral research and so had a specific purpose for learning their language. The fact that I was a university lecturer made things difficult for them because this meant my status, to a certain extent, was as high as theirs but I was enrolled in an undergraduate class. Eventually they decided that I was allowed to ask questions, and, if I chose to disagree with them publicly, I could preface my comment by 'in my opinion'.

*[Of course I never disagreed with them!]*

We studied a book full of examples of Chinese - Australian business terminology. Greatest problem was that none of us was business people, so neither the Chinese nor the Australians understood some of the concepts, even in their own native language.

Classroom practice was Chinese. Rote learning, four hours of class, three hours of one-to-one tutorial, four hours of homework every day if there was any chance of learning about one hundred complicated characters a week. Visits to schools, meetings with teachers, visits to banks, bookshops, libraries, joint ventures, computer software and hardware manufacturers, weekly tests, mid-course and end of course exams.

My time with Professor Sun was a real joy to both of us. We had many things in common, since he was from Canton (Guangzhou) originally and I had spent about 10 years in Hong Kong, so we had a common dialect. He was a small jolly man and spoke Mandarin with a southern accent as I do.

*[Zhong and Qin only obliquely referred to this 'fault' - after all he was a professor and as such could not be criticised. Zhong and Qin had given me strict instructions on how I should address Professor Sun. I must never ever use his given names, even if was asked to, and they told the, perhaps apocryphal, story of an Australian teacher who had once called out to Professor Sun, in public, in the hearing of many students and teachers, and had used his three names. I could not quite understand who had lost the most 'face' but it was obvious that the behaviour had been a great embarrassment to everyone who had witnessed it.]*

His English was also very good and, when I was desperate, we broke all the rules and spent time talking in English. We also found ourselves a warm place in my room to study privately, since Professor Sun did not seem too well and was always cold. He helped me out of all of my problems with Zhong and Qin and, with some desperately hard work from both of us, taught me to write an extra 500 characters that I had not known. This was to enable me to write all my tests and exams in characters rather than the pinyin I preferred, which would have got Zhong and Qin in a lot of trouble with the authorities.

Professor Sun and I soon discovered that we were both Christians and, rather than revise work which I could do on my own, we spent hours talking about faith, world politics, Mao and the cultural revolution, his life and his marriage, democracy, and Tiananmen Square and his children's involvement. He continually encouraged me with new vocabulary and eventually we were doing all this in Mandarin.

The lasting impression I have of this man is that he is one who loves his country. Both his children had left, and were living and studying in America, and both were proposing to marry Westerners, which was difficult for him to contemplate. It appeared that his daughter had really had to leave quickly at the time of Tiananmen Square, and whatever she had done had forced an early retirement on him. He and his wife had been to the USA, but found what they saw as the violence of the society hard to cope with and preferred the much more Spartan life in China. He and his wife, a maths teacher, were happy in their work. They continually worked with foreign students living in China and, to a certain extent, from the cards he showed me, these became a sort of transient substitute family. Hardship had become a normal part of life. He laughed at his time in the 'country' during the Cultural Revolution - he claimed that he had spent most afternoons fishing and, although he and his wife were separated, he said that there

had always been ways to see each other - their children were born during this time! He believed that, for his generation, the Cultural Revolution was easier to live with than the period of rapid change that China was, and is undergoing. Communism was certain - the move to a market economy, political Change, was making the 'old men' long for the 'old days' when everything was sure.

We studied together with a continual sense of elation, brought about by telling each other things that we could not possibly learn any other way. I amused him by telling him how foreigners with Government blessing were printing Bibles in his own town. This was not known inside China, just in the West! He told me about the intrigues of University hierarchy, and of Communist cadres and the way they stabbed each other in the back. I could sense the underlying fear that he had always lived with. I could also see that he had reached a time in his life where old age had brought about a sense of resignation, bordering on contentment, which had dulled the sharp edges of the ever painful present.

#### STUDENTS

Since it was almost Spring Festival (Chinese New Year) most of the local university students left Nanjing for their homes shortly after our arrival at the University. Holidays and rest (*the midday 'xiu xi'*) are very significant to Chinese people. When they have a holiday, it is obvious, a time for the family and for sightseeing; they do not disturb this for work, (*even a foreign teacher's research*). This means that holidays become very busy periods in Chinese life because a lot of effort is put into having fun!

(When they rest, and they rest in the middle of every working day for two hours, they really rest. They sit at their desks and read the newspaper or sleep and ignore all requests for help, in any language. Or they escort you to the door and firmly help you out, telling you, verbally or in body language, that you must have a rest.)

I resolved that if I were going to come back to China, I would make sure that I did not come during a holiday period (*and that I would **never** have a rest in the middle of the day!*)

I felt rather cheated by this since it seemed to remove the possibility of involving in my research any local university students, or anyone in the University's Education Faculty, as collaborators or interpreters. So my contacts with Chinese students were limited, very limited. I was living in a hostel for foreign students and we were closely supervised. Visitors to our rooms were carefully scrutinised and logged.

I looked desperately hard for Chinese students but the only Asians in the hostel were Japanese or Korean. I once had a very strained conversation in Chinese with a Korean girl as we shared a washing machine but it was almost too difficult to communicate since we both seemed to have a very limited vocabulary. I did see a few local students doing some desperately hard last minute cramming for exams, walking round the campus, learning by heart, reciting the text book, in a last minute attempt to get the required high marks.

Most of the foreign students on the campus, apart from the few Australians, were Africans. I could not actually understand which country they were from, but French was the basic language of communication. (*I was quite relieved by this because my French was still better than my Chinese was at the time!*) The Africans were mostly studying medicine and were there long-term. Their first year was spent studying the Chinese language and then they would spend another five or six years studying both Chinese and Western medicine.

#### CHINESE TRADITIONAL SCIENCE, MEDICINE AND COMPUTERS

I experienced medical 'culture shock' when I got bronchitis for the second time in a month in China. I had finished a complete course of antibiotics that I had brought with me as an insurance against sickness, and so was forced to go and see a doctor. I had dreaded this because I had imagined the medicine. [*Recollections of Chinese medicine shops in Hong Kong, so many antlers and bear paws*]

Professor Sun came with me, on a day when the outside temperature was about -10°C, and the surgery was similar to that in my textbook, item for item. The surgery was stuffy and hot. The nurse was sitting in the corner next to a coal fire, clothed in many layers, wearing a woolly hat. She did not stop knitting all the time or do anything very medical. Her presence was obviously very important though. The doctor came in. He was wearing his outdoor clothing with a white lab coat over the top and a white surgeon's hat on his head. He talked to me slowly and I found him easy to understand. I used the vocabulary of *Chinese Practical Reader, Volume 2, Chapter 3*, which I had studied two years previously.

[This vocabulary was totally sufficient but I had always wondered why, Palanka, the English heroine of the story, studying Chinese in Beijing, had need to be admitted to hospital just because she had flu. And what were the injections for? I asked myself as I gazed at the doctor.]

'I have the flu and I have a temperature. I have a bad cough'. He asked me to cough so I did. This was the end of the examination. He began to write a prescription. He stopped and looked at me: 'Why have you got bronchitis?'. I thought this was an odd question, but putting

on my Chinese thinking hat, I knew I must not talk about germs and infection. Ten years in Hong Kong had taught me this was not the Chinese rationale on sickness, and I presumed it would have to be the same here. I answered, 'At Spring Festival, I went to Beijing. The temperature outside was very cold; the temperature inside was very hot. This was not good for my body so I am sick'.

This was obviously the right answer and he told Professor Sun, an old friend, that I must be a good student because my Chinese was good. I knew that it was my culturally correct answer he approved of not my tones. The correct answer, left unsaid, was obvious to me.

*[This is a highly polluted city with continuous smog [they even taught us the word for 'air pollution' so they must know] because you burn so much coal to purify your water. The water is polluted because of all the effluent you pump into the Yangse River. Your people sometimes border on malnourishment and there is still a lot of tuberculosis around. They spit on the ground all the time and so infection spreads quickly]*

After some thought from the doctor, I received both Chinese and Western medicine, because I was a Westerner in China. Chinese medicine, I was told, would work more slowly and more thoroughly than Western medicine, and was efficient in China because its speed of action was comparable to the slower pace of life. However since I was a Westerner and I would be very busy with study and research, I would need Western medicine that would work at the same pace as my body usually did. I could tell the Chinese cure was laced with codeine though (which seemed to be cheating a little) from the way I walked around in a daze when I took it.

I managed to pay a visit to the University Computer department (I was a Computer lecturer myself at the time in Australia). This was a definite culture shock too. The computers, 386s and old at the time, were kept in a special air-conditioned and carpeted room. People wore white coats and slippers if they wanted to use them. Most students (and only the best study computers) were doing basic Basic programming. I tried to investigate whether they used Windows, or anything modern, but the lecturer was only interested in the length of computer courses in Australia. There seemed to me to be no parallels in our curriculum at all. The students seemed only to learn Basic programming [*I wondered what job this would qualify them for!*] and a considerable amount of theory with little or no application to the computing problems which might be experienced in work or research.

It seemed too that things like word processing [*the Chinese have a special keyboard and it takes 5 keys together to create one character*] were a matter for female secretaries and did not enter the arena of the university. I tried to explain the issue of the 'computer as a tool' but I could see that the body language was saying 'Crazy Westerner!' when I tried to put across the concept of teaching

the long-term unemployed to use computers. Computers are for the young and highly intelligent in China.

#### FORMING A RELATIONSHIP WITH A MIDDLE SCHOOL

As a language class we paid a visit to Ning Hai Road Middle School, a good school that was attached to the University. The schoolteachers were all geared up for our visit and we sat through a lesson on the geography of Australia. It was as I had expected. A crowded classroom of more than forty 14-15 year olds. I was hoping to find some candidates to interview here, so paid particular attention. The teacher entered the classroom and, on the bark of a harsh Chinese command from a student, the children jumped to their feet. Just as quickly they all sat down. The teacher read from a textbook and the children read together after her. I seem to remember the details of a large land with a large desert in the centre, water under the ground, kangaroos and koalas. We then watched a video with shots of the Opera House and the Gold Coast, surfing predominated in many of the clips.

Next lesson was English and the teacher was using a 'new method', small group work. Groups of 4 or 5 students acted out little plays and here there was at least a small sign of life from the children. I was then chosen to be the 'volunteer' to teach the class. I can remember articulating in my best BBC English, 'Where is the Post Office?'

*[I also answered the routine questions: 'How old are you? How much do you earn?' After class I was surrounded by a horde of teenage girls asking questions and gave many autographs! I was relieved to find 'normal' teenage behaviour after the boring straightjacket of the classroom].*

The school was a bit of a disappointment. I could see no method of making contact with individual students unless I could build a relationship with the teachers or parents. Life is notoriously disorganised in China, I realised that this was a more difficult task than I had first imagined.

The biggest problem was translation of my survey questions and my comprehension of the answers. I found that, even with the help of Professor Sun, the two of us would take about three hours to translate the equivalent of one page of a paperback book. This meant that any interviewing was a mammoth task and, while asking the questions was becoming an easier task, understanding the answers beyond my own Chinese comprehension.

I had a meeting with some teachers from Ning Hai Road School. First we had a talk from the Principal, which was a politically correct speech about how good his school was. I grasped

that, in fact, it was not a first-grade school (a highly funded key school) but one in the second-category (classified as a school which uses electronic equipment) which was rather a disappointment to him. I managed to have a talk to the science teacher who could actually speak some English but could get no glimmer of interest from him when I mentioned my research. I realised that I did not have the right status really because I had come to China as a student of Chinese rather than as a researcher. I saw that I would not have a real opportunity to carry out my research in the way I intended.

I had hoped too that I might be able to get hold of some research in the same field, constructivist science education, which had originated in China and in the Chinese language. Although I had spent some long hours in the University library (*which really does have one of the best education collections in China, don't tell me again, I believe you, I believe you!*) I did not find any evidence to suggest that this is the case (*and I read so slowly so you have to believe that my research is thorough if nothing else.*)

I resolved I would return [*the next year!*], most likely as a teacher, and then take the opportunity to build a relationship with some students and interview them. I would completely translate all my interview questions in Australia before the visit (rather than in China, which had seemed so obvious). I would also develop some method of writing the responses to the questions rather than relying solely on tapes because Chinese dialects are hard for the foreigner to interpret. During the interval I would continue to improve my Chinese so as to make the process that much more easy.

*[So many Chinese have told me funny stories about speaking Putonghua, the common language of China, which we tend to call Mandarin. The problem with it is that nobody in the south of China really speaks it and so it is really a 'common second language' to be used with foreigners, and to a certain extent within the academic world. Every small town has its own dialect and so the 'common' language is generally the local dialect. A native of Shanghai has as much of a problem with the correct pronunciation of Putonghua as the native of Sydney!]*

*The Chinese resort to the method of writing things down if they feel they cannot communicate. Written Chinese is essentially the same, whatever dialect is used to speak it.]*

#### INSIDE THE SCIENCE CLASSROOM

Fortunately for me, Professor Sun's wife was able to provide an introduction to a science teacher, since she was a middle school maths teacher. Surprisingly, or perhaps not so surprisingly really, middle school science (this is equivalent to High School for the West) is not generally taught in a laboratory but in a normal classroom. I began to realise too why I had not



been able to find a wide range of literature on constructivism in school science education. This is because, generally speaking, the science class, be it physics, chemistry or biology, was identical to the geography class which I had already observed. A series of facts, of equations or theories or principles were learned and applied. The teacher tested the students on the previous lesson's work and then the teacher read a portion of the textbook to the class. The class of students then read the passage in unison and finally random students answered questions on the small portion of text.

(I have checked my facts by laboriously reading many textbooks, in several cities, across the science disciplines, and confirmed this with Chinese graduate students and professors in Australian but, looking back as I write the story, I learned that day in Nanjing that science is just a different set of facts)

The science teacher told me that science is always theoretical, never practical. Just occasionally, a teacher may provide a brief demonstration of a scientific experiment (the example used was that of developing photos, a popular hobby in China) but not until university will the brightest students get some hands-on science experience. I tried to ask questions but my science vocabulary is limited. There is a vague and general reference to issues such as pollution and the environment in the Senior Chemistry curriculum, for example, but the links between scientific principles and their application in society are not explicitly made in the curriculum. The teacher did not see this as some glaring omission but, without Western experience or expectations, did not understand my obsession with pollution and laboratories.

#### FINDING A SUBJECT FOR MY RESEARCH

*This is the story of the development of a friendship with one of my teachers, Qin, and his perspective on culture, nature, science and science education. I trialed Cobern's (1995b) methodology on Qin and the results are embedded here.*

#### QIN

I spent a lot of evenings talking to Qin. I think it started when I finally began to understand his accent, and discovered he had a Masters degree in Western philosophy, and he had a well-developed philosophy of science and education. He was surprised that I had an interest in philosophy and was trying to read Confucius in Chinese. He had an amazing theoretical knowledge of the West, and had read widely in English literature, and even as far back as the early Catholic writers such as Thomas Aquinas. We had very strained conversations because he would not use any English and I bought a dictionary of philosophy to help us. Memorable evenings include going with him and others to the Confucius temple, eating very strange food in

the market and then coming back and trying to compare the moral values of Confucius with those of Jesus. He read Confucius slowly to me in Chinese and tried to explain the 12 Virtues. I read the Bible to myself and tried to translate what was there into simple Chinese for him. Our conversation continually drifted back to our relative cultures; he really wanted to know why Australians behave as they do [*naive, loud and drunk was the inference*], why did they not keep rules, why did the non-Chinese Australians not study hard? I had to keep reminding him that, really, I am not an Australian, and talked to him about the values I had gained from my parents, what I had taught my children, how I related to my husband. We conjectured together about the 'big, lucky country'.



Figure 10: Confucius Temple in Nanjing

*[It seems that all Chinese people know that Australia is a lucky country, a place of good fortune. But the concept of luck and fortune evoke a deeper response from the native Chinese than from their 'mates in the bush'. Deeply embedded in Chinese rites, traditions and superstitions is the desire for good fortune, luck, or at least the absence of trouble. So 'the lucky country' conjures up images of Nirvana for the untravelled and unsuspecting Chinese.]*

We talked about stereotypes and his images of the West were those of not-so-modern Hollywood. The image of the heavily made-up, smoking, drinking Western woman [*she must be a prostitute!*] was firmly in his mind. I gained approval for my lack of make-up. I don't smoke or drink but my appearance, which I saw as a scruffy attempt to simultaneously maintain dignity and blend in, gained me some kudos.

*[I realised I would need to make attempts to fit in on the first day I wore coloured leggings in the streets of Nanjing. They were not even bright, just striped. A helpful Chinese person, I can't remember whom, told me that bright colours and patterns, the vivid greens and reds of the market clothing stall and Friendship store, were only appropriate for unmarried women in the teens and early twenties. Women over forty like me, ('You can't be, you are very healthy'), may only wear plain and subdued clothing. Marriage seems to be a far more significant*

*time of transition than I had realised. The place of the female is very confusing. In the university or school, there is obvious equality and great respect is shown. Respect seems to be given for sensitivity, for intelligence, for a desire to learn and I am introduced to other female academics who are afforded great deference. In the market and the factory women do the same work as men but it does not seem that they are really valued in the same way. Why do I meet so many male academics who tell me their wife is a bookkeeper (how many bookkeepers does this country need?). There are still things the women do not do. They do not seem to go out at night with their husbands - the playing (this is the word they use when guys go out together to drink and play funny games that I cannot understand) is definitely for the boys, but my presence is acceptable. It is quite innocuous play. Just fun, and no apparent reason why wives are not present. At banquets (so many banquets!) the high-ranking women do not talk much either. I have to wonder if they are 'puppets' in their high power jobs in the department of education or is there great power being wielded, so silently, 'behind the throne'.]*

Qin gave me answers to questions I had asked other Chinese people in the past. I wondered how he thought a Western woman should behave. I asked if he was offended if I behaved as I would at home. He thought about it and decided that the expectation was that Westerners should behave in a slightly outspoken way in China and there would be some disappointment if we did not do so [*would we bore them?*]. However it was left unsaid that this Western behaviour should fit strictly into a good understanding of Chinese society if there was to be real cooperation.

The Chinese Business Language textbooks, printed in Beijing, were full of examples of 'good practice' in Chinese eyes. Three days of superficial speeches of welcome, applause, exchange of gifts, more applause, sightseeing, statistics, eating and drinking. On the final evening, brief and painless negotiation, (*How much for two million pieces? I accept. Who will pay the dispatch fees? I will write a Bill of Exchange*). This itself was a naive view of life. It appears the purpose, within the culture, is to remove all sense of conflict, the removal of feelings of disempowerment or advantage. This is achieved by something that can only be said in Chinese, **guanxi**. This means relationships but something more, much more. It means the obligation of friendship, a debt that can never be repaid, passed on to your heirs and theirs'. When we have **guanxi**, we can trade, share secrets. This is why we need mutual friends, we even pay people to be our mutual friends, my **guanxi** and yours, then we can go through the ceremony of the 'arranged marriage', whatever the context.]

We talked about education and he thoroughly approved of the rigid conservativeness of his own system. He continuously recited lists of facts and dates, Chinese dynasties and other notable memorabilia. I vainly tried to remember the facts of high school [*hydrogen, helium, lithium, carbon.. , 1066 William the Conqueror*] but did not even try to display what I knew.

We discussed the theme of my research. He got very passionate about something I could not totally understand. He kept telling me that something important happened in 1912, something to do with what I was studying and this, he considered, had a very bad effect on Chinese society. *[I ran my mind through events of the time, sinking of the Titanic, Russian revolution, World War I, but it was none of these.]* Eventually, with the help of a third party, I was able to understand that in 1912 China sent its first scholars overseas to study Western science. In Qin's opinion, this led to the undermining of cultural values, the development of a social and political agenda which mimicked that of the West and a loss of all that had been good in Chinese society. His perspective was that the values of Confucius (12 virtues) with an emphasis on honour and filial piety, were lost in this experiment and talked about the 'spiritual pollution' which had taken place in traditional Chinese life. We discussed this issue at length because I feel that one can easily assert that the West has lost traditional Christian moral values since Victorian and Edwardian times, and yet we would not naturally blame this on Western science education. I don't think we resolved this issue, but we surprised ourselves when we compared the teaching of Jesus and Confucius, and found enormous commonalities in our personal and cultural, moral and ethical values.

We started talking about Chinese traditional religion, Buddhism and Taoism, and something of the nature of worship which I had seen in Hong Kong. This included family altars, gods and goddesses of the hearth and home, giving food for spirits and demons to eat in order to protect the family life, grave cleaning and the ritual offering of pigs. At first Qin found this a difficult subject to discuss so I told him that I believed in the existence of spirits. He said,

'My mother believes in demons ..... She gets very frightened and she has to do many things to keep them away'. He looked at my face and did not see disapproval or ridicule. So he continued:

'My wife believes in demons and she has to be very careful of our son. I don't believe in demons but.. I did have a very bad illness once.'

*[I had to really encourage him to continue. It was really important to me to find out if Mao's communism had really removed all forms of superstition and worship as claimed. Had he become an idol himself? The almost-demised Deng Xiao Ping's regime had allowed an openness in the area of faith, and I had seen newly opened Buddhist temples, Catholic churches (no affiliation with Rome) and practising Moslems]*

He told me that when he was sick, he had nearly died and then a spirit of death had come from hell to get him *['You call him Satan,' he said]*. It seemed obvious that this had been a terrible

experience and it seemed that his mother had to use some kind of traditional ritual to make it go away.

I asked Qin if I could use him to trial my research methodology. He was happy to do this and his survey results are included here. I do not really know how well I explained what I was doing but I think he understood because we had spent so much time talking together.

I felt he was displaying what I had imagined would be a typical Chinese world view. I could see responses to nature that he would have been taught in his science lessons at school. I could also identify a perspective that allowed for the views on the mysterious and spiritual nature of the world to be held in tension with the scientific views of the concrete and the material. I was surprised too in his description of the world as frightening and with concepts of chaos. As I reflected on his stories of his life, the turmoil of childhood in the Cultural Revolution, and now separated by legal bureaucracy from his wife and child for more than two years, I wondered quite how he defined nature and how it was separate from life itself to him. I felt like he had given me something of his perspective on life, in the guise of his concepts of the natural world.

QIN'S THOUGHTS ON NATURE

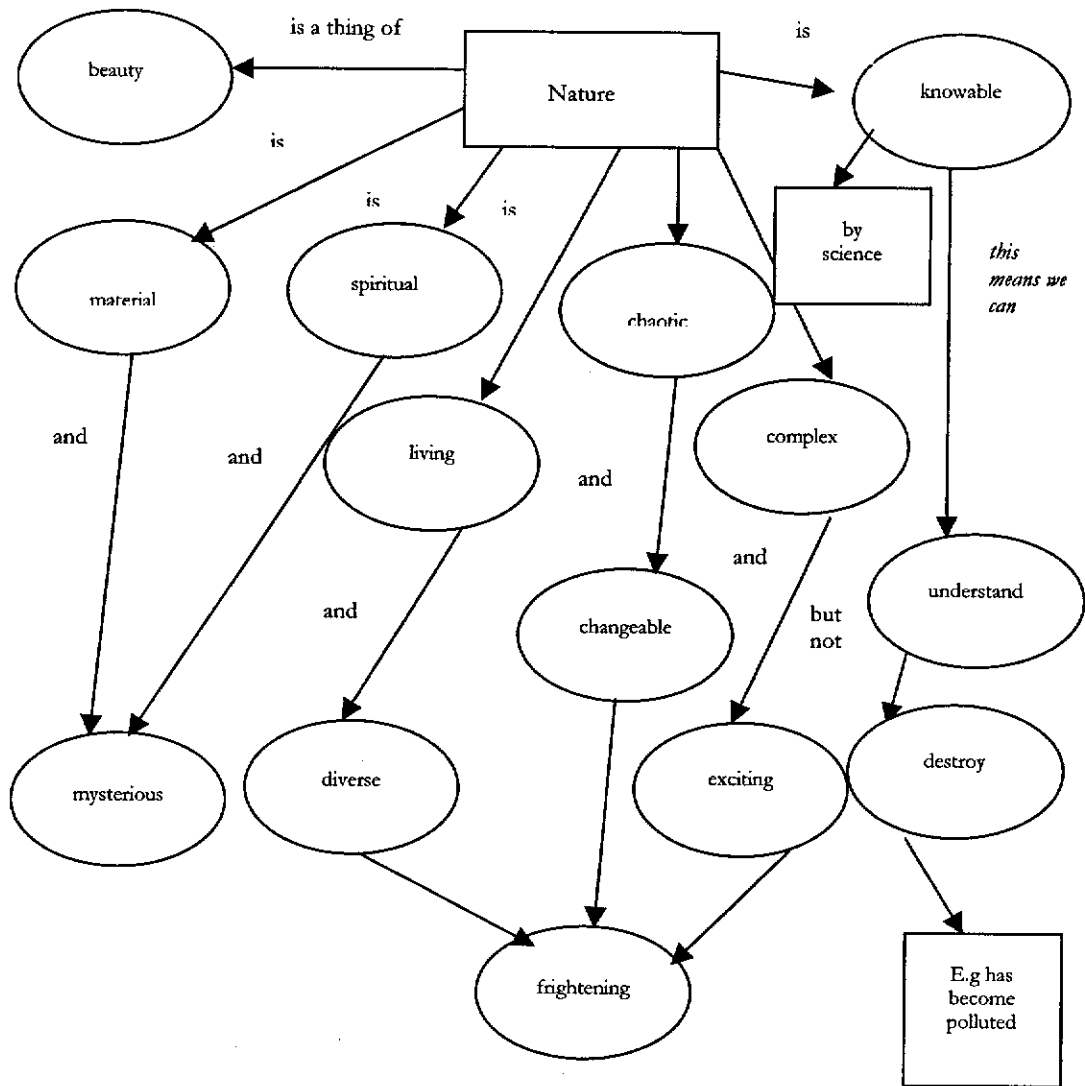


Figure 11 Qin's Concept map and narrative

I believe that Nature is beautiful. It is living and diverse and is sometimes chaotic and very changeable. This means it is complex and exciting. It can even be frightening at times.

I believe Nature is the material world around me and it is a material world. Some people believe in a spiritual world. My mother and my grandmother believe in spirits that make them sick. This means that Nature is mysterious. I believe Nature is knowable through science and it is understandable, but this has caused Nature to become polluted too.

### Assertion

Qin's concept map and narrative (Figure 1) indicate that he discusses the world with two perspectives. These are a scientific one and a spiritual one that he separates from each other in his thinking. He is, in fact, unwilling to own the 'non-scientific' perspective, since it is traditional and, in his narrative, female. Further discussion of this assertion is carried out in Chapter 9.

## TRAVELLING IN CHINA

The final four stories in this chapter provide more of the cultural and historic framework of Mainland China, and the place of history in modern life. In visits to the countryside and Beijing, and some observations on public security and religion I highlight aspects of society and culture which are very different to those in the West, and influential on the lives of those teaching and learning school science.

### THE COUNTRYSIDE

Every University and College has a bus, or collection of buses. The main feature of the buses seems to be that they must be remnants of the Long March (*remember Mao Ze Dong and 1949, etc.*) They must be almost roadworthy, so that there is some hope of reaching the destination but held together with rope, wire or masking tape, with racks all round to hold bicycles, animals or other oversize luggage. The seats will be garishly covered with inappropriate cotton covers but still tainted by the well-squashed remnants of picnics, insects and other nameless dirt.

It is also very important that all foreign visitors, students or teachers, are regularly loaded into the bus to be taken sightseeing. We visited several important-but-maybe-not-too-noteworthy places. This was important to my research because I wanted to see Chinese 'life and culture'.

The countryside was a disappointment; the best word to describe it seems 'decay'. Someone seemed to be taking the villages to pieces, with piles of bricks all over the place, very few people to be seen (*I know there is a great movement of country people to the cities but surely they have not all left!*).

Here and there, as if playing with a giant Lego set, there were enormous examples of modern construction. The most notable one was a huge flyover, a motorway bridge, straddling a relatively quiet country road. However there was no new highway anywhere in sight so the

bridge sat there in 'splendid isolation'. It seemed that this might be an important metaphor for the time. China is building bridges but, at present, we are not quite sure what is being joined. East and West? Past and Present? Communism and Capitalism? All of these seemed appropriate since the news was full of conjecture about what might happen on the death of Deng Xiao Ping. We heard he was being kept alive on a ventilator in his own home, hopefully until June 30<sup>th</sup> 1997, when he might fly peacefully into Hong Kong and claim it back for China. Talk involved the effect of Shanghai power on the stability of government in Beijing and the importance of real economic reform.

We visited several temples and I was surprised at the resurgence of real Buddhist worship. It seemed that Buddhism and Taoism were now really openly allowed and that the monks were paid by the government. This was seen as reinstating the link with history. To me the confusing aspect was the devotion shown in worship, by younger people as well as old. I felt that this should not happen so easily, it all seemed too natural as I watched the worship. Mao Ze Dong was meant to have removed all 'superstition', how is it that it has reappeared so easily?

We visited several parks and other monuments, usually tombs or temples. The important linking factor was the continued celebration of history - dead poets, writers, musicians, politicians were all remembered on a grand scale. Sometimes it seemed to me that the event being remembered was not large or significant enough to demand such a memorial! The size of the temples has to be seen to be believed. Hundreds and thousands of steep steps up mountains to visit temples, pagoda-shaped buildings and Buddhas, many with their once smiling faces deformed, or even erased, during the Cultural Revolution.

In a small village somewhere we came across a frozen moment in time. Although most monuments to Mao have been removed, a village leader somewhere had faithfully saved the posters and pictures of heroes of the time, and they were displayed all along the street, as if spitting in the face of modern reform. Conversation with passers-by seemed to indicate there was a common love of 'all things Mao' in the place.

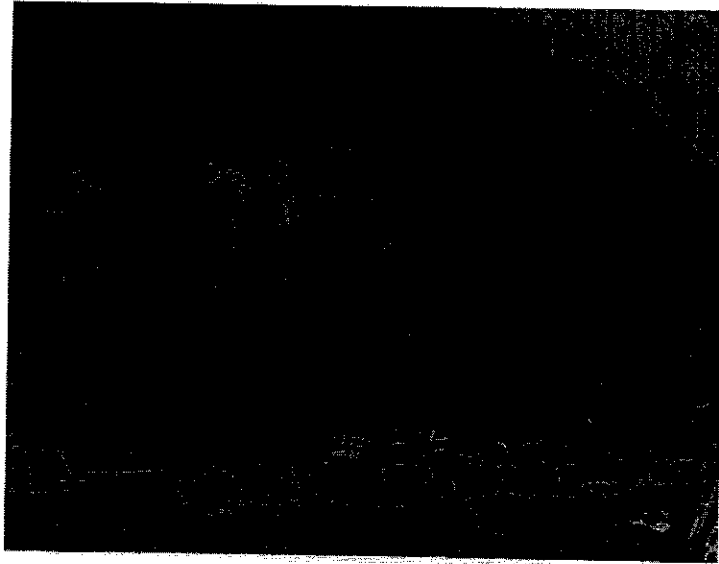




Figure 12: Market trader in the village

This village will also go down in my personal history as the 'place of rats'. In a quick walk through the village market I found many stalls which appeared to be selling dead rats. I could not believe that they would really eat rats. This did not make much sense until someone explained that they were selling rat poison! How many of us would collect dead rats, and carefully display them in orderly rows, to demonstrate the efficiency of our patent poison!

Once we had lunch in a village with a large lake. The comment that sticks in my mind was from a very old man who sat nearby watching us. He was impressed that I was a teacher and wanted to know where I came from. I told him I had come a long way (*the curious phrase in Chinese seems to translate as 'over many seas and mountains', so patronising!*) He was very excited that I had come via Hong Kong. He told me that he was looking forward to the day, coming so soon, when his government was going to 'liberate' the people of Hong Kong. My feelings were so mixed as I heard his interpretation of a soon-coming reality and thoughts of the Tiananmen incident and the ensuing fear which seem to trap many of my friends, quickly passed through my mind.



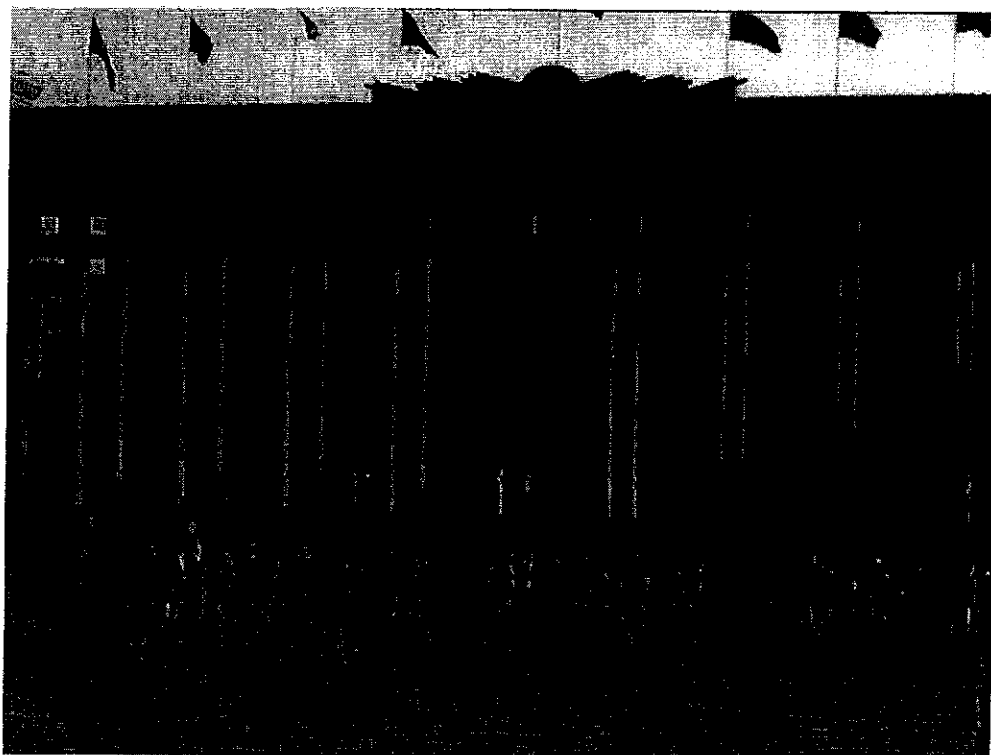
*Figure 13: Old women in the market*

## BEIJING

At Spring Festival I took the opportunity of spending three days in Beijing. It was good to travel north and to spend even a few days in the relative luxury of a centrally heated Westernised hotel.

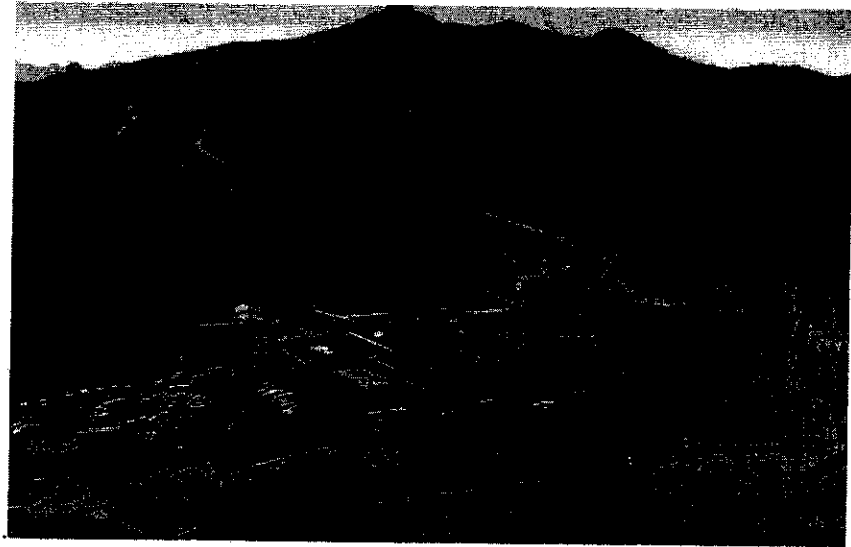
The best aspect of Beijing for me was language rather than culture. Finally I realised that the Chinese I have learned is basically Beijing dialect and so was able to make myself understood, even to make jokes. I had been feeling quite inadequate in the markets of Nanjing where no one could consistently understand my Putonghua.

Beijing had never seemed so big on television, or even in my textbook. It was interesting to wander the streets and see Mao's mausoleum and other places that had played such an important part in modern history. Tiananmen Square (*remembering what I can only call the poignancy of all the tears that terrible day in 1989 - 'they are killing our brothers' was the cry in Hong Kong*) is such an important place and was heavily guarded. Someone was demonstrating against something and was hastily removed (*This is the 'Entrance to Heavenly Peace Square' and its peace must never again be disturbed!*)



*Figure 14: Tiananmen Square showing countdown to 'liberation' of Hong Kong*

I visited the Great Wall, Summer Palace, Beihai Park, and Forbidden City in the company of three Australian Chinese students. It was interesting to be eyeball to eyeball with the history of China and gain a sharper perspective on the enormity of the Emperor's power. Something that has stayed in my mind is that China was still entrenched in the feudalism of a warring Emperor and his powerful mother, arguing over what colour to paint the palace, while Europe was having an Industrial Revolution. While I am sure that Queen Victoria had a temper too, I am convinced that this feudalism must have stunted the development of science and technology in the country.



*Figure 15: View from the Great Wall*

The Great Wall was just as all the films portray it and, when I visited the -10 degree temperature and gusty wind made it impossible for me to climb to the highest tower. I bought the T-shirt but felt I needed something like 'I did not quite manage to climb the Great Wall' on mine. Photos of the day show me padded like the old and proverbial 'Michelin man'. It is not really an attractive place - just another link to a feudal past.



*Figure 16: 'Michelin Man' at the Great Wall*

## PUBLIC SECURITY

'Public security' is a phrase that does not seem to have a good meaning in English but in China, and in the Chinese language, it is very important. With quick glance around a crowded street or University campus, one's attention is always drawn to the large numbers of uniformed people who, in some subtle or not so subtle way, are 'keeping the peace'. The uniforms are generally a shade of green somewhere between khaki and bottle green, liberally decorated with coloured badges, red armbands and hat bands.

Many seems to be security guards whose purpose is to make sure people get off their bikes as they pass through the gates of colleges and factories. Others are 'real' policemen and women who direct the traffic and watch the population in a lethargic fashion. Older men sit on tiny chairs by the side of the road, holding little red flags that they wave at errant cyclists. These are retired 'model workers', given a government job of what seems to be medium-high status, to see them through retirement.

Hotels, offices, banks and large shops, as well as schools, colleges and universities all have guards but it is difficult to see what is being guarded, and from whom, in many situations. However the public is very sure it is secure!

Cadres are a different form of public security. They are members of the Communist Party who hold junior and, in some cases, more senior positions of power in society. In their trademark black leather jackets, and with their mobile phone and beeper (*this is called a 'da-ge-da', a big brother! in Chinese*) they are evident within the University and frequent the large hotel in the City. A fair amount of fear is engendered by them and authority flows from them as they sweep around the campus. They control the computer and the photocopier. They authorise financial transactions and accompany us on bus trips.

There are so many rumours about their role within the Overseas Students' Hostel. Some claim that our phones are tapped, our rooms are bugged and our luggage is searched but I have no evidence for this. Once a man walked into my room unannounced but he looked more like a visiting public servant of some sort rather than a spy. I do know that I was strongly advised not to allow a man who I had met on a train to come and visit me, but could not work out if this was a moral or security problem!

## RELIGION

Once I actually went to church! This was exciting because I had heard so many stories of the underground church that was often banned or raided by the Government, but I think it was also a lesson in understanding the culture.

A foreign teacher told me that I could go to church and I would have to meet her secretly early in the morning. We met and went to a college where about twenty people met in a small fifth floor classroom. The congregation consisted of local Chinese students, African and European students and a Korean and a Spanish teacher. We sang songs in English and an African student preached in French, which was interpreted, by another African student, into Chinese. I felt this was a very special and a moving experience but the feature that I thought was most incongruous was the fact that, although we were meant to be meeting secretly, we sang really loudly. Afterwards we had lunch together and the college catered this for us. So it was hardly a low-key affair.

It was explained to me that as an unregistered group we did not really exist so we were not breaking the law. I was told that the Government knows that Christians meet in this way and that they know that we know that they know! There is no conflict while the meeting does not in anyway oppose the Government agenda. In fact I visited a 'proper' church with a western style building in Nanjing too. Notices announced times of Sunday services, women's afternoon meetings and prayer meeting so this was obviously allowed by the State.

I decided however that the whole issue of religion and the State would be one that I would investigate again. I particularly wanted to understand the role of Confucius in Chinese society, ancient and modern and why a philosopher (*just a man!*) was (*almost*) worshipped in his temple. I also wanted to understand whether Mainland Chinese clung, even secretly, to the traditional forms of Taoism and ancestor worship, as practised in Hong Kong. Trips to the country seemed to suggest this, with pictures of the gods, and goodluck messages pasted around the doorframes of the village houses. I suspected this was what was being called 'superstitious'.

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## CHAPTER EIGHT

### CHINA 2

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#### OVERVIEW OF THE CHAPTER

In this chapter, I offer interpretive tales of my experiences in China during 1998. The purpose of these tales is to provide a *bricolage* of the setting in which my Chinese studies were carried out, and to provide perspectives on Chinese culture and their effect on students' understanding of science in general, and the natural world in particular.

This chapter is the story of my visit as a teacher/researcher to Shandong Province in early 1998. It adds to the perspective I gained as a student in 1995. During this time I interviewed seven students using Cobern's methodology (Cobern 1995b) and it includes the data gained from these interviews and assertions and other knowledge claims based on this data.

#### CHINA, EASTER 1998

*The first 9 stories describe particular aspects of Chinese life which I observed or experienced during my second visit to China. My intention here is to draw attention to my preparations for my research and, in each story, I have spent time reflecting on the Chinese culture. My underlying concern was to check up on my own understanding of the Chinese culture. I felt it would be very arrogant to act as an expert and offer an opinion on the relationship between modern Chinese culture and students' conceptualisations of nature, or even act as an interpretive researcher, if I had not truly understood some of the complex changes which had happened in Chinese society during the intervening three years. I have documented some of these changes in my reflections adding to the understanding of Chinese culture that I gained in 1995.*

#### REVISITING THE CULTURE

##### *Preparation*

After a two-year digression, I am preparing to return to China. This time not the ignominy of the foreign student but the high-status of the Foreign Expert. Miraculously my research career is taking off and I have been able to get some work published in the field of Internet and Education. Through a friend in Hong Kong, I have made contact with a University in Shandong Province, in the state capital Jinan, who want me to come and give some lectures. I

am also going to do some sort of research with them, into using the Internet but I cannot quite get them to be specific about what this research will entail.

I am thoroughly prepared for my teaching because this is the bread-and-butter of my current work, but am doubting my capacity to carry out my desired research in Science Education in Chinese. I always ask myself the question 'is my Chinese good enough?' and I am not sure that I know the answer. Back home, I have been having some regular conversation with a Chinese graduate student who has been a 'critical friend' as we have carefully translated the interview questions into Chinese.

Major question has been how do we ask Chinese students if they think the natural world is 'holy', 'mysterious', or 'spiritual'. My friend Rui assures me that Chinese people cannot possibly think like this about the natural world. I tell her that I want *them* to tell me this, if this is true. We debate how to say things like 'spiritual'. We both understand what the dictionary says but, for example, 'spiritual' really only has bad connotations to traditional Chinese people and a word like 'exploited' has good ones. Finally we agree on the list and we translate them into characters and pinyin (romanisation) to make sure I will pronounce them properly.

Rui and I have become friends. She has given me a new name, a Chinese name, Ling, it means 'exquisite lace' and it is a very 'good' name for a female. I feel highly honoured. Her Chinese name means the centre of a flower, the pistil or stamen, and the Chinese character is a picture of three hearts, something like 'heart of hearts', and instinctively I know this too is a very good name. She insists on having an Australian name and we choose Rae, or even Raelene, which to me conjures up pictures of the Australian bush. I do not like this name but she is very happy with it.

Rui says my Chinese is OK. She says that she can understand me and she makes me laugh. She says 'the tones are not always right but I can understand you, you sound like a little bird singing.' She explains once more that Chinese people also have the same problems with the tones of standard Chinese and that I would not be alone in the occasional mispronunciation. I am not really satisfied!

### *Arrival*

China at its worst! I have been stuck in Shanghai Airport for 30 hours. A Thai Airline's 747 crash landed on the only runway and skidded off the end into the mud. No one was hurt but they cannot move the plane. The airport was full last night with passengers continuing to

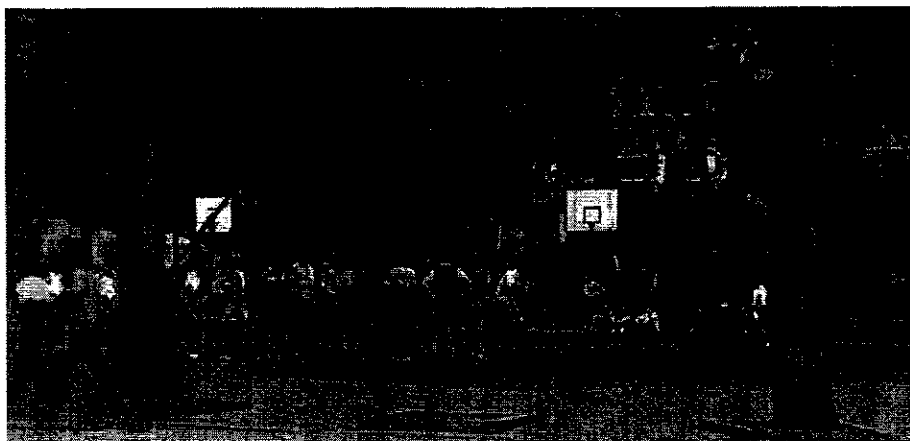


check-in for flights that were not going to leave that day. At 11.30 p.m., a small riot and with much shouting and some fighting in the over-crowded waiting room, everyone is sent, at their own expense, to hotels. At 1 a.m. I arrived at the Holiday Inn and spent a few hours asleep. Now it is 4 p.m. and I am *still* waiting and I am determined to use this language. I fight my way to a desk and tell them my situation and, miracle of miracles, they understand. The crowds around me are still dense and the pushing is quite violent. I manage to understand that my luggage has disappeared (*gone on ahead it seems on the non-existent plane!*) and change my ticket for the evening flight to Jinan.

This time I get stopped as I check-in and show some frustration as they claim that I have a dangerous weapon in my luggage. It turns out that this time they don't like my scissors. I assure them, in Chinese, that these are just 'teacher's things' and that I am not a bad person and they let me go through. (*This gives me a chance to check up on Confucius because he instructed people to show respect to teachers - it seems to be true because they smiled with me and did not laugh at me*) Finally at 11 p.m., we arrive in Jinan and, as I expected with long-anticipated embarrassment, I am met by half of the Engineering Department with flowers and welcome banners. They have met every flight into the airport that day from Shanghai!

### *A Day in the Life*

The 'morning call' in the Shandong Institute of Architecture and Engineering is the dull thud of the basketball at about 4.50 a.m. as the first students take to the basketball courts. This is followed closely by the sound of older people getting up, coughing and spitting in traditional, nauseating style. So I am really 'home' in China!



*Figure 17: Morning activity at the Shandong Institute of Architecture*

At 6.00 a.m. the day starts in earnest with the sound of martial music blaring from the loud speaker and, at about 6.30 a.m., students march onto the sport's oval for the Government regulation morning sports. As I listen, I remember that this is how I learned to count correctly. 'Yi, er, san, si, wu, liu, qi, ba'. The numbers from one to eight are repeated over and over again.

*(Of course, this does not happen on Tuesday. On Tuesday, we get the full works with marching band, speeches and flags as well as many announcements and applause. I seem to remember this from **Chinese Practical Reader Book 2**).*

I also know that if I were to turn on the television I would get the televised version of morning sports, first with school children and then, following, their yuppie older brothers and sisters doing aerobics to the same rhythm. To complete the picture we would need to take a quick peep around the corner of the basketball courts, which would give us a glimpse of the older generation doing the graceful body movements of tai ji.

After the morning parade the loud speakers plays music, traditional and old-modern Western, Bridge over Troubled Waters, By the Rivers of Babylon (*is there a secret message here?*) until classes start at about 8 a.m. There is continual basketball practice outside the window during this time. Morning routine includes boil water for drinking, heat water to wash, try to remove some dirt from the kitchen.

*(I have a small apartment in the Overseas Teachers Hostel. This is some sort of cultural play on words that I have stopped trying to understand. I live in a 5-storey hostel. It is always full but I have been told that I am the only foreign person in the College. When I ask who else lives in the building I am told 'no-one' but I talk to many 'no-ones' each day. I think I am the only person here officially!)*

The building has a large staff but I realise that no one is meant to be looking after my place. I work out that there are about six girls who clean the stairs and windows and provide hot water to the people who live unofficially in all the other rooms. There is a lady at the bottom of the stairs who gives out tickets.

*(My best guess is that these are tickets to use the bathrooms in the building. Some days there are long queues to use the public bathrooms - it seems too that Wednesday is hair-washing day. I seem to remember that when they build student accommodation in China it is very basic with six to a room with no washing facilities. In Nanjing there was not even one shower for 2000 residential students - seems like the statistics are only a little better here.)*

There are also two older men and a little boy at the bottom of the stairs and a lady behind a desk. The old man fixes my bike and the little boy will play football with me. Apart from that, China seems as over-staffed and under-employed as ever.

I am only expected to teach four one-hour classes a week. Actually this is the normal workload and when the teachers do not have a class, they do not hang around. It seems to be a very easy life.

*(During the time I spent a lot of time doing my own reading and catching up on research. I gave four lectures on 'The development of the Internet', one on the 'Implications of the Internet for University Administration' for the whole College senior management, two on 'Advanced Use of Search Engines', one on 'Modern Teaching Methods'. I also spent a lot of time installing and teaching software (improving my reading in Chinese in the process) and making bilingual WWW pages).*

Classes are held between about 8.00 a.m. and 12.00 midday with the statutory break for a 'rest'. Lunch begins at about 11.30 a.m. and I decide that my days will be less complicated if I eat one meal in the Teacher's Canteen. I also decide to protect my stomach from the stranger dishes and live mainly on egg and vegetables with rice.

*(With my genuinely improved Chinese, I am beginning to achieve what I might call a real form of literacy. They really do eat dog meat! I read the menu in the local restaurant, '5 kinds of dog meat' and then I only just avoided eating camels' feet because a kind professor felt sorry for me. And a walk through the market makes me aware that the guy selling little furry kittens and rabbits is saying 'Very tasty, really good to eat!')*

*And then the sounds that are emitted from the small motorised-tricycle delivery vans that stop outside the kitchen door! The meat is still alive and making little squeaking noises! Is it a bird? A cat? I do not really want to know! That's why I live on eggs and vegetables. What could they do to an egg?)*

Students finish class at 12 midday for lunch. The basketball courts are occupied all morning with students in their sports classes playing the game. Afternoon classes start at 2.30 and seem to extend until about 5.30. The loudspeaker starts playing '60s' western music at 4.00 and this continues until 8.00. Basketball continues until dusk with the occasional official game replacing the unofficial ones. These draw large crowds and there is much applause, even pseudo-American cheerleaders.

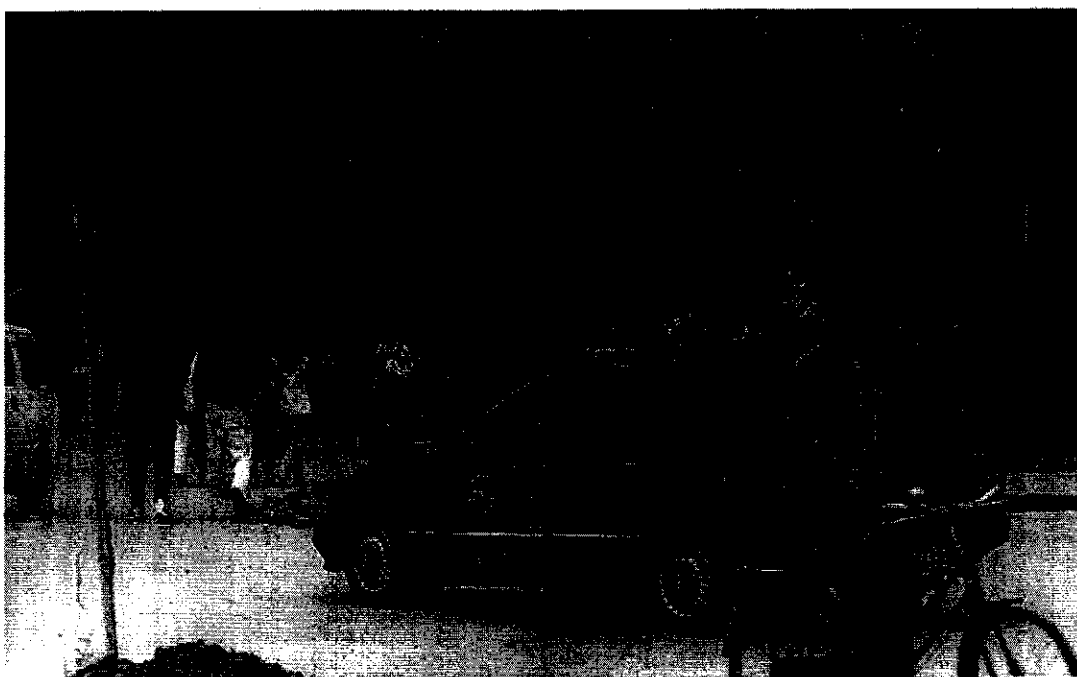
I have been given all the modern conveniences one could desire in China: TV, radio, a daily copy of the only national English language newspaper, an air-conditioner and bike. The bike is my pride and joy because it provides an independence that I could not achieve in any other way.

It is purple in colour and has a basket and a bell. I use the bike to travel around the neighbourhood and find that outside bigger shops you can safely leave your bike in the Bike Park with an old man or woman and be charged one Australian cent for the privilege.



*Figure 18: View from my bike*

I go shopping every day in the market and find myself regular suppliers of the bananas, strawberries, apples, bread and yoghurt that are my staple diet. Soon the vendors are calling me (in Chinese) 'Australia' and 'Old friend'. This moves me because the local people are genuinely friendly in a way that I have never seen in Hong Kong or Nanjing. Everyone has an Australian story to tell me, an uncle, father or cousin who went there on business and saw a large clean country. Or else, we relive the occasion when Sydney was selected to hold the 2000 Olympic Games rather than Beijing. Moreover, sometimes, we replay the old lines 'How old are you? Are you an English teacher? There is even 'How much do you weigh?'. Locals are also protective and make sure I cross the road safely. Once I drew a crowd when a market vendor was trying to overcharge me. A group of students bargained for me and then, unable to complete the deal on my behalf, convinced me to shop elsewhere, escorting me down the road to a better place. Primary school children practice their one or two lines of English and I reply in my best BBC English accent. (*Good afternoon. How do you do? My English name is Gloria*)



*Figure 19: Street scene in Jinan*

In my room, I try to watch TV. I begin to understand more but TV only offers the choice of Chinese soap operas, both modern and historic, where occasionally the whole cast bursts out with traditional high-pitched Chinese opera. There is also other culturally appropriate material. We have the Farmers' Channel where I learn how to fatten my ducks and increase the yield of grain. There is the Business Channel where I am encouraged to buy, buy, buy (*more of this later!*) and Children's TV where children compete in tedious quizzes, watch cartoons with a good moral ending, and learn English or computers.

The day ends at 9.00 p.m. for the students with the sound of something like the Last Post being played over the loudspeaker and, most nights, I go to bed too. China makes me tired because I get sick in China (*I think we all, Western and Chinese, get sick in China*). In five weeks, I manage to have the flu badly and also get food poisoning.

*[This time things have changed at the Doctor's Clinic. As a visiting expert, I am taken to see the head doctors because I have flu (symptoms here seem to include sweating which reminds you of malaria, bad cough and complete physical weakness). The doctors, one male, one female, are sitting in their office accompanied by three middle-aged men who seem to be chatting. The men reluctantly leave as I enter with the Deputy Head of the Foreign Affairs Department who is looking after me. The doctors just have a quick talk to me in Chinese and we all agree that I am sick because there is too much pollution, too many people, too much infection and they give me a lot of Western medicine.]]*

Noise from the ever-surrounding construction sites continues until late into the night. This is interrupted occasionally by the sounds of revellers returning from the local bars and restaurants.

*Impressions of New China (Or Working Earnestly to Enrich our Customers' Life with our High-Quality Service)*

I had heard a lot about the Changes that have happened in China over the last few years with a move towards a market economy. I had treated this information quite cynically but the news seems to be true.

Old slogans that I had seen on public buildings in 1994 had said something like 'Working earnestly together for the good of the country'. The new slogans were much more user-friendly like the Post Office's which boasted 'Improving internal and international friendship - we give high quality service to our customers'. The supermarket, reflecting the national unemployment situation, announced 'If we are not working hard for our customers today we will be working hard tomorrow looking for a new job'. I found it almost impossible to believe that the situation should have changed so much in four years.

Quality and safety has suddenly become very important. Most companies, both large and small, boast ISO 9000 quality systems. Street food sellers use tongs to handle food and stallholders in the market have to be licensed and to use Western scales. Shop assistants give voluntary help to customers and do not seem to stand around like display mannequins, ever observing but never saying a word. .

All primary school children wear yellow hats to make them very visible to drivers and protect them from the sun. Motorcyclists wear helmets and taxi drivers give receipts. The bus driver has a little notice over her head saying, 'Have a good and safe journey'. There is a recorded message on the bus that tells you to watch your step and be careful when alighting. Even the local airline, China Eastern Airlines give a safety demo before take off and serves coffee, which is favoured over tea, and stewardess speaks to me in good English.

The effects of a market economy are quite noticeable. Chinese people are buying their own apartments and businesses, banks give mortgages and it is possible to have, and use, a credit card. Market traders have wads of money in their pockets and the small denomination paper money is worthless and not being replaced. More than seven modern hotels have been built in Jinan (the centre of nowhere really!) in four years.

The Government's monopoly of telecommunications in China is broken and even civil servants are being made unemployed. This means that everyone has his or her own little business 'on the side' (Don't tell anyone but I own the local XXX franchise, my own restaurant, I'm doing consulting in graphic design, etc.). Everyone has a video CD player, a pager, 20 % have mobile phones.

### *Remnants of Old China*

The education system seems to be one of the facets of life that has not changed. Talking to teachers in higher education seems to indicate that promotion still comes by status and connection. Major talking point is that the new University President (similar to Australian Vice-Chancellor) does not actually have an academic qualification but got the job by virtue of the fact he was the local Communist party secretary. Conversation with him convinces me that this is true. He displays the cold and formal demeanour of the cadre rather than the distinctive wisdom and academic ability of the older intellectual. It is difficult to fathom what he really does with his time! This obviously leads to problems with academic promotion.

Another interesting feature of a relatively small university department is that it can have something like 20 professors, 17 associate professors and 4 lecturers. On any given afternoon my anecdotal evidence would be that the 4 lecturers (known as 'the young teachers') would be present plus one or two of the older staff. The 'young teachers' might already have Ph.Ds but age makes their contribution in teaching or research insignificant in the cultural scheme of things. The whole department has to gather on a Thursday afternoon for two hours of political study and university announcements, but that is the only time they all seem to be around. It seems that any given teacher only has to teach one subject, ever. So if your subject is Rock Structures 2 then you teach that every Semester 2 for four hours a week and the rest of your time is your own. Curriculum redesign is basically unheard of because there is a national curriculum. However the Changes in political thinking (*Deng Xiao Ping Thought seems to be 'whoever can make money is now allowed to provided there is some benefit for the country which we can attribute to our own brand of communism'*) seems to indicate that unemployment will now be accepted and 'owned'. Probably the next step will be to allow this to extend into the education sector from local and national government.

The rhetoric of the Government press indicates that the whole school /university system is being examined and words like quality, educational outcomes, school/work transition are being used as in Western education. There is also a need for massive funding to pay for the

networking of the Chinese universities and other higher education institutions, the development of a modern telecommunication industry and the hardware needed to bring the Internet to 2000 universities and colleges and 500 middle-schools. User pays is now allowed in China!

### *Friendships With Teachers*

I found it more difficult to relate to Chinese teachers as a Foreign Expert than I had done as a student. It seemed that both students and teachers had been prepared for my arrival (*this College had only employed about 4 foreigners in the memory of even the longer-term members of staff*) and had been told not to disturb me and to give me plenty of time on my own. This meant that for some time I found it difficult to find anyone to talk to me in a casual way.



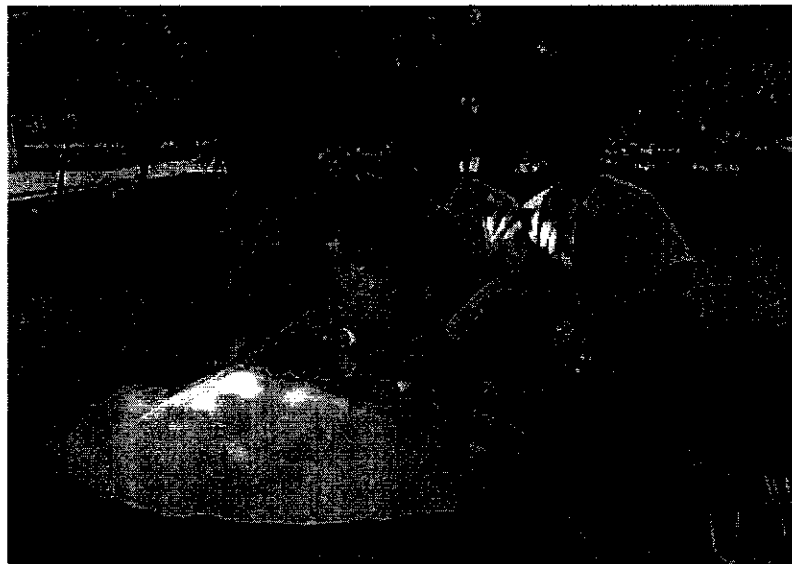
*Figure 20: My favourite interpreter*

I was assigned two interpreters who followed me around quite faithfully (*all the time!*) until I suggested that I really did not want that and I would like to speak Chinese where possible. My interpreters were both young teachers. One of them, Xiao Qin, really drove me to distraction by the use of 'cool' language that she must have learned on the radio - the problem was that it was not quite cool enough. The other, Xiao Zhong, was very sweet and we found we were both very nervous of each other. I was longing to teach her what she wanted to know about computers but was frightened to ask in case I was not allowed. She was so shy that she took two weeks before she began to relax with me. The two girls were the opposite of each other. Xiao Qin was relatively outspoken and modern, longing to have a high standard of English so that she could go and study in America. Xiao Zhong was modest, dressed in very traditional clothes, eyes always facing the floor, laughing demurely behind her hand, especially in male company. I spent a lot of time with Xiao Zhong and in fact most of my collaborative research was done with her rather than her boss, the Professor, who had invited me, and who seemed



intimidated by my Westernness. I was very confused by his absences since he had gone to a lot of trouble and expense to bring me there. I think I learned again that, in China, research does not mean the same thing as it does in Australia. Xiao Zhong and I translated a journal article which Professor had had published in Chinese. It was held up as an example of good research but was actually, in my eyes, a series of figures and some commentary and criticism of Government policy. All good stuff, and perhaps true, but I think I am going to find that the Chinese theoretical basis, the constructivist work which parallels Western research in science education, does not actually exist

My best times were spent with Qin Laoshi, the Deputy Head of the Foreign Affairs Office, who had been assigned to look after me. I was drawn to her because she was the only person who had spent anytime in the West and she could actually understand the cultural nature of any problems I experienced. We were relieved to find that we did not have any cross-cultural communication problems too. We spent hours talking - communism, Chinese history, our families- and she made efforts to take me anywhere I wanted to go. I went to her home, shopping and to her son's wedding.



*Figure 21: The Wedding*

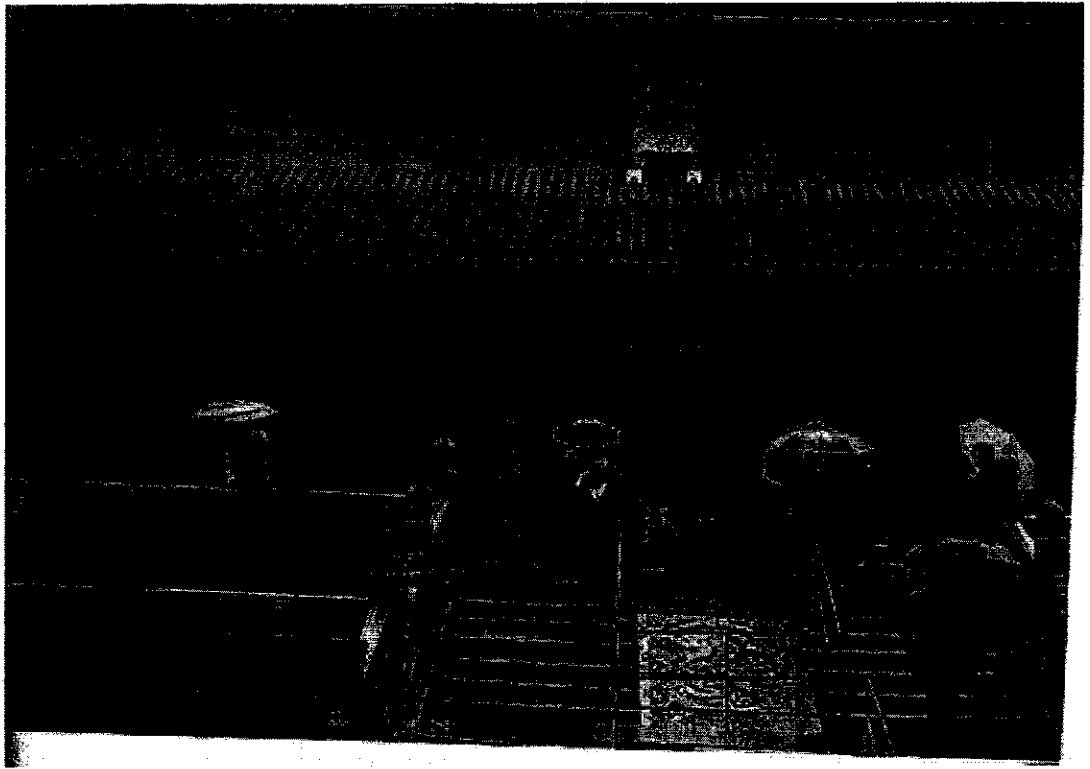
My most memorable experience with Qin was in the office of the Chief of Police. We had to go to the Police Station since, with a Foreign Expert's visa, each foreigner has to have an interview with the Chief of Police to receive a lecture on how to be a good Chinese citizen. When we arrived at the office we were treated very politely and I was given a survey form to fill out which asked questions about how I had been treated in their office. I used some of the

expansive and glowing Chinese terms of satisfaction that I had learned in my Chinese lessons to describe my happiness with the Jinan Police Bureau (*the fact that at I had not met any of them at this time was of no importance*). This augured well for my interview and I was happy to find out that the Chief of Police was a young man, not at all intimidating, and that I could understand his Chinese. Qin knew that I wanted to go to Church and was not sure if the law (*or the police, which is probably a different thing anyway*) would allow me to do so. She decided to ask the Chief of Police if I could go. She thought it might be culturally more acceptable to tell the Police Chief that, although I was a Christian (*bad thing!*), my father had been a Marxist (*good thing!*) and so she recommended that I should be allowed to go. The Chief of Police thought this was a good idea too, and said I could go as long as I did not 'propaganda' them. He proceeded to start a theological discussion with me. He asked me to explain (*in Chinese!*) the difference between Protestant and Catholic Christianity and was also interested in the songs we sang in Church. That's why Qin and I ended up singing 'Silent Night' in the Chief of Police's Office in Jinan at Easter!

### *Return to the Countryside*

Each weekend during my stay, I spent at least one day in sightseeing. These exhausting trips usually culminated in my seeing a famous temple, poet or philosopher's home, scene of natural beauty (or ex-natural beauty).

I think I understand this a little more. I stood in a room of a house of a famous female poet and looked at a model of how her home might have appeared. To my European eyes, this was just a replica of a concrete reality. To the Chinese standing listening, it was far more important to be in this place. The fact that we had driven about 100 km on an old bus and were standing in the pouring rain did not seem to matter. This experience brought the reality of the poet's words to life - I felt that there was something deeply significant here but also much that I could not understand.



*Figure 22: Confucius in the rain*

I also made a pilgrimage to Qufu, the birthplace of Confucius. This was another trip taken in the pouring rain. Qufu is about 3 hours from Jinan by minibus and the journey was relatively bad, with rain dripping in the window and the choking fumes of many cigarettes on the grossly overloaded bus. I had been excited by the possibility of Qufu because Confucius holds such a monumentally significant place in Chinese history. However, the large estate with its massive palaces just seemed empty and dead to me. Historic buildings, tour guides begging to be allowed to show us around, and stone monuments to a reality which is actually enshrined in the Chinese people's way of life.

A trip to a famous Buddhist temple allowed me to ask a little more about faith, pre and post-Mao. I watched old people bowing reverently in Buddhist worship. This did not surprise me because I had been told that the old people, and the country people, had always carried on their traditional religion. However, as I stood watching, two things surprised me. The first was a Buddhist priest who came up to me in quite an angry fashion and asked me if I was a Buddhist. I told him I was not and it was quite obvious that he did not want me there - in fact he told me to go away. This is a very un-Chinese attitude to Westerners in my experience - they

have always been so passive in their faith and not at all protective of their shrines. The second was a conversation I overheard between a father and his approximately ten-year-old son. The father was encouraging the son to prostrate himself in front of the large Buddha. The son asked 'Why, dad?' The city-clothed father replied to the effect that it was important that they maintain Chinese traditional culture and values. The son went through the rituals with immense seriousness after one quick look at an old lady to see how it was done.

I asked several professors who accompanied me to tell me the truth. I really wanted to know what had gone on during the time of the Cultural Revolution. Did they, as academics and city people, give up their faith and their traditional values? One of them explained that although the Government had managed to control their behaviour, they had never been able to control what was going on in their heads. This made me feel a little more comfortable with my intuitions about the Chinese people and their attitude to their culture.

Trips through the countryside showed a little more of the development of village life. The pace of construction of roads and modern buildings has continued and even escalated. Shandong Province has a network of high-class toll roads that seem well constructed.

A modern metaphor seems to be being enacted in the villages. Old houses are being knocked down and their bricks stacked in uneven piles along the roadside. Eventually the bricks are being recycled and new houses, in a more modern style, are being formed from the old. Then, in the majority of cases, the houses are being given a thin veneer of ceramic tile and the houses then resemble the Asian Mediterranean 'modern' style of the New Territories in Hong Kong or, maybe, Malaysia. In one or two cases, modern tower blocks, tiled as above but with pagoda shaped roofs and perhaps ten storeys tall, were rising out of the partial rubble of a still functioning Chinese village. This indicates to me a reworking of the old to resemble Western values and standards, while clinging to the heart of all that is Chinese and valued. I think this is modern China.

With my new found literacy it was also interesting to see that one in three of the shops along the roadside was a bar or hotel with not-so-interesting names such as the New China hotel. Of the other two, one was usually a bike or even car repair establishment, and the others were very miscellaneous. It seems that most serious shopping is still done in the market in town. It was also interesting to note the signs fixed to the doorpost of many houses and shops alike; these were not political or inspirational but traditional and superstitious, bringing luck and keeping away evil spirits.

### *Rituals and Celebrations*

I had the opportunity to take part in many celebrations while I was in Jinan. The phenomenon of my position as an honoured guest was not one that I had been looking forward to. I am generally very shy and do not like being the centre of attention. I had been mentally preparing myself for the trauma of the banquets and speeches that I knew would occur.



*Figure 23: National Foreign Experts' Day Banquet*

Banquets are very special. I was welcomed and farewelled by them. I celebrated my 45<sup>th</sup> birthday with two of them (morning and lunch) and I attended a wedding one, and one in honour of all Foreign Experts. Banquets are an integral part of life and are very meaningful. Shandong banquets are even more special. As the guest of honour, I had to be toasted three times by each important person there. They also have to say three complimentary things about the guest of honour too, which can be very embarrassing for a Westerner. There is an also an art to be learned for the non-drinker, in reaching the end of the banquet and remaining sober, without causing considerable loss of face to the host.

I had not realised how important songs are at banquets. The Vice-Chancellor (President) of the University farewelled me with a song. Not to be outdone, so did his three deputies and the Dean of Engineering; they sang opera in Chinese, Russian and French. I was forced to reply in kind with 'Edelweiss'! This was the best I could manage at short notice and the only one on the karaoke machine that I could even begin to attempt to sing.

Banquets are always accompanied by speeches. Speeches are long and politically correct and contain lists of irrelevant statistics. This is a time for astute language learners to see if they can translate a sentence before the interpreter, and then argue over the meaning with a colleague, without actually listening to the meaning. This is a cross-cultural pastime.

Signs and banners are an integral part of every celebration. It is very important that a very large handpainted sign greets any visitor to any institution. This sign always has the same format (*we warmly welcome..*) and is kept on the wall until the day the visitor leaves. This is a very big honour, lots of face is given, but tends to be an embarrassment to the reserved visitor.

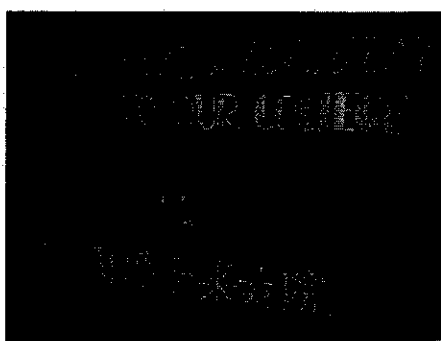


Figure 24: A somewhat premature title?

Tea has long been recognised as an important part of Chinese tradition. My experience was that every time a visitor sits down, or a foreign expert begins to teach a class, the visitor is offered tea. If the tea is drunk out of politeness, more tea is given until no more tea can be drunk. Blackboard cleaning is also a modern ritual offered as an act of kindness to the foreign expert. If a foreign expert uses the blackboard and fills it up, several students, and possibly a couple of professors, will compete to be the first to clean it.

### *Religion*

I finally went to church in Jinan on the last Sunday. It was like a large English Methodist church and we sang four old hymns about 7 times each and there were 3 expository sermons, a little one, a bigger one and a long one. I recognised the hymns immediately as the work of turn-of -century, English, Methodist missionaries, translated word for word, highly figurative language and totally un-Chinese in style. People helped me to find the hymns in the hymnbook, and lent me a Bible, but the service was so familiar I did not really need help. One old lady asked me if I was a new Christian. I was not sure if I was about to be 'evangelised' or what, but decided that she was troubled with my lack of ability in singing and finding my way around a

Chinese Bible. In addition, I was not so comfortable in praying aloud in Chinese with everyone else, which is a feature of some forms of Chinese Christian worship services.

There were approximately 800 people present and there was a large choir, with robes and a typical organist and choirmaster. I could imagine the weekly choir practices with the same sort of church wrangling and politics over choice of hymns and readings that we might find in any church in any Western country.

The average age of the congregation was about 65. The pastor was very old, maybe 85, and needed help up to the pulpit. I came away moved by the genuine faith of poor people who had probably suffered considerably to maintain their traditions. However I wished I could have seen some of the new smaller churches and groups who meet in homes in the villages and small towns in Shandong. It would be good to see if they have developed a Chinese expression of a modern Christian faith.

## RESEARCH

*The central portion of this chapter provides reflections on my interviews with seven Chinese students using a modified form of Cobern's methodology (1995b). Each student's perspective on nature is provided in the form of a concept map and narrative.*

*The significance of these stories is that they allow me to reflect on my investigation of students' world views while carrying out research to elicit these world views - forming two parts of a triangulation of methods within my research.*

## MEETING STUDENTS AND DOING THE RESEARCH

I met many delightful students. Scores of them very willingly helped me with my research. I include the results of seven of these interviews here and share with you the thoughts of Yan and Li Na (female students) and Bao Cai, Sheng Bo, Da Peng, Jie and Hai Tao (male students). All the students are between 17 and 18 years of age and all are in First Year of a College of Engineering. In school they would have been students who received good credit or distinction grades. Their curriculum includes theoretical courses in Physics, Chemistry, Mathematics, English, Computer Studies and Politics. There is little evidence of any engineering content in their current studies.

*(Useless Trivia #1: Chinese people, as most know, generally provide you with their family name followed by their given name. Almost all family names consist of one character [or syllable in English]. Given names consist*

*more commonly of two characters although one character name are not rare. Given names are not used much in the formal sense. Parents and family use pet names, and friends, even close friends tend not to use the given name. If invited you may call a person who is younger than you Xiao (meaning little), followed by the family name. Older people are called the equivalent of auntie or uncle, craftsman or teacher, and still, sometimes, comrade, depending on their age, status and the region. Here I have used the students given names to identify them though, when I talked to them I called the Xiao followed by their family name).*



*Figure 25: Little Red Hat English Corner*

I spent hours talking to them, going out to parks to have my photo taken and speaking English to people who, although they had a 7000 word English vocabulary gained over seven years, had never spoken to a Western person before. I was recruited to run a twice-weekly English language club. In China, this sort of informal language class is called an 'English corner'. So I became the third official member of the 'Little Red Hat English Corner' and have the hat to prove it.

Little Red Hat meetings were strange. The first one was arranged for my first Tuesday evening in Jinan. I was escorted to the class by the two founder members, Yan and Jie, who I will introduce later.

We climbed the stairs to a 3<sup>rd</sup> floor classroom at 7.00 p.m. in the dim light of some dusty neon tubes. As we walked along the empty corridors the smell of toilets, pervading the dusty



night atmosphere, wafted in front of our noses. I entered what I presumed would be a traditional classroom with student arranged before me in rows and found a candle-lit room with the chairs creatively around. In front of each chair, strategically placed on a desk that had been arranged in a casual fashion, was a plastic cup of jasmine tea. I could recognise my place, however, because there was one place that had two cups, one of tea and one of coffee. I recognised the honour in the underlying metaphor, the coffee was a sign of recognition, an acknowledgment of my Westernness.

*(When I saw the coffee close-up, I squirmed inwardly. I knew I would have to drink it, there was no way I could avoid it, but this was an example of the local Chinese coffee, grown on Hainan Island, way down south. However long it is percolated or filtered, there never seems to be any method of removing all the grounds. They seem to settle in the mouth and on back of the tongue whenever you drink it, and they take a long time to remove. This too could be a Chinese metaphor about western influence. However long you percolate or filter out the western influence, the 'grounds' of it still remain.)*

There were something like 100 students in the room, and I was overwhelmed to think that I was the first native speaker who some of them had seen, let alone talked to. I found that Yan and Jie had arranged a program of set speeches to which I had to respond. I wanted to listen to the students all the evening, because they had obviously picked their stars to perform on the first night. The highlight of the evening to me was Sheng Bo, who I will introduce later as well. He had the softest roundest face I had ever seen, and sang Edelweiss for me in the highest male voice imaginable. *(I don't know why, but he reminded me of one of the eunuchs that the Chinese emperors were reported to keep at the courts for entertainment).* I had not imagined that I would be required to sing, and actually refused. I talked about computers and the West because I had not actually known what to prepare for the evening.

I decided immediately that I would restructure the program if I were going to find myself acting as an informal English teacher (I had actually come to do research in the use of the Internet in higher education!). I felt the most important exercise would have to be practice in speaking the language, and learning new vocabulary. I spent the next few weeks talking to them about the things that teenagers really need to know – slang, fast food, boy friends and girlfriends, student life and how to get on with your parents - much more relevant than a rendition of Edelweiss.

Students would stop and talk to me all the time. They just did not seem to be able to really understand what we are like. Some were surprised that I had not used a gun, that I had children who *(usually)* obeyed me, that I was married and not contemplating divorce. It seemed to me

that this is a generation with a poor understanding of Western society and values, living in a culture which is deeply and firmly rooted in its own history. They seem to learn and understand Western science and desperately want (and deserve to have) the material rewards which can be reaped from it. This is a generation in transition which is considering, if not publicly then privately, which direction to take next and how to make links with the West without taking on the mantle of Western culture.

YAN

My favourite student was Yan, a seventeen-year old country girl. There was really no reason why Yan had such fluent English; she had come from the country and had no special lessons or advantage but her English was far more fluent than many of her professors. She told me a lot about country people and gave some insights into student life.

She talked about China's one child policy. Yan is passionate about children and their care, and feels the one child policy is absolutely correct. She is a little disappointed with her sisters and neighbours who, being country people, have been allowed to produce more than one child. *(If the first is a girl you can have a second chance, but I am sure I saw families with two boys as well).*

Yan, like most of her classmates, is very worried about the West. In particular our high divorce rate bothers her and the way the newspapers have told her we ill-treat our children. She had no idea of Western cultural values (either Christian or humanist) or the way we live our lives.

Yan would love to travel to the West but wants to end up in her own village. Her village is the best place in the world and is the only place for miles around *(in the whole of China?)* which is not polluted. She described her village as a clean place where the sun always shines. She hates the pace of student life although she is very hard working. She envies her brother, who only has to go out to the fields if he feels like it, except at the busiest time of year. She is studying to be an engineer but, like the majority of her classmates, she did not pick this discipline, the Government allocated her to engineering in this particular college based on her high school graduation marks. She would have preferred to study English but now thinks she will study computers and set up her own computer college in her village when she graduates *(this is possible in New China!)*

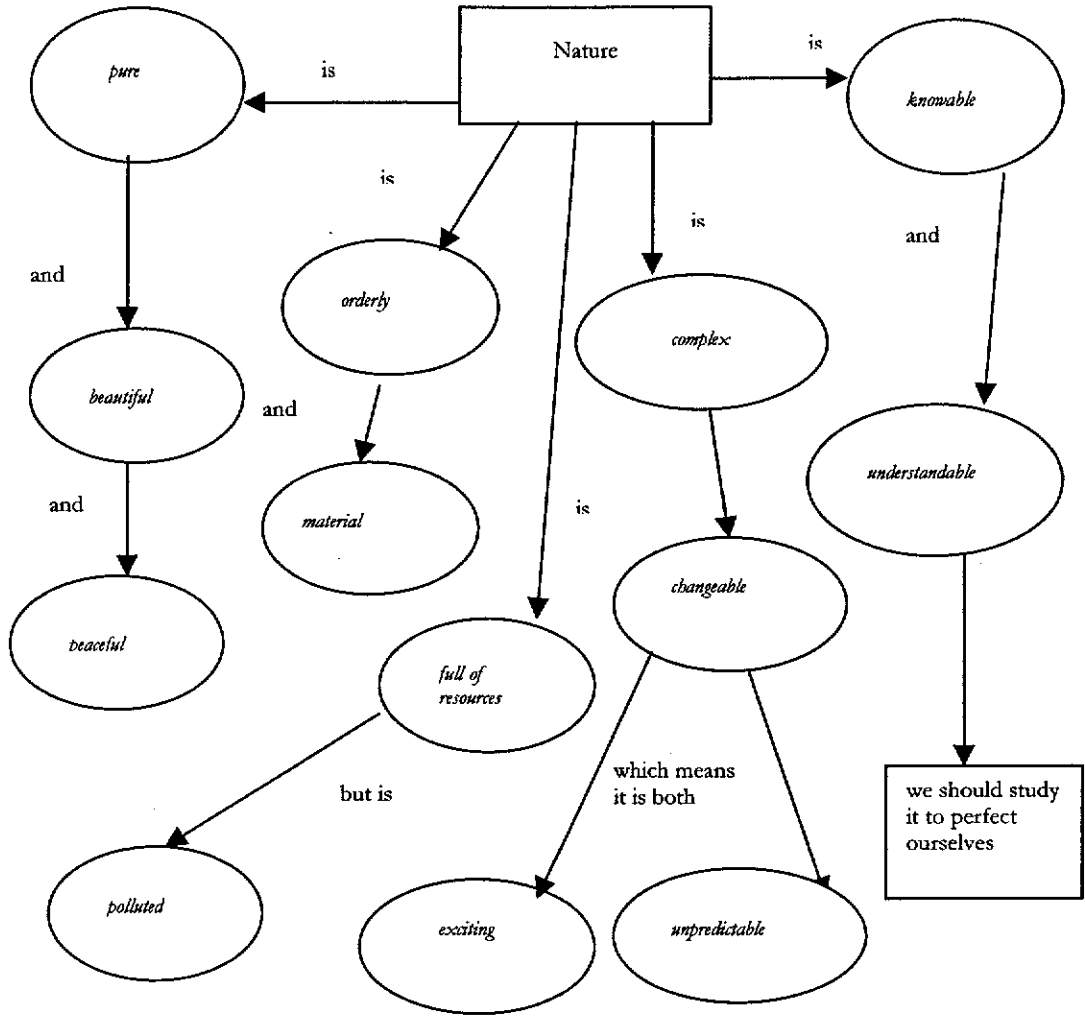
Yan likes fashionable clothes and would like to learn to drive like Western women. Her elder brother started to teach her secretly when their parents were not home, but a neighbour

spotted her and now her parents have forbidden her from driving the truck again. Each time her mother goes out leaving her in the house with her brother, she reminds Yan not to try to learn to try again and Yan feels obliged to obey her.

Yan feels that life in China is improving for people, especially country people. She is proud of the country's economic development. She remembers the time when people did not have enough to eat and had to survive on vegetables and rice. 'Now', she proudly told me, 'they have eggs and meat most days'.

When we talked about nature, Yan's perspective was very clear. Her view of nature was definitely that of her science teacher. Nature is material. It is powerful, real and concrete. It could not possibly be considered sacred, spiritual or holy. Actually the words we translated as 'sacred' and 'holy' were really the same word in Chinese, there is really no difference in their meaning. The word we translate as 'spiritual' is one that can be paraphrased as 'pertaining to a realm of spirits, both good ones and evil ones'. However, the modern Chinese world does not really hold to concepts of the spiritual or the sacred as in the West. Yan did think that nature was mysterious but I think this was with a view to saying it was puzzling and not completely defined. Yan's concept of nature was one that did not really seem explicitly to include man. She included a concept in talking about man that was repeated by other students in my conversations with them, though. This was the one of man's need to perfect himself. This seemed to be an important role which man is meant to play in the world and in nature. (*I am sure this concept comes from Confucius*). How he was meant to do this was not made clear. I did feel that it was, however, deeply embedded in the Chinese mind along with the concept of service. The paramount role of man (and woman) is to serve the country. All the students I spoke to expressed this with passion and without embarrassment.

*Yan's Thoughts on Nature*



*Figure 26 Yan's Thoughts on Nature*

I think nature is beautiful , peaceful and pure. It is made of matter and is orderly and material. Nature is knowable and it is understandable. We should study it to perfect ourselves. Nature can be complex and changeable which makes it unpredictable and exciting.

Nature is full of resources and I feel unhappy because it has become polluted. We must work very hard to protect nature.

## AN INTERLUDE IN THE PARK

I spent an interesting afternoon in the 'Flower Park' (this is Yan's English translation of Botanical Gardens) with Li Na and Yan. I always have a mental chuckle at the Chinese concept of 'Flower Park', and especially at the grander notion of 'botanical gardens' as interpreted in China. I will try and explain why.

The Flower Park was situated at the industrial edge of downtown Jinan. It was not really obvious by its trees and flowers, but rather by the massive colourful collection of street sellers and food hawkers gathered at the side of the road. I had to fight my way through the crowd and fight them off, as they pleaded with me, the only Westerner for miles around, to buy the dumplings, fish and strange meat products they were cooking on primitive barbecues and ovens. The area was very dusty and polluted by the fumes from buses and cars that crawled by this human 'traffic calmer' (*no need for speed bumps here!*).

The entrance to the Flower Park reminded me of a crepe paper, country cousin of the truly authentic and plastic Disneyland. We were faced with more merchants and booths selling films, food and drinks, arranged in neater rows and forming a corridor to the delights ahead. When I arrived, I did not know that I was there, because it still did not look like a Flower Park. This overcrowded place contained a German Beer Garden, complete with German Beer brewed in Shandong Province.



*Figure 27: With Li Na, Yan and classmate in the Flower Park.*

There was definitely some grass and, miracle of miracles, we were allowed to walk and sit on it. There were a few flowers arranged around concrete-and-stone 'rockeries', and small and bored pools of stagnant water. Families and couples congregated round the pools and under some ornamental flower-covered arches, draping themselves artistically in nature, in long photographic sessions.

Along some of the pathways there had been some attempt to plant and classify various species of native and foreign trees and plants. This truly 'botanical' section however took up just a small percentage of the area of the park. We spent some time trying to work out the English names of the plants and trees (*I found it more helpful to use the Latin names which were provided rather than the Chinese characters*).

On a large area that we might call an oval, many enterprises and individuals were 'showing and telling'. I could not understand it all. However I could see several insurance companies were trying to interest people in life insurance. There were booths where you get weighed and have a free health check. There was a display by a University but I could not tell what their purpose was. Round the ovals were spread little plaques or labelled markers. Yan and Li Na explained that each College and University had a space allotted where they could come and serve the community and showed me the one belonging to our college. I did not really understand the nature of this service until I saw a long line of children. It was explained to me that one form of service was that an organisation might supply a plastic bag to each child, who had to return it full of rubbish collected in the park. The organisation would then reward the child with a prize. I was amused to see that as the children waited in line for their reward they were entertained by a person dressed as giant animal, something like Mickey Mouse or Yogi Bear. This seemed such a typical pragmatic Chinese approach to preserving the environment and enculturating part of the 'glamour' of the West.

I sat on the grass with Yan and Li Na. We took heaps of photos but also, as we spoke, drew a crowd of interested bystanders. A few dared to try out their English on me, but the majority was happy just to stand and watch. I learned a lot about Li Na and Yan by listening to them talk informally about China and their hopes and dreams. They definitely saw the future in an academic career and then in marriage and a baby (*one baby, and they did not mind at all if it was a girl!*).

We spent some time watching people and especially the little children playing in the hazy sunshine in the late afternoon.

*(Useless Trivia #2: Chinese mothers [and especially grandmothers] take great pride in getting babies 'potty trained'. They start, as early as possible, by 'holding the baby out' every 30 minutes or so, in any convenient location. There is also a growing market in disposable diapers, as in the West. However, something important happens when the baby reaches its first birthday [which is possibly a bit later than a Western first birthday because Chinese New Year places a role in developing the formula for calculating one's age]. The child's trousers are officially 'opened' at the crutch, allowing the child to become independent in its toilet habits as it wanders*

*around with its bottom exposed to the world. They are only sowed up when the child is about 4 years old, or completely trustworthy. In conversation I found that if a child is walking before his or her first birthday, and thus can have its 'crotch' open before the age of one year, then some 'face' is gained by the mother; I don't know why really).*

LI NA

Li Na was a very interesting girl. She had come to Shandong from another part of China and her features were those of southern China rather than the rounded face and sturdy build of the Shandong people. She was also interesting because her English was unforced and quite natural. She had told me how her parents had called in some favours to allow her to attend an experimental school in Jinan, a cooperative venture with some Australian educators, where she studied with Australian students and had had some Western teachers.

Li Na was the first student I spoke to who was actually committed to engineering as a career, and she intended to go on to graduate study when she had finished her degree. She was a very vivacious person and exuded enthusiasm for life.

She presented me with what I had now realised were going to be 'typical' answers, they seemed almost inbred but maybe acquired through rote learning and imbued this way, about the nature of nature. Nature is material, made from matter. Nature is orderly and predictable. It is complex and diverse and of course we should study it.

She did add that she thought nature is holy (and sacred which is the same word in Chinese). This was not a Christian or 'god' sort of holiness, I felt, but one which I think is a traditional form of thinking. She explained that holy is associated with the concept of 'heaven' but this is not associated with 'god'. Heaven is really just somewhere else which is not 'earth' ('heaven' and 'earth' form a kind of bipolar pair in Chinese, with a deeper meaning which I believe is founded in Taoism [see Chapter 5]).

Once again, she showed some concern about pollution and thought that nature was definitely endangered and even doomed. She felt that it was important to study therefore to protect nature from pollution and that this would 'serve her parents'. In this she too raised the concept of service which I had heard expressed before. This seemed to me to be, once again, rooted in Confucianism and a response to both teaching and the national media in China. Over recent years TV has concentrated on educating the young to be aware of the causes of pollution,

and to cooperate in its eradication. A new modern hero is one who does not smoke, does not take drugs and does not drop his or her litter on the ground.

*Li Na's Thoughts on Nature*

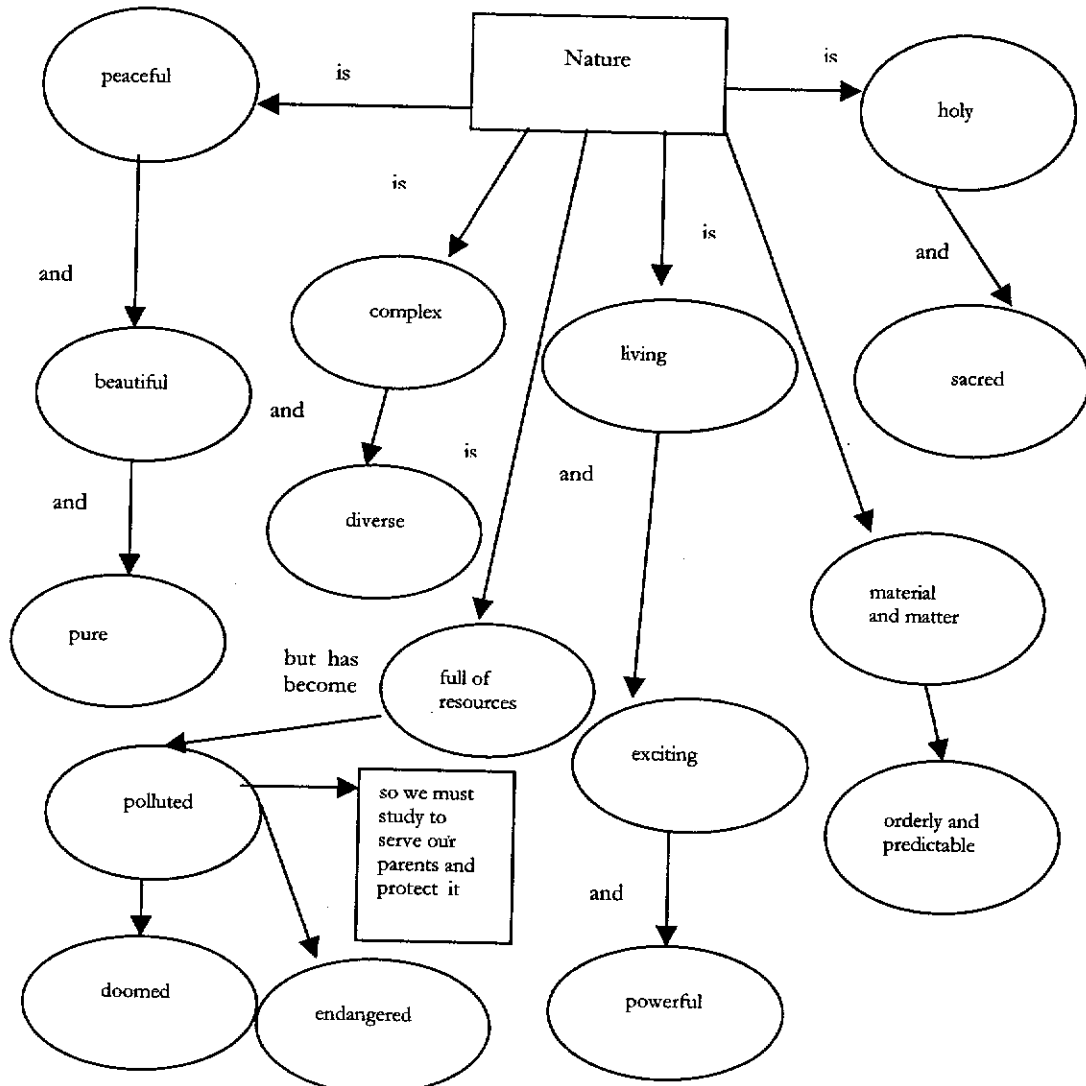


Figure 28 Li Na's Thoughts on Nature

I think that nature is peaceful, beautiful and pure. It is complex and diverse, made of matter and is orderly and predictable.

Nature is full of resources but has become doomed and endangered by pollution. We should study nature to protect it and serve our parents and our home towns. I think it is living, exciting and powerful. I also believe it is holy and sacred.

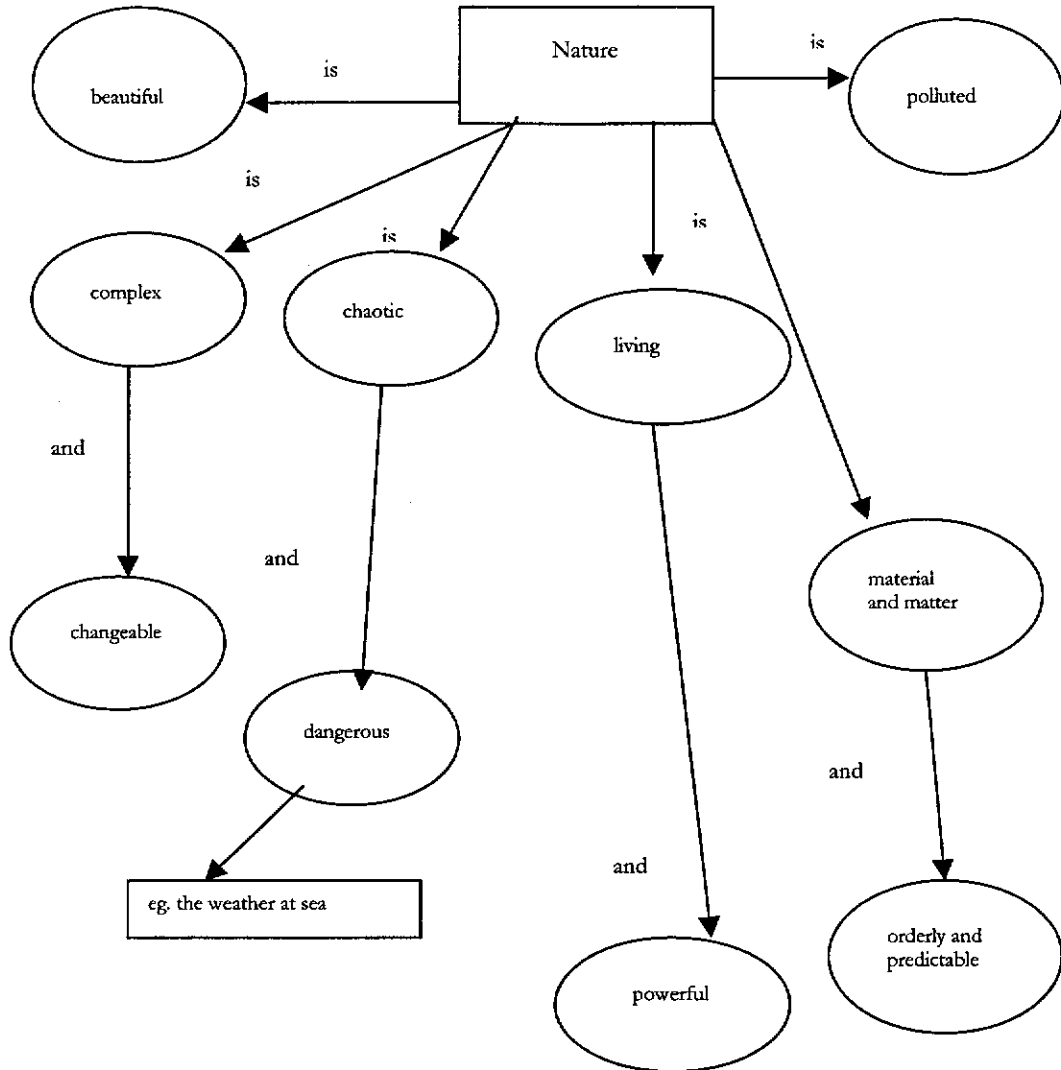


## BAO CAI

My memory of Bao Cai is that he is small, quiet and intense, certainly not the type to stick out in a group. He displayed many of the attitudes and opinion of his peers and classmates. He too had not wanted to study engineering and had really wanted to study whatever was necessary to join the merchant navy and go to sea. He definitely had a strong desire for travel, but, in speaking to me, he expressed a deep love for both the sea and the countryside. The term nature unquestionably both of these and, apart from this, I could really not identify any deep passion, or individuality in the concepts he expressed.

He saw that nature was changeable and complex. He could even identify danger in nature, but here I am sure we were still talking about ships, the sea and storms and other natural phenomena. Otherwise, his views were unremarkable ones that seemed to reflect those of his school science teachers and modern Chinese physics and chemistry texts.

*Bao Cai's Thoughts on Nature*



*Figure 29 Bao Cai's Thoughts on Nature*

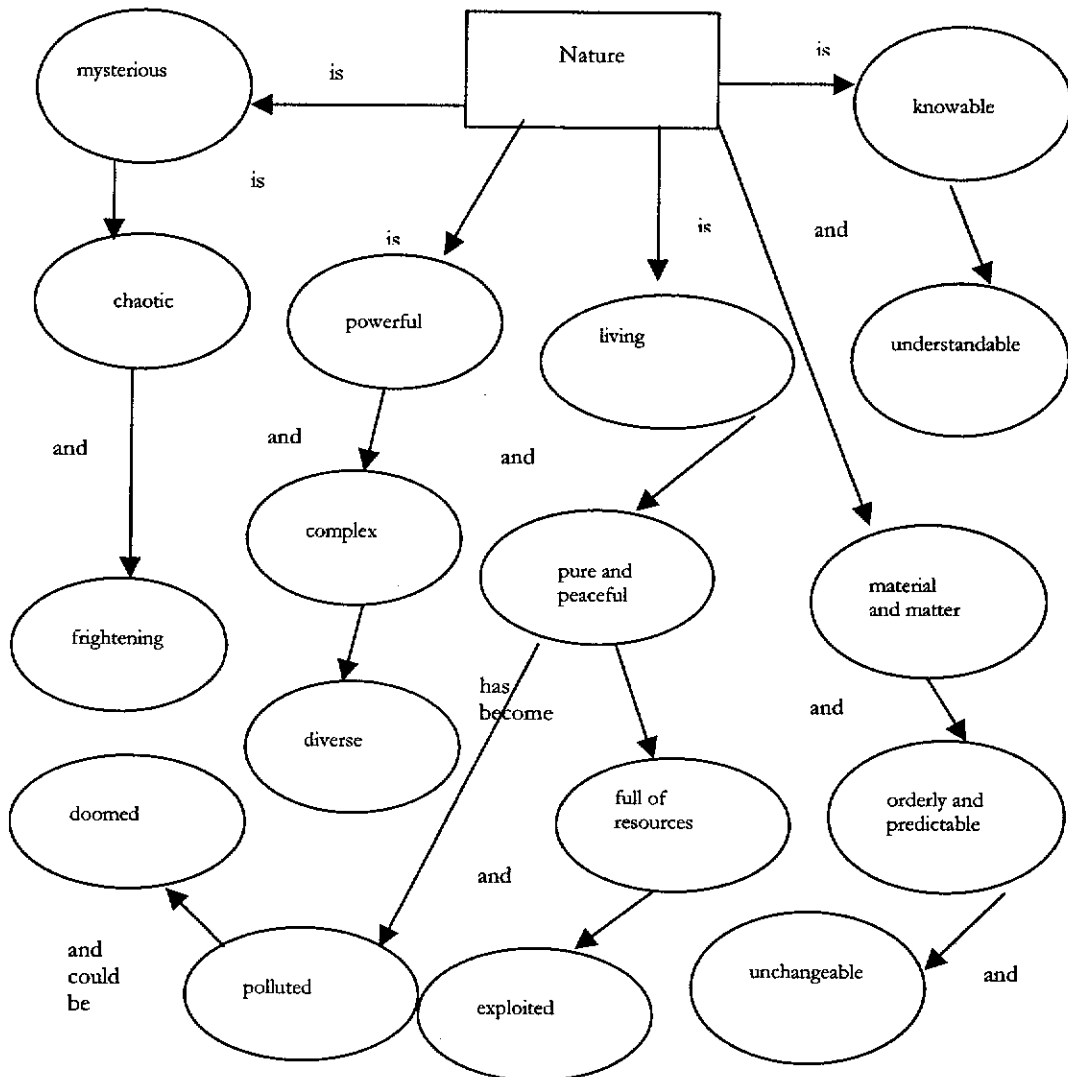
Nature is beautiful and I see beauty when I spend time in the country. Nature is made from matter and is material and concrete. It is generally orderly and predictable but sometimes it is complex and changeable. Nature is living and powerful. Sometimes the weather at sea can be chaotic and dangerous.

## SHENG BO

Sheng Bo was very interesting to talk to. He enjoyed practising his English on me. He was the only student who displayed an interest in philosophy and was very pleased when, unprompted, I said I believed that Confucius was one of the greatest influencers of modern China. I am not really how sure I hold this to be true for modern China, but Sheng Bo was very definite about this fact, and a keen follower of Confucius's philosophy. He was quite cynical about religion though, and did not have concepts of god, the sacred and spiritual in his perceptions of nature. He was on a path that leads towards self-perfection, as recommended by Confucius, but this is something that he hoped would happen spontaneously in his mind, as he studies.

He was not going to follow Confucius and be a teacher though. He did not think teaching as such was a good career and wants to be an engineer first and a businessman later. He moved from the country to the city and does not really want to move back again. He thought that the best method of using his head would be to use it to make money (*when he has perfected himself?*) Then he would be able to serve his country.

*Sheng Bo's Thoughts on Nature*



*Figure 30 Sheng Bo's Thoughts on Nature*

Nature is living, peaceful and pure. It is full of resources but has become exploited, and its purity has become polluted and it might even be doomed. Nature is powerful, complex and diverse. The natural world is material and made from matter. It is orderly, predictable and unchangeable. However sometimes it is mysterious and chaotic to us and can be frightening. It is important for us to study philosophy. The work of Confucius helps us to perfect ourselves and understand nature.

## DA PENG

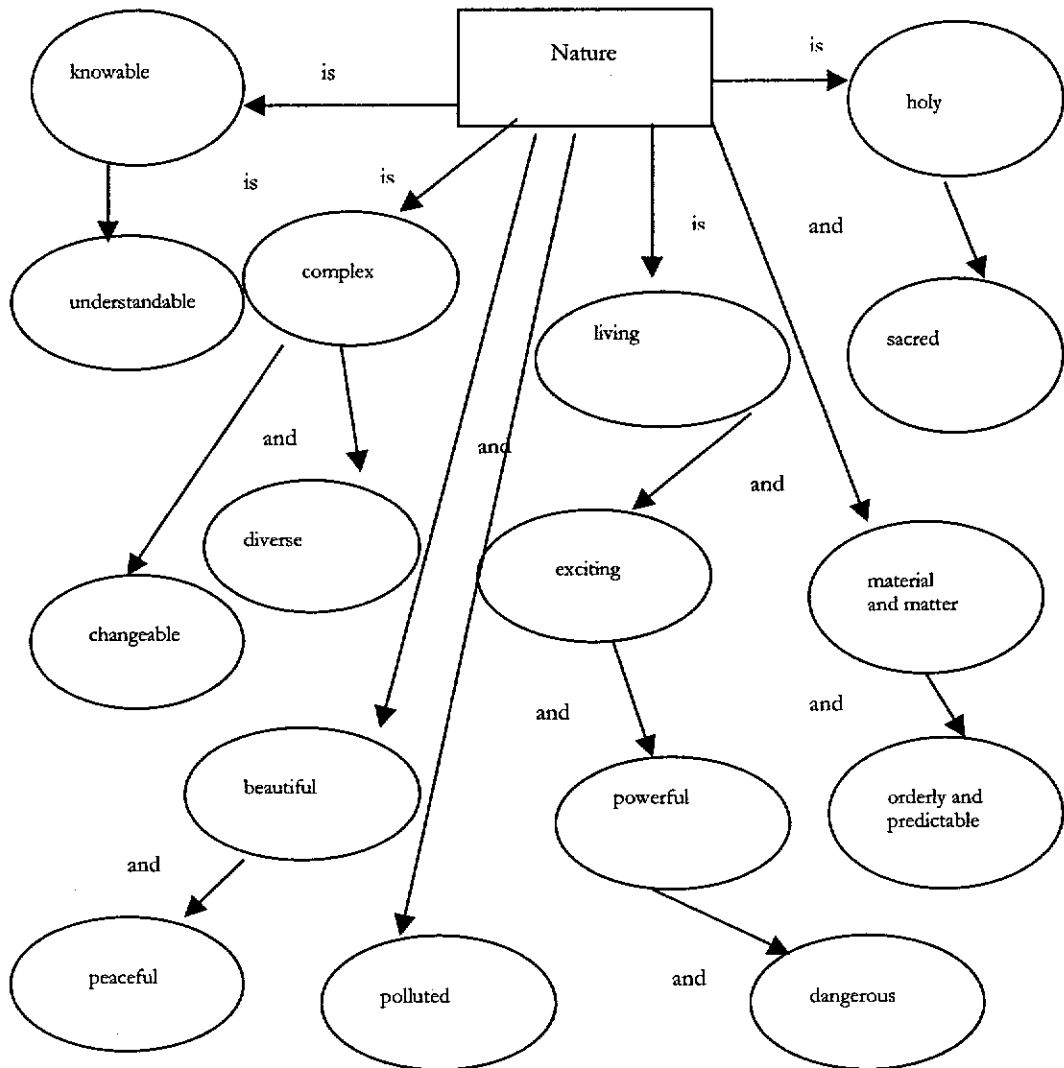
If Sheng Bo reminded me of Old China of the Emperor's court and classical music, then Da Peng reminded me of New China and economic rationalism. He certainly reminded me of many of the businessmen I had known during my time in Hong Kong. He seemed to display many of the pragmatic qualities that a businessman might expect to possess.

Da Peng had come from the country to work in the city and there was no way that he was going to move back. I was a little unsure whether he would be allowed to remain in the City, given strict laws about residential permits, but he explained that as long as he graduated he would be allowed to find a job and live in the city.

His major conversation centred on how he could make money for himself, lots of money. He displayed rather less patriotism than his classmates and saw himself finishing his engineering training and then setting up his own business.

He was cynical about concepts of god and religion but once again saw aspects of holiness and spirituality in nature. His views were very similar in most regards to the rest of the class and I was not really surprised at this.

*Da Peng's Thoughts on Nature*



*Figure 31 Da Peng's Thoughts on Nature*

Nature is beautiful and peaceful. It is holy and sacred. Nature is material and made from matter. It is orderly and predictable. Nature is knowable and we can understand it through study. Nature is living and exciting. This means it is powerful and can even be dangerous for us. Nature is very complex and diverse, it is also changeable. Nature has become polluted.

#### JIE (ANOTHER INTERLUDE IN THE FLOWER PARK)

I got to know Jie because he was at least half of the motivating force behind the Little Red at English Corner. I found him easy to be with because, of all the students, he appeared the most Westernised. He came to find me on my first day and gave me a written plea from the students explaining why they needed to spend time with me. This was where I first saw the expression 'perfecting ourselves'. It was important for the students to study English with me so that they could 'perfect themselves'. I really did not have a problem with this anyway.

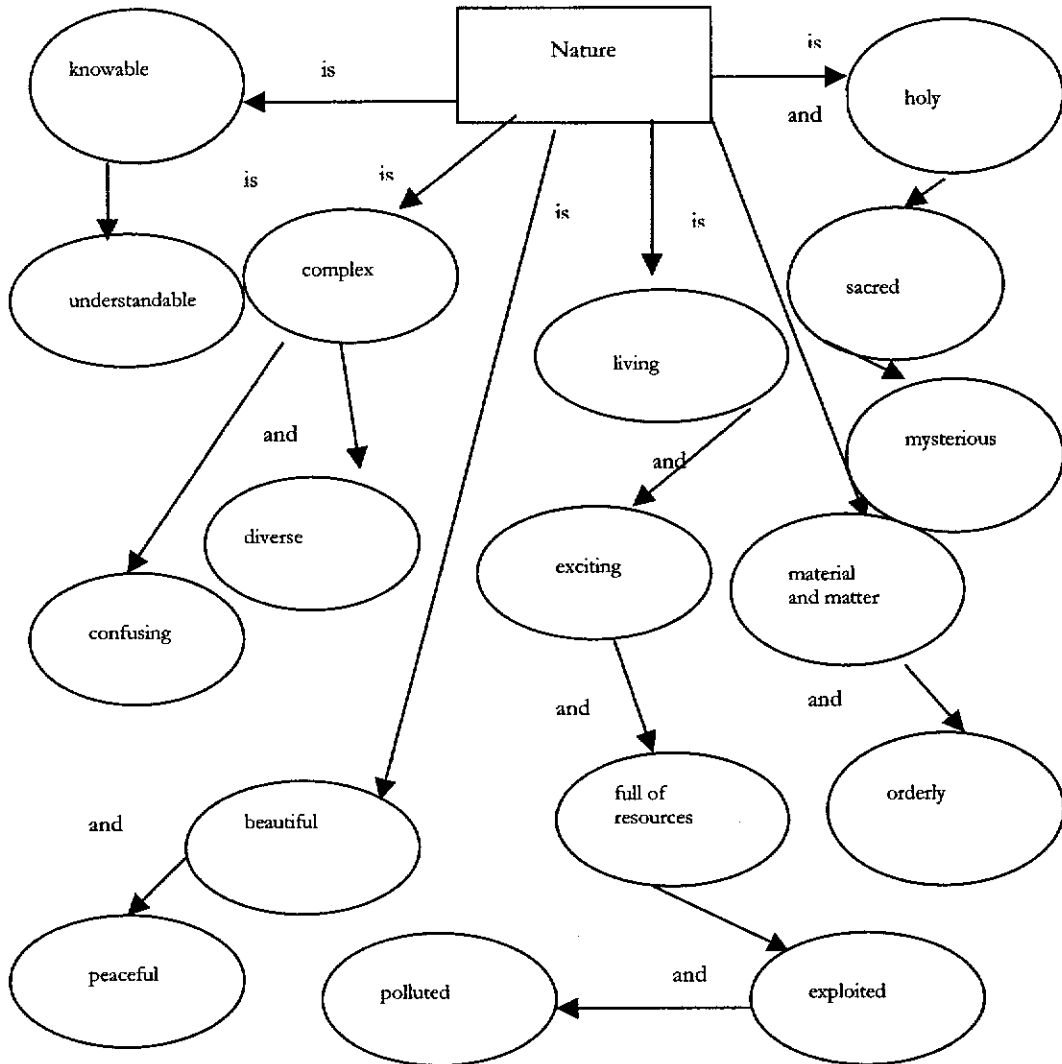
Jie was definitely not native to Shandong province, and I could not work out if it was this fact which made him a loner. He definitely did not spend so much time with the group. His parents lived in a town on the coast, a few hundred kilometers away. His father has relatives in America and, when he graduates, Jie is going to live in California and work for his uncle's business.

Jie and I spent an afternoon in the Flower Park and he took many photos of me (his first Westerner). He insisted on paying for a taxi and buying me drinks but somehow he managed to get his pocket picked and, on the way home, had no money to pay for the taxi. This time I paid, but he lost a lot of face in this incident and I hardly saw him again. I did not have any technique in my cross-cultural armoury to help alleviate his shame and embarrassment.

Before this incident we did sit under a large tree for an hour or so and talk. He told me about his hopes and dreams and we talked about the West. We managed to draw a large crowd; soldiers, mothers with their children, and old people out enjoying the warm afternoon, gathered around us. I was uncomfortable but realised Jie was basking in the warmth of something that was being reflected from me (not exactly glory, but something similar, I think).

I enjoyed Jie's company but his thoughts on nature, while a little different from his classmates, still largely reflected the view of science he had learned in the classroom. This was getting to be a repeat of the same answers each time!

*Jie's Thoughts on Nature*



*Figure 32 Jie's Thoughts on Nature*

Nature is beautiful and peaceful. It is living and exciting and full of resources but these have been exploited and so it has become polluted.

Nature is complex, which means it is both diverse, and, sometimes, confusing. Nature is both knowable and understandable by study. It is material and made from matter and it is orderly.

Nature is holy and sacred and mysterious.



## HAI TAO

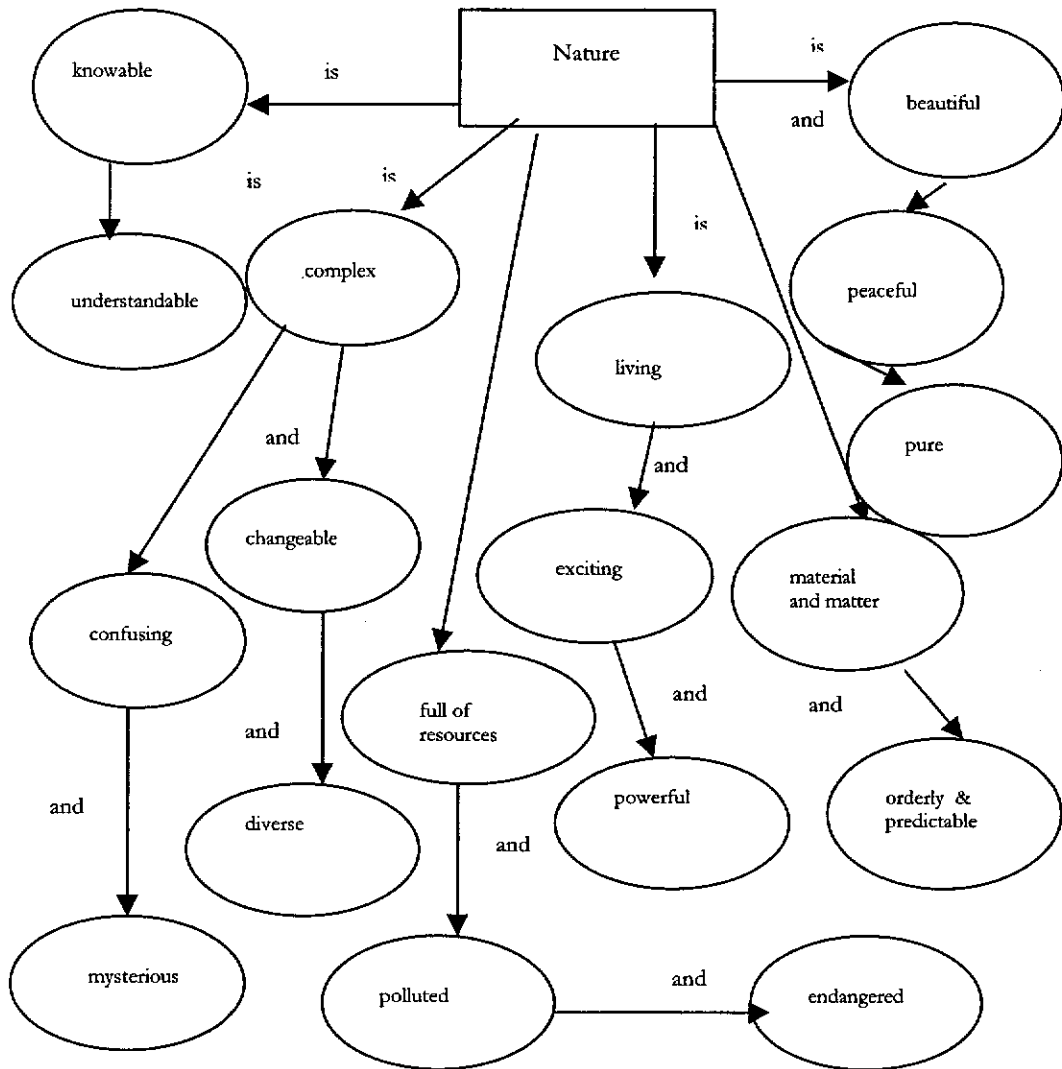
Hai Tao was the only student that even remotely suggested he did not like study. He is a country person and he really only wants to go back to the country and be a 'worker' like his father. One of his classmates explained to me that, with the high unemployment rate in China, it was highly likely that the only employment available for Hai Tao, and others, would be as factory workers. Professional and academic opportunities are very rare and are only available for high achievers.

Hai Tao told me he did not know why he had gone to university. He liked computers but he had very little opportunity to study them on his engineering course. He was very shy and did not want to talk to me really. He certainly did not want to try out his English and lacked confidence all round. He feared that he was going to fail his English exam anyway.

Hai Tao made no lasting impression on me. I could see his lack of confidence and stress reflected in his body language. It seemed to me that he might feel a lot better if he returned to the country and his family.

His answers to my questions were very similar to his classmates. He reflected the countryman's love of nature as he spoke. He was definite that there was no god, and there was no concept of the spiritual or sacred in his understanding of nature.

*Hai Tao's Thoughts on Nature*



*Figure 33 Hai Tao's Thoughts on Nature*

Nature is complex and changeable and very diverse. However because it is complex it can be confusing and mysterious.

Nature is material and made from matter and is orderly and predictable. Nature is living exciting and powerful. It is also beautiful, peaceful and pure. The country is always peaceful and pure.

We can know and understand Nature by study. Nature is full of resources and these have become polluted and endangered

## TENTATIVE ASSERTIONS

In this portion, I have presented four of the seven possible assertions developed by induction from my concept maps and narratives. I have referred to those interviewed as 'Chinese college school students', or students. The institution at which the students sampled study is better described as a college than an Australian or American university – it is probably similar in curriculum and status to an old Australian institute or college of technology. It is difficult to assert whether these students are rural students or those from the city. Jinan is a large Provincial Capital with a population of six million people. Many of the students would describe themselves as country people but, because of the nature of the Chinese education system, have boarded at school since the age of eleven years, with mixed and often idealistic perspectives on rural life.

### **Assertion #1**

Chinese college students tend to discuss the natural world using the same set of perspectives. The students do not display a diverse range of attitudes. Each seems to provide concepts from the domains of science, aesthetics and conservation in their concept maps.

Examples of this are displayed in Yan, Hai Tao and Jie who share similar perspectives across domains. Yan asserts 'I think nature is beautiful, peaceful and pure. It is made of matter and is orderly and material... I feel unhappy because it has become polluted. We must work very hard to protect nature.' While Hai Tao offers a very similar perspective 'Nature is material and made from matter and is orderly and predictable. .. It is also beautiful, peaceful and pure. .. Nature is full of resources and these have become polluted and endangered'. Jie offers his perspective on the complexity of nature but generally offers the same concepts as Yan and Hai Tao 'Nature is beautiful and peaceful. It is living and exciting and full of resources but these have been exploited and so it has become polluted.

Scientific perspectives, as gained in the Chinese science classroom, are very evident in students' perspectives on nature. The students interviewed are all high achievers if this is measured by their ability to learn scientific concepts and formulas by rote. There is an understanding too, within what is apparently a secular and humanistic society, that the explanations of natural phenomena offered by modern Western science are the only ones which are publicly acceptable.

## Assertion #2

Male and female college students appear to describe nature in a very similar manner and there does not appear to be any correlation between the range of concepts used by Chinese college students to discuss the natural world and gender.

Examples of this are apparent in the narratives of Li Na (female) and Jie (male) who offer perspectives which are equivalent across the four domains (spiritual, aesthetic, conservationist and scientific).

I think that nature is peaceful, beautiful and pure. It is complex and diverse, made of matter and is orderly and predictable. Nature is full of resources but has become doomed and endangered by pollution. ... I think it is living, exciting and powerful. I also believe it is holy and sacred. (Li Na)

Nature is beautiful and peaceful. It is living and exciting and full of resources but these have been exploited and so it has become polluted. Nature is complex, which means it is both diverse, and, sometimes, confusing. Nature is both knowable and understandable by study. It is material and made from matter and it is orderly. Nature is holy and sacred and mysterious. (Jie)

Yan offers this perspective 'I think nature is beautiful , peaceful and pure. It is made of matter and is orderly and material. Nature is knowable and it is understandable. We should study it to perfect ourselves' which is very similar to that of Sheng Bo who adds a philosophical dimension as he states 'Nature is living, peaceful and pure. ..The natural world is material and made from matter. It is orderly, predictable and unchangeable. ..It is important for us to study philosophy. The work of Confucius helps us to perfect ourselves and understand nature'.

The Chinese education system has been designed to be totally equitable and fair across the genders. This is very well defined and accepted within society and there does not seem (and has not seemed) to be any conflict in this area, at least since 1977. Gender inclusivity is not a big issue with the education system and it would therefore seem apparent that female students would actually be expected, or even be taught, to display the same perspective as male students. (The reality of the education system in some poorer Western China rural areas is that high school education is not available for female students because their parents cannot afford to pay the small fee required by the government for their schooling.)

### Assertion #3

Spiritual beliefs and traditional concepts are articulated in some Chinese college students' thoughts on nature. The strength of spiritual beliefs varies among students but does not appear to play a part in shaping the students' scientific perspective on nature.

Three students offer perspectives that could be translated as 'holy' or 'sacred', since these are the same word in Chinese. Li Na's comments about nature include the fact that 'I also believe it is holy and sacred'. Deng Bo agrees 'It is holy and sacred' and Jie concurs also 'Nature is holy and sacred and mysterious'.

'Holy' and 'sacred' are translated with two Chinese characters. Each character has the same meaning and is, at its roots, associated with 'gods' or a 'supernatural realm'. This indicates that in these students there is an underlying, and almost unarticulated, acceptance of some traditional beliefs be they Taoist or Confucian which still underlie Chinese society, urban and rural.

There does not appear to be an apparent conflict between the students' scientific and spiritual views. These three seem students seem to have spiritual beliefs and well-formed scientific views.

Spiritual views that are displayed might be seen as vague or poorly-defined by Western standards. I believe this vagueness is due to the underlying Taoist philosophy in Chinese society, which is holistic in its understanding of the whole of the natural world as sacred. This is also in contrast to the Christian tendency to dissect, compare and define phenomena according to the Bible or Church teaching effectively causing a philosophy which is not holistic but very fractured, or compartmentalised, in its perspectives on nature. This assertion is further discussed in Chapter 9.

Traditional views, derived from Confucianism are articulated by three students who offer perspectives on nature such as Yan's 'We should study it to perfect ourselves' and Li Na's 'We should study nature to protect it and serve our parents and our home towns'. Sheng Bo states quite clearly 'The work of Confucius helps us to perfect ourselves and understand nature'.

These views are clearly Confucian with their emphasis on serving parents and country and on the need, articulated by Confucius, for an educated man to prove his education by taking part in a continuing process of self-improvement. This is further discussed in Chapter 6

#### **Assertion #4**

The level of science integration with everyday thinking is high. Discussion of nature by Chinese college students involves the use of school science knowledge.

- Students appear to see order in nature
- Some students appear to display well-developed science perspective

A major aspect of each narrative is that it expresses the traditional science explanation of a concrete, material and orderly world that is predictable by scientific means. This is a view that is very easy to trace through each student's narrative. This view would be expected because of the nature of Chinese education in general, and science education in particular, which concentrates on the rote learning of formulae, theories and principles and largely excludes interpretation and the social applications or implications of modern science.

These data are further analysed in Chapter 9.

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SECTION 4

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CONCLUSION

*CONFUCIUS SAID:*

*'DON'T WORRY ABOUT BEING MISUNDERSTOOD BUT ABOUT  
UNDERSTANDING OTHERS'*

*(ANALECTS 1:16)*

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## CHAPTER NINE

### CONCLUSION

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#### OVERVIEW OF THE CHAPTER

In this chapter, I offer my “objectively reasonable” knowledge claims (Fenstermacher, 1994, p. 49) regarding the conceptualisations of nature held by the two groups of students that I interviewed. These knowledge claims are presented in narrative form and are coupled to my own narrative of inquiry. My inquiry focussed on the effect of culture on my student’s understanding of scientific concepts and my concern to be fair and equitable to all those who I was teaching.

Here I tell of both the outcomes of my inquiry and the processes that shaped and restrained the nature of the inquiry. In this way, I make explicit not only what I learned but also how my inquiry was governed by unanticipated factors which constrained the scope and feasibility of the research, and which resulted in an inquiry that owes its character more to an aesthetic appreciation of two cultures than to a scientific analysis.

This chapter allows me to compare these two particular groups of rural Queensland senior high school students’ and Chinese college students’ conceptualisations of nature, and then to consider the implications of my study for my own teaching practice, in the light of recent research in cross-cultural issues in science education.

#### STUDENTS’ CONCEPTUALISATIONS OF NATURE

##### AUSTRALIAN STUDY

In developing a theoretical Western world view (Chapter 4), I argued that a modern Western scientific world view is a theoretical entity. I demonstrated that the Enlightenment provided the foundation for a scientific world view, based on empiricism and rationalism, which presented the world as impersonal and predictable. This order within this world of nature could be completely and objectively understood by science. I argued too that a ‘typical’ science teacher with such a world view would identify features such as orderliness, predictability and reliability of scientific method in discussion on the nature of nature. This teacher would avoid any reference to spontaneous action being displayed by the natural world or make any allowance



for a spiritual or phenomenological explanation for a natural event. They would also refrain from making an emotional response to an ordered and predictable reality.

However, the concepts displayed by my sample of Australian students paint the picture of a world that they tend to describe in terms of its beauty and the effect of this beauty on their emotions. They have a particular awareness of the need to conserve nature within this beautiful world, but there is very little emphasis on the sort of concepts that would have been used to describe nature in their school science classes.

My own teaching experience in the Far North of Queensland was a time for me of both frustration and growth as I struggled to come to terms with a group of learners who did not seem to see the world in the same ordered way that I did. I have concluded that my own perspective on nature was originally the enlightenment one that was presented to me at school. However, I have had to adapt this over the years, because experience in Asia has made me challenge scientific explanations some of the phenomena that I have seen or experienced. Although I could identify some common ground in our faith, my students way of understanding the natural world was very different to mine. I thought that maybe some of what I saw as odd ideas might have been produced by the alternative lifestyles which their parents had chosen in the Australian bush, the New Age and alternative beliefs or the drug scene.

Of the four tentative assertions presented from those that I developed from my Australian study (in Chapter 5), the first and the fourth clearly demonstrate to me perspectives that are not aspects of the theoretical modern Western scientific world view. These include concepts of random activity and the natural world acting in a highly disorderly fashion. They demonstrate that the students' thinking is affected by everyday life in the subjective postmodern world. This confirms to me that family backgrounds, their current and previous geographical locations and other social factors all influence the students' views.

JB and Celia told me how they do not see the relevance of what they are taught at school and feel that they can best understand nature experientially. JB says that 'Nature cannot always be predicted using rules - it does not always obey the rules it should. Sometimes Nature will change from predictions because mankind cannot change Nature. Teachers try to tell us all about nature but they can only tell us some things about it. We have to go to Nature and study it for ourselves before we can understand it fully. It is hard to understand if you have not experienced it for yourself.' while Celia believes 'Nature is beauty, living beauty. It is a gift to us from God and we cannot control it. We need to have a response to Nature before we can appreciate it. Nature is not understandable; it is very unpredictable and hard to explain. I believe

we should study Nature and it is important to understand how things work in Nature. I do not think you can teach someone Nature though. That is why students are misled, because of the teachers '

They appear to demonstrate a lack of faith in, and an incredulity (Lyotard 1984) towards, their teachers' metanarratives on the natural world as expressed in the modernist perspective of school science. They do not perceive the world as the same predictable and orderly one that underlies the curriculum taught by their teachers. They actually tend to discuss the natural world using combinations of aesthetic and religious and conservationist perspectives. There does not seem to be any kind of link between their scientific views, which are rarely displayed, and their views on pollution or mankind's ability to control nature.

Hayley's and Jerome's perspectives on nature also illustrate this. Hayley does not believe in the orderly and predictable world of the Western science classroom and finds difficulty in understanding why she should study science (although she is a high-achieving student) but says 'I believe that everything has a purpose but Nature appears to be random and unpredictable. Animals can cope with the unpredictable behaviour of nature but we adapt our surroundings to ourselves, which is not natural. Natural is a puzzle, a mosaic, which fits spontaneously.. It is not necessary to understand how things work in Nature and I am not sure whether it is difficult to understand or not. It depends how we view it. I think that sometimes we should accept Nature and take it for granted'. Jerome sees the importance in understanding nature and, as a high-achieving student does not view this as a difficult task, believing that 'although it has aspects that are spiritual and mysterious, I believe it is important to understand nature and it is not difficult for us to do this'.

Here, it seems to me, that both students do have a basic understanding from a modernist world view that the natural world has order and purpose. However, they have views that are tempered with relativism and personal perspectives that are non-science. They each have views, derived from their backgrounds and culture, which challenge the possibility of simplistic, causative analysis, while continuing to argue that reality is, in some significant sense, hidden from direct observation and commonsense.

It seems very likely that many of the students who I taught in the Far North harboured the same mixture of relativism and personal opinion as they sat through my teaching of science. I reflect on the pleasant time I spent with some of my students, being deflected from my original lesson plans and practicals as I dealt with their interests. Emotions that I still carry are the

feeling of utter confusion as to why my students could not learn my teaching content, mixed with memories of the pleasure of their company.

#### CHINESE STUDY

When I developed a Chinese world view from theoretical sources in Chapter 6, I discovered that important aspects of this world view, which impact on all areas of Chinese belief and understanding, include a unified national identity with an understanding of mankind in general (and the Chinese in particular) incorporated into nature. I proposed that a lack of individualism in thinking would be displayed with a high emphasis on moral standards. I expected to see tension in understanding between spiritual and mystical aspects of the natural world and a modernist view of science.

I believe that only Qin, the one teacher who I interviewed, displayed this mixed standpoint on nature. Illustrated here, he says:

I believe Nature is the material world around me and it is a material world. Some people believe in a spiritual world. My mother and my grandmother believe in spirits that make them sick. This means that Nature is mysterious. I believe Nature is knowable through science and it is understandable, but this has caused Nature to become polluted too.

I feel this illustrates a traditional Chinese view of the natural world, held in tension with the perspective on nature derived from the theoretical modern Western scientific world view which has been presented in school and college in China since the 1950s (see Chapter 6). Nature is described as the knowable material world of modern science but this view is augmented by a traditional view of causality from Chinese Taoism. It is interesting to note that if a Western person displayed this perspective it might be termed 'postmodern'. For the Taoist, it is actually 'pre-modern'.

I noticed that the whole Chinese group who I interviewed tended to present a common understanding of science. They did not display a diverse range of attitudes but tended to discuss the natural world using the same set of perspectives. This perspective was very much the perspective that I heard presented in their school science classes and read in their textbooks. However in their conversation they always included references to beauty, peace and the need to preserve the nature world.

Da Peng told me (Chapter 8) 'Nature is beautiful and peaceful. It is holy and sacred. Nature is material and made from matter. It is orderly and predictable. Nature is knowable and we can understand it through study. .. Nature has become polluted'.

He (and his classmates) definitely displays the modernist perspective of school science taught in China for the past 40 years. They also provide evidence of the rote-learning style and emphasis on a unified national understanding of the world and traditional Confucian values such as filial piety, which I described in Chapter 6.

I traced these same themes about the orderly and predictable nature of nature, and its existence as a concrete and material world, in each student's narrative. Li Na reinforced this when she said that 'I think that nature is peaceful, beautiful and pure. It is complex and diverse, made of matter and is orderly and predictable. .. Nature is full of resources but has become doomed and endangered by pollution. We should study nature to protect it and serve our parents and our home towns. I think it is living, exciting and powerful. I also believe it is holy and sacred'.

I saw these ideas demonstrated in Jinan too during my visit – the need to protect nature was ever present in children's TV programs, on posters in the street and airport. In fact it is now another national unifying theme within Mainland Chinese society.

The students did articulate some spiritual beliefs and traditional thinking in talking about nature. These beliefs and concepts do not appear to play a part in shaping their scientific perspective on nature at all.

. Li Na's comments about nature include the fact that ' I also believe it is holy and sacred'. Deng Bo agrees ' It is holy and sacred' and Jie concurs also 'Nature is holy and sacred and mysterious'. Traditional views, derived from Confucianism are articulated by at least three students who offer perspectives on nature. Yan's 'We should study it to perfect ourselves' and Li Na's 'We should study nature to protect it and serve our parents and our home towns' both reflect Confucianism quite clearly. Sheng Bo articulates this ' The work of Confucius helps us to perfect ourselves and understand nature'. These views emphasise filial piety and a duty to one's country and on the need, articulated by Confucius, for an educated man to prove his education by taking part in a continuing process of self-improvement.

#### WHAT DID I LEARN IN THIS STUDY?

I learned that, within the two groups of students that I interviewed, the Australian students make little use of the concepts apparently taught in the school science classroom. They display a

range of spiritual and religious views which do not tend to be linked to their scientific one and their focus within the natural world is their emotional response to it, rather than their scientific understanding of it. There is a reasonable amount of variation in the personal perspectives that they present.

The Chinese college students tended to discuss the natural world using the same set of perspectives. They presented a common answer to questions about nature, using the vocabulary and terminology of their school science classes with very little variation. They articulated some spiritual beliefs and traditional concepts that did not appear to play a part in shaping their scientific perspective on nature.

It is possible, in the Chinese case, that a Chinese traditional world view, was being 'compartmentalised' and held in parallel with that of an (Enlightenment) scientific world view. Students might be presenting an understanding of nature drawn from school science while privately holding another opinion based on traditional philosophy. However this dichotomy was not displayed, even microscopically, in any conversation which I had or overheard.

Chinese rulers over the last two to three centuries, as described in Chapter 6, have come to see Western science as a vehicle for social and economic development. Chinese customs and mores dictate the need to maintain the perspective that Western scientific thinking is the only means by which nature might be described within an educational context. It is possible too that I was told what the students thought I (and their Government!) wanted and needed to hear. I will never have any means of knowing if this was true.

The process of carrying out this research was far more difficult than I could have imagined in 1994 when I began to think it. Issues in cross-cultural research appear to me to be unknown until experienced. Practical issues, such as language learning and the development of important vocabulary were difficult in themselves, but philosophical issues were more challenging.

A cross-cultural researcher is by definition an outsider, living with the tensions of rejecting misinformation, trying to exclude all forms of bias in data and refusing to patronise or colonise the subjects under examination. Problems faced by early anthropologists are experienced – ethnography appears to be more art than science. The issue of what is essentially ethnography within a scientific discipline has challenged me. Have I created art or science and how will or should this be received? This is essentially, according to Fenstermacher (1994) and others, an issue for the reader.

I have been challenged as I have been working in two very different “foreign” cultures, Australia and China. The possible effects of my own cultural interpretation of the data I have collected have continually confronted me. I have had to face issues of epistemology as I have struggled with the issue of “how do I know this is true” and “how can I prove this is true?”. This is why I have relied very heavily on the work of Fenstermacher (1994). His notion of ‘objectively reasonable’ has allowed me to attach an academically acceptable degree of certainty to my knowledge claims. I have therefore illustrated the role of my own subjectivity (‘practical reasoning’ as an ethnographic fieldworker) in generating these claims and used a narrative form of writing as the form most suitable for representing the relationship between them.

## CONCLUSION

### CREATING MY OWN LIVING EDUCATIONAL THEORY

In Chapter 3, I described how I was excited to discover the work of Jack Whitehead (1989, 1994) and wanted to situate my research within his framework. This framework is summarised as:

1. I identify a problem because some of my educational values are negated.
2. I imagine a solution to the problem.
3. I act in the direction of the solution.
4. I modify my actions and ideas in the light of my evaluations. (Whitehead, 1989)

In Chapter 3, I used this framework to present my own situation thus:

I feel that in my teaching, and in what I have observed in the teaching of others, there is no deep comprehension of the effect of the students’ culture, or worldview, on their understanding of science. This means that my teaching is not fair and equitable to all those in my class.

I want to investigate students’ attitudes to scientific concepts and determine whether they correlate to a Western scientific worldview, or a worldview gained from their own culture. I want to have a basic understanding of several different cultures and then try to determine the effect of different facets of the culture on student’s understanding of the natural world. Then I will be able to adjust my teaching to allow for differences in attitude caused by different cultural perspectives.

I will interview students who are receiving a traditional Western science education either in English (my first language) or Chinese (which I can speak reasonably well). I will use the methodology that Bill Cobern has established but will adapt the interview technique if it proves culturally inappropriate. I will maintain the same focus as his research and use the same survey instrument. I will tell the stories of my experiences in carrying out the interviews to illustrate particular aspects of the culture and world view of those I have interviewed.

I will use the results of my interviews to make assertions regarding the effect of culture on students' understanding of the natural world. I will use these assertions to make adaptations to my own teaching.

Having completed the first three tasks, I have made a series of knowledge claims about the possible effect of culture on students' understanding of the natural world. The final task is to consider the implications of these for my own teaching.

#### CULTURALLY SENSITIVE SCIENCE EDUCATION – PERSPECTIVES FROM RESEARCH

My reading in 1995 provided a basis for deepening my understanding of research on culture, worldview and multiculturalism in science education. More research published in 1998 and 1999 has provided some extra insight into the basic question underlying this research. This is the issue of providing solutions for the science teacher to the cross-cultural problems that are faced in the science classroom.

My private reflections on my reading in 1995 were as follows. I could see that there was an awareness of the issues faced when teaching science across cultures, and Cobern's methodology provided an avenue whereby students' conceptualisations could be determined and their problems predicted. However, I could not find a major body of research in science education that provided practical solutions to the issues being faced in the science classroom.

Research published in 1999 however, shows a movement within science education that is beginning to consider the implications of cross-cultural work in for the science teacher. Several researchers deal with the issue of modern science, and science education, as a subculture within Western society.

Ogawa (1999) sees Western science as a foreign culture for non-Westerners, and refers to Aikenhead's (1996, 1997) metaphor of the 'cultural border crossing' in picturing the student from an indigenous background taking part in the process of learning modern science. He explains that each culture has its own 'personal' science and that it is difficult for some students

to 'cross' to the closed culture of modern science. He sees that a possible way forward in the non-Western science classroom would be for modern science to be established as a 'mirror', a model for the comparison of indigenous science, and from this model, multiperspective science might be created within the classroom.

Jegede and Aikenhead (1999) also look at the implications of 'crossing cultural borders' in science teaching. They agree that 'multiperspective' (Ogawa, 1999) or 'collateral learning' (Jegede, 1995) is necessary in the acquisition of the culture of modern science as an indigenous student moves from his or her everyday world to that of the science classroom. They define collateral learning as the ability to hold in long term memory the sometimes unresolved conflict of two explanations of everyday phenomena. They suggest that this conflict might be moved towards resolution, with the learning made more 'secure' for the student, by the following means:

- Science curriculum being contextualised within the students' daily lives,
- Culturally sensitive instructional strategy,
- Native language science teaching,
- Contribution of non-Western scientists being acknowledged,
- Bridges being built between the indigenous world view and that of modern science with the use of indigenous science knowledge and the comparison of the relative epistemologies of the indigenous culture and modern science.

They feel that it is important to make border crossings explicit rather than implicit, with the science teacher taking on the role of the 'cultural broker'.

Similar themes to those expressed by Jegede and Aikenhead (1999) are found in the work of Allen and Pewewardy (1999) in their research among Native American science teachers and learners. They identify the need to deal with wide-ranging conflict caused by factors such as second language learning of science, students' concepts of their own 'self-efficacy' in learning Western science, disempowering pedagogies and apparently irrelevant and disconnected science curricula.

Some researchers have begun to explore the construction of new science curricula based on non-Western frameworks. Hua, Chang and MacRaven (1999) explore the tenets of Taoism and their implication for the construction of a holistic science education curriculum. Hammond



(1999) reports on the development of science curriculum in a multicultural population in California, based on the indigenous horticultural knowledge of some of the South East Asian students' families, and its implications for their learning.

Rodriguez (1999) extends the role of the science education researcher, and the science teacher educator, to that of 'cultural warrior'. He notes that wide-ranging research evidence has been obtained on cultural issues evident in science education, but questions how this research has affected classroom practice or teachers' pedagogies. He believes that it is important to deal head-on with the resistance to change in pedagogy, especially that experienced from new teachers who have been 'apprenticed' to old methods by their own school experience and observation. He sees a need to use multiple theoretical frameworks in developing pedagogies, to acknowledge resistance to change among teachers and to develop strategies which will allow research results to become a catalyst to counter this resistance.

#### REFLECTIONS ON RESEARCH PERSPECTIVES

My teaching context in Australia is one that is probably similar to many classrooms in the Western world. Many of the students in my high school class (or now my university class) compare well with the students I interviewed in my Australian study detailed in Chapter 5. They come from a wide range of ethnic backgrounds and, while the native religion and customs of their parents may influence their home life, their life experiences would be very similar to those of my sample group. My class also includes international students, largely from Asia. Many of these Asian students have received a "Westernised" form of education, especially in Hong Kong or Singapore. However, some would have been produced by similar cultural, educational and social systems as the students interviewed in Chapter 8.

As I noted above, modern research has described Western science as a "foreign culture" (Ogawa, 1999) and the issue of teaching for "cultural border crossing" (Aikenhead, 1996, 1997) has been tackled by several researchers. I presumed that in my research I would identify the "borders" which Chinese students would cross as they entered the school science world of their Australian counterparts. I accepted that I would need to adapt my teaching to create a multiperspective science (Ogawa, 1999) and help to build bridges between Chinese and Western understanding of scientific concepts.

My research results surprised me. My preconceptions were that Mainland Chinese students would bring to the science classroom attitudes influenced by traditional religious and cultural beliefs and that these, even if apparently hidden, would prevent them from integrating school

science with their everyday thinking. However, my research indicates that students from Mainland China can hold a traditional and integrated modern Western scientific world view without apparently being aware of the “borders” that they have crossed in their science classes. In fact, for the generation of students interviewed, no “borders” have been crossed because the revolution of 1949 (see Chapter 6) effectively removed all superstitious or religious thinking from the realm of academia. A modern scientific world view was encouraged within the context of Chinese communism.

The situation in other parts of Asia, such as Hong Kong, Singapore and Taiwan is different. In these countries traditional religion and beliefs, accompanied by a modern upsurge in Confucianism, have been maintained in parallel with the scientific technological and economic development of recent decades. As I commented in Chapter 2, some researchers in Taiwan and America have begun to explore the construction of new science curricula based on non-Western frameworks for Asian students from these developed backgrounds. Hua, Chang and MacRaven (1999) explore the implication of Taoism for the construction of a holistic science education curriculum in Taiwan, and Hammond (1999) reports on the development of science curriculum in California, based on the indigenous horticultural knowledge of South East Asian students’ families. My research seems to indicate that such a use of alternative frameworks, and as I commented previously in this chapter, frameworks which are actually ‘pre-modern’, would not be deemed as appropriate for Mainland Chinese students.

I had expected that I would gather evidence of a traditional modern Western scientific world view from the Australian students who were interviewed. However, what I have described in Chapter 5 is a group of Western students whose world view is not recognisable as that of traditional modern Western science. Postmodernism, as described in Chapter 4, and other cultural and social effects have influenced them to such an extent that some have clearly not ‘crossed the border’ to a modern Western scientific world view. Recently (Linkson, 1999) some Australian science educators have commented on the ‘border crossing’ metaphor within Australian, and particularly Australian indigenous, science education. They see this metaphor as ‘inhibiting holistic approaches’ and use instead the metaphor of the development of ‘knowledge spaces’ where intercultural dialogue centred on stakeholders’ epistemologies might take place. This compares well to the perspective arising from similar research in science education carried out among Native Americans (Allen & Pewewardy, 1999). This offers the image of the ‘talking circle’ where similar intercultural dialogue might be situated and ‘each participant comes as an equal’.

My research findings are ironic to me since they are diametrically opposite to what I had expected. I had intuitively realised that there was a cultural barrier within my own science classroom and had imagined that Mainland Chinese students would bring a world view full of alternative perspectives to that of school science. I had likewise expected that my Australian students would bring the modern Western scientific world view to the science classroom and that this world view would be the same as my own.

#### IMPLICATIONS FOR MY TEACHING

In recent work (Cobern, Gibson & Underwood, 1999), the authors, in a study of semi-rural ninth grade high school students similar to that undertaken in 1995 (Cobern, 1995a, 1995b) comment on the diversity of understanding of the natural world displayed by the students. They suggest that this diversity will cause 'inadvertent hindrances to learning in the science classroom' especially where the teacher has a strongly modernist perspective on science.

As I reflect on my own teaching in North Queensland, narrated in Chapter 5, I can see the 'inadvertent hindrances' I caused for my own students. I can see two major factors at play in my behaviour. I bring to the classroom a strong modernist perspective on science and a resistance to pedagogical change. I believe that both of these factors are a result of my own education, my nature and the focus of modern teaching.

At high school I was a 'potential scientist' (Costa, 1995) and did not have any problem in thriving in the culture of school science. I was able to learn quickly from the 'transmission' style teaching of the time and culture. My school friends and classmates at University, regardless of cultural backgrounds, were also relatively high achievers so intuitively I have expected all learners to make a smooth transition to the world of the science classroom. Later experience, as described in Chapter 1, has taught me experientially that an individual's world view has a major impact on his or her understanding of science. I believe that I have only partially allowed this knowledge to effect my practice as a teacher.

Similarly, I enjoyed high school and university maths and science classes, and have memories of my teachers and lecturers as 'good' educators. I have to some measure (see Chapter 5) modelled my teaching on that of my own teachers. Although, objectively, I can identify all the shortcomings in their methodologies, subjectively I believe I have taken on board some of these shortcomings myself.

Rodriguez (1999), in examining the role of researchers in science education as 'cultural warriors for social change', sees that a major focus of the role is in being a positive force in

bringing about pedagogical change. While I am aware that I have often publicly espoused pedagogical change, I can identify an internal resistance within myself to the very change I believe in. Along with the respondents in Rodriguez's research, I can identify with the view that pedagogical change often seems 'untenable' given the need to develop, for example, student-centred learning, while covering a 'rigorous science curriculum and maintaining class control'.

I can see evidence of these two factors in the stories of my own science teaching in North Queensland. As I describe my experience as a physics teacher, I can identify my desire to model my classroom practice on the highly structured teaching of my own school days. I can also remember the difficulty of developing a physics work program that covered a large amount of content that the State curriculum demanded. I can also remember the panic I felt when I realised that my school had neither books nor equipment to teach the required syllabus.

I believe that if I were to face the same teaching situation again I would be freer, educated by my own research, to cover the content of the work program with local examples which would be familiar to my students. I can envisage, along with Ogawa, that I would be able to establish 'models' from modern science and then hold up other sub-cultural images to them and create 'multiperspective science' (Ogawa, 1999). Potential topics, taken from the lives of my students in Far North Queensland, abound. Some of my students, for example, had lived in the bush for short periods, hunting and fishing or alternatively prospecting for gold with their parents. They had learned a considerable amount of 'science' in this manner. Although I did occasionally refer to these types of experience in my teaching, I ways always, internally, questioning the validity of my teaching practice.

I identify, as do Jegede and Aikenhead (1999), the need to cross 'cultural borders' in my teaching and establish 'collateral learning' (Jegede, 1995) so that students can hold on to two or more alternative explanations of a phenomenon in a secure manner. However, in the Australian multicultural classroom, Linkson's concept of a "knowledge space" is one that needs to be considered. It is highly unlikely that our classrooms contain just two alternative explanations of scientific concepts. This research suggests it is credible that students' perspectives on science will be both objective and subjective. However those who hold subjective beliefs on science may come from a wide range of backgrounds and their beliefs will vary quite considerably. Therefore, it is helpful to consider the science classroom as a three-dimensional space where these beliefs may be articulated and the relative epistemologies compared and contrasted.

I have often tried to move away from the style of my own teachers and allow my classroom or lecture to be a place where alternative explanations, or experiences of science and technology,

can be brought and discussed. I have found it difficult to engender discussion, and have even found that my students have disliked me doing so. I remember, during my time in North Queensland, a student who told me that I talked too much about China, my husband and children. There was also another who claimed I was not 'teaching properly' because I encouraged my students to carry out research independently and bring back the answers to the class. When I reflected on what I was doing, I realised that I had tried to illustrate the application of physics to engineering, my husband's profession. I had also tried to describe the lifestyle and expectations of the other cultures we had experienced, in the context of science classes and to encourage some independent learning. These comments caused me, as an inexperienced teacher, to reflect on the validity of my illustrations and keep my science free from 'subjectivity'. I believe now that my research has equipped me to withstand the comments of students who have been enculturated into an 'objective' science and conservative pedagogy. I will be better equipped to encourage them to explore the effect of their own culture on their own understanding of science.

#### MOVING ON

As I acknowledged above, this thesis reflects my desire to overcome a perceived problem, the effect of culture on my students' learning of science. I carried out this research to create my own Living Educational Theory (Whitehead, 1989) and to find a solution to the problem. I now have some ideas about how I can improve my own practice since, with Whitehead (1989), I have been able to acknowledge myself as a 'living contradiction, holding educational values while at the same time negating them.'

The irony for me is that, during the four-year process of undertaking this research, and perhaps because the title 'researcher' confers some higher status, I have 'moved on'. I have 'progressed' from high school teacher to TAFE (technical college) teacher to university lecturer to academic staff developer. Now I teach lecturers how to improve their teaching and share knowledge gained over forty plus years of life but only eight years of formally developing my own educational theory.

Therefore, I am 'moving on' again. Knowledge claimed here in this research is clearly only valid for the small groups sampled within very specific locations and situated in two cultures. I want to extend this work to other groups; obvious choices to me are Westernised Chinese students or urban Australians. I have also made a decision to return to teaching students. I can develop my own Living Education Theory only if I return to the classroom, tutorial or lecture

theatre and test my ideas in a science education environment. I need to continue the cycle of action and reflection by which I can validate, develop and refine my theory.

For me the end of the thesis is therefore just an end to one cycle of creating my Living Education Theory and the beginning of the next. More cycles will allow more 'moving on' to seek new understanding and other means by which to improve my practice as a teacher.

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APPENDIX 1

INTERVIEW ELICITATION DEVICE (COBERN 1995A) WITH CHINESE TRANSLATION  
AND PRONUNCIATION

TASK ONE TERMS

Beautiful	美丽	Mei3 li4
Changeable	可以改变的	Ke3 yi3 gai3 bian4 de
Chaotic	乱七八糟	Luan4 qi1 ba1 zao1 de
Complex	复杂的	Fu4 za2 de
Confusing	混淆的	Hun4 xiao2 de
Dangerous	危险的	Wei1 xian3 de
Diverse	各色各样地	Ming1 se1 ming1 yang3 de
Doomed	命中注定的	Ming4 zhong1 zhu4 ding4 de
Endangered	危险的	Wei1 xian3 de
Exciting	兴奋的	Xin4 fen4 de
Exploited	摧残的	Cui1 can2 de
Frightening	害怕的	Hai4 pa4 de
Full of resources	有很多资源的	You3 hen3 duo1 zi1 yuan2 de
Holy	神圣的	Shen2 sheng4 de
Knowable	可以理解的	Ke3 yi3 li3 jie3 de
Living	有生命的	You3 sheng1 ming4 de
Material	材料	Cai2 hiao4



Matter	物质	Wu4 zhi4
Mysterious	神秘的	Shen2 mi4 de
Orderly	有规律的	You3 gui1lu4 de
Peaceful	和平的	he2 ping2 de
Polluted	污染的	Wu1 ran3 de
Powerful	有力的	You3 li4 de
Predictable	可以预料的	Ke3 yi3 yu4 liao4 de
Pure	纯正的	Chun2 zheng4 de
Sacred	神圣的	Shen2 sheng4 de
Spiritual	神灵的	Shen2 ling2 de
Unchangeable	不可以改变的	Bu4 ke3 yi3 gai3bian4 de
Understandable	可以理解的	Ke3 yi3 li3 jie3 de
Unpredictable	不可以预料的	Bu4 ke3 yi3 yu4 liao4 de

#### TASK TWO STATEMENT SORT

Since these statements make use of the vocabulary from the terms above, no detailed translation is provided

1. Nature (自然 zi ran) is something that should be studied so that we can learn more about it
2. It is important to understand how things work in Nature
3. Nature is difficult to understand

4. To me Nature is mysterious
5. I see in Nature the work of God
6. I find in Nature a spiritual quality
7. Nature is the result of purpose and things happen in Nature because of purpose
8. I view Nature as something solid, substantial and reliable
9. Nature is the material concrete world around us
10. The natural world is all there is, all there ever was, all there ever will be
11. The material world of Nature is the only real world here is
12. I see beauty in Nature
13. I have a pleasant emotional response to Nature
14. Nature is an everyday part of life that I generally do not think much about
15. Nature is an important resource: water, energy, food, materials for making things
16. Without the things that we get from Nature we could not enjoy the lifestyle we have today
17. I believe Nature needs to be protected
18. I am concerned about pollution and the damage it does to Nature.